

REVIEW AND APPROVALS

BOMBAY HOOK NATIONAL WILDLIFE REFUGE

Smyrna, Delaware

ANNUAL NARRATIVE REPORT

Calendar Year 1992

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REFUGE MANAGER	DATE	ASSOCIATE MANAGER-SOUTH	DATE
<u><i>Donald H. Young</i></u>		<u>4/14/93</u>	
REGIONAL OFFICE APPROVAL		DATE	

INTRODUCTION

Bombay Hook National Wildlife Refuge was established under the authority of the Migratory Bird Conservation Act in 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 27,630) and 8 miles from Smyrna (population 5,231). The surrounding area is characterized primarily by agricultural lands on which corn, soybeans, and wheat are the principal cash crops. The refuge currently comprises 15,122 acres of which approximately 12,500 are a broad expanse of brackish tidal marsh, mud flats, and tidal creeks and rivers. Other portions of the refuge include 1,000 acres of agricultural land, 4 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 white-tailed 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 recreation in the form of waterfowl, deer, and small game hunting still forms a large portion of the refuge program.

INTRODUCTION

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NTR

A. HIGHLIGHTS

A coordinated search and rescue effort mounted by the refuge and cooperating agencies resulted in locating two SCS technicians who had spent the night stranded in a remote portion of tidal marsh. (Sections E.6, H.17)

Mosquito control on the Delaware refuges once again became a hot political topic. A task force was established by Director Turner and DNREC Secretary Clark to come up with solutions to the problem. (Section F.10)

The bald eagle pair produced their first eaglet to flight stage since 1988. (Section G.2)

Fall duck populations reached the highest peak in 14 years. (Section G.3)

Deer harvest was by far the highest on record. (Section H.8)

A parking lot was constructed at the Air Force Tract in an effort to zone public use to cut down on illegal target practice, vandalism and littering. (Sections H.17, I.1)

Finis Dike received a much needed rehabilitation. (Section I.2)

An old channel in Raymond Pool Was cleaned out to permit complete drawdown. (Sections F.2, I.2)

A new John Deere 4055 tractor and 15 foot wide flex-wing mower were received in November. (Section I.4)

A World War II vintage plane, which crashed in refuge marsh during a 1944 training flight was partially recovered for display in the Dover Air Force Base Museum. (Section J.3)

B. CLIMATIC CONDITIONS

The past year could best be characterized by a mild winter followed by a relatively cool summer. On September 25 we received heavy rains and high tides as the tropical storm Danielle brushed off our coast. On December 11 and 12, we experienced two days of northeast winds and very high tides. No significant damage occurred on the Refuge although extensive damage to coastal communities occurred 50 miles to the south.

Temperatures this year ranged from a low of 11 on January 11 and 12 to a high of 94 on July 14 and 15. The last day of subfreezing temperatures in the spring occurred on March 25 and the first day of subfreezing temperatures in the fall was October 20 although light frost was observable on the ground as early as October 7. Winter temperatures were mild with no prolonged spells of bitter cold weather. Conversely, the summer was pleasantly cool although humid as usual. Even July and August had many days in which the highs never left the 70's.

Precipitation for the year totaled 39.63 inches, which is 6.4% below the average of 42.30 inches. Snowfall was virtually nonexistent with the largest amount being a 1.1 inch accumulation recorded on February 13. With the exception of dry weather during January and April, Bombay Hook received normal amounts of precipitation for most of 1992. August and September were the months in which we experienced the most precipitation as 7.07 and 5.86 inches respectively were recorded.

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)

<u>Month</u>	<u>Maximum</u>	<u>Minimum</u>	<u>Precipitation (Inches)</u>
Jan	69	11	0.98
Feb	63	12	2.62
Mar	65	20	4.32
Apr	78	30	1.42
May	89	37	4.87
Jun	88	49	2.64
Jul	94	60	2.34
Aug	92	52	7.07
Sep	85	46	5.86
Oct	82	30	1.53
Nov	68	29	2.93
Dec	66	17	3.05
Extremes	94	11	Total 39.63

C. LAND ACQUISITION

1. Fee Title

There was some action on the proposed DeMarie property acquisition during 1992. This 796 acre parcel adjoins the refuge on the southwest and consists of approximately 600 acres of high quality salt marsh as well as a significant amount of cropland suitable for waterfowl food production and a small acreage of brush. On November 12 Howard Rybolt (Realty) visited to conduct an appraisal of the property. He and Manager Daly met with Mr. and Mrs. DeMarie in the refuge office prior to Mr. Rybolt accompanying the DeMaries to their property for the appraisal. From here on our acquisition should depend upon whether we can negotiate an acceptable price with the landowners.

There was no action to report on the proposed acquisition of Great Cypress Swamp (11,000 acres) in southern Delaware in 1992.

2. Easements

No action has been taken on our recommendation from 1991 that the Service divest itself of the 1.3 acre Daugherty property which was foisted upon us through the Farmers Home Administration program. This "refuge" is a farm ditch on property which is a two hour ride from Bombay Hook. It was not visited this year.

D. PLANNING

2. Management Plan

The following plans were rewritten and submitted for approval this year:

Hunt Plan	6-26-92
Sign Plan	8-12-92

In addition, the Safety Management Plan was updated during August, 1992.

Annual Programs were prepared for Hunting, Fire Management, Water Management and Trapping. All were approved.

4. Compliance With Environmental and Cultural Resource Mandates

After many years of testing, chlorinating and retesting of the public water supply at the Headquarters/visitor center building only to have the test result eventually show recontamination with coliform bacteria, steps were taken to permanently correct the problem. Bottled water is now used as the primary drinking water supply and a permanent chlorination mechanism was installed at the domestic well head. The State Health Department requires chlorination if the public even has access to the water should it test positive for bacteria.



#1 Maintenance Worker Straughn installs the new automatic chlorinator at the Headquarters Building well.
8/92 Daly



- #2 Instead of a small well cap, we are now forced to have a rather obtrusive well cover due to the size of the chlorinator.

8/92 Daly

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 was begun during 1989 and is presently in the fourth year of data collection. Following is an abstract from the 1992 progress report.

Snow goose populations were monitored through three wintering seasons by the use of aerial surveys and ground observations within and around Bombay Hook and Prime Hook National Wildlife Refuges. Surveys were flown during two different periods of the day, i.e. dawn and mid-morning, in an effort to enumerate roosting and feeding populations of geese along the Delaware coast. Mid-morning flights included a survey route into several counties of Maryland's eastern shore as well as areas in western Delaware. Unlike the 90-91 season no surveys were flown within New Jersey. Habitats utilized by each flock were recorded. Permanent vegetational transects

were established and run within the marshes of Bombay Hook and Prime Hook. Aerial slides and video tapes of the marsh eat-outs created by the feeding activities of the birds were taken periodically throughout each winter period and were compiled on a plastic overlay to determine total acreage denuded by the geese on Bombay Hook and Prime Hook. Results of the special snow goose hunt within the Bombay Hook salt marshes were analyzed in conjunction with the activities of the geese in an attempt to correlate goose use with hunting activity. The extent of snow goose denudation on Bombay Hook was similar to that incurred during the previous two winters as the preferred areas were stripped bare each year. Assessing the impact of hunting the Bombay Hook marshes on the activities of the birds remains a difficult task. The large numbers of goose hunters during October obviously prevents any significant daytime feeding within the saltmarsh during that period and may influence the birds to instigate off refuge feeding forays which have become more and more significant in recent years. However, the extent of the eat-outs on Bombay Hook is relatively constant and the hunt appears most likely to influence only the timing of when the marsh is denuded.

2. Bombay Hook NR91 - Movements and Habitat Use by Wintering Greater Snow Geese on the Delmarva Peninsula (A cooperative effort by the U.S. Fish and Wildlife Service, Delaware Division of Fish and Wildlife, and Eastern Kentucky University) 51550-2

Field work for this project was completed during April 1991. Data analysis and thesis preparation was completed during 1992. Following is an abstract of the project as contained in the Master of Science thesis of Michael Robert John Hill.

During the mid-1980's, peak populations of wintering greater snow geese at Bombay Hook National Wildlife Refuge in Delaware reached a high of 75,000. This large concentration of geese combined with their voracious foraging habits caused destruction of parts of the refuge tidal saltmarsh prompting the refuge to initiate a special snow goose harvest season in 1983 in an effort to disperse the geese. Although damage to the tidal saltmarsh was only slightly reduced, there were significant changes in goose movements and habitat use patterns. This study was conducted to determine the local movements, habitat use, and the effects of hunting on greater snow geese at Bombay Hook National Wildlife Refuge and on the Delmarva Peninsula. One objective of the study was to assess the impact of a special greater snow goose harvest season on dispersal of geese that were creating large "eat outs" in the Bombay Hook NWR tidal

saltmarsh. Therefore, 36 adult female greater snow geese were captured and radio-tagged at Bombay Hook National Wildlife Refuge and monitored from October through March 1990-1991. Movements were estimated by 1) following radio-marked geese from the night roost to initial feeding sites, or from their final feeding areas to their night roosts, 2) by measuring distances between overnight roosting sites and amount of interchange between broad roosting regions and specific sites within regions, and 3) by observing the movements of a radio-marked bird for an entire day. Habitat use was estimated from the habitats used by radio-marked individuals. Each location was classified as either roosting or feeding habitat. Habitat use was also compared to availability of major agricultural and wetland habitats.

During October-November, marked birds did not move large distances from roosting to feeding sites (5.4 ± 6.7 [SD] km) or between roost sites (3.9 ± 5.4 km). The habitats most often used for roosting from October through November were farm ponds (39.4%), tidal saltmarsh (30.6%), and freshwater impoundments (28.0%), and harvested corn was the most visited type of feeding habitat (53.4%). From October through November when habitats were compared to availability, harvested corn and "other" were used more than expected ($P < 0.05$) as feeding habitats, and farm ponds and freshwater impoundments were used more than expected as roosting habitats. Interchange by radio-marked birds between different roost sites occurred frequently (66.9%) but not between regions (30.6%). Total distance moved by a goose in one day averaged 15.5 ± 15.0 km in October and November. Greater snow geese probably did not travel long distances in October and November because there was an abundance of waste corn near the refuge.

Hunters taking part in the special greater snow goose harvest season (15 October through 31 October) dispersed the geese from the tidal saltmarsh during daylight hours. However, flocks of geese could be seen flying into the tidal saltmarsh to roost in late evening or after dark. Large areas of denuded tidal saltmarsh became apparent in November and early December which coincided with observations of night movements by marked birds into the tidal saltmarsh. Hunter participation decreased after the beginning of the regular waterfowl season, probably reducing the effectiveness of hunting disturbances on dispersing the geese. Therefore, the special harvest season was not effective in reducing the size of the "eat-out."

Mean distances traveled per day increased in December and January (21.0 ± 19.9 km) with some feeding flights up to 37 km from the roosting area. During January there was

minimal use of Bombay Hook NWR, when many of the birds were found roosting on farm ponds (36.1%) mainly in Kent County, Maryland and freshwater impoundments (32.2%) mostly at Prime Hook NWR in Delaware. Distances traveled between roosting sites averaged 22.9 ± 28.9 km and averaged 11.4 ± 13.1 km from roosting to feeding sites which were significantly larger ($P < 0.05$) than in early season. Harvested corn was still the most heavily used feeding habitat (47.2%). When habitat use was compared to availability, harvested corn was used more than expected for feeding, and farm ponds and freshwater impoundments were used more than expected for roosting. Interchange between regions (49.5%) and sites within regions (80.8%) peaked in December and January. The longer distances traveled in December and January may have been due in part to the depletion of food resources around the refuge and to the development of fat reserves during December, permitting geese to expend energy in search of high energy foods such as corn.

In February and March radio-marked birds began returning to the Bombay Hook NWR area, roosting mainly in freshwater impoundments (51.8%). Habitats most often used for feeding were small grains (35.1%), "other" (29.2%) (included mainly cattle feedlots and goose pasture) and harvested corn (28.8%). Small grains were used more than expected for feeding when compared to availability and farm ponds and freshwater impoundments were used more than expected for roosting. Average distances moved from roosting to feeding areas (4.3 ± 4.4 km) declined ($P < 0.05$) in February and March as did mean distances between roost sites (10.8 ± 19.6 km). Distances moved per day decreased in February and March (13.5 ± 8.9 km). Interchange between roosting sites (45.2%) and change between regions (33.6%) was less frequent in February and March. Radio-marked greater snow geese possibly returned to the Bombay Hook NWR area as small grains and green crops were beginning to grow, providing the geese with a new food source that was rich in protein.

Overall, radio-marked female greater snow geese used a variety of habitats and were found to disperse widely over the Delmarva Peninsula and into New Jersey and Pennsylvania. Individual greater snow geese also showed a significant amount of interchange between roost sites and a lack of flock integrity. Future studies are needed to better understand the timing of nocturnal flights into the tidal saltmarsh and to determine the nutrient value derived by greater snow geese from tall saltmarsh cordgrass. Also, the long term effects of grazing by greater snow geese on saltmarsh regeneration need to be studied in order to determine how to manage "eat out" areas.

3. Bombay Hook NR92 - Effect of Intensive Management on
Annual Wood Duck Production from Artificial Nest Boxes
51550-3

This project was initiated at the suggestion of Zone Biologist Laskowski and is part of an overall study which includes data collected in a similar fashion at Prime Hook National Wildlife Refuge. The objective of the study is to determine if wood duck nest boxes which are intensively managed on a monthly basis throughout the nesting season, produce a greater number of ducklings than boxes which are not managed.

A sample of 100 wood duck boxes at Bombay Hook was selected for the study. A treatment group of 50 boxes along with 50 control boxes was randomly selected from this sample.

Treatment boxes were checked once each month during the nesting season from March through July. Detailed records were maintained on the number of eggs laid per box, date of nest initiation, nest status, and outcome. During the course of monthly checks, any nest which was abandoned was removed from the box to the box available for renesting. Boxes with clutches which were being incubated, were checked and any eggs which were not at the same level of development as the majority of the clutch were also removed. Clutches being incubated which were in excess of 18 eggs were reduced to 18 eggs. A final box check was conducted during July to determine outcome of any late nesting attempts and to collect finalized box production data for the season. During the final box check, no eggs or membranes were removed from the boxes. Nest contents were left intact for comparison with the same data collected during winter box maintenance activities.

Control boxes were treated in the same manner as treatment boxes, with the exception that no nest contents were removed at any time during the nesting season.

As of the writing of this report data has been collected for one nesting season and we are preparing to conduct routine winter maintenance activities. Data on nest contents will again be collected for both treatment and control boxes during routine winter maintenance activities. The difference between nesting season and winter collected data will be used to assess loss of precision of once a year data collection and how this will affect management decisions.

E. ADMINISTRATION

1. Personnel



#3 Top (on deer stand L to R) Arthur Straughn, Paul Daly
Bottom (in duck blind L to R) Frank Smith, Steve
Wunderley, Suzan Staley, Howard Cottman, Teresa
Hammond and Marian Johnson-Pohlman.

12/91 Humbert

1. Paul D. Daly	Refuge Manager	GM-13	PFT
2. Stephen M. Wunderley (Transferred 10-18-92)	Asst. Refuge Mgr.	GS-11	PFT
3. E. Franklin Smith	Refuge Biologist	GS-11	PFT
4. Marian Johnson-Pohlman	Outdoor Rec. Planr.	GS-11	PFT
5. Teresa R. Hammond (Transferred 11-01-92)	Office Assistant	GS-6	PFT
6. Barbara J. Meade (EOD 11-29-92)	Office Assistant	GS-6	PFT
7. Suzan M. Staley	Office Auto. Clerk	GS-4	PPT
8. Howard H. Cottman	Maintenance Worker	WG-8	PFT
9. Arthur T. Straughn	Maintenance Worker	WG-8	PFT
10. Barry T. Clark	Bio Science Student	GS-4	
11. Debra S. Wunderley	Clerk-Typist	GS-3	TPT
12. Verna Price	Recreation Aid	GS-3	TPT
13. Bob Jones	Recreation Aid	GS-3	TPT
14. Mark Connelly	Recreation Aid	GS-3	TPT
15. Kelly L. Boscher (EOD 6-14-92)	H.S. Coop Student	GS-1	TPT



#4 From left to right, Kelly Boscher, Barbara Meade and Verna Price.

3/93 Johnson-Pohlman

Barry Clark was not on active duty at the refuge this year. He is expected to graduate in the summer of 1993. At that time he will either come to work for the Service or go to veterinary school.

The manager's position was upgraded on March 8 to GM-13 based on his appeal to the FWS Personnel Office of audit results conducted by the Region 5 Personnel Office the previous year.

The primary assistant manager position became vacant in October when Steve Wunderley transferred to the Washington Office to fill a job dealing with Service law enforcement policy. Steve had been at Bombay Hook since July 1989.

The assistant manager position remained vacant at the end of the year. Recruitment efforts had gone as far as green sheeting the position when it was decided to not fill it until at least March, 1993. Needless to say, operating a station of this size (together with a major satellite - Prime Hook NWR) with no assistant manager is a most difficult proposition. We have attempted to allow paperwork exercises (reports, plans, etc) to be the primary casualties of this vicissitude.

Another key position, that of office assistant, changed incumbents in 1992. Teresa Hammond transferred to the Delaware Bay Estuary Program on November 1. This program has their office in the old YACC/YCC building on the refuge; therefore Teresa's new location is only about 300 yards away.

We were fortunate to be able to fill the office assistant position with little delay. Barbara Meade arrived on November 29 after transferring from the enhancement office in Manhattan, Kansas. Barbara has had previous experience at the Wichita Mountains NWR and is a most welcome addition to our staff.

A farewell luncheon was held at the Blue Coat Inn, Dover on October 29 for Steve Wunderley and Teresa Hammond. They were suitably presented with both "gag gifts" and the regular kind.

Following is a summary of the staffing situation at this station for the past five years:

	<u>Number of Employees</u>			<u>Total FTE</u>	
	<u>Permanent</u>		<u>Temporary</u>		
	<u>Full-time</u>	<u>Part-time</u>			
FY 92	8	1	5	10.0	
FY 91	8	0	4	8.5	
FY 90	8	0	1	8.2	
FY 89	9	0	0	9.0	
FY 88	8	1	0	8.6	

Following is a listing of formal training received by Bombay Hook personnel in 1992:

<u>Training Course</u>	<u>Location</u>	<u>Date(s)</u>	<u>Name(s)</u>
Saturated Forest Wetlands Management	Annapolis, MD	1/29- 1/31	Wunderley
Time Management	Dover, DE	2/18	Pohlman
Biological Workshop	Cape Charles, VA	2/24- 2/27	Daly Smith
Regional NAI Conference	Chincoteague, VA	3/18- 3/20	Pohlman
Fire Management/ Line Officers	Tallahassee, FL	3/23- 3/26	Daly
Moist Soil Management	Chincoteague, VA	4/16- 4/17	Smith
Law Enforcement Refresher	Cape Charles, VA	4/6- 4/11	Smith Straughn
Law Enforcement Refresher	Cape Charles, VA	4/13- 4/18	Daly Wunderley
ARPA Law Enforcement	Savannah, TN	5/11- 5/15	Daly
Water Ditching Safety and Survival	Edison, NJ	6/11	Daly Smith Straughn Wunderley
CPR	Refuge Auditorium	8/13	Staff
Defensive Driver Refresher	Refuge Auditorium	8/25	Staff

4. Volunteer Program

The volunteer program at Bombay Hook finished its tenth successful year with 104 volunteers contributing almost 2900 hours of service. This was the largest number of hours donated to date; and of this total, 1866 hours were donated in visitor services. Visitor services include staffing the visitor center, working with school and scout groups, drafting text for brochures and displays and running the cooperative association sales outlet.

One field work student, Rusty Humbert, from Delaware State College completed an internship at Bombay Hook this year. He worked 10 hours per week during a semester and earned 4 credits. Rusty worked with school and scout groups and also spent time helping plan upcoming handicapped accessibility projects.

Volunteers from around the state helped count horseshoe crabs during the May and June full moon, 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, residents along the Delaware Bay beaches, and birders.

Each year a group of enthusiastic Bombay Hook birders join in the annual Christmas Bird Count and Spring Bird Count. This year these individuals were recognized at the annual volunteer awards ceremony held at the refuge.

ORP Pohlman conducted spring and fall volunteer workshops and orientation sessions. Volunteers are also encouraged to attend the two day environmental education workshops offered in the spring and fall. Twenty six volunteers attended the above sessions.

Twenty five volunteers took advantage of a variety of field trips which were offered them this year. A ranger from Brandywine State Park provided an orientation to the Nature Center, volunteer program, and a nature hike to three volunteers during the fall. Eight volunteers were given a tour of the Delaware Museum of Natural History during March. Fourteen volunteers participated in an interpreted canoe trip on May 16 at Abbotts Mill, a Delaware Nature Society site. Four volunteers represented the Refuge volunteer corps at the state volunteer dinner on April 30 this year. The Friends of Bombay Hook Cooperating Association paid for their dinners.

ORP Pohlman again participated in the 4th Grade Environmental Education program for Kent County, Maryland at Eastern Neck Refuge. This year Pohlman conducted the beach study, which included seining by the students. This had been handled

previously by the Health Department. About 200 students from around the county participated in staff and volunteer led activities during this program.

Several Eagle scouts supervised fellow scouts in woodchipping our trails, placing numbered posts to correspond to new interpretive trail brochures, building a brochure box for one of the trails, and clearing back vegetation from around a photo blind and a deer platform for hunters in wheelchairs. A Mennonite Church group also woodchipped a trail and picked up litter at Finis woods.



#5 Volunteer groups assisted in spreading woodchips on our foot trails.

4/92 Pohlman

The volunteer program has proven to be extremely valuable over the past 10 years, and much has been accomplished that would never have been possible with limited staff. Volunteers and the number of hours worked have also increased each year.

The family of a deceased volunteer (Frances Robertson) who was very active in the Bombay Hook program, donated \$2500 toward the purchase of several auto tour route interpretive signs now being made by Wilderness Graphics.

The Annual Christmas party and awards ceremony for volunteers was held on December 13 with 30 refuge volunteers in attendance. Awards were presented in various categories ranging from staffing the Visitor Center, and working with

educational groups, to assistance with computer programming and operation of the sales outlet. Awards presented included the following: refuge sweatshirts and T-shirts donated by the association, volunteer T-shirts and caps, service pins, mugs, bird guides, two books for special awards--America's Wildlife Hideaways and Wildlands for Wildlife, and the Refuge System wildlife calendar by John and Karen Hollingsworth. A second volunteer has now received the Service's 500 hour pin, and two additional volunteers have received the Service's 200 hour pin (bringing the total to 14 volunteers). Twenty volunteers received special recognition awards.

5. Funding

Five Year Chronology of Station Funding (Thousands) One-Year Funds Only

	<u>1261</u>	<u>1262</u>	<u>6860</u>	<u>9100</u>	<u>Total</u>
FY 93	385.7	183.0	2.0	.5	571.2
FY 92	341.2	228.0	2.0	.5	571.7
FY 91	285.5	136.0	2.0	1.0	424.5
FY 90	251.9	125.0	2.0	4.5	383.4
FY 89	231.3	121.5	2.0		354.8

Funds not shown in the above table included "no year" categories such as quarters maintenance (8610) and fee collection (4960) as well as end-of-year purchases made for the station by the regional office. During FY 92 these end-of-year purchases included a replacement vehicle (pickup truck) and computers for the manager and assistant manager.

6. Safety

Meetings continued to be held with the combined Bombay Hook/Prime Hook staff; generally on the last Wednesday of the month. Delaware Bay Estuary personnel were invited to participate and sometimes they did attend. Various staff members had responsibility for selecting a topic and presenting it at the meeting according to a schedule prepared at the beginning of the year. Some of the topics included Lyme disease, AIDS, water safety/hypothermia, substance abuse, CPR/first aid, safety around electricity and defensive driving.

Annual audiometric testing was performed on required staff members January 8 and 9.

1992 was the first year in which physical examinations were required for refuge law enforcement officers and fire management personnel. Paul Daly, Frank Smith, Steve Wunderley and Arthur Straughn passed their exams which were completed in March.

Safety officers of Bombay Hook and Blackwater Refuges conducted reciprocal inspections of station facilities during April.

On April 7 the new Regional Safety Officer, Phil Sorenson, visited for an orientation tour.

Four employees who regularly fly aerial surveys (Daly, Smith, Straughn and Wunderley) completed a one-day training course in "Water Ditching Safety and Survival" conducted by OAS at Edison, New Jersey on June 11. It was an excellent, practical course on steps to take if an aircraft crashes in water during surveys or law enforcement operations.

Delaware hunting safety and ethics classes for initial hunt license applicants were conducted each month from July through the end of the year in the refuge auditorium. Each monthly session consisted of three consecutive evenings of instruction for over three hours each evening.

Eastern Shore of Virginia NWR Electrician Jerry Loomis visited from September 21-23 to perform an inspection of all electrical systems. Jerry found a few things which needed correction and repaired them; however everything was in pretty good shape overall.

Personnel of various Federal, State and local agencies participated in an all night search for two SCS technicians who did not return home the evening of September 25, after working all day in the refuge tidal marsh. A more detailed report of the search and successful rescue is recorded in Section H.17.



- #6 Biologist Smith was presented with a certificate and cash award for his efforts in the search and rescue operation on September 23-24. Assistant Manager Wunderley received a similar award.

12/92 Pohlman

7. Technical Assistance

During May Manager Daly advised Mr. Paul Tavel, Facilities Manager at the Smithsonian Institute Environmental Recreation Center, Edgewater, Maryland regarding the initiation of a deer hunt on the center. Mr. Tavel manages an area of about 3000 acres which is becoming overpopulated with deer. It was suggested that he work with Maryland DNR and consider placing hunters on stands for maximum harvest efficiency and safety. He was sent a complete packet of our hunt information and procedures.

Manager Daly provided assistance to Holger "Rusty" Harvey, Executive Director of Delaware Wildlands Inc. in that organization's plans to convert some of their cooperative farming to "sustainable agriculture." Delaware Wildlands is a non-profit conservation organization which purchases suitable wildlife areas when they become available, eventually turning them over to a State or Federal agency for management (sort of a Nature Conservancy on a State level). In this instance the main course of action suggested to Mr. Harvey was to pursue a graduated scale of rent (zero to \$50 per acre, which is current) for farmers who will adopt some or all of the new sustainable agriculture practices.

Manager Daly counseled a Mr. Roger Ramcharita of the British Columbia Fish and Wildlife Agency during July on procedures for managing a Young Waterfowlers Hunting Program. Mr. Ramcharita is setting up such a program in that Province.

8. Other Items

During the week of June 1 an evaluation of the refuge biological program was conducted by regional personnel. Visiting us during that time were Associate Refuge Supervisor Tom McAndrews, Zone Biologist (South) Hal Laskowski, Zone Biologist (Central) Charles Pelizza and Regional ADP Coordinator Paul Steblein.



- #7 Discussions during the station evaluation of biological programs ranged from impoundment and moist soil management to goose browse and improvement of woodcock habitat. Here Central Zone Biologist Pelizza, Regional ADP Coordinator Steblein and Associate Manager McAndrews inspect a ladino clover field with Refuge Biologist Smith.

6/92 Daly

F. HABITAT MANAGEMENT

1. General

Over 12,000 acres of Bombay Hook's 15,122 total acres consist of tidal salt marsh. Other important habitats include freshwater impoundments (1,100 acres), croplands (980 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 NWRs. 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 (JVs), have been established to implement the plan. In Region 5, The Lower Great Lakes/St. Lawrence Basin and the Atlantic Coast JVs 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 to favor growth of plant communities and habitat conditions desired by waterfowl. Black ducks and Canada geese are of particular management concern at Bombay Hook. Waterfowl foods are also provided through cooperative farming agreements with local farmers.

NAWMP Activity Highlights on Bombay Hook in 1992

Eight proposed moist soil development sites which are scattered throughout the cropland management units were funded to the tune of \$26,900 through the Ducks Unlimited MARSH program and our own budget. Our regional funding was available during 1992 but the DU funds do not become available until FY93. A portion of the 1992 funds were used to buy the water control structures. The remainder of the funds were included in a cooperative agreement with the Kent

Conservation District who will perform most of the construction during the summer of 1993.

Refuge staff assisted Regional Office NAWMP Joint Venture Coordinator Dick Dyer in performing a Level I contaminant survey on the Milford Neck Focus Area (Williams-Asche Wetlands). The survey was completed July 31 and submitted to the Regional Office the following Monday.

2. Wetlands

Tidal Marsh

Bombay Hook's salt marsh is a rather unique habitat on the east coast from Delaware northward in that it mostly remains in a pristine, unditched condition; having escaped the grid-ditching done for mosquito control on similar coastal 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.

Such habitat management as occurs is carried out primarily with the objective of reducing the effects of feeding by concentrations of snow geese in portions of the low marsh. When the refuge populations reached 70,000 to 75,000 birds in the mid-1980's, extensive "eat-outs" were created in the Money Marsh and Leatherberry Flats areas, as well as around George's Island (approximately 1,000 acres). Between 1988 and the spring of 1992 the areas devegetated by geese remained roughly the same but varied up or down in size by as much as 100 acres each year. As of the writing of this report the acreage denuded during 1992-93 appears to have expanded somewhat, but the amount of the increase won't be determined until the geese have departed the area.

The snow goose hunt, conducted as a management tool on the critical marsh sites since 1983, appears to have influenced off refuge feeding forays and has at least influenced the timing of the "eat-out" if not the total extent of it. Increased use of the salt marsh by feeding snow geese after the hunt was terminated on November 30 this year may have been encouraged by the lack of disturbance normally provided by hunters. If this is in fact the situation, then hunting or lack of it may also be an important factor in determining the ultimate size of the "eat-out".

Other than the snow goose hunt, the only active management on the tidal marsh is prescribed burning; selected high marsh units are burned in mid-winter to divert the attention of snow geese away from the vulnerable low marsh. A 500 acre portion of tidal salt marsh was burned on Bombay Hook Island

during late Winter. Some sporadic use of the burned area by snow geese was noted.

Impoundments

Once again the past year was a successful one in that management objectives for the major impoundments were all met.

Drainage capabilities within Raymond Pool were enhanced by the excavation of a ditch parallel to the east dike. Complete and rapid drawdown which was impossible during past years is now feasible.

Phragmites control in and around Bear Swamp and A-Pool was conducted by aerial application of Rodeo to 66 acres during late August.

The Finis dike was restored and raised to accommodate higher pool levels and the slopes were brought up to grade (Section I.2).

Our vegetative sampling techniques for the impoundments were modified from a transect to a plot system (with the exception of Finis where the transect system was still used) which coincides with the computer program (Vegdata) developed by our zone biologist to monitor our wetlands management programs. Although time consuming and physically difficult to implement, we are convinced the data collected this year was the best ever and the computer program was extremely helpful in organizing and presenting the data collected.

Finis Pool (205 acres)

The aerial treatment of Decodon with glyphosate during 1990 and 1991 within this impoundment was extremely successful as the percent cover for this plant dropped to from 1 to 3 percent over the three monitored transects. This year a spring drawdown, reflooding and subsequent early summer drawdown were performed to both enhance the growth of smartweeds and to enable contractors to re-slope and raise the dike. Both objectives were met as smartweed growth was the best noted in several years. In addition, Cyperus growth was the most impressive ever recorded during the past 15 years. However, the long drying out period did result in significant growth of bedstraw within the pool.

In addition to its consistent yearly function as a wood duck breeding and brood rearing area the impoundment this year provided conditions which were eagerly sought by mallards, green-winged teal, black ducks, and gadwall during the fall.

Green herons were observed by the dozens within the pool during the late summer.



- #8 Finis Pool produced exceptional quantities of duckweed (foreground) this year, as well as desirable emergent vegetation.

9/92 Daly

Sheariness Pool (560 acres)

Actual water levels closely approximated those of the water program objectives except during April and May when high levels were maintained in an effort to flush water through the Raymond-Sheariness canal and through Raymond Pool in an effort to lower salinities there.

Desirable vegetation was again abundant. Sprangletop, panic grass, and Walter's millet predominated and produced heavy quantities of seed. Waterfowl use was again impressive. Our gradual increase in water levels in the fall attracted pintail and green-winged teal flocks by the thousands. An estimated 15,000 ducks were counted within the pool on November 3. Snow geese and Canada geese and a few tundra swans also used the pool for resting and roosting.

Raymond Pool (95 acres)

During the past several years a buildup of silt in the southeast corner of the pool has prevented the total dewatering of the impoundment during drawdown. As a result the remaining shallow water after a drawdown attempt would evaporate and contribute concentrated salt to an already highly saline pool bottom. (Soil salinities this year ranged

from 13.2 to 21.8 ppt.) After an unsuccessful attempt to complete a ditch force account with the Blackwater-owned track mounted backhoe, we contracted locally and successfully excavated a ditch 1400 feet long by 4 feet wide by 3 feet deep adjacent to the east dike during late summer. We now can achieve total drawdown within the pool when desired. While we had the tracked vehicle we planned to experimentally manipulate portions of the pool bottom with a harrow to break up the salt crust, but were unable to do so due to the soft nature of the pool bottom. The vehicle could be driven only on the pool edges and there with extreme difficulty. The water control structure within this pool is badly deteriorated, leaking water and is proposed for replacement during 1993.



- #9 A rather large washout at the main Raymond Pool water control structure will require repair and rehabilitation of the structure. This was one of the few water control structures at Bombay Hook which was not rehabilitated during the BLHP program.

3/92 Daly



#10 Fortunately, we have received funding for the rehabilitation work during FY 1993.

3/92 Daly

During 1992 water levels were maintained at close to or slightly less than objective levels for most of the year. Nearly 70% of the pool was devoid of emergent vegetation. Virtually all vegetation was confined to the pool fringe where Scirpus, Panicum, and Walter's millet predominated. Despite the lack of vegetation and the high soil salinities migratory bird use of the pool was excellent. Based on bottom sampling we found the pool produced a substantial supply of chironomid larvae which were eagerly sought by waterfowl (especially shovellers) and shorebirds. This pool continued to be the primary feeding and resting area for the refuge's avocet population which reached peaks of 250 birds in October. Shorebirds, primarily dunlin, semipalmated sandpipers, and dowitchers utilized the pool by the thousands. The area is a favorite for visiting bird watchers since it is easily accessible and contains a large and diverse population. Shorebird use was heavy throughout the spring, summer, and fall period. Wading birds were also attracted to the pool especially during drawdown periods. Both Canada and snow geese used the pool for roosting and resting and the snows also fed extensively in the bulrush beds along the pool fringes.

Bear Swamp Pool (240 acres)

Pool levels were maintained slightly below objective levels during most of the year. We attempted to draw the water off most of the pool surface while still maintaining water within the borrow pits and interior ditches. We were successful in accomplishing this although, as expected, it was difficult to obtain enough freshwater to reflood the pool in the fall. Spikerush growth was good over much of the moist pool bottom and sprangletop occurred on the drier sites. Unfortunately, Pluchea remains a problem and this year occupied 10% of the pool bottom. Drying out of the pool bottom during the late summer likely contributes to this problem. Unfortunately, any type of spring or summer drawdown within this pool may contribute to expansion of this plant since it is very difficult to add freshwater to the pool during the summer months.

Waterfowl use appeared heavier this year and may have been enhanced by the lower water levels. Up to 2000 green-winged teal were observed there during the fall. Goose use increased as well with both snows and Canadas resting and feeding within the pool. This pool was also the most heavily used of the refuge's impoundments by wading birds. As many as 150 each of Great egrets and blue herons were recorded during May. The area continued to be, along with Finis, one of our best nesting and brooding areas for wood ducks.

Paddy Fields

A-Pool (12 acres) - The impoundment's chemically treated Phragmites canes were burned during January. The dike was repaired in several places and a new water control structure was installed. Excess water was pumped from Bear Swamp on a couple of occasions during the winter and spring, but apparently the pool bottom is not conducive to holding water over long periods of time. The soil characteristics indicate that top soil may have been removed from this area in the past to be used on other construction projects, and what is left may be too permeable for effective impoundment of water. During the period when water was covering the pool bottom use by waterfowl, shorebirds, and wading birds did occur. We will experiment further with this area during 1993 to determine what water regime will be the most feasible and useful to wildlife.

B-Pool (8 acres) - The dry winter and spring period failed to provide the water necessary to fill the ditch bisecting the pool or the pool bottom. Our submersible pump installed this year did not provide enough pumping capacity to flood the area while the ditch was dry. A second water control structure was installed within the ditch in the back of the pool to close the ditch at both ends so that it did not

require as much water to fill it. The pool bottom was disked on two occasions to set back succession. No significant use of this area was realized by migratory birds during 1992.

Straughn Pool (2 acres) - This area held water throughout the year. No stoplog manipulation was tried. A natural partial drawdown resulted in growth of wild millet and panic grass around the fringe while cattail covered 30% of the interior. Invertebrate abundance in the pool was noteworthy, especially backswimmers. The pool was used frequently by small flocks of waterfowl, primarily teal and mallards.

Other Moist Soil Management

A Ducks Unlimited MARSH project was approved in 1991 involving the construction of seven small moist soil units scattered throughout the cropland units. Total amount of wetlands created will be 30 acres. The Service will be providing funds on a 50:50 BASIS with Ducks Unlimited. The Service share (\$13,450.) was received in 1992 and a portion was used to purchase water control structures and culverts. The remainder, plus the DU money to be received in 1993 (these are "no year" monies) will be used for actual construction. The Soil Conservation Service is assisting with pool design and the local ASCS District will do the construction under terms of a memorandum of Agreement signed this year.

3. Forests

Wooded habitat includes 453 acres of upland hardwoods (primarily white oak, red oak, and hickory), 385 acres of hardwood swamp (black gum, sweetgum, red maple, yellow poplar) and 192 acres of shrub community (buttonbush, wax myrtle, sumac). Most acreage is in scattered woodlots and along field and marsh edges rather than in large blocks. No management activities were conducted in these habitats during 1992 other than permitting deer hunting and the erecting of wood duck nest boxes.

Karen Felton, of the USDA Forest Service, visited the refuge on November 19 to search our woodlots for gypsy moth egg cases. Fortunately, none were found.

4. Croplands

Refuge shares from three cooperative farming agreements (Carrow, Snow, and Hurd) were as follows in crop year 1992:

Storable Corn (banding bait)	125 bushels
Standing Corn	50.1 acres
Winter Wheat (drilled)	80.1 acres
Buckwheat/Crimson Clover	57.5 acres
Ladino Clover	201.7 acres
Ryegrass (overseeded on corn)	154.0 acres
Crimson Clover (overseeded on beans)	245.7 acres

Emphasis continued in two main areas: increasing ladino clover and other green browse (especially crimson clover) for geese, and maintaining hot foods in the form of standing corn. After maintaining a field in ladino clover for 2-3 years the field is rotated back to corn as either cooperator or refuge share. The clover provides a significant boost of nitrogen which need not be added by the farmer. During the past year all ladino clover fields were mowed four times each during the growing season to favor the clover over invading grasses, with the final mowing accomplished in early to mid-September to place it in prime condition for utilization by geese.

This was the first year that crimson clover was seeded extensively. We wish to assess its attractiveness as goose browse to go with its well known benefits as a soil builder. It was aerially seeded over soybeans on September 7. This date appears to be a bit too late for it to make significant fall growth in our area; therefore we will push the seeding date back to the first two weeks of August in 1993.

Refuge shares were based on charging the cooperators \$50 per acre for use of refuge fields to grow their corn or soybeans. Rainfall was very good during the growing season and excellent crop yields were achieved by refuge farmers. Harvested corn (318.8 acres) ranged from yields of 90 to 150 bushels per acre with the average around 130. Soybeans (263.7 acres) yielded from 30 to 55 bushels per acre with an average of 45.

This was the first year that all our farming information was computerized by using the Croplands database program developed by Zone Biologist Laskowski. The program simplified data storage and retrieval for each field. In addition the database provided storage of information related to waterfowl use in croplands. It is much easier now to document phenomenon which previously had only been recorded as occasional observations.

Waterfowl utilization of the cropfields was much different this year than 1991. Both snows and Canadas used the harvested corn fields heavily immediately after harvest in the early fall. However, the snows did not invade and decimate the clover fields as they did last year. In fact, after the waste corn was cleaned up there was very little refuge field feeding by snows until late January, 1993 when the standing corn was mowed. Most of the feeding by the snows occurred off refuge or within the salt marsh. Fortunately, during December the Canada geese made good use of the green browse in refuge cropfields but did not destroy them as the snows normally do.

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 (100% predation) on the dike edges. Fields which are in either sericea lespedeza or wild grasses are burned or mowed on a three year cycle to prevent invasion of shrub species.

9. Fire Management

Prescribed burning was accomplished on 547 acres proposed for burning during the year. An additional 120 acres were burned as a result of a wild fire. Below is a summary of each of the fires during 1992.

01/23/92

Approximately 25 acres of treated Phragmites, grass and brush were burned within Unit N (A/Pool). Burning conditions were excellent and desired results of removal of Phragmites canes and controlling brush invasion in a paddy field were achieved. The interior dike slopes of Shearness Pool (Unit L) were also burned on this date to eliminate chemically treated Phragmites canes.

02/03/92

Approximately 22 acres of treated Phragmites, grass and brush were burned within Unit K. Again conditions were excellent and desired results of removal of Phragmites canes and controlling brush invasion within Raymond Pool were achieved.

03/13/92

Approximately 500 acres of tidal saltmarsh were burned on Bombay Hook Island (Unit E) under excellent conditions. Above ground removal of salt hay and cordgrass permitted snow geese easy access to below ground roots and rhizomes during late March.

04/06/92

Approximately 120 acres of tidal marsh were burned, presumably by arsonists, within Units G and F. The Leipsic Volunteer Fire Company responded to the fire. The entire fire was confined to marsh islands and was declared out on the morning of 04/07/92.

10. Pest Control

The following herbicides were applied on portions of the cropland management units during 1992:

<u>Herbicide</u>	<u>Crop</u>	<u>Target Species</u>
Roundup	Spot treatment in all fields necessary	Johnsongrass, Canada thistle
Dual	Corn, soybeans	Annual grasses/weeds
Scepter	Soybeans	Broad-leaved weeds
Gemini	Soybeans	Broad-leaved weeds
Lorox	Corn, soybeans	Grasses & Broad-leaved weeds
Command	Corn	Grasses & Broad-leaved weeds
Prowl	Soybeans	Grasses & Broad-leaved weeds

Excellent control was achieved on all target species. Application was by cooperative farmers with the exception of glyphosate on fields not included in the agreements. Control of the latter was by those refuge personnel who are Certified Pesticide Applicators. No insecticides were required on refuge crops; in fact, none have been used since 1985.

Rodeo (glyphosate) was aerially sprayed during late August around A-Pool and Bear Swamp (a total of 66 acres) for the control of phragmites.

1992 was an average year for salt-marsh mosquito infestations. The Delaware Mosquito Control Section made the following applications of larvicides and adulticides:

Abate	May 12, June 4, July 3
Altosid	May 15, June 18, July 7, July 30
Vectobac	August 3, August 13, August 18
Dibrom	July 12, August 25

12. Wilderness and Special Areas

Marshall Island (50 acres) and an unnamed 70 acre island to its west in the Leipsic River form 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 1992 on the predominantly 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, has been operated for many years by the Delaware Division of Historic and Public Affairs under long term (10 year) special use permit from the Service. The structure has been on the national Register of Historic Places since 1971. The occupants of the residence, who are State employees, open their home to the public on weekend afternoons from 2:00 pm to 5:00 pm.

G. WILDLIFE

1. Wildlife Diversity

Bombay Hook's habitat mixture supports a wide variety of animal species. There are documented records of 314 species of birds (43 being accidentals), 34 mammals and 27 reptiles/amphibians. Of the bird species, 55 are confirmed nesters, and 31 are probable nesters.



#11 The monarchs of the milkweed are a welcome sight when they pass through on their September migration.

9/92 Pohlman

2. Endangered and Threatened Species

a. Bald Eagle

After three consecutive years of failed nests we were very happy that our nest this year successfully produced one young eaglet. On May 27 Paul Burns of the Delaware Division of Fish and Wildlife climbed the nest tree (an 85 ft red oak) and banded the eaglet estimated at no more than 4 to 5 weeks old. This year's nest was again located in the woodlot adjacent to Shearness Pool.

b. Peregrine Falcon

Although peregrines are infrequently sighted during the fall, winter and spring we have never had a successful nesting attempt on our saltmarsh nesting tower. Through the use of properly installed predator guards we have been able to eliminate raccoons from the nesting platform but are still plagued by competition from great horned owls.

During an inspection of the tower on March 4 we discovered and removed two horned owl eggs. Follow up checks of the tower throughout the spring revealed no

more activity by the owls and on May 27 one peregrine was perched on the tower. No observations were made of a mate for this bird nor were any nesting attempts noted.

3. Waterfowl

Total waterfowl use-days for CY92 were 6,619,501. This is an increase of 1,134,808 use days from CY91. The most significant increases occurred with snow geese and ducks while Canada geese declined to levels not experienced in 25 years. Table G.3.1 compares the last four years use day figures.

Table G.3.1 Waterfowl Use-Days 1989-92

<u>Species</u>	<u>1989</u>	<u>1990</u>	<u>1991</u>	<u>1992</u>
Tundra Swan	2,170	1,437	3,740	6,261
Ducks	1,598,570	1,985,995	1,781,813	2,416,398
Canada Geese	607,992	550,870	690,487	518,233
Snow Geese	2,740,168	4,157,862	3,008,653	3,678,609
TOTAL	9,948,900	6,696,164	5,484,693	6,619,501

a. Canada Geese

Despite our habitat management efforts which included closed areas to the general public as well as increased acreages of clover and standing corn, Canada goose use on the refuge declined to the lowest level in 25 years. The peak population for the year was recorded on January 8 when 8,000 birds were counted. By the first week in March only a few hundred birds remained. Fall populations built up very slowly. By the end of October less than 2,000 birds had arrived. The numbers grew slightly as a peak of 4,000 birds occurred in November and 7,500 were surveyed during the end of December.

b. Snow Geese

Snow goose use days showed an increase as the birds spent more time feeding and roosting in the saltmarsh during the fall and early winter than they did during the previous two seasons. During the period January through March use of the refuge was light as the birds were spending most of the time in the vicinity of Prime Hook.

The fall flight was almost exclusively adult birds as we encountered only about 3% juveniles. This made for poor hunting within the refuge marshes and soon discouraged local hunters. Despite the presence of thousands of birds hunters lost interest and chose not to participate in the refuge hunt. Goose use in the saltmarsh was

heavier than normal and resulted in larger eat-outs than a year ago. By the first week of October nearly 40,000 birds had arrived on the refuge. This number grew to 54,000 by mid November and numbers remained at around 40,000 through the end of the year. Goose use on the refuge was largely confined to the saltmarsh and impoundments as use of our agriculture fields by the end of the year was much lighter than previous years.

For the fourth consecutive year our staff and the personnel from Delaware Fish and Wildlife conducted aerial snow goose surveys over the upper Delmarva peninsula throughout the wintering period. Roosting sites as well as feeding sites were monitored. Populations in our survey area (Delaware, portions of Cecil, Caroline, Kent and Queen Anne Counties in Maryland) peaked at approximately 120,000 birds which was slightly below last year's peak of 137,000.

c. Swans

Use of the refuge by tundra swans was minor again this year, but was up slightly from 1991. Peak numbers of 200 were recorded on January 20. Swans normally utilize Bear Swamp and Shearneck Pools and occasionally the saltmarsh for roosting and loafing. They fly out to neighboring farm fields to feed.

d. Ducks

Duck use days showed an increase of 35% over the previous year. Adequate water this year during October and November provided optimum conditions within our impoundments, particularly Shearneck Pool. This resulted in very high numbers of green-winged teal and pintails during those months. In addition, significant increases in mallard and black duck numbers were recorded in the February and November surveys. Following is a listing of species and peaks during 1992 based on aerial surveys by the refuge staff.

Black Duck	02/20/92	3,126
Mallard	12/02/92	2,932
Green-winged teal	11/06/92	10,671
Pintail	10/20/92	5,966
Shoveller	03/09/92	1,627
Gadwall	12/12/92	309
Wigeon	11/06/92	260
Scaup	11/06/92	3,300
Common Merganser	03/09/92	134

The wood duck nest box program again received considerable attention. Maintenance Worker Arthur Straughn once again did an excellent job in monitoring

all boxes, checking each a minimum of three times during the nesting season, erecting new boxes where needed, moving boxes, and keeping detailed records of bird use and nesting success. This included entering all data into the computer and collecting and organizing the data for the management study discussed in the Research and Investigations section.

Hatchability of wood duck eggs increased from 47.4% in 1991 to 55.0% this year. This marked the second consecutive year that hatchability has increased. Apparently this is a result of having isolated our nest boxes in an effort to reduce competition among hens.

During recent years our attempts to band wood ducks during the pre-season period have been successful for primarily only juvenile birds. This year in an effort to increase our adult hen banding success we decided to band the birds in the nest boxes. We captured and banded 60 adult hens during the nesting season while conducting normal box checks. Disturbance to the active nests was not a factor, since we did not detect any difference between boxes where the hens were captured and where they were not.

One interesting observation was made during the boxchecks which we had not seen previously. A recently hatched live wood duck chick was found in a nest box with juvenile screech owls. We surmised that the owls apparently incubated one of the duck eggs which were already in the box.

Production estimates for waterfowl species other than wood ducks remain little more than educated guesses. We still do not believe we 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, brood surveys and general observation of broods within the impoundments are our principle means of arriving at production estimates.

Table G.3.2 Estimated 1991 and 1992 Waterfowl Production

<u>Species</u>	<u>1991</u>	<u>1992</u>
Mallard	225	150
Black Duck	250	200
Wood Duck	776	727
Blue-winged Teal	100	100
Gadwall	150	175
Canada Geese	1	16

4. Marsh and Water Birds

Data are collected for marsh and water bird use within the refuge impoundments regularly by refuge staff and volunteers during the period March through November. In addition boat surveys of the tidal saltmarsh and bayshore are conducted during the spring and summer. Table G.4.1 illustrates representative peak populations of various species during 1992. Wading bird peaks seem to vary and are influenced considerably by our water management (particularly dates of drawdown) regimes within the impoundments. Dry conditions in the late summer often concentrate prey items and in turn attract large numbers of waders. This was not the case this year to the extent that it occurred in 1991.

Table G.4.1 Marsh and Water Bird Peaks 1992
(1991 peaks in parenthesis)

<u>Species</u>	<u>Number</u>	<u>Date</u>
Double-crested cormorant	1641 (400)	04/28
Great egret	135 (900)	05/23
Snowy egret	97 (1000)	06/20
Glossy ibis	497 (700)	06/09
Great blue heron	128 (235)	05/23

5. Shorebirds, Gulls, Terns and Allied Species

Large concentrations of spawning horseshoe crabs along the bayshore during May and June once again served as a major attractant to migratory shorebirds. Weekly boat censuses were conducted during this period. Peak counts of the predominant species from these surveys are listed in Table G.5.1. These numbers do not represent total refuge populations of these species, but are an index since the same survey route is censused each week. Numbers were considerably below the past few years for most species, since crab spawning was later than expected and much lighter than has been observed in previous years.



#12 Spring at Bombay Hook and at other spots along Delaware Bay brings horseshoe crabs ashore to spawn.

5/92 Pohlman



#13 This ritual is followed by large numbers of a variety of shorebird species which stop off for a few brief weeks on their northward migration to fatten up on the crab eggs.

5/92 Pohlman

Table G.5.1 Shorebird Peaks 1992
(1991 peaks in parenthesis)

<u>Species</u>	<u>Number</u>	<u>Date</u>
Dunlin	4630 (2937)	05/10/92
Ruddy turnstone	4036 (8455)	05/28/92
Knots	391 (4087)	05/28/92
Semi-palmated sandpiper	6020 (13877)	05/28/92
Dowitchers	1773 (4595)	05/10/92

We again provided our data to the Manomet Bird Observatory in Massachusetts to be used in their cooperative shorebird population surveys. Avocets and black-necked stilts continue to increase on the refuge. The stilt now is quite common within the impoundments as well as the saltmarsh and nests extensively. The avocet, although not confirmed as a breeder on the refuge, reached a peak of 250 birds within Raymond Pool on October 22. Raymond Pool receives the greatest amount of shorebird use of the four major impoundments. This 95 acre impoundment is managed with shorebirds being a top priority. Peaks of 2000 dunlin and 1500 dowitchers were seen using the pool during May. The pool is also a favorite for yellowlegs, phalaropes, and less common species such as hudsonian godwits. Chironomid larvae seem to be the primary food source.

Manager Daly ran a route of the North American Woodcock Singing Ground Survey on April 27. The route was near Prime Hook NWR in Sussex County, Delaware.

6. Raptors

No unusual raptor population fluctuations were detected this year. Kestrels, great horned owls, screech owls, barn owls, black vultures and red-tailed hawks were all known to have successfully produced young in 1991; and it is likely that the northern harrier, red-shouldered hawk, and turkey vulture did so as well.

7. Other Migratory Birds

This was the sixth year of the bluebird nest box program and the fourth year in a row that saw an increase in bluebird box use. A total of 27 boxes were available for nesting bluebirds. Fourteen were used by bluebirds and a total of 35 young were successfully fledged. Competition with tree swallows was the main impediment to greater use by the bluebirds.

8. Game Mammals

a. Big Game

The only big game mammal present on the refuge is the whitetail deer. The population, estimated through periodic spotlight surveys, is believed to be increasing slightly. Currently the pre-season population is estimated at 350 to 400 animals. Habitat remains in excellent condition with no browse line and no detectable increase in crop depredation. Herd health is excellent as reflected in average weight of fawns and 1 1/2 year old animals during the year. The regulated deer hunts held here for many years have helped maintain the herd size at a manageable level. A liberalization of the hunter bag limit and special antlerless season in 1992 were welcome modifications which should set back the expanding herd and enable us to keep the population within acceptable limits and protect our habitat.

All deer harvested during the hunts are brought to an official State check station on the refuge where we collect data relative to overall condition, weight, age and antler beam diameters. All measurements indicated a continuation of excellent herd condition. (Section H.8)

b. Muskrat

Portions of the salt marsh 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 areas known as Money Marsh and Leatherberry Flats have had nearly 1,000 acres of tall form Spartina alterniflora removed annually, thereby rendering them unsuitable for muskrat use. An index of the population is normally obtained by an aerial house survey each winter; although the accuracy of this technique is influenced greatly by the presence or absence of snow cover as well as tide stage. Several portions of Bombay Hook support good muskrat populations based on trapping data; but are not accurately censused due to the tendency in those areas for the animals to use bank dens rather than houses.

c. Raccoon

The raccoon is extremely abundant on Bombay Hook both in the uplands and throughout the salt marshes. We know they prey heavily on waterfowl nests and would desire a much reduced population. Commercial trapping is permitted, but the annual catch is low, seldom exceeding 100 animals. Fur prices are so low that there is virtually no interest in trapping for them. The low level of harvest is insignificant in terms of reducing

the population. During 1991 a rabies outbreak decimated refuge raccoon numbers with the staff observing many sick and dead animals. Positive diagnosis was obtained on one dead raccoon. The population appears to still be below the levels in the pre-rabies years, but the animal is still quite numerous and creates depredation problems during our pre-season duck banding efforts.

d. Otter

Otter sign is common within the refuge impoundments and salt marsh, although sightings of the animals are infrequent. We have no reliable estimate of their population size, although we have seen nothing to indicate a change in the population from previous years.

e. Other Mammals

Beaver were seen throughout the year and are flourishing throughout Finis Pool, the upper end of Shearneck Pool as well as the back portions of Bear Swamp. Although they occasionally plug the water control structure in Finis Pool they do not create significant problems.

No changes were noted in cottontail rabbit, red fox, grey squirrel, opossum, and woodchuck populations. Red fox continue at high population levels with many mangy, diseased specimens sighted. The red fox has historically been fully protected within the state; thus we had few control alternatives. However, during the past year a limited hunting season has been approved which may offer some future options.

10. Other Resident Wildlife

Bobwhite and ring-necked pheasant are sighted commonly on the refuge. No noticeable trends were observed which indicated anything but stable populations of both these species.

On a few occasions wild turkeys were sighted on the refuge during the past year. Turkeys are rapidly expanding throughout southern and central Delaware and it appears likely they will become permanent residents on Bombay Hook.

16. Marking and Banding

Bombay Hook and Prime Hook were once again assigned a combined quota for pre-season wood duck and black duck banding. Considerable effort was expended at both stations. Bombay Hook wood duck banding was conducted in the southern portion of Bear Swamp and Finis Pool as well as within nesting boxes; while black duck banding was attempted at Hay Ditch. Although the non-quota mallard can easily be captured

at Bombay Hook we find it extremely difficult to capture pre-season blacks. Low refuge populations of scattered individuals contribute to the difficulties. Fortunately, Prime Hook is much more successful. Tables G.16.1 and G.16.2 summarize our 1992 banding efforts.

Table G.16.1 Bombay Hook Waterfowl Banding Totals 1992

<u>Species</u>	<u>HY-Male</u>	<u>HY-Female</u>	<u>AHY-Male</u>	<u>AHY-Female</u>	<u>Totals</u>
Wood Duck	46	58	4	65	174
Mallard	--	--	5	2	7

Table G.16.2 Combined Bombay Hook/Prime Hook Totals 1992
(Quota in Parenthesis)

<u>Species</u>	<u>HY-Male</u>	<u>HY-Female</u>	<u>AHY-Male</u>	<u>AHY-Female</u>	<u>Totals</u>
Wood Duck	86 (50)	104 (50)	44 (50)	172 (50)	406
Black	65 (50)	21 (50)	4 (50)	9 (50)	99
Mallard	43	44	8	12	107
MallxBlk	2	1	-	-	3
Hood Merg	-	-	-	1	1

H. PUBLIC USE

1. General

Total public use visits were 81,945 this year, compared to 78,133 visits in 1991. Wildlife observation accounted for 64.7% of all visitor activities, followed by environmental education (to include interpretation, outdoor classrooms, and educational assistance) 32.2%, and hunting/trapping 3.1%. These percentages fluctuate to some extent annually as we provide more self-service brochures and exhibits.

This was the fourth full year of charging entrance fees. Following is a comparison of the fees collected and passes issued during the past four 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).

	<u>1989</u>	<u>1990</u>	<u>1991</u>	<u>1992</u>
DP (\$)	17,024.00	16,829.53	16,043.37	14,219.64
GEP (#)	76	89	90	109
GEP (\$)	1,900.00	2,225.00	2,250.00	2,725.00
GAP (#)	432	446	457	471
GACP (#)	14	4	10	0
FDS (#)	871	796	426	385
FDS (\$)	10,887.50	9,950.00	6,390.00	5,775.00

The refuge share from daily entrance fees and golden eagle passes (30%) returned as 4960 money was \$5,083.39. These funds were used mainly for the funding of a seasonal recreation aid, but also for other facets of the interpretation and environmental education program. This year golden passes (sales and free issue) were up and duck stamp sales and daily entrance passes were down. This trend may continue as visitors become more aware of the various golden passes.

Table H.1.1 - Monthly Entrance Fees Collected for CY 1992

January	\$ 1260.00
February	987.00
March	1002.00
April	1242.00
May	1455.00
June	960.00
July	771.00
August	1281.00
September	1545.00
October	1172.72
November	1298.92
December	1245.00

Table H.1.2 - Public Use Activity 1983-1992

<u>Year</u>	<u>Total Visits</u>	<u>Interpretation</u>	<u>Outdoor Classroom</u>	<u>Observation Vehicle</u>	<u>Foot</u>	<u>Number Groups</u>
1992	81,945	40,295	3,613	74,004	8973	145
1991	78,133	52,088	2,292	69,565	6622	103
1990	81,676	60,433	1,756	70,469	7046	101
1989	78,258	36,232	1,694	70,090	6635	105
* 1988	83,347	44,648	1,597	74,519	7156	110
1987	83,286	36,194	1,337	74,968	7380	113
1986	81,987	40,313	1,786	72,626	6957	124
1985	77,752	32,564	2,093	67,735	6773	103
1984	55,890	24,860	1,672	52,302	3736	111
1983	32,079	11,041	967	26,103	3035	76

* Refuge entrance fees instituted in June, 1988

For the past two years, three temporary recreation aids have shared one position on a seasonal basis. One, Bob Jones, is an artist, writer, and previous environmental education teacher. Bob provides the art work for our brochures and lesson plans. This year his major art projects were a Calendar of Nature Events, a History Brochure, and site specific lesson plans for our outdoor classroom activities. Another, Verna Price, is a retired environmental science teacher, and in addition to working well with the school groups, has been a tremendous help in keeping the sales outlet running smoothly. A third, Mark Connelly, is familiar with computers and also conducts off site programs for the refuge.



#14 Recreation Aid Mark Connelly works with students and teachers during an outdoor classroom activity on the refuge.

11/92 Hollingsworth

ORP Pohlman continued to provide assistance to Prime Hook and Eastern Neck Refuges as requested. No requests were received from Blackwater Refuge this year. Pohlman worked on lesson plans, made pre-trip visits to schools, and worked with volunteers for the 4th Grade environmental education days held at Eastern Neck in the fall. Two environmental education workshops (fall and spring) were conducted at Prime Hook this year. Each was 6 hours long for 2/5 inservice teacher credit. The workshop included an orientation to Prime Hook refuge and an interpretive walk along the boardwalk trail by the assistant manager. The ORP conducted the habitat studies of forest, marsh, pond, and beach. Pohlman also prepared a sign plan for Prime Hook and ordered those needed to bring refuge signing up to Service standards. She also prepared public use plans for Prime Hook and Eastern Neck Refuges this year.

During 1992 Pohlman became actively involved with the Chesapeake Bay Girl Scout Council, not only as a scout leader, but also as an outdoor consultant. As such, she prepared lesson plans and activities for an area encampment and also for a week long summer camp. Refuge volunteers conducted the activities at the area encampment and Pohlman conducted the activities at the week long scout camp.

On September 1 and 2 the Delaware Bay Estuary Program held a public outreach workshop in the refuge auditorium. ORP Pohlman attended and participated in the workshop. Along these lines, Pohlman participated in a two day meeting at Great Meadows NWR on September 29 and 30. The subject was "Total Quality Management" in public use. As part of this TQM team, Marian will work with other regional personnel to ensure high standards for public facilities and programs in all Service operations, and the team will evaluate the public use planning process.

2. Outdoor Classrooms - Students

Over 3500 students toured the refuge this year, and most (92%) engaged in environmental education activities, e.g. wetland and forest studies. Students also receive information about our wildlife management program. Many also take interpretive walks along the trails, with emphasis being placed on the importance of wetlands to wildlife.



- #15 This year we included a brackish pond as part of our environmental education habitat studies. Students enjoyed catching grass shrimp, killifish and other organisms which they compared to their findings in fresh and salt water.

10/92 Pohlman

Teachers and volunteers conducting the outdoor classroom studies are provided with equipment such as aquatic, seine and aerial nets, clear plastic jars, white pans, spades for digging the leaf litter, identification guides, magnifying lenses, lesson plans, and water test kits.

More schools are now including 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 and Port Mahon to the south.

ORP Pohlman and refuge volunteers participated in outdoor classroom activities at Camp Todd in Maryland, a Chesapeake Bay Girl Scout Camp. Over 280 scouts attended these programs. As outdoor consultant for this organization, Pohlman is now preparing wildlife lesson plans for various girl scout events.

Pohlman and two refuge volunteers joined staff and volunteers from Eastern Neck in conducting outdoor classroom activities for the Kent County, Md. fourth grade environmental education program during the fall.

3. Outdoor Classrooms - Teachers

Outdoor Recreation Planner Pohlman conducted two (one in the spring and one in the fall) fifteen hour environmental education workshops for one in-service credit each. Twenty-nine (29) teachers attended these workshops. Refuge workshops include an orientation slide show and wildlife management tour, sessions on management techniques and surveys, habitat studies (which include fresh and saltwater marshes and bay beach areas, forest, and meadow), educational resources review, simulated activities (from such sources as OBIS, Project Learning Tree, Project Wild and Aquatic Wild), and activities on current environmental issues and problems. 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, and several of the Service-wide brochures. The Service habitat pacs are also provided. These packets 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.



#16 ORP Pohlman and teachers examine results of seining an area of Delaware Bay which was part of the 15 hour environmental education teacher workshop.

4/92 Littleton

This year 321 teachers spent 1553 activity hours on the refuge, engaging in various environmental and interpretive type activities.

A Project Wild Workshop was conducted by personnel of the Delaware Department of Natural Resources and Environmental Control at Bombay Hook during August and 29 teachers attended.



#17 Teachers enjoy searching for animals of the soil during an environmental education workshop they attended in preparation for bringing their students to the refuge.

4/92 Pohlman

4. Interpretive Foot Trails

New interpretive brochures were received for the Boardwalk, Bear Swamp and Parson Point trails early in the year. These brochures make it easier for teachers to conduct their own interpretive walks, and also give the general public additional information when walking the trails. Three eagle scout groups installed posts along the trails to correspond to numbers in these brochures, and also woodchipped these trails to help prevent erosion. One eagle scout made a box for trail brochures; the other two boxes were made by maintenance staff. 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 3252 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. Two site specific interpretive signs are presently on the route, one subject being the bald eagle and the other shorebirds and the horseshoe crab connection. Six additional signs on management topics were ordered from Wilderness Graphics and will be installed in 1993. Topics covered on the new signs will be: waterfowl, wading birds, water level management, cooperative farming, tidal salt marsh, and snow geese. The major source of funds for these signs came from the family of a deceased volunteer, Frances Robertson, who was our most active volunteer in conducting interpretive programs and staffing the visitor center. The Friends of Bombay Hook Cooperating Association also donated funds for these signs. ORP Pohlman made an interpretive auto tour tape to be used by the visually impaired or by visitors that prefer this form of media over a brochure. It is now available to visitors on loan through the Friends of Bombay Hook sales outlet.

New recreational symbols were applied to the permitted/prohibited sign near the refuge entrance. The old symbols had faded since the sign was erected about 6 years ago.

Conducted and self-guided tours emphasize the station message, which includes wildlife management techniques utilized at this refuge, species of interest, plant and animal identification and ecological principles. Trained volunteers, field work students, teachers, and the outdoor recreation planner gave conducted tours to 3606 individuals.

The visiting groups fell into the following categories:

- 60 elementary or secondary schools
- 14 colleges and universities
- 16 scout groups
- 6 senior citizen and handicapped groups
- 30 miscellaneous groups (including birding, conservation, garden club, civic club, church, camp, general public, and volunteer groups)

6. Interpretive Exhibits/Demonstrations

Wildlife artists (photographers, painters and carvers) exhibited their work in the refuge auditorium on fall and spring weekends. One regular exhibitor, Richard Clifton, won the Delaware Duck Stamp Contest this year.

The frame for a six panel outdoor kiosk has been received from Wilderness Graphics and we are now awaiting the panels which will be purchased with Watchable Wildlife funds. The

kiosk panels will cover 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. This exhibit (kiosk) will be erected near the Visitor Center and will prove beneficial in providing refuge information, particularly when the Center is closed.

The refuge has a portable velcro exhibit which is used for various offsite events. Wildlife management techniques, refuges on the Delaware and Chesapeake Bays, and the importance of wetlands are the usual topics covered on this exhibit. The refuge uses this exhibit each year at Coast Day in the fall, and also used it this year for several Earth Day events in April.

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.

The Bombay Hook Annual Field Day was held on November 7. Visitors were offered refuge tours, nature walks, boat trips, beach studies and a live reptile and amphibian program. Of the 265 people that entered the Visitor center, about 126 attended these programs. On an average Saturday in the fall, over 1000 visitors drive through the refuge.

ORP Pohlman and Recreation Aids Mark Connelly and Verna Price conducted 20 off-site programs this year on various wildlife topics and opportunities for careers in fish and wildlife management.

They participated in a state sponsored school program entitled "What in the World", providing information on wildlife and Service careers. Approximately 2,068 individuals were reached off site with the Service and Refuge message.

Faith King and Leo King, experienced volunteer birders, conducted several bird walks for the general public this year.

WBOC-TV, Salisbury, did a feature on the evening news covering prescribed burning on Bombay Hook. Video footage and an interview with the manager were done on January 23. The following month, Phil Feliciangeli of WDOV, in Dover, Mike Dalzell of WILM, Wilmington, and Ken Clark of Channel 6, Philadelphia, interviewed manager Daly on the same topic. We never quite know what will tickle the media's fancy until the news release is issued. In May, Daly was a guest on a live radio "talk" show at WDOV, Dover. He responded to

general questions on current refuge events including pool drawdowns, visitor wildlife observation opportunities, moist soil management developments, and visitor facilities (including those for the handicapped).

Assistant Manager Wunderley served as a judge for the Delaware duck stamp contest in February. Numerous fine examples of art work were represented, with Richard Clifton of Sussex County, Delaware being the winner this year.

Pohlman participated in the Regional NAI (National Association of Interpretation) Conference held at Chincoteague NWR in March. She gained valuable information on handicapped accessibility and auto tour route tape production.

8. Hunting

Due to the small size and relatively dense population of the State of Delaware there are heavy demands placed on lands open to public hunting. Much of the private land which can provide waterfowl hunting opportunities is leased, usually at high cost. Demand for refuge hunts is therefore high; and we conduct a variety of migratory waterfowl, upland game and deer hunts during portions of the regular state seasons.

Waterfowl-South Area

The South Waterfowl Area, also known as Kelly Island, consists of 20 blinds accessible only by boat. A user fee of \$10.00 is charged per blind, each of which will accommodate up to three hunters. Permits are issued through a daily lottery system near the public access boat ramp at Port Mahon by refuge staff until 7:00 a.m. Prospective hunters who arrive after 7:00 a.m. can register for unassigned blinds at the State's Little Creek Management Area a few miles to the south until 1:00 p.m. Delaware's duck season this year was again 30 days with a daily basic bag limit of 3 birds; the Canada goose season was 40 days with a daily basic bag limit of 1 bird; and the snow goose season was 105 days with a limit of 5. The south area is primarily a duck hunting area.

This was a relatively good year as total hunter take was up 22% over the 1991-92 totals. Ducks bagged per hunter were up slightly from the previous two seasons. As usual black ducks formed the largest portion of the duck hunter's bag (29.2%) followed by the mallard (26.7%) and the green-winged teal (20.0%). The high take of black ducks is noteworthy considering only one black per day is permitted.

The following is a summary of success on this area for the past three years; hunting is conducted only on Monday, Wednesday, Friday, and Saturday.

South Waterfowl Hunt Area

	<u># Hunters</u>	<u># Ducks Harvested</u>	<u># Blacks Harvested</u>	<u>% Kill Blacks</u>	<u># Ducks Hunter</u>
92-93					
<u>Season</u>					
11/4-7 (3 days)	135	179	49	27.4	1.33
11/23-28 (4 days)	115	153	42	27.5	1.33
12/14-1/02 (11 days)	<u>301</u>	<u>287</u>	<u>90</u>	<u>31.4</u>	<u>0.95</u>
TOTAL	551	619	181	29.2	1.12
91-92					
<u>Season</u>					
11/4-9 (4 days)	152	215	56	26.0	1.41
11/25-30 (2 days)	47	55	18	32.7	1.17
12/18-1/04 (10 days)	<u>279</u>	<u>212</u>	<u>78</u>	<u>36.8</u>	<u>0.76</u>
TOTAL	478	482	152	31.5	1.02
90-91					
<u>Season</u>					
11/1-7 (4 days)	96	55	17	30.9	0.57
11/20-24 (3 days)	90	91	14	15.4	1.01
12/19-1/5 (11 days)	<u>261</u>	<u>267</u>	<u>54</u>	<u>20.2</u>	<u>1.02</u>
TOTAL	447	413	85	20.6	0.92

Waterfowl-West Area

The restrictive changes implemented during the 91-92 season remained in effect this year. The area was open for hunting during two mornings (Tuesday and Saturday) per week during the state Canada goose season. Eleven blinds were available. Hunters were charged \$10.00 per blind (maximum of 4 hunters) as a user fee. Individuals were permitted to hunt the area only once during the season. Hunting was poor throughout the season and especially during the early portion. The low number of Canadas within the state and the refuge was a major factor. Public interest in the hunt has decreased substantially in the last couple of years, since only one hunter visit is allowed annually. Rarely were all eleven blinds in use. Despite the fact that snow geese were abundant throughout the season they rarely showed interest in decoying or making low passes over the area and the resultant hunter take was the lowest in 10 years.

West Waterfowl Hunt Area

<u>Year</u>	<u># Hunters</u>	<u>Canadas Harvested</u>	<u>Snows/ Harvested</u>	<u>Canadas/ Hunter</u>	<u>Geese/ Hunter</u>
92/93	253	85	2	0.33	0.34
91/92	315	107	48	0.34	0.49
90/91	662	205	22	0.31	0.34
89/90	895	502	40	0.56	0.61
88/89	1259	604	150	0.48	0.60
87/88	1378	1010	138	0.73	0.83
86/87	1311	757	13	0.58	0.59
85/86	1542	770	80	0.49	0.55
84/85	1790	1148	4	0.64	0.67
83/84	1586	1158	20	0.73	0.74
82/83	1491	698	--	0.47	0.47
81/82	1453	496	--	0.34	0.34
80/81	1557	895	--	0.57	0.57

Waterfowl-Snow Goose Area

Managed hunts on portions of the refuge tidal marsh have been employed for several years in an effort to disperse the concentrations of geese causing marsh damage in the form of "eat-outs" in the areas known as Leatherberry Flats and Money Marsh. Various other techniques have proven ineffective in deterring massive marsh denudation. This year we had hunting (without pre-constructed blinds) within the tidal marsh during the state season as well as during a period in November when Bombay Hook was the only open area within the State. The hunt appears to be only partially successful in meeting our objectives, since approximately the same acreage had been denuded annually during the prior three years. However, until this year the "eat-outs" had not expanded appreciably. During the first day or two of the season this year hunter turnout was high as usual and plenty of birds were in the area. The low number of juveniles (less than 3%) made hunting very difficult and the take was extremely light. Quickly hunter interest declined and by early November we experienced days when no hunters showed up. We therefore elected to shutdown the season on the refuge effective November 30. Unfortunately, probably as a result of lack of disturbance from refuge hunters, the birds began to spend more time in the saltmarsh feeding than we have seen during the past four years. As of the writing of this report it appears that the size of the "eat-out" has increased substantially from previous years. During April 1993 we will photograph the area and determine the actual "eat-out" size. Hunt results for the past seven years are as follows:

Snow Goose Hunt Area

<u>Year</u>	<u># Hunters</u>	<u># Geese Harvested</u>	<u>Birds/Hunter</u>
86/87	241	139	0.58
87/88	552	757	1.37
88/89	661	1079	1.63
89/90	670	721	1.08
90/91	426	389	0.91
91/92	422	688	1.63
92/93	246	76	0.31

South Upland Area

This area, known as the "Air Force Tract" and locally as the "Davy Crockett Area", consists of 551 acres of brush, woodlands and a small amount of marsh on the southwest edge of the refuge. It is open for 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 makes it difficult to obtain accurate information on hunter participation or success; however, random patrols during the season indicate that there is ample demand by hunters during the deer and small game seasons, as well as by fox hunt (chase) groups. The area is closed to all hunting between March 1 and September 1 to eliminate disturbance to nesting wildlife.

Deer

Public deer hunting during portions of the archery, primitive weapon, and shotgun State seasons continued to be provided this year. Since our deer herd continues to slowly expand we believe in the necessity of a substantial annual harvest to protect the habitat for migratory birds. Interest in our hunting and participation by sportsmen remained high. This year marked the first year that hunters were permitted to shoot two deer with any weapon. Furthermore, special antlerless deer permits were available so that hunters could shoot additional antlerless deer over and above those allowed with their license. This resulted in a much larger deer kill than we had ever previously experienced. A total of 126 deer were taken during the combined seasons, up from 78 recorded a year ago (+62%).

User fees were in effect for the third year. Fees were \$5.00/hunter for muzzleloader and shotgun hunting on the Regular Area and \$10.00/hunter for shotgun hunting on the Headquarters Area.

Archery hunting was permitted on the first two Saturdays of the State season on the Regular Deer Hunt Area with an 11:00 a.m. closure. For the second year we opened the Fischer Tract to self-serve deer hunting on week days during October.

During the primitive weapons season (October 5-10) hunting was permitted during 3 days on the Regular Deer Hunt Area.

During the shotgun season the Regular Deer Hunt Area was open for 3 days during the November season, one day during a special antlerless only season in December and one day during January. The Headquarters Area was open for 2 days during the November season and for one day during the December antlerless only season. Hunter success was good on both areas. The tables on the following two pages are a summary of Refuge deer hunts since 1985:

Percent	# Hunter		# Days	# Deer	
	<u>Regular Area</u>	<u>Visits</u>	<u>Open</u>	<u>Harvested</u>	
Success					
SHOTGUN	1985	128	3	16	12.5
	1986	148	3	21	14.2
	1987	162	3	17	10.5
	1988	151	3	15	9.9
	1989	164	3	25	15.2
	1990-91	208	4	38	18.3
	1991-92	202	4	33	16.3
	1992-93	258	5	39	15.1
MUZZLELOADER					
	1985	108	3	3	2.8
	1986	136	3	3	2.2
	1987	156	3	6	3.8
	1988	157	3	13	8.3
	1989	138	3	7	5.0
	1990	109	3	2	1.8
	1991	145	3	19	13.1
	1992	149	3	25	16.8
ARCHERY	1985	199	5	1	0.5
	1986	173	5	2	1.2
	1987	184	5	1	0.5
	1988	181	5	2	1.1
	1989	156	6	2	1.3
	1990	86	4	0	0.0
	1991	61	2	2	3.3
	1992	95	2	2	2.1
HDO/Fischer Areas					
SHOTGUN	1985	80	2	24	30.0
	1986	100	2	29	29.0
	1987	95	2	30	31.6
	1988	101	2	27	26.7
	1989	102	2	29	28.4
	1990	93	2	32	34.4
	1991	100	2	22	22.0
	1992	141	3	59	41.8
NON-AMBUL.					
	1985	8	2	3	37.5
	1986	7	2	1	14.3
	1987	3	2	0	0.0
	1988	4	2	1	25.0
	1990	4	2	2	50.0
	1991	2	2	1	50.0
	1992	5	2	1	20.0
ARCHERY	1991	56	19	1	1.8
	1992	44	15	0	0.0

**TOTAL DEER HARVEST - ALL WEAPONS
1985-1992**

<u>Year</u>	<u>Harvest</u>
1985	47
1986	56
1987	54
1988	57
1989	63
1990-91	74
1991-92	78
1992-93	126

Summary of Age and Weight Data 1990-92

<u>Age Class</u>	<u># Bucks</u>			<u># Does</u>			<u>Average Weight Bucks</u>			<u>Average Weight Does</u>		
	<u>90</u>	<u>91</u>	<u>92</u>	<u>90</u>	<u>91</u>	<u>92</u>	<u>90</u>	<u>91</u>	<u>92</u>	<u>90</u>	<u>91</u>	<u>92</u>
0.5	19	28	40	11	12	29	64.0	62.4	59.7	45.6	54.0	54.5
1.5	13	21	26	5	3	10	119.5	119.0	111.2	99.8	89.7	94.2
2.5	5	6	2	9	5	9	147.4	147.0	154.0	107.9	105.2	114.8
3.5+	1	0	3	2	4	5	178.0	000.0	184.7	121.0	116.0	111.0



#18 The biggest buck of the season? You are correct sir! Biologist Smith and Maintenance Worker Cottman admire this 195 pound (dressed) beauty.

11/92 Pohlman

9. Fishing

No sport fishing is permitted from lands or within waters which are part of the fee title area of the Bombay Hook National Wildlife Refuge. The tidal waters within the refuge boundary, which are closed to waterfowl hunting by proclamation, are commercially fished with white perch and eels being the most commonly taken species. Refuge impoundment water levels are manipulated to encourage growth of emergent or submergent vegetation for waterfowl; and this management is generally contrary to that which would encourage game fish populations and sport fishing.

10. Trapping

Extremely low fur prices, the deterioration of the marsh due to snow goose feeding, and possibly the aging of our trappers resulted in very limited interest in trapping on the refuge. Total rental fees for the 1991-92 season were only \$1,426.00 (from 4 trappers). The following fur bearers were removed by trappers during the 1991-92 season: muskrat 1497, raccoon 57, and opossum 32.

11. Wildlife Observation

Wildlife observation has been and probably always will be the reason most visitors come to Bombay Hook. This year individuals or families drove their personal vehicles along the auto tour route (74,004 visitors), took walks along the trails (8973 visitors) or photographed wildlife (3700 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. 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 mild winters recently have resulted in more refuge visitors during the December through February period than was the case several years ago.

In February, Manager Daly was contacted by Frances Hamilton, who is the author of the "birding" column in the Sunday Wilmington News-Journal, regarding information on wildlife observation opportunities, snow goose management and eagle nesting progress.

Former Service Director John Gottschalk stopped by for a combination birding and personal visit in May with Dr. Bill Ricker of Navaismo, British Columbia.

Jacquelyn Bolden of Channel 29, Philadelphia visited October 27, to do a video tape with manager Daly about waterfowl migrations and to get as much wildlife footage as possible. She and her cameraman spent about 5 hours on the refuge.

Photographers with Southern Living magazine took aerial shots of the refuge in November for a future issue.

12. Other Wildlife Oriented Recreation

The Delaware Bay Retriever Club again held field trials both in the spring and fall this year. The group, which has conducted trials on the refuge annually for over 40 years, had about 600 individuals attending on each occasion. The trials take place on the Dutch Neck and Finis portions of the refuge.

16. Other Non-Wildlife Oriented Recreation

We continue to get a few joggers and runners plus an occasional cross-country skier. They cause no problem and hopefully are enjoying wildlife while getting the physical benefits of their exercise. No other non-wildlife oriented recreation regularly takes place on the refuge.

17. Law Enforcement

We began 1992 with four refuge officers and, due to the assistant refuge manager vacancy, ended the year with three. The staff shortage occurred just prior to the period of highest potential for violations and consequently we were unable to fully cover even the areas where we know the greatest amount of illegal activity occurs. The former assistant manager was detailed back to us for a few weeks from his new position in the Washington Office and we were also able to "borrow" a refuge officer from nearby field stations on occasion; however this amount of assistance, although welcome, was far from sufficient.

Assistance was provided to us by Refuge Officers John Stasko (Patuxent NWR) and Bob Lamoy (Eastern Neck NWR) during our early duck season in November. In return Bombay Hook NWR Officers Daly and Smith assisted Eastern Neck at their muzzleloader deer hunts and Patuxent at their shotgun deer hunt.

All refuge officers completed refresher training at Cape Charles, Virginia in April and requalified with their service weapons in the fall. Officers Daly and Wunderley requalified at Eastern Shore of Virginia NWR in September while Officers Smith and Straughn did so at Broadkill Sportsmen's Club near Prime Hook NWR in October.

Manager Daly attended a one week course on Archaeological Resources Protection Act Law Enforcement given at Savannah, Tennessee during the period May 11-15. The course was presented by FLETC with field work at Shiloh National Military Park.

Summary tables of 1992 violations by type and comparison with the prior ten years are presented in the following tables:

Violations Processed by Bombay Hook Officers Since 1982

<u>Calendar Year</u>	<u>Number of Individuals</u>	<u>Number of Violations</u>
1992	16	27
1991	25	33
1990	14	16
1989	21	23
1988	23	24
1987	7	11
1986	20	27
1985	20	26
1984	20	22
1983	45	58
1982	28	38

Summary of CY 1992 Violations at Bombay Hook

<u>Violation</u>	<u>Written Warning</u>	<u>Forfeiture of Collateral</u>	<u>Pending</u>	<u>Total</u>
Take protected species of migratory bird			1	1
Vehicle trespass in closed area			3	3
Trespass on foot in closed area			1	1
No entrance pass		2 (\$50)	1	3
Trespass after hours	8 (juvenile)			8
Littering	8 (juvenile)			8
Speeding	2			2
No driver license			1	1
	18	2 (\$50)	7	27

During May refuge personnel noted an increase in littering in the area of Finis Gate. At this particular site a public road makes a 90 degree turn and leaves room just off the road (and outside the refuge) for several cars to park. This creates an ideal site for various activities which result in litter being deposited both on the public road and on the refuge, since the area is about a mile from the nearest habitations. The beer and coke cans and other debris were being deposited on a regular basis which prompted a night surveillance. Amazingly, the very first night (a Friday) stake out resulted in a flurry of cars arriving at the area about 9:30 p.m. The intrepid refuge officers watched the activity with a night vision scope from approximately 50 yards until they were certain that litter had been thrown over the gate onto refuge property. At that time radio contact was made with Delaware Wildlife Officer John Hennessey (whose house is about one mile distant) and a State Police Unit. Both of the state officers had been on standby. All officers converged on the scene from different directions, breaking up a party which would eventually have grown to a large magnitude. As information was being taken on each of the high school age youths, several other cars drove up and were turned away. The beer was confiscated and

letters were sent to the parents of each juvenile. The best part of the effort was that the word got around and the problem did not arise again for the rest of the year.

Two SCS technicians became stranded well out in the tidal marsh on September 25, when they left their boat on a creek bank and could not find their way back to it. Manager Daly received a call from their supervisor at 11 p.m. that night with the information that they had not returned home. Dave Stout (Delaware Bay Estuary Program) who lives in the refuge residence, was contacted to ascertain that their vehicle and trailer were still at the refuge boat ramp (they were). Assistant Manager Wunderley and Biologist Smith were dispatched to the refuge to coordinate with other search and rescue personnel, who were contacted through the Kent County Emergency Center. A multiagency search and rescue effort ensued, with Coast Guard, Delaware and Maryland State Police, Delaware Marine Police and Leipsic Volunteer Fire Department involved, along with Service personnel. Four helicopters were active over the marsh all night with no success. After daybreak three boat crews launched to search over different sections of the refuge marsh. Wunderley and Smith discovered the SCS boat near Shearneck Gut about 6:30 a.m., followed a short while later by the cold, wet pair of technicians who had taken refuge in a wooden survey tower about a mile off Raymond Dike behind George's Island. Needless to say, they were glad to see the refuge folks. Excellent cooperation was received from all agencies involved as well as the Delaware Bay Estuary personnel (Stout, K. Day, R. McCorkle and G. Breese). Letters of appreciation were sent to all. WBOC-TV Salisbury interviewed Manager Daly for a spot on the evening news and an article also appeared on the rescue in the Delaware State News.

Bombay Hook Refuge and the Delaware Division of Fish and Wildlife came to an agreement during the summer on a strategy to alleviate public use problems at the Air Force Tract and adjacent state-owned lands. This tract, which is in a remote section of the refuge, has been the scene of target shooting, vandalism and trash dumping for many years. We improved the situation some years back by bulldozing down an old military bunker which had been an attractant for the target shooting, and by closing a loop road which provided vehicular access. However, most of the problem shifted to the end of the state-owned road (Marshtown Road) adjacent to our boundary.

On the theory that most of the violators would rather not walk a half mile to "do their thing", we agreed that the state would build a small (4-5 car) parking lot on the refuge a hundred yards or so from the last private residence on Marshtown Road. They would then place a locked gate across the road and the refuge plus the farmer who owns the property across the road would have keys to the gate. The parking lot was constructed in September and most illegal activities were

greatly reduced through the end of the year (see Section I.1.).

18. Cooperating Associations

The Friends of Bombay Hook Cooperating Association started sales in September of 1990. During its first full year gross outlet sales topped \$7,000. This year the Association outlet more than doubled sales (to over \$15,000). The outlet stocked only 12 items at its inception, and by the end of this year, items totalled 83. Membership is presently 130.

The Association finished paying off its loan to the Fish and Wildlife Foundation this year and was in a position to offer financial assistance to the refuge program. They donated Bombay Hook T-shirts and sweatshirts for the volunteer awards program, paid entrance fees for field trips for volunteers and "Friends", paid for four volunteers to attend the State volunteer dinner, donated 12 books and 12 cassette tapes to the refuge library, replaced two refuge directional signs along Route 9, and funded brochures and interpretive tour route signs.

This year the "Friends" adopted the highway entering the refuge (Road 85) and also part of the road (Route 9) forming the western boundary of the refuge. Twice a year the Friends will clean these two roads. On November 8, sixteen individuals participated in the first clean up effort.



#19 "We've been adopted"! Road 85, which leads to the refuge from route 9, also borders several of the refuge farm fields.

7/92 Daly

A new business manager, Mary Neiman, started with the Association this year. To avoid overload of work on this position, much of the day to day business is handled by Recreation Aid Verna Price. At election time this year, the President (Price) and Vice President Donald Dean switched roles since no one came forward for these positions. The other officers had not yet completed two years of service. At the board meeting for election of officers, Dr. Norman Dill, a botanist from Delaware State College, spoke on endangered plants, the Endangered Species Act, and the Earth Summit.

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, and the Association officers submit articles as appropriate and needed. An experienced volunteer birder writes "Bird Notes".

Recreation Aid Bob Jones designed the new Bombay Hook Friends patch which is now available for sale in the outlet. We also have a program with the boy scouts and girl scouts, whereby they can earn this patch at cost or free, for completing activities and/or service projects at Bombay Hook. Several troops have participated to date.

Several field trips were offered to Association members this year, including the Delaware Museum of Natural History, Brandywine State Park, and Abbotts Mill (canoe trip).

The only problem at present is finding new people to run for office. Even though membership is high, most individuals are not interested in taking an active role in "Friends". Therefore, the same officers serve repeatedly. Fortunately at present these officers are still interested. Overall, the Association has been a tremendous success and will be in an even better position next year to help financially with refuge programs and projects.

I. EQUIPMENT AND FACILITIES

1. New Construction

As mentioned (with rationale) in the law enforcement section of this report, a parking lot of four to five car capacity was constructed at the Air Force Tract near the entrance to the old loop road in September. To date we have experienced no problems at the lot and the illegal target practice and littering problems at the terminus of the Marshtown Road have been greatly reduced.



#20 The new parking area at the "Air Force Tract" is intended to cut down drastically on target practice, dumping and other activities which used to occur with regularity about 1/2 mile down past the cable gate shown.

8/92 Daly



#21 The small parking area, intended for hunter use, is approximately 100 yards from two private residences established within the past year to the west on Marshtown Road.

8/92 Daly



- #22 The remoteness of the area from other refuge facilities means we cannot prevent certain activities from continuing; however target practice has decreased dramatically to date. We investigated several names and addresses found with this dumped material, but ran into a dead end.

9/92 Daly

A contract was let during early fall for an addition to be built on the old YACC/YCC building which is now utilized as office space by the Delaware Bay Estuary Program. The new addition will more than double the size of the building. At year end the addition was over 50% completed.

2. Rehabilitation

Finis Dike was raised in elevation two feet over its 300 foot length in late summer. The contractor, Eastern States Construction Company, did an excellent job. The work began August 12 and was completed September 4. As part of the work, willows were removed from the Shearness Pool side of the dike, rip-rap was placed along the entire dike length and after proper slope was obtained grass was seeded so as to be well established by cold weather. Total contract cost was \$86,150.



#23 Looking north along the Finis Dike just prior to the rehabilitation project. There were times when Finis Pool (to the left) water would almost top the dike at desired winter management levels.
8/92 Daly



#24 The dike was raised with material hauled in from offsite, slopes were graded, and both dike toes were rip-rapped.

8/92 Daly



#25 Finally, grass seed was sown on the slopes and mulch was placed down. Gravel was then spread on the dike (roadway) top.

9/92 Daly



#26 About three weeks later, the dike slopes were already covered with an excellent stand of grass.

9/92 Daly

The water control structure and pipe culvert between Bear Swamp and Pool A were completely replaced during late March and early April. This will, together with repairs to the low levee between the pools, permit greater accuracy in manipulation of water levels and facilitate moist soil management on Pool A.



#27 The old culvert between Bear Swamp and Pool A was dug out and replaced with a new one; plus a new water control structure on the Pool A side.

4/92 Daly



#28 View looking northeast from Pool A to Bear Swamp. Pool A is filled from Bear Swamp Pool when necessary by means of a Gator Pump operated off our tractor PTO.
4/92 Daly



#29 After installation of the new culvert/WCS and repairs to the low levee on the east side of Pool A, fresh water can be pumped into the 12 acre pool with excellent results (view to south).
4/92 Daly



#30 View of Pool A to the southwest after pumping to full pool. This unit is managed for late winter and spring use by waterfowl, primarily mallards, greenwinged teal and black ducks.

4/92 Daly

During August a channel within Raymond Pool was cleaned by William A. Simpler of Millington, MD utilizing a crane with bucket. The channel runs from the main water control structure 1400 feet to approximately mid-way along the dike. The channel will now permit a complete dewatering of the impoundment when we desire. The sight of the channel being dug began some rumors among the local bird clubs that we were going to "turn Raymond into just another waterfowl (horrors) impoundment". The fact is, our water management program calls for holding a couple of inches of water in Raymond during spring and fall expressly for shorebirds. This technique attracts thousands of a variety of species, which in turn attracts thousands of birders to view them. Things began to get nasty in a hurry with birding groups threatening all kinds of actions, including writing congressional representatives, petitioning the FWS Director, etc. All this occurred without their checking at the refuge office to get the facts. The situation was defused as rapidly as it began following a 30 minute meeting between the refuge manager and the head of the Delaware Ornithological Society.



- #31 The first effort to clean out the channel leading to the Raymond Pool water control structure consisted of borrowing Blackwater Refuge's tracked "Bombardier" and promptly burying it in the organic muck.

7/92 Smith



- #32 The procedure which proved successful involved contracting for a crane and bucket to set up on Raymond Dike and dig a channel parallel to the dike toe.

8/92 Smith



#33 The completed channel permits full drawdown of Raymond Pool when desired.

8/92 Smith

3. Major Maintenance

All 32 waterfowl blinds and 79 deer stands were inspected and repairs made as needed prior to hunt season. Other "pre-hunt season" maintenance included reposting sections of the refuge boundary and installation of "public hunting" signs where needed.

The Friends of Bombay Hook Cooperating Association purchased two new signs for the refuge to replace ones which had been vandalized. These signs, which direct visitors to the refuge, were erected on the northbound and southbound sides of Route 9 by the State Highway Department.



- #34 The "Friends of Bombay Hook" group purchased this sign and one for the southbound lane of route 9. The Delaware Highway Department installed the signs.
4/92 Daly

4. Equipment Utilization and Replacement

The highlight of the year in this category was the delivery on November 23 of a new John Deere 4055 tractor (4 wheel drive) with 15 foot wide flex-wing mower. Our old Massey Ferguson 1085 tractor had begun to consume a large quantity of precious maintenance dollars annually.



- #35 Maintenance Worker Cottman is "taken 'em down".
 Cornstalks can be mowed in half the time with our
 new John Deere 4055 tractor and 15' flexwing mower.
 1/93 Daly

A new Ford Aerostar 8 passenger van was delivered during September. It replaced an old 1978 Dodge crew cab which dated back to the YACC program.

The Case 850D dozer was loaned to Forsythe NWR on December 29 for use in a force account dike construction project.

7. Energy Conservation

The table below reflects non-vehicle energy use at this station for the past four years:

	<u>Electricity</u>		<u>Fuel Oil</u>		<u>Propane</u>		<u>Total Energy</u>
	<u>KW</u>	<u>Cost</u>	<u>Gal</u>	<u>Cost</u>	<u>Gal</u>	<u>Cost</u>	<u>Cost</u>
1989	55,345	\$5746	400	\$239	979	\$ 665	\$6650
1990	60,040	\$4768	822	\$704	1359	\$1319	\$6791
1991	59,239	\$5074	626	\$469	827	\$ 725	\$6268
1992	71,363	\$6629	---	---	1360	\$1385	\$8014

The table below reflects vehicular energy use during the past seven years:

<u>Year</u>	<u>Gasoline Use (Gallons)</u>	<u>Diesel Use (Gallons)</u>
1986	2463	1050
1987	1761	963
1988	1862	1368
1989	1929	1531
1990	2348	1181
1991	2533	1454
1992	2126	1498

J. OTHER ITEMS

1. Cooperative Programs

Rick Gillespie, who heads the International Group for Historical Aircraft Recovery (TIGHAR), led a group under refuge special use permit into the tidal marsh during May to locate a historical aircraft (P-47 Thunderbolt) which crashed during a training flight in 1944. His group is the one which claims to have located Amelia Earhart's plane recently in the South Pacific. The Dover Air Force Base Museum wishes to recover as much of the plane as possible and restore it for display. The plane was located on the north portion of Kelly Island, clearances were obtained from the Regional Historic Preservation Officer, and a portion of the plane was recovered during December. The portion recovered, a wing section, was in remarkable shape considering the passage of 48 years. The group may attempt to recover other portions of the plane in early 1993; this will depend on whether other parts can be gotten up without their disintegrating.

Frank Smith continued to serve as Delaware's Fish and Wildlife Service Field Response Coordinator (FRC) for oil and hazardous chemical spills. Prime Hook Assistant Manager George O'Shea is the alternate FRC.

An oil spill of 500 to 600 gallons of #6 heating oil into Delaware Bay off the mouth of the Leipsic River occurred on April 17. Frank Smith and Arthur Straughn investigated over the April 18-19 weekend. Early on the morning of April 18 the Coast Guard and their private contractor (Guardian Environmental) were onsite cleaning scattered tar balls from the beach and water between Port Mahon and the southern portion of Bombay Hook Island. The Coast Guard had also boomed the Simon's River (but not the Leipsic nor the Mahon). Strong easterly winds and the heavy nature of the spilled material rendered the booms ineffective at any rate. Frank had notified all appropriate personnel including Tri-State

Bird Rescue, several of whom were on standby in case their services were needed. Fortunately, most shorebirds which had already arrived on the bayshore were utilizing Raymond Pool (which had already been drawn down) due to the rough bay waters. Frank and Arthur continued to monitor the situation through Sunday mid-day. No problems were observed with oiled birds. On Monday April 20 Arthur Straughn and Steve Wunderley again monitored the shoreline and picked up one snow goose which was transported to Tri-State's rehabilitation facility.

We were fortunate that the spill did not occur 30 days later in spring during the horseshoe crab spawning and shorebird peak migration. As it was, all oil was cleaned off the beach and intertidal zone, leaving only material in the detritus above the normal high tide line. At that location it would have caused more environmental damage to try to clean it up than to leave it.

Frank Smith also continued to serve as Delaware Team Leader for the Private Lands (Partners for Wildlife) program during most of 1992. We were forced to phase him out of the program at the end of the year due to our acute staff shortage and heavy workload on the refuge itself. Fortunately, since the Delaware Bay Estuary Program was hiring new personnel at the same time we were suffering vacancies, they agreed to assign one of their staff to this somewhat time consuming program.

3. Items of Interest

Refuge Biologist Frank Smith attended the Arctic Goose Conference in Vallejo, California January 8-11. Mike Hill, who did research in greater snow geese at Bombay Hook in 1991, presented a paper at the conference.

Mr. John Buckalew, assistant manager at Bombay Hook in the "very early days" of the refuge, stopped by for a visit on January 17. Mr. Buckalew, who later became a U.S. Game Agent, retired in the Chincoteague, Virginia area.

Assistant Manager Wunderley attended a workshop on Saturated Forest Wetlands in Annapolis, Maryland during the period January 29-31.

Biologist Smith attended a workshop dealing with the private lands program at Montezuma NWR March 30-April 2.

Assistant Manager Wunderley and ORP Pohlman assisted Patuxent Wildlife Research Center at their dedication ceremonies for the addition of former Fort Meade lands to that refuge on April 3.

Biologist Smith attended a moist soil management workshop at Chincoteague NWR on April 16 and 17.

On May 15 the Delaware Bay Estuary Program held a ceremony on the refuge to celebrate the inclusion of Delaware Bay on the list of wetlands of international importance. Service Director John Turner and Regional Director Ron Lambertson attended, along with representatives of the governors of Delaware, New Jersey, and Pennsylvania as well as several other dignitaries.

On June 8 Manager Daly delivered the annual revenue sharing check in the amount of \$59,783 to the Kent County Levy Court.

Regional Director Ron Lambertson visited on July 14 and took a tour of the refuge roads, dikes and the auto tour route. He was in Delaware for a meeting with Delaware Division of Fish and Wildlife Director Wagner regarding Atlantic Flyway waterfowl regulations.

Matt Perry and Marcia Wilson of Patuxent Wildlife Research Center visited on July 13 and were given a refuge tour. Matt and Marcia, who is the new Deputy Branch Chief in the Office of Migratory Bird Management, are interested in research needs on the Delaware Refuges.

On July 15 and 16 we were visited by John Wilson and Rick Kanaski, the Regional Historic Preservation Officer and his deputy respectively, regarding an archaeological survey of the site where the old YACC building, now the Delaware Bay Estuary Program office, would be extended. They found nothing of archaeological significance.

Pat Holloway from the Office of the Inspector General performed a property audit on July 14.

Manager Daly traveled to Great Meadows NWR on July 22-23 to participate in regional meetings on the FY 1993 budget.

An administrative inspection of Bombay Hook NWR was performed by Kathy McClellan (R.O.-Refuges) during the period July 21-24.

First Aid and CPR training was provided to Bombay Hook and Prime Hook staff on August 13 by ORP Pohlman and Office Assistant Hammond. A second training class for Delaware Bay Estuary personnel was conducted by the same instructors on August 17.

On September 9 Frank Smith gave a refuge tour to 35 biologists who were attending the Northeast Furbearer Committee meeting in Dover. They were very interested in our muskrat, raccoon and beaver management programs.

On October 21 Former Chincoteague (and Back Bay, Eufaula, Holla Bend etc.) manager Denny Holland stopped by for a visit. He was accompanied by Mr. Cigar Daisey of

A BRIEF HISTORY OF BOMBAY HOOK NATIONAL WILDLIFE REFUGE



Known to the Indians as Canaressse, meaning "at the thickets," and later referred to as Ruyge-Bosje, meaning "shaggy bushes" or thicket, Bombay Hook received its final name from the corruption of the Dutch "Bompies" or "Bompies Hoeck" meaning "little-tree point". In 1679 Mechacksett, chief of the Kahansink sold Bombay Hook wetlands to Peter Bayard, an early Dutch settler. The price for the area was 1 gun, 4 handfuls of powder, 3 waistcoats, 1 anchor of liquor and 1 kettle.

Bombay Hook National Wildlife refuge was established March 16, 1937 as a resting and feeding area for migratory and wintering waterfowl.

On April 1, 1938, the Civilian Conservation Corps (CCC) based at Leipsic started work on the refuge. The CCC constructed dikes, buildings, water control structures and impoundments. The CCC built Raymond Pool, removed timber from Shearness and Finis swamps, transplanted 300 Ash trees, built a 99 foot lookout tower, a boat and boat house, ran ditches for mosquito control, and conducted various wildlife surveys. The camp ended March 18, 1942. Nationally the CCC built facilities at many refuges and parks across the country.

While the refuge is home and a stopping place for a wide variety of birds, mammals and reptiles, the most popularly recognized species utilizing the refuge are eagles, deer and vast flocks of migrating waterfowl and shorebirds.

Eagles have been a documented nesting species throughout the history of the refuge. During the 50 year period from 1938-1988, only 14 successful nests with 23 eaglets fledged. eagles did not attempt to nest. While data from 4 3 years is missing, all other years during the tempted to nest, but were unsuccessful at either rearing young.

In 1949, 1950, and 1954, two nests the refuge. In 1982 an eaglet was placed in rejected by the nesting pair. In 1986 an of toxin adversely affected the nesting disappeared and one was successfully pair established territory on the the same time but did not attempt to cessfully hatched and fledged of two eaglets at Bombay Hook



however, there have been There were 10 years when years is sketchy, and period eagles at-hatching eggs or were present on the nest but was undiagnosed type pair. One eagle rehabilitated. A second refuge at approximately nest. In 1987 this pair suc-two young, the first production since 1976.

There was a noticeable absence of eagles on the refuge during 1942-1945. This can be explained by the activity on the refuge during that period. pesticides, e.g., DDT had begun to be used of the refuge and on the refuge. A hatching success was seen, beginning continuing through the 1970's. Egg unsuccessful nests in the 1970's shell and that DDT residues were present.



presence of military Beginning in the 1950's, in the general vicinity noticeable decrease in in the mid 1950's and shell fragments collected from confirmed a thinning of the

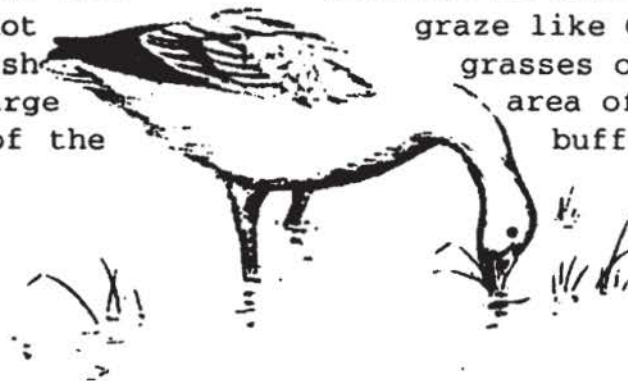
The first record of deer on the refuge was in 1941 when the herd consisted of 4 individuals. The population built up to 45 animals by 1947. In 1948, the first complaints of deer damage came from farmers adjacent to refuge lands. The first refuge shotgun deer hunt was held in 1953. Of the 120 animals on the refuge, 56 were taken. During the first archery season in 1955, 8 deer were harvested. By 1970 the deer herd had expanded to 150 animals, and in 1972 the first primitive weapon deer season was held. Gradual increases in the deer herd throughout the 1980's has resulted in a healthy herd currently estimated at about 300 animals.



In the early 1940's waterfowl use of the refuge was very low due to the use of three sections of the refuge for aerial bombardment testing during World War II. By 1957 refuge cropland management programs and changes in agricultural patterns on the Delmarva Peninsula resulted in an increase to 15,000 Canada geese and 5,000 Snow geese.

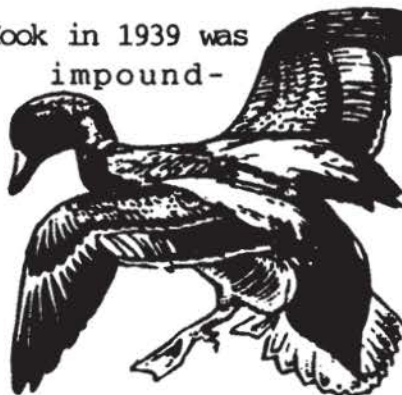
Throughout the 1960's Snow goose peaks averaged around 35,000 and Canada geese averaged around 30,000. In 1977 Canada geese peaked at 69,000 while Snow goose population remained stable. During the 1980's the Canada goose population declined with the average 1991/92 population being 10,000. This decline was due in part to the drought of the 1980's which affected production, the warmer winters recently, which caused some geese to remain in New York and Pennsylvania and overhunting on the Eastern shore of Maryland and Delaware.

During the 1980's the increase in Snow goose use of Bombay Hook was phenomenal. Snow goose peak numbers have spiraled upward from 5,500 in the 1978/1979 season to 20,500 in 1979/1980, 46,235 in 1984/1985 and a record peak of 75,000 in the 1987/1988 season. These large rises in Snow goose populations at Bombay Hook have resulted in certain management problems. Snow geese do not graze like Canada geese, but rather pull saltmarsh grasses out by the roots, resulting in a large area of marsh becoming a tidal mudflat instead of the buffering estuarine salt marsh it once was.



Beginning in 1983, a limited Snow goose hunting program was begun in an attempt to disperse the large concentrations of Snow geese from the salt marsh. This management technique proved successful, significantly reducing the amount of damage the birds inflicted on the fragile salt marsh habitat, and continues to be used in the fall and winter months. The incredible snow goose numbers attracted the attention of National Geographic's "Explorer" and in October 1986, film crews broadcast live from the refuge amid a tremendous storm of landing Snow geese.

The duck population of Bombay Hook in 1939 was mostly Black ducks. A series of impound-ments, totalling 1,100 acres, were constructed between 1939 and 1961 to provide a diversity of habitat for waterfowl. Rice was cultivated on the refuge during the 1950's to also encourage waterfowl usage. Records of 1952 document an overall increase in Black duck usage to about 70 birds per square mile of refuge. In 1953 Black duck/Mallard hybridization was noted as increasing.

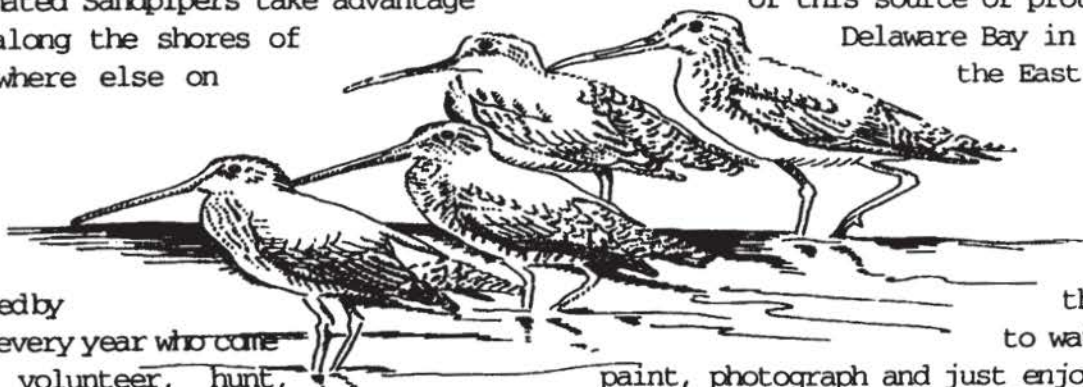


During the late 1970's and early 1980's peak duck populations on the refuge declined, reflecting the lowered continental populations due to loss of wetlands. In the season of 1977/78, ducks peaked at about 38,000, while in 1980/81 they peaked at 24,800. From 1981 to 1984 duck populations decreased to a low of about 13,800. Duck numbers on the refuge rebounded beginning in 1985 due to initiation of intensive management of the impoundments and resulting abundance of food plants. The 1990/91 season saw a peak population of about 28,000 ducks.

Its location on the Delaware Bay gives Bombay Hook the ideal opportunity to provide major resting and feeding grounds for hundreds of thousands of migrating shorebirds. The annual shorebird flight from wintering grounds in South America to their Nesting grounds above the Arctic Circle, coincide precisely with the egg-laying activities of Horseshoe crabs along the bay shores.



Each year in May, the crabs lay their small, green eggs at the shallow water's edge. Migrating shorebirds, particularly Ruddy Turnstones, Red Knots, Dowitchers, Dunlins and semi-palmated Sandpipers take advantage of this source of protein, concentrating along the shores of Delaware Bay in numbers not seen anywhere else on the East coast.



Bombay Hook is appreciated by thousands of visitors every year who come to watch birds and mammals, volunteer, hunt, paint, photograph and just enjoy the outside environment.

Hook is thousands of to watch birds and paint, photograph and just enjoy the out-

For further information contact:
Refuge Manager
Bombay Hook National Wildlife Refuge
RD 1 • Box 147 • Smyrna, Delaware 19977-9764
Telephone: (302) 653-9345

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



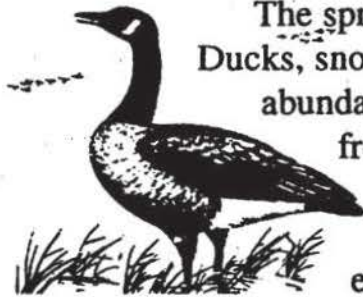
Red tailed, marsh and rough-legged hawks are commonly observed. Bald eagles begin working on their nests. Whitetail deer herds are seen in the fields at dusk.

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.

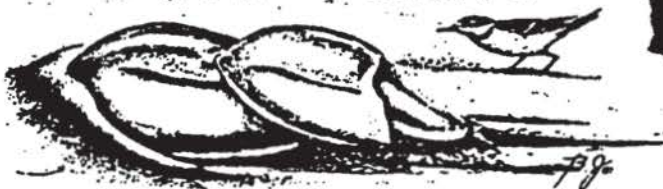
April

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



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.

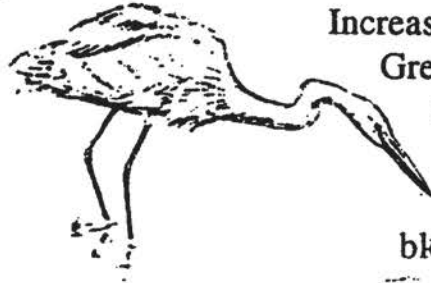
July



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.



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 repellent 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, R.D. #1, Box 147, Smyrna, DE, 19977-9764 or calling (302) 653-6872.





United States Department of the Interior

FISH AND WILDLIFE SERVICE

BOMBAY HOOK NATIONAL WILDLIFE REFUGE

RD 1, BOX 147

SMYRNA, DELAWARE 19977



ACCIDENTAL BIRDS OF THE BOMBAY HOOK NATIONAL WILDLIFE REFUGE

June 4, 1991



The Bombay Hook National Wildlife Refuge encompasses 15,122 acres of tidal salt marsh, freshwater pools and swamps, woods, grasslands, and crop fields. This habitat diversity attracts a wide variety of bird life -- waterfowl, shorebirds, and songbirds.

The list of accidental species, a supplement to the standard refuge bird list, is intended as a guide for experienced observers. These species have been recorded less than six times or in less than six years since the establishment of the refuge in 1937. The list includes some casual wanderers far out of their normal range. Some of these, especially waterfowl, may be escapees but were included if there was not evidence of captivity. Also listed are some species that because of inconspicuous plumage or secretive habits may be more common than records indicate.

If you observe any of these accidentals or other rare species, please substantiate the record as thoroughly as possible and report it to the Bombay Hook Refuge Office, RD 1, Box 147, Smyrna, Delaware 19977. Telephone (302) 653-9345 or 653-6872 (Visitor Center).



Bombay Hook NWR
Accidental Bird List
December 1990

1. Red-Necked Grebe - 3/14/59, W. Jones; 4/29/77, 4/3/88, Slocum and Bernstein; 10/29/89, D. Barnard.
2. Wilson's Storm-Petrel - 8/5/64, D. Kunkel
3. American White Pelican - 12/8/46, Roberge; 12/2/83, 12/8/83, 12/16/83, 8/9/85, K. Liehr; 8/17/83, 12/10/83, 12/16/83, M. Pohlman; 8/17/85, G. Hess, J. Russell; 5/21/89, J. Swertinski, 6/29/89, D. Autct; 7/1/89 (Mahon), D. Shoch, Campbell, Ball, Short, 7/26/89, P.G. Dumont, 5/21/90, J. Swertinski et al.
4. Great Cormorant - 10/29/66, C. Carlson; 12/24/83, Christmas Count; 9/28/85, D. Sahin; 12/19/85, Horson; 11/8/90, K. Howard et. al.; 11/11/90, T. Williamson.
5. White Ibis - 9/1/68-9/10/68, 10/17/68, 8/9/70-9/21/70, 10/23-10/25/70, N. Holgersen and A. Robb; 8/28/65, 7/17/71, 9/5/71-9/11/71, , R. Rowlett; 7/29/72-9/5/72, 7/24/77, 8/6/77, J. Citron; A. Ednie, J. Swertinski 7/31/89, 8/7/89, , 8/21/89, D. Shoch, 9/4/89, M. Kay and M. Rubin, 9/13/89, F. King.
6. Greater Flamingo - 9/11/73, 9/20/73, Holgersen; early 80's, Refuge staff, pale pink plumage - probable escapee.
7. Chilean Flamingo - 4/5/85, Refuge staff; 5/3/85, N. Corson, escapee.
8. Pink-footed Goose - 11/1/53, 11/11/53, 11/1/55, D. Cutler; 1/21/74, widely seen, escapee.
9. Bar-headed Goose (Asian-species) - 1/1/62, T. Florio, 10/2/70, Holgersen; 6/12/88, M. Anthony, Bear Swamp, escapee.
10. Lesser White-fronted Goose - 12/21/72, shot by D. Smith and confirmed by J. Weske and J. Aldrich; 1974, D. Cutler; one found dead, date unknown, 1981, 1982, Christmas Count.
11. Brant - 10/30/65, Christmas Bird Count (CBC) 1981, 12/19/82, CBC 1982, 12/24/83, CBC; 10/20/85, A. Ednie, (DOS); 10/25/87, K Liehr; 10/29/90, J. Merlino & N. Holgersen; 11/4/90, Sussex Bird Club.

NOTE Species favors winterlike climates and may not be an accidental.

Accidental Bird List cont'd.

12. Barnacle Goose - CBC 1941, 11/13/65, 11/25/67, 11/13/73, 11/18/73, 12/1/73, 12/26/73, 1/1/79, 1/19/80, 2/20/82, 12/15/82, 12/19/82, 2/6/86, P.W. Smith and K. Liehr.
13. Common Shelduck - 7/16/70, 8/15/71-9/15/71, 7/6/73-9/25/73, N. Holgersen; 7/22/72-10/4/72, R. Rowlett; 7/15/74-7/17/74, 7/26/82, 3/31/83, K. Liehr; 8/10/83, 8/18/83, 9/1/83, D. Perkuchin; 8/15/71, 9/21/71, 7/29/72, 9/1/74, 7/27/75, 7/25/76, 8/15/76, 8/21/76, J. Citron; escapee.
14. Green-winged Teal (Old World Race) - 3/27-31/69, 12/26/69-12/31/69, N. Holgersen. and D. Cutler; 2/4/72, J. Lehman. (Species formerly known as common teal).
15. Cinnamon Teal - 8/64, S. Baker and Carlson.
16. Common Poachard - 10/2/60-10/27/60. F. Lesser; (Formerly known as Red-crested Poachard); escapee.
17. Common Eider - 12/2/42, J. Herholt, R. Newman. B. Reiman; 1949 Christmas count.
18. Surf Scoter - 4/6/89, H. & I. Loescher; 11/2/89, R. & A. Kiemoss.
19. Northern Goshawk - 12/18/45, 2/11/46, G. Spinner, 10/1/63, C. Hardy; 5/13/72, D. Brezina; 12/23/73, CBC, 3/15/81, 1/1/90, R. Ryan; 12/27/87, J. Miller; 1/2/90, J. Lawes; 1/6/90; F. & L. King.
20. Yellow Rail - 2/11/38, J. Herholt; 10/20/68, J. Eaches, specimen at Smithsonian; September 1970, Refuge staff; 9/24/71, captured by H. Cottman, banded by N. Holgersen, Port Mahon, May 1991, various observers.
21. Purple Gallinule - 7/14-27/75, J. Citron; 8/10/75, 2 adults and 3 young nest at Finis.
22. Sandhill Crane - 10/18/69-1/10/70, 3/2/70-3/12/70, N Hogersen; 12/87, Woodland Beach.
23. Northern Lapwing - 3/14/53, J. Miller and C. Price; 3/15/53, D. Cutler.
24. Great Golden Plover - 7/27/89, G. Scarpulla.

Accidental Bird List cont'd.

25. Rufous-necked Stint - 7/22/84, P. Dumont (off Refuge); 7/28/84, J. Abbott (off Refuge); 7/23-29/86, Little Creek, B. Freck, Barnhill, Hess et al.; 7/21/86, Refuge staff and C. Peterson; 8/1/86, Little Creek; 7/22/87, E. Wilson, Russell, Barnhill, Hess, et al.; 7/29/90, Gene Hess (Little Creek).
26. Red Phalarope - 10/21/54, P. Springer and R. Stewart; 10/22/54, D. Cutler; 5/18/74, P. Dumont, Little Creek, 10/12/82, Checkolls, V. & K. McGrath, 11/6/88 A. Ednie, C. Perry, B. Moscatello.
- *Note*, May be a normally occurring species.
27. Parasitic Jaeger - 9/18/45, G. Spinner.
28. Lesser Black-backed Gull - 8/22/70-8/30/70, C. Carson; and J. Walker; 1982 Christmas count, 12/11/82, Barnhill and S. McCandess; 2/3/84, Ednie; Taylor's Gut, 2/27/87, P. Hurlock.
29. Glaucous Gull - 2/6-12/65, 3/27/65, Dyke, Carrick, Carlson, E. Kramer, Little Creek; 8/14/65, Pickering Beach, 5/21/66, Carlson; 5/19/68, Little Creek, H. Brokaw, K. Liehr; 8/12/70, Ellis, Teele, 1/11/83, K. Liehr; 2/2/83, K. Liehr and L.S.; 1/8/83, K. and D. Bart; 1/8/83, O. and B. Knarr; 1984 Christmas count, 2/16/89, T. Donohue.
30. White-winged Tern - 7/27/74, W. Wayne; 7/11-7/13/87, Palumbo, Merritt and Knoulton (DOS); 7/14-7/17/87, M. O'Brien and D. Stotts; 7/18/87, Port Mahon, R. Goff; 8/27/87, E. Spaulding, Little Creek - Pickering Beach. 7/22-7/30/89, N. Holgersen, B. Cooper, G. McKinnon, B. Augustine, A. Hill, et al., 7/27/89, Refuge staff.
31. Snowy Owl - 1/15/40, J. Herholt; 12/12/42, Dr. Galtsoff and J. Herholdt; 2/11/54, D. Hickok; 12/8/83, 12/20/83, B. Ulmer; mid seventies, 12/2/86-3/4/87, Refuge staff.
32. Chuck-will's-widow - 5/1/66, B. Carrick, 1975 Spring count.
33. Piliated Woodpecker - 4/27/76, 4/19/87, A. Hill.
34. Olive-sided Flycatcher - 9/4/54, Reported in Kenton & BH; 10/29/70, 9/6/71, 1977 and 1979, Spring count, 9/8/81, 5/7/83, 9/29/89, F. & L. King; 9/20/81, H. Keller, et al.
35. Hammond's Flycatcher - 12/28/86, Christmas count.
36. Western Kingbird - 1949 Christmas count; 9/9/54, 12/1/69-12/5/69, K. Leih and N. Holgersen; 9/6/70, C. Carlson and J. Walker; 5/7/71, unknown; Fall 1988, Faith King.

Accidental Bird List cont'd.

37. Scissor-tailed Flycatcher - 5/4/68, G. Suskeep, D. Ward and R. Ward; 12/17/73, K. Liehr and M. Garner (VA-OS); 12/83, Refuge staff, 5/21/88, B. Murphy; 5/22/88, R. Hilton.
38. Cliff Swallow - 5/15/77, Little Creek, Barnhill 1977, and 1980 Spring count, 7/22/89, (pig farm, Smyrna on Big Oak Rd.) DOS notes, 9/17/90, 10/5/90, F. & L. Long.
39. Fieldfare - 3/30-4/1/69, N. Holgersen; 4/4/69, R. Keele and D. Ward.
40. Sage Thrasher - 10/29/85, E. Wilson.
41. Philadelphia Vireo - 4/26/69, C. Carson; 9/29/83, K. Grim; 5/5/85, unknown, 9/3/89, N. Holgersen.
42. Orange-crowned Warbler - 1954 Christmas count; 1977 CBC.
43. Yellow-throated Warbler - 4/10/69, 5/2/69, N. Holgersen, 6/4/77, J. Kauffman; Bombay Hook notes, 3/29/89, P. Vanderhorst.
44. Mourning Warbler - 5/24/69, N. Holgersen; 9/13/70, P. Dumont; 5/31/78, 9/6/82.
45. Dickcissel - 7/15/89, B. Cooper & B. Augustine; (off refuge - Little Creek).
46. Vesper Sparrow - 11/8/58, CBC's 58, 59, 60, 62 and 1963; 1969 Christmas count; 4/24/71, W. Wayne. 1976, 1977 and 1980, Spring Ct.; 4/24/81, 4/7/90, F. Buhleral (off refuge on Rte.9); 4/9/90, N. Holgersen.
47. Lark Sparrow - 11/19/41, J. Herholt and D. Cutler; 8/26/73, C. Pinkard, M. Barnhill.
48. Lark Bunting - 10/20/65, 10/30-11/30/65, C. Hardy; 5/13/71, K. Liehr, photo.
49. Painted Bunting - 12/22/68, Leipsic, Barnhill; 8/19/89-8/27/89, D. Shoch & C. Shoch et. al.; Fall count, 1989; 8/21/90, staff.
50. West Nile Red Bishop - 7/11/87, 9/1/87, M. Anthony and Refuge staff; 8/15/87, B. Cooper and B. Augustine; escapee, immature.
51. Henslow's Sparrow - 1941 Christmas count; 4/21/51, 5/30/56, J. Miller.

Accidental Bird List cont'd.

52. Lincoln's Sparrow - 10/23/54, D. Cutler; 10/11/64, Anderson; 12/5/75, Census, J. Patterson et al.; 10/25/89, Vanderhorst.
53. Yellow-headed Blackbird - 8/17/65, 8/13/76, 9/20/81, 7/21/86, Refuge staff; 10/22/73, L. Purey; 8/18/75, D. Cutler; 10/29/75, Port Mahon, C. Johnson; 1/15/78, near Dover, L. Purey; 9/20/81, Hess, Speck, and Brooks, 1/5/89, D. Shoch; 7/20/90, L. Nock and M. Milton, (3/15/90 Southern Liepsic, H. Hallowell, J. Warren).
54. Brewer's Blackbird - 2/10/51, 11/3/51, 10/5/53, 10/24/53, 11/20/53, 11/29/53, 12/6/53, 4/10-4/11/54, 10/22/54, 11/6/54-11/7/54, 4/2/55, 4/23/55, 12/22/56, 3/10/57, 2/4/62, 12/6/68, 12/27/70, 4/26/75, 1/23/76, 2/21/76, 3/21/76, 4/10/76, 4/17/76, 11/13/76, 11/27/76, 12/19/76, 11/12/77, 12/24/77, 11/12/78, 12/23/79, Bombay Hook NWR; 12/2/90, F. & L. King; 12/22/90, (off refuge in Leipsic) C. Campbell & E. Powajkc.
55. Red Crossbill - 12/29/63, 1969 CBC, 12/28/69; 5/8/70, N. Holgersen; 12/23/73, CBC.
56. Common Redpoll - 12/28/69, 1969 CBC, K. Richards; 1/11/70, 1/25/70, N. Holgersen; 2/1/70, D. Brezina; 3/7/70, 2/10/74, 4/10/82, T. Slaughter; 12/26/77, CBC.

Other rare or accidental birds that have been reported in the vicinity of the Bombay Hook Refuge are:

Western Grebe
Leach's Storm Peterel
Gannet
Gyr Falcon
Roseate Tern
Dovekie
Oregon Junco
Boreal Chickadee

Sprague's Pipit
Warbling Vireo
Connecticut Warbler
Pine Grosbeak
White-winged Crossbill
Yellow Bellied Flycatcher
Fork-tailed Flycatcher

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

Bear Swamp Trail

Bombay Hook National Wildlife Refuge

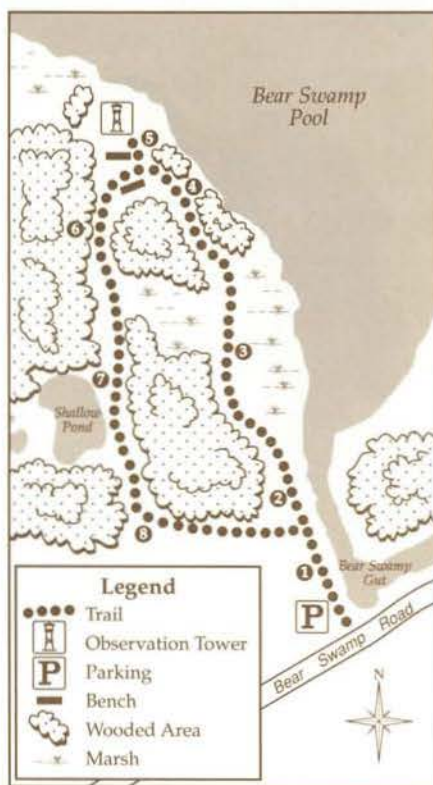


Delaware

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.

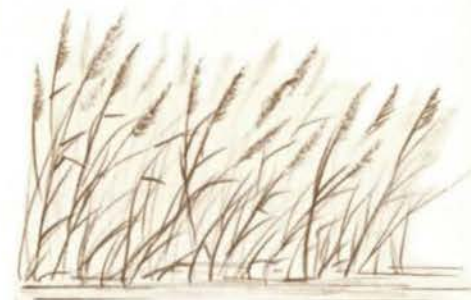
2 Near this stop, the trail passes through the forest and along the marsh. The red maple trees indicate this area is in the second stage of forest succession. Look here for the sassafras, which produces a fleshy blue fruit eaten by songbirds and quail.

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.

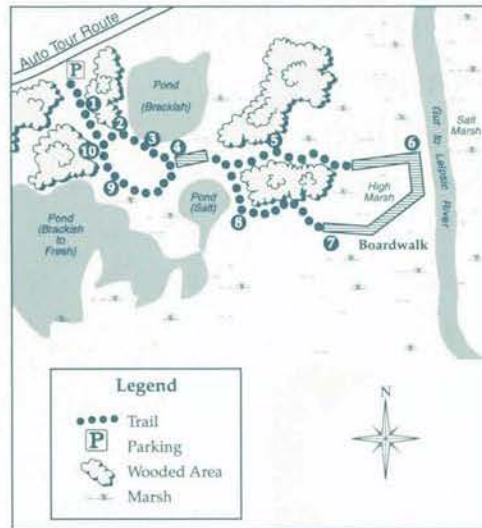
8 We hope you enjoyed your walk today. Freshwater ponds such as Bear Swamp Pool add a whole group of plants and animals to Bombay Hook Refuge. These ponds give waterfowl and shorebirds a place to rest, feed, and nest. Mammals attracted to freshwater ponds include beavers, otters, raccoons, and mink.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



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 Waterfowl Management Plan in 1986. The Plan establishes population goals for waterfowl through the year 2000, and gives special attention to species

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

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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.

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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

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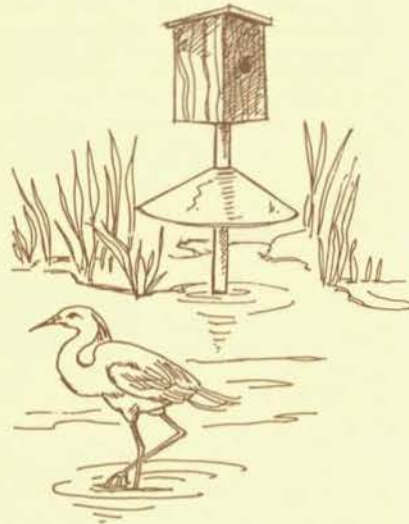
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Illustrations by Sandy Rhodes

Auto Tour



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U.S. FISH AND WILDLIFE SERVICE

Bombay Hook National Wildlife Refuge

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1. History

Recorded history of the area began in 1679 when the Indian Machacksett, Chief Sachem of Kahansink, sold some marshland called "Boompies Hook" for a price of "...one gun, fower hands full of powder, three Mats coats, one anckor of Liquors and one Kittle..."

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Muskrat house

Bombay Hook Refuge, comprising 15,122 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.

2. Cooperative Farming

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.

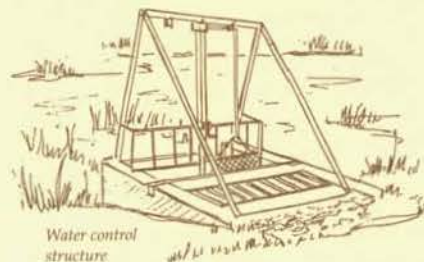


Wheat

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.

3. Freshwater Impoundments

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 (the yellow bar structure). 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.



Water control structure

During the summer, emergent plants like wild millet, three-square bulrush, cattail, pond weed, widgeon 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.

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.

4. 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.



Saltmeadow cordgrass

Saltmarsh cordgrass

Bombay Hook Refuge hosts up to 75,000 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.

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.

5. Shearneck Pool

Shearneck 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 Shearneck 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.

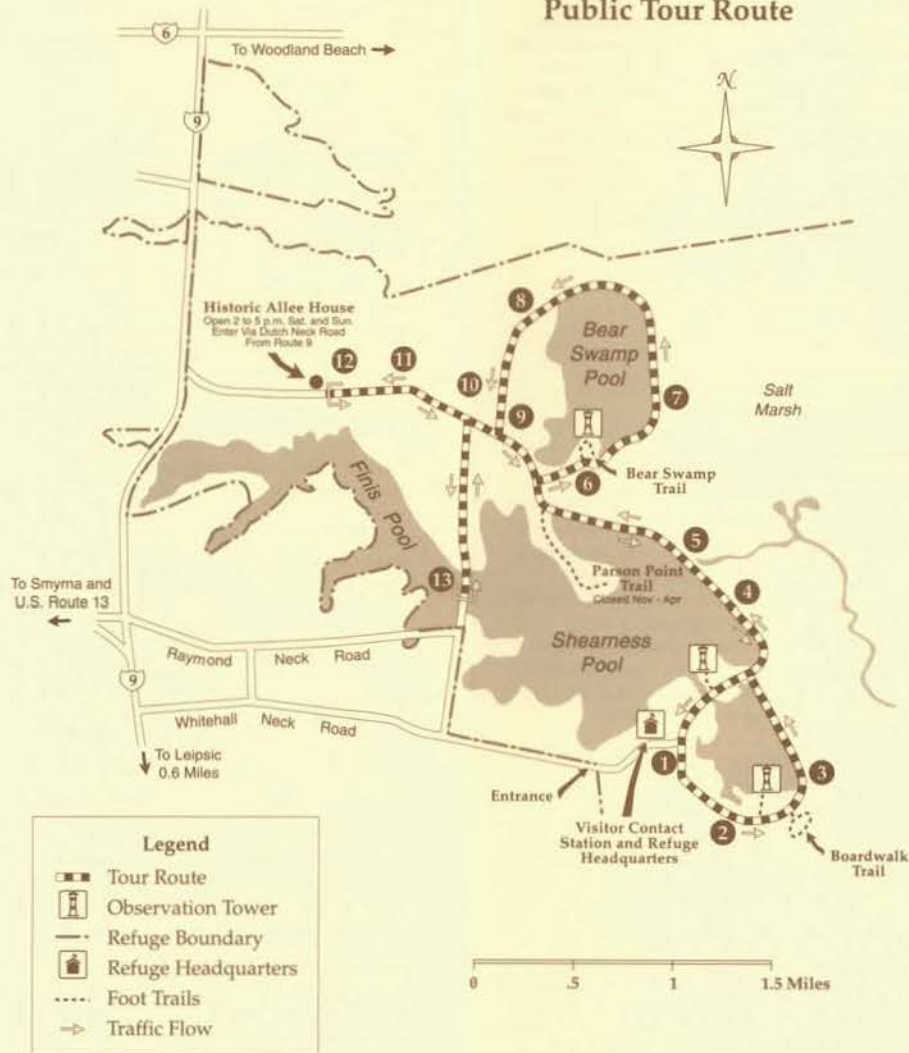
6. Wildlife Food Plot

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

BOMBAY HOOK
National Wildlife Refuge
 Kent County Delaware
Public Tour Route



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

7. Loafing Area

The islands to your left in the Bear Swamp Pool are loafing (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.



Corn bins

8. Corn Bins

The bins to your left store corn used during waterfowl banding. When banding takes place, the age and sex of captured birds is 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.



Bird band

9. Old Field

This old field has been retired 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 every two or three years to prevent the growth of woody vegetation.

10. Woodland

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 pink lady slipper also grow here.

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



Fox

11. Grassed Waterway

The depression to the right, which separates the two fields, is a grass-covered waterway, graded to carry excess water away from the fields without causing erosion. This type of waterway is mowed during the non-nesting seasons to prevent woody plants from growing in the drainage.



Allee House

12. 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. Today, the Delaware Division of Historical and Cultural Affairs maintains the Allee House, which is open to the public on weekend afternoons.

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.



Beaver

13. Finis Pool

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.



Nest box

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.

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.

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Boardwalk Trail

Bombay Hook National Wildlife Refuge



Delaware

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RL-51550-1

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Bear Swamp Trail

Bombay Hook National Wildlife Refuge



Delaware

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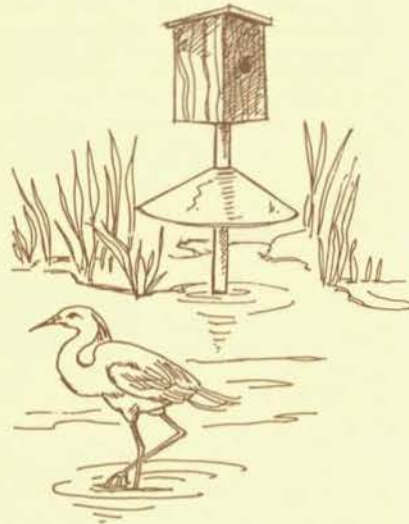
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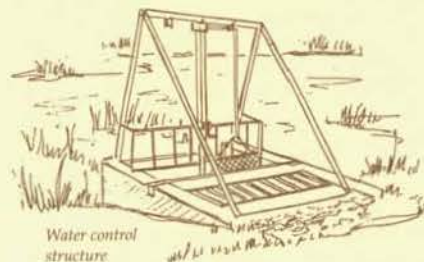


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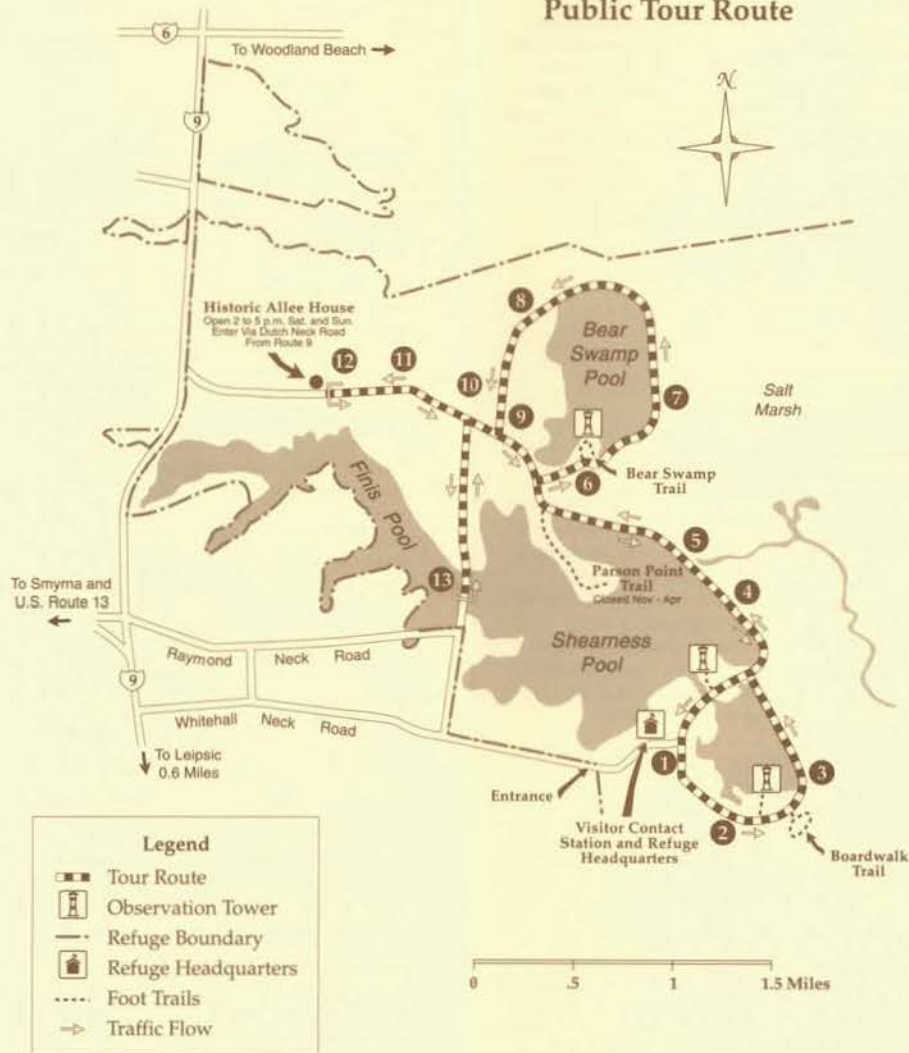
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Food plots are usually prepared and planted by neighboring farmers as part of their cooperative farming agreements with the Refuge.

7. Loafing Area

The islands to your left in the Bear Swamp Pool are loafing (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.



Corn bins

8. Corn Bins

The bins to your left store corn used during waterfowl banding. When banding takes place, the age and sex of captured birds is 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.



Bird band

9. Old Field

This old field has been retired 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 every two or three years to prevent the growth of woody vegetation.

10. Woodland

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 pink lady slipper also grow here.

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



Fox

11. Grassed Waterway

The depression to the right, which separates the two fields, is a grass-covered waterway, graded to carry excess water away from the fields without causing erosion. This type of waterway is mowed during the non-nesting seasons to prevent woody plants from growing in the drainage.



Allee House

12. 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. Today, the Delaware Division of Historical and Cultural Affairs maintains the Allee House, which is open to the public on weekend afternoons.

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.



Beaver

13. Finis Pool

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.



Nest box

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.

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

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For further information please contact:

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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!

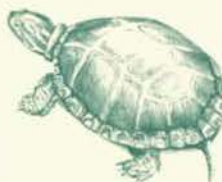
Welcome to Bombay Hook National Wildlife Refuge. The Parson Point Trail is one mile round trip and provides the opportunity for visitors to see many kinds of plants and animals - maybe even a bald eagle! Isolated forested areas with tall, mature trees are key requirements for nest-building eagles. Bombay 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 bullfrogs.

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.

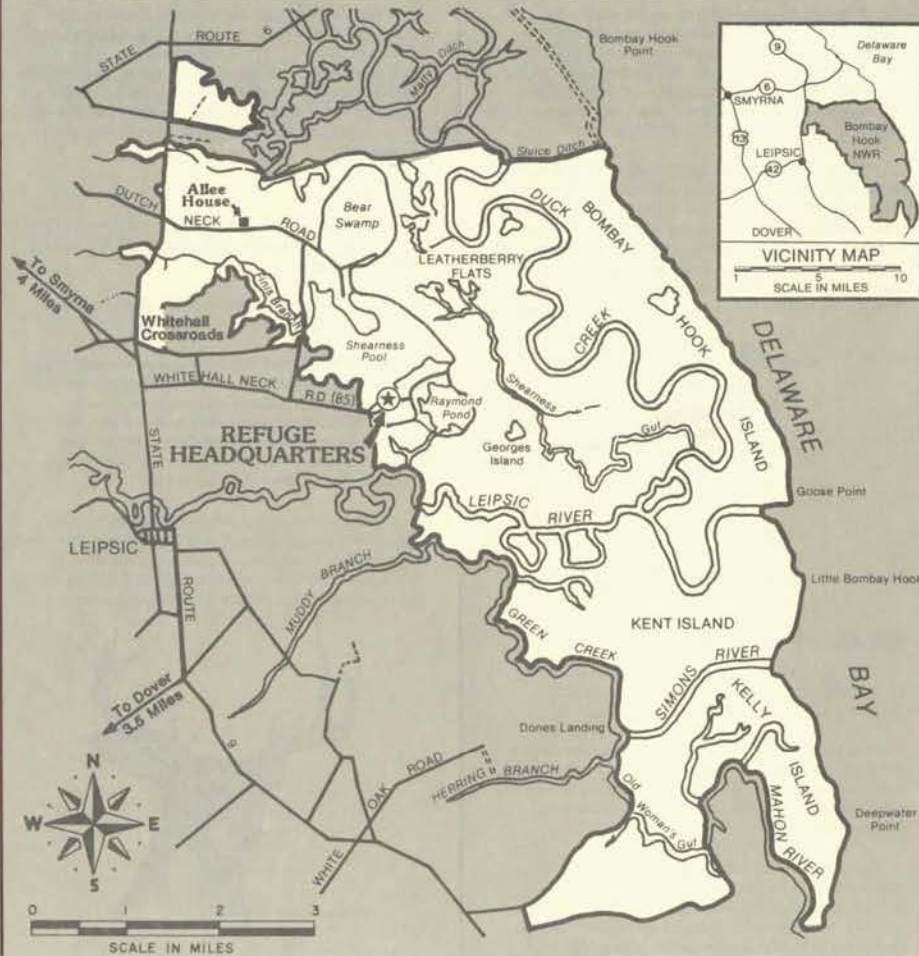
8 As you near the end of the trail, Phragmites plants will become more noticeable. Phragmites, introduced from Eurasia, grows where marshes have been disturbed by man. The plant has no food value for wildlife and competes with millets, sedges, and other plants which are a valuable source of wildlife 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 Shearneck 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.

Shearneck 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.

BOMBAY HOOK NATIONAL WILDLIFE REFUGE



DIRECTIONS

Heading North on Route 13 from Dover, take Route 42 East to Route 9, Leipsic. Proceed North on Route 9 for 2 miles to Road 85 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 Road 85 after 1/4-mile.

U.S. Fish and Wildlife Service

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For further information please contact:

Refuge Manager
 Bombay Hook National Wildlife Refuge
 RD 1, Box 147
 Smyrna, Delaware 19977
 Telephone: (302) 653-9345

Black-necked stilt by Bob Jones
 Other illustrations by Julien Beauregard



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

RL-51550-2

June 1992

Bombay Hook

National Wildlife Refuge



Delaware



Canada goose

Welcome

Bombay Hook National Wildlife Refuge comprises 15,122 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, 1,000 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 of \$3.00 per vehicle or purchase one of two annual passes - the Duck Stamp and Golden Eagle Passport. Both are sold at the Refuge. Anyone who is 62 years of age or older, or who is

disabled, is eligible for a free pass that 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 1940's 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.

Refuge Management and Objectives

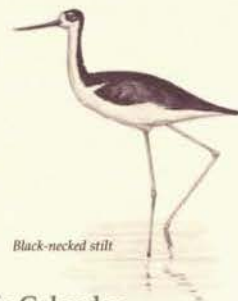
The Refuge management programs are primarily aimed at developing and protecting desirable habitat for waterfowl and other migratory birds, including the endangered bald eagle. The Refuge is located at a focal point for waterfowl migrating between their northern breeding grounds and various wintering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



Snow goose

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 1,000 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.



Black-necked stilt

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-tailed deer, beaver, muskrat, red fox, river otter, woodchuck and Virginia 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.

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.



White-tailed deer

Public hunting, primarily for waterfowl and deer, is permitted under special regulations on portions of the Refuge during the legal State season.

NOTES

Date _____ Time _____

Observers _____

Weather _____

Tides _____



U.S. Fish and Wildlife Service

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Cover illustration by Julien Beauregard



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

RL-51550-2

June 1991

Birds

Bombay Hook National Wildlife Refuge



Delaware

Bombay Hook National Wildlife Refuge lies low and flat on the Atlantic Coastal Plain along the western shore of Delaware. Nearly two-thirds of its more than 15,000 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.



This folder lists 261 birds that have been identified on the Refuge, and is in accordance with the Sixth American Ornithologists Union Checklist.

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

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

LOONS - GREBES - CORMORANT

Red-throated Loon				r	r	
Common Loon				r		
Pied-billed Grebe †	o	o	u	o		
Horned Grebe	o	u	o	u		
Eared Grebe				r		
Double-crested Cormorant	u	u	c	u		

BITTERNS - HERONS - IBIS

American Bittern †	o	u	u	o		
Least Bittern †	o	c	o			
Great Blue Heron	c	c	a	c		
Great Egret	u	a	c	o		
Snowy Egret	o	a	c	r		
Little Blue Heron	o	c	c			
Tricolored Heron	o	u	o	r		
Cattle Egret	o	u	o			
Green-backed Heron	c	c	c	r		
Black-crowned Night-Heron	c	c	c	u		
Yellow-crowned Night-Heron	o	o	o	o		
Glossy Ibis	c	c	u			

SWANS - GEESE - DUCKS

Fulvous Whistling-Duck	r	r	r			
Tundra Swan	o	r	c	u		
Mute Swan	r	r	r	o		
Greater White-fronted Goose	r		r	r		
Snow Goose	c	r	a	a		
Ross' Goose			r	r		
Canada Goose †	a	c	a	a		
Wood Duck †	c	c	a	o		
Green-winged Teal	a	o	a	c		
American Black Duck †	c	c	c	c		
Mallard †	a	c	a	a		
Northern Pintail	a	o	a	a		
Blue-winged Teal †	c	u	a	r		
Northern Shoveler †	c	o	a	u		
Gadwall †	c	a	a	u		
Eurasian Wigeon	r	r	r	o		
American Wigeon	c	o	a	c		
Canvasback			o	o		
Redhead	o		o	o		
Ring-necked Duck	o		u	o		
Greater Scaup	u	o	u	u		
Lesser Scaup	u		u	u		
Oldsquaw		r	u	o		
Black Scoter	o	r	o	o		
Surf Scoter	o		o	o		
White-winged Scoter	o		o	o		

Common Goldeneye	u	r	u	u
Bufflehead	c	r	c	c
Hooded Merganser	u	o	u	c
Common Merganser	u	r	c	c
Red-breasted Merganser	u	r	u	u
Ruddy Duck	c	o	c	c

VULTURES - HAWKS - FALCONS

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

PHEASANT - QUAIL

Ring-necked Pheasant †	c	c	c	c
Northern Bobwhite †	c	c	c	c

RAILS - CRANES

Black Rail	r	r	r	
Clapper Rail †	c	c	c	o
King Rail †	c	c	c	o
Virginia Rail †	u	u	u	o
Sora	u	o	u	

Common Moorhen †

Common Moorhen †	o	u	o	r
American Coot †	c	u	a	u

PLOVERS - SANDPIPERS

Black-bellied Plover	c	u	c	o
Lesser Golden-Plover	r	r	o	
Semipalmated Plover	c	u	c	r
Killdeer †	c	c	c	u
Black-necked Stilt †	u	c	o	
American Avocet	u	c	u	r
Greater Yellowlegs	c	c	a	o
Lesser Yellowlegs	c	c	c	o
Solitary Sandpiper	o	o	o	
Willet †	a	a	o	r
Spotted Sandpiper	u	o	u	
Upland Sandpiper	o		o	
Whimbrel	r	r	r	

	s	S	F	W
Hudsonian Godwit	r		o	
Marbled Godwit		r	r	
Ruddy Turnstone	c	o	u	
Red Knot	u	o	o	
Sanderling	c	o	c	
Semipalmated Sandpiper	a	c	a	
Western Sandpiper	o	o	c	f
Least Sandpiper	c	c	c	r
White-rumped Sandpiper	u	o	u	
Baird's Sandpiper	r	r	r	
Pectoral Sandpiper	o	c	c	r
Dunlin	a	o	a	c
Curlew Sandpiper	r	r	r	
Stilt Sandpiper	u	o	o	
Buff-breasted Sandpiper			r	
Ruff	r	r	r	
Short-billed Dowitcher	c	c	a	r
Long-billed Dowitcher		o	o	
Common Snipe	c	o	c	u
American Woodcock †	c	u	c	r
Wilson's Phalarope	o	o	o	
Red-necked Phalarope	o		o	
GULLS - TERNS				
Laughing Gull	c	c	c	
Bonaparte's Gull	o	o	o	
Ring-billed Gull	c	u	a	c
Herring Gull	c	c	a	c
Great Black-backed Gull	c	c	c	c
Gull-billed Tern	o	o	o	
Caspian Tern	o	u	o	
Royal Tern		o	r	
Common Tern	o	o	o	
Forster's Tern	o	c	c	
Least Tern	o	c	o	
Black Tern	r	r	r	
Black Skimmer	r	o	o	r
DOVES - CUCKOOS - OWLS				
SWIFTS - HUMMINGBIRDS				
Rock Dove †	o	o	o	o
Mourning Dove †	c	c	a	c
Black-billed Cuckoo †	o	o	o	
Yellow-billed Cuckoo †	c	c	c	
Barn Owl †	u	u	u	u
Eastern Screech-Owl †	u	u	u	u
Great Horned Owl †	c	c	c	c
Barred Owl †	c	c	c	c
Long-eared Owl			r	r

	s	S	F	W
Short-eared Owl †	o	r	o	o
Northern Saw-whet Owl	r		r	r
Common Nighthawk	o	o	o	
Whip-poor-will	o	o		
Chimney Swift	c	c	c	
Ruby-throated Hummingbird †	c	c	c	
Belted Kingfisher †	c	u	c	c
WOODPECKERS - FLYCATCHERS				
Red-headed Woodpecker	r		r	r
Red-bellied Woodpecker †	c	c	c	c
Yellow-bellied Sapsucker	o		o	o
Downy Woodpecker †	c	c	c	c
Hairy Woodpecker †	o	u	u	o
Northern Flicker †	c	c	c	o
Eastern Wood-Pewee †	c	a	c	
Acadian Flycatcher †	u	c	o	
Alder Flycatcher	r		r	
Willow Flycatcher †	o	o	o	
Least Flycatcher	o		o	
Eastern Phoebe †	c	u	c	r
Great Crested Flycatcher †	c	c	c	
Eastern Kingbird †	c	a	c	
LARKS - SWALLOWS - JAYS - CROWS				
Horned Lark †	c	o	c	c
Purple Martin †	c	c	o	
Tree Swallow †	c	a	a	r
Northern Rough-winged Swallow	u	o	u	
Bank Swallow	o	c	c	
Barn Swallow †	c	c	c	r
Blue Jay †	c	c	c	c
American Crow †	a	c	a	a
Fish Crow †	c	c	c	o
TITMICE - NUTHATCHES - WRENS				
Black-capped Chickadee			o	o
Carolina Chickadee †	c	c	c	c
Tufted Titmouse †	c	c	c	c
Red-breasted Nuthatch	o		o	u
White-breasted Nuthatch	u	o	u	u
Brown Creeper	c		c	c
Carolina Wren †	u	u	u	u
House Wren †	c	c	c	r
Winter Wren	u		u	c
Sedge Wren †	o	o	o	r
Marsh Wren †	c	c	c	o
KINGLETS - THRUSHES - THRASHERS				
Golden-crowned Kinglet	o		c	c
Ruby-crowned Kinglet	c		c	o

	s	S	F	W
Blue-gray Gnatcatcher †	c	u	o	r
Eastern Bluebird †	u	u	u	u
Veery	c	o	c	
Gray-cheeked Thrush	o		o	
Swainson's Thrush	c		c	
Hermit Thrush	c		c	o
Wood Thrush †	c	c	c	
American Robin †	c	c	c	o
Gray Catbird †	c	c	c	o
Northern Mockingbird †	c	c	c	c
Brown Thrasher †	c	c	c	o
WAXWINGS - SHRIKES - STARLINGS				
American Pipit	u		u	o
Cedar Waxwing	o	r	o	u
Loggerhead Shrike	o		o	o
European Starling †	a	a	a	a
VIREOS - WOOD WARBLERS				
White-eyed Vireo †	c		c	
Solitary Vireo	o		o	
Yellow-throated Vireo †	o	o	o	
Red-eyed Vireo †	a	a	a	
Blue-winged Warbler	o		o	
Golden-winged Warbler	o		o	
Tennessee Warbler	o		o	
Nashville Warbler	o		o	
Northern Parula	c	o	c	
Yellow Warbler †	c	c	c	
Chestnut-sided Warbler	c	o	c	
Magnolia Warbler	c		c	
Cape May Warbler	o		o	
Black-throated Blue Warbler	c		c	
Yellow-rumped Warbler	a		a	c
Black-throated Green Warbler	c		c	
Blackburnian Warbler	o	o	o	
Pine Warbler	c	o	o	
Prairie Warbler	c	o	o	
Palm Warbler	c		c	r
Bay-breasted Warbler	o		o	
Blackpoll Warbler	c		c	
Cerulean Warbler	r			
Black-and-white Warbler	c	o	c	
American Redstart †	c	o	c	
Prothonotary Warbler †	u		o	o
Worm-eating Warbler	r		r	
Ovenbird	c	u	c	
Northern Waterthrush	c	o	c	
Louisiana Waterthrush †	o	o	o	

	s	S	F	W
Kentucky Warbler †	c	c	o	
Common Yellowthroat †	c	a	c	r
Hooded Warbler	r	r	r	
Wilson's Warbler	o		o	
Canada Warbler	c	o	o	
Yellow-breasted Chat †	u	u	u	r
TANAGERS - SPARROWS				
Scarlet Tanager †	c	c	c	
Northern Cardinal †	c	c	c	c
Rose-breasted Grosbeak	o	u	o	
Blue Grosbeak †	c	c	u	
Indigo Bunting †	c	c	c	
Rufous-sided Towhee †	c	c	c	o
American Tree Sparrow	o		c	c
Chipping Sparrow †	c	u	c	r
Field Sparrow †	c	c	c	c
Savannah Sparrow †	c	r	a	c
Grasshopper Sparrow †	o	u	o	
Sharp-tailed Sparrow †	a	a	a	o
Seaside Sparrow †	a	a	a	o
Fox Sparrow	o		u	o
Song Sparrow †	c	c	c	c
Swamp Sparrow †	c	c	c	c
White-throated Sparrow	a		a	a
White-crowned Sparrow	o		o	o
Dark-eyed Junco	c		c	c
Lapland Longspur				o
Snow Bunting			o	o
BLACKBIRDS - FINCHES				
Bobolink		u	c	c
Red-winged Blackbird †	a	a	a	a
Eastern Meadowlark †	c	u	c	c
Boat-tailed Grackle	o	o	o	r
Common Grackle †	a	a	a	c
Brown-headed Cowbird †	c	c	c	c
Orchard Oriole †	c	u	o	
Northern Oriole	u	u	o	
Purple Finch	o		r	r
House Finch †	o		u	u
Common Redpoll			r	r
Pine Siskin	o		u	u
American Goldfinch †	u	c	c	u
Evening Grosbeak	o		o	o
House Sparrow †	a	a	a	a