

BOMBAY HOOK
NATIONAL WILDLIFE REFUGE
Smyrna, Delaware 19977

ANNUAL NARRATIVE REPORT

Calendar Year 1986

U.S. Department of the Interior
Fish and Wildlife Service
NATIONAL WILDLIFE REFUGE SYSTEM

REVIEW AND APPROVALS

BOMBAY HOOK NATIONAL WILDLIFE REFUGE

Smyrna, Delaware

ANNUAL NARRATIVE REPORT

Calendar Year 1986

Paul D. Daly
Refuge Manager

2/27/87
Date

Edward S. Moses
Refuge Supervisor Review

4/10/87
Date

Charles Young
Regional Office Approval

4/13/87
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 23,507) and 8 air miles from Smyrna (population 4,750). 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 980 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 nests 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.

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K. FEEDBACK

A. HIGHLIGHTS

Mosquito control operations and methods became the subject of discussions and meetings with the Delaware Division of Fish and Wildlife Mosquito Control Section. (Section F.10)

The poisoning of an adult bald eagle and its successful rescue, rehabilitation and release results in considerable news coverage and public scrutiny. (Section G.2)

Greater snow goose peak population and use-days reached record proportions for yet another year. (Section G.3)

Total duck use-days for 1986 were the highest in six years. (Section G.3)

Post-season duck banding was very successful. (Section G.16)

Total refuge visitation reached a new annual high. (Section H.1)

A new central exhibit for the Visitor Center was installed in December after many delays. (Section H.6)

Shotgun and primitive weapon deer hunting regulations were modified to require hunting during certain periods from elevated stands placed by the refuge. (Section H.8)

Refuge Secretary Virginia Baughman retired after 31 years service. (Sections E.1 and J.3)

National Geographic, British Broadcasting Corporation and Turner Broadcasting cooperated in a live telecast from Bombay Hook and other venues world-wide on "World Safari" October 26, 1986. (Section J.3)

B. CLIMATIC CONDITIONS

Annual precipitation for 1986 totaled 36.21 inches compared with 42.30 inches of precipitation during an average year. Temperatures ranged from a high of 96°F on July 7 to the minimum temperature of 7°F on January 29. The first killing frost in autumn was much later than normal, on November 13. The precipitation received from January through March was near normal; however, only 8.72 inches were recorded during the period April-September. November and December were very wet, and brought the year's precipitation up considerably, but we still ended the year below normal. Snowfall was light as 17.0 inches were recorded, with the greatest one day total being only 3.7 inches on February 11. All weather data was collected by the Delaware Highway Department at their weather station in Dover approximately 12 miles southwest of the Refuge office.

<u>Month</u>	<u>Maximum Temperature (°F)</u>	<u>Minimum Temperature (°F)</u>	<u>Precipitation (Inches)</u>
January	63	7	3.84
February	64	11	3.46
March	82	21	2.29
April	78	29	2.12
May	93	37	1.20
June	93	41	1.29
July	96	52	1.82
August	94	45	3.94
September	91	44	1.73
October	90	35	2.40
November	79	24	5.46
December	63	14	6.66
EXTREMES	96	7	TOTAL 36.21

D. PLANNING

2. Management Plan

The following management plans were written or updated and submitted for approval during 1986:

	<u>Submitted</u>	<u>Approved</u>
Wildlife Inventory Plan	2/18/86	2/28/86
Safety Plan	3/04/86	3/31/86
Marsh & Water Management Plan	3/03/86	3/11/86
Law Enforcement Plan	6/16/86	

4. Compliance with Environmental and Cultural Resource Mandates

A Section 7 evaluation document was prepared and submitted through channels covering the refuge hunt program. This effort was an update of a similar document prepared in 1978; primarily to discuss changes in the program which have occurred since the original evaluation. The conclusion, which was supported at higher levels, was that our hunt program would not effect Bombay Hook's endangered species: the bald eagle and peregrine falcon.

5. Research and Investigations

1. Bombay Hook NR86 - Delaware Mosquito Control Section Research at Bombay Hook

Research performed by the Delaware Division of Fish and Wildlife (Mosquito Control Section) on the Bombay Hook National Wildlife Refuge during the 1986 calendar year consisted of 3 projects. Following is a

summary of the past year's study activities prepared by William Meredith of the Delaware Mosquito Control Section.

- "1) A quantitative comparison on the Open Marsh Water Management (OMWM) site of larval mosquito production between OMWM and control plot, and quantitative observations of vegetation pattern and system integrity;
- 2) evaluation of the mosquito breeding potential on approximately one-half of the refuge's salt marsh habitat;
- 3) two large scale field evaluations of the efficacies of various BTI formulations for mosquito larval control.

One severe Aedes sollicitans mosquito brood was sampled on the OMWM study site on July 24, 1986. mosquito production was measured using a mosquito index (MI) which incorporates larval density, percent frequency of occurrence, and percent of available water. The control plot yielded a MI value of 349.9 while the OMWM treatment plot's MI value was 2.8. This represents a spatial difference of 99.2 percent (baseline data indicated similar mosquito production on control and pre-treatment OMWM plots). These data demonstrate that OMWM systems on Bombay Hook continue to provide excellent mosquito reduction 5 years after installation.

Qualitative observations of vegetation and hydrographic patterns were made on the Bombay Hook OMWM site during the year. Emergent vegetation patterns remained unchanged from previous years; revegetation of spoil areas by the original vegetation types is nearly complete, with ca. 99% of the spoil areas vegetated. Undesirable vegetation encroachment is limited to an occasional shrub (Iva or Baccharis) or a few stunted sprigs of Phragmites. A few small, originally closed OMWM systems remain connected to tidal features as a result of muskrat burrowing (these systems had been tidally-connected during previous years due to the closed systems terminating too close to tidal features - current OMWM system designs consider the impact of muskrat activities). No deleterious environmental effects were evident around and within these muskrat-altered systems.

Work was begun in 1986 on quantitatively assessing and indexing salt-marsh habitats on Bombay Hook for their mosquito breeding potential. This field survey was systematically done on a grid network by foot, boat and helicopter. Approximately 4,180 acres of

salt-marsh area were evaluated, primarily areas north of the Leipsic River and east of Georges Island (including all of Bombay Hook Island). A total of 634 acres of salt-marsh mosquito breeding habitats were identified. Out of this total, 546 acres of breeding habitat were in salt hay areas and 88 acres were located in Spartina alterniflora zones. The remaining salt-marsh acreage on Bombay Hook (ca. 4200 acres) will be evaluated for mosquito breeding potential during 1987.

Two large-scale field insecticide tests were performed in July and August to examine the efficacy of Bacillus thuringiensis var. israelensis (BTI) against salt-marsh mosquito larvae. BTI is a spore-forming bacteria that is toxic to mosquito larvae when ingested. These tests were performed in conjunction with technical representatives from companies manufacturing BTI formulations. Aerial and hand applications of granular products and aerial application of liquid products were evaluated.

The July test was inconclusive since product application was delayed (due to weather and tide conditions) until the brood had progressed to late-larval stages (generally the least effective time of larvicide application). The August test was performed during mid- to late-larval stages, thus providing more meaningful results. During the August test no larval mortality was documented as a result of aerially-applied liquid BTI products. Aerially-applied BTI granular products yielded larval mortalities from 0 to 73% (90% reduction is considered satisfactory). Seven of the eight hand-applied granular BTI products failed to produce adequate control (observed mortalities ranged from 32 to 75%). One hand applied BTI granular product provided 96% control, showing promise as a control agent. This product and others will be tested by the Section in 1987 in further evaluating BTI's utility for salt-marsh mosquito control."

2. Bombay Hook NR86 - Assessment of OMWM Practices Influence on Waterfowl, Shorebirds and Wading Birds

Preliminary work was begun during FY-86 by the Patuxent Wildlife Research Center to assess how Open Marsh Water Management (OMWM) practices influence waterfowl, shorebird, and wading bird use of treatment vs. control marsh ponds. Following is a summary of this year's activities by R. Michael Erwin the principle investigator:

"...the OMWM treatment area used earlier by Delaware Department of Natural Resources and

Environmental Control (DNREC) biologist was surveyed and 20 study plots were marked. In addition, 20 "control" (natural) ponds were marked in 4 different locations. Ponds were surveyed for submerged aquatic vegetation and some pilot sampling of fish and shrimp was performed. Meter sticks were placed in the center of each pond and 5 depth measurements were made. In September, observation platforms, ca. 7m in height, made of tubular steel scaffolding were erected in the treatment area and in one of the control areas (north of Duck Creek). Aerial photographs were taken of the study sites during the fall in preparation for aerial surveys during the winter. Surveys are scheduled to begin in January."

E. ADMINISTRATION1. Personnel

8 9 1
5 2 7
3

1.	Paul D. Daly	Refuge Manager	GS-12	PFT
2.	E. Franklin Smith	Assistant Refuge Manager	GS-11	PFT
3.	Charles A. Pelizza	Assistant Refuge Manager	GS-07	PFT
*	4. Walter N. Johnson	Assistant Refuge Manager	GS-07	PFT
	5. Marian Johnson-Pohlman	Outdoor Recreation Planner	GS-09	PFT
**	6. Virginia E. Baughman	Secretary	GS-05	PFT
***	7. Teresa R. Hammond	Clerk-Typist	GS-03	PPT
		Secretary	GS-04	PFT
	8. Howard H. Cottman	Maintenance Worker	WG-08	PFT
****	9. Arthur T. Straughn	Maintenance Worker	WG-06	PFT
*****	10. Richard O. Webster	Maintenance Worker	WG-06	PFT

* EOD 9/07/86, Transferred 12/07/86 to Blackwater NWR

** Retired 3/31/86

*** Promotion effective 5/26/86

**** EOD 6/08/86

***** EOD 6/08/86, Transferred 9/07/86 to Blackwater NWR

The year was a busy one, personnel action-wise. Bombay Hook continued to serve as a prep school for Blackwater Refuge as two new employees (Richard Webster and Buddy Johnson) were hired only to be spirited away to Cambridge after short tours of duty at the "Hook". Fortunately, we were permitted to keep one new employee as Maintenance Worker Arthur Straughn came on board 6/8/86. Arthur is a welcome addition who played an important role in reducing the deficit in some long over due maintenance activities, as well as assuming a major role as waterfowl check station operator on the South Hunting Area.



#2 Buddy Johnson wasn't with us long but contributed a great deal during his tenure. His short stay also enabled us to have his "welcome" and "farewell" party on the same day!

Hammond

Secretary Virginia Baughman retired effective 3/31/86 after more than thirty years of government service. Virginia was a permanent fixture here for many years. It won't be the same without her as her many contributions will be sorely missed.

Permanent part time Clerk-typist Teresa Hammond was converted to a permanent full time GS-04 Secretary effective 5/26/86. Teresa has assumed the duties of the Secretarial position in an exemplary manner. Her cheerful disposition and willingness to tackle any job makes her a real joy to work with.

Following is a summary of the staff manpower situation at this station for the past five years.

NUMBER OF EMPLOYEES

	<u>PERMANENT</u>		<u>Temporary</u>	<u>Total FTE</u>
	<u>Full-Time</u>	<u>Part-Time</u>		
* FY-87	9	0	0	9.0
FY-86	7	1(6days/pp)	1 (14 wks)	7.9
FY-85	7	0	1 (14 wks)	7.2
FY-84	7	0	1 (14 wks)	7.2
FY-83	6	0	1 (14 wks)	6.2
FY-82	7	0	1 (14 wks)	7.2

*Reflects the situation as FY87 began. Two of the positions are vacant, however, without authority to fill them.

2. Youth Programs

The summer YCC program began June 16 and ended August 22. The enrollees (3 male, 3 female) were hired from the 29 male applicants and 7 female applicants. The program was led by Group Leader Karen Dresch. Karen is a special education teacher at a local high school throughout the remainder of the year.

This year's program was one of the most successful and rewarding ever hosted by Bombay Hook. The major projects accomplished during the year were the placement of 530 tons of rip-rap along a severely eroded shoreline, and the installation of 48 wooden deer stands throughout our hunting areas. These stands were erected for the safety of our hunters. Other projects included clearing boundaries, painting fences and planting waterfowl foods. The projects exposed the enrollees to most aspects of refuge management. This allowed for a range of educational discussions concerning topics ranging from upland habitat improvement to water manipulation for waterfowl foods.

The two major projects, deer stand placement and rip-rap, were jobs which would have been nearly impossible to complete without the assistance of the YCC. Our leader, Karen, did a remarkable job of maintaining the motivation level of the enrollees at a high level. We also attribute the fact that we had no reportable injuries to the safety conscious effort of Karen and the staff who worked with the YCC this summer.

This summer's enrollees also had the opportunity to work with three other YCC camps. Bombay Hook hosted crews from Tinicum NEC, Eastern Neck NWR and Prime Hook NWR. Our crew also traveled to Eastern Neck and Prime Hook.

The experience of meeting others involved with the same work atmosphere, yet from various social and economic backgrounds, was beneficial for all involved. Plans are already established to repeat these experiences next summer.



#3 Placement of deer stand platforms throughout the hunt areas proved to be a valuable YCC project this summer.

Pelizza



#4 Enrollees also assisted with a myriad of other smaller projects such as maintenance of the boardwalk trail.

Johnson-Pohlman

3. Other Manpower Programs

Five students from Delaware State College (Department of Agriculture and Natural Resources) participated in the 1986 student internship program at Bombay Hook. Dan Sahin and Dave Weesner each earned 4 credits in wildlife management for 10 hours of work per week during the spring and fall semesters respectively. Dan participated in a variety of work experiences including waterfowl banding; waterfowl, shorebird, eagle and peregrine surveys; landscaping; cover plot seeding; boundary posting and trail work. He also updated our accidental bird list and helped prepare cooperative farming agreement maps. Dave conducted waterfowl surveys on a weekly basis; manned waterfowl and deer hunt check stations; and participated in goose trapping and banding.

Terry Fabean, Mike Clancy and George Anderson each worked 10 hours per week during the spring semester and earned 4 credits in environmental education and interpretation. All three students worked with school groups conducting tours, trail walks and outdoor classroom activities; besides occasionally staffing the Visitor Center. Each

of the students did a preliminary draft for one of our trail brochures; Terry for the Boardwalk Trail; Mike for Bear Swamp Trail; and George for Parson Point Trail. These brochures, which have been reviewed and edited by the refuge staff, were printed in limited quantities for distribution to teachers and volunteers in leading conducted tours. If funds are available they will be printed for distribution to the general public next year. In addition to the preceding, each student assisted with a fish survey in both freshwater areas and the tidal waters.

4. Volunteer Program

The size of our volunteer program leveled off in this, its third full year of operation; but the training of volunteers and consequently the quality of their service improved significantly. During 1986 forty two volunteers donated 1,485 hours of service. The majority of their time was spent in staffing the Visitor Center on weekends (713 hours); followed by conducting outdoor classrooms, trail walks and tours (251 hours); wildlife censusing and banding (132 hours); drafting interpretive brochures (121 hours); and fewer hours in categories such as maintenance, clerical, and staffing a refuge booth at the State Fair. Bombay Hook volunteers span all education levels and ages from teenagers to senior citizens; however, the majority are college educated and 31-60 years of age.

Prior to contributing any service, volunteers must attend a two hour mini-workshop. They are also encouraged to attend an all day workshop offered in the spring and fall as well as subsequent training offered in individual subjects. The all day workshop includes an orientation slide show and training in refuge tours, facility orientation, bird identification, wildlife management techniques and habitat studies. In an effort to produce more interaction between the volunteers and the regular staff, an evening meeting was held September 10 at the Visitor Center. Manager Daly and the staff emphasized Service policy to the volunteers and the fact that questions from the public regarding policy are to be referred to the office if the volunteer on duty is at all in doubt as to the answer. The meeting also gave everyone a good chance to meet each other in an informal setting.

Outdoor Recreation Planner Johnson-Pohlman normally coordinates all volunteer activities. During the time she was on maternity leave from September 7 to October 26, Assistant Manager Buddy Johnson acted as coordinator; fulfilling an important function at a time of year when fall activities were shifting into high gear.



#5 Volunteer Frances Robertson demonstrates for a local school group the use of a sweep net in catching insects in the meadow during this outdoor classroom activity.

Johnson-Pohlman

The annual volunteer award ceremony was held just before Christmas. Frances Robertson received the "Volunteer of the Year" award for her many hours working with Assistant Manager Buddy Johnson and the other volunteers in coordinating schedules while the ORP was on maternity leave. Harold and Mary Lou Campbell also received an award for having the second largest block of hours donated. A local artist donated a box of wildlife calendars which were given to all active volunteers at Christmas. Other artists donated matted prints of Bombay Hook scenes which were awarded to Frances Robertson and the Campbells. Other volunteer appreciation activities included a spring canoe trip, taken this year in the tidal marsh; and their reception, as a group, of a certificate of appreciation from the State of Delaware for their hours donated.

5. Funding

During the past five years Bombay Hook has had adequate funding to maintain its existing programs, resources and facilities. Portions of ARMM funds had to be used to cover salaries during fiscal years 84 through 86. The outlook for FY87 is rather bleak as many normal expenses for the Refuge are not funded as of the writing of this

report. The projects are listed as unfunded special needs projects and include such things as leaflet printing, interpretive programs and discretionary travel.

Five Year Chronology of Station Funding (Thousands)

	<u>1210</u>	<u>1220</u>	<u>1240</u>	<u>1994</u>	<u>1400</u>	<u>5610</u>	<u>1260</u>	<u>6860</u>	<u>1520</u>	<u>1510</u>	<u>8610</u>	<u>Total</u>
FY87	--	--	--	--	--	--	252.2	2.0	--	--	3.3	257.5
FY86	--	--	--	--	--	--	287.7	2.0	13.0	1.4	2.5	306.6
FY85	--	--	--	--	--	--	281.2	2.0	13.1	--	--	296.3
FY84	--	--	--	1.0	--	--	336.0	2.0	--	--	--	339.0
FY83	180.0	7.0	57.0	1.0	3.0	2.0	--	--	--	--	--	250.0

Funding totals for Fy-86 included \$86,000 of Accelerated Refuge Maintenance Management (ARMM) funds and \$5,000 in Resource Problems, under the 1260 account. A partial list of projects completed with these funds included:

1) Building and facility maintenance	\$2,500
2) Headquarters maintenance	4,900
3) Boardwalk maintenance	700
4) Road & parking lot maintenance/repair	6,500
5) Rip rap for dike system	4,900
6) Water control structure maintenance	750
7) Boundary maintenance	400
8) Entrance and directional signs	900
9) Purchase of exhibit and station wagon	25,000
10) Brush control	4,000
11) Johnsongrass & thistle control	5,000
12) Grounds maintenance	2,000
13) <u>Phragmites</u> control	1,000
14) Boat motor and trailer maintenance	1,600
15) Vehicle and equipment maintenance	10,100
16) Office machines maintenance	900
17) Radio maintenance	690

6. Safety

Our Safety Plan was re-written this year and approved. Safety meetings were held monthly in conjunction with personnel at Prime Hook Refuge; responsibility for developing and presenting safety topics rotated among all staff members.

For the second year in a row there were no accidents involving YCC. A manageable Camp size, conscientious group leader and good group of enrollees enabled us to duplicate last year's accident free season.

No accidents occurred involving Bombay Hook staff personnel. However, Dave Windsor, a Maintenance Worker

at Prime Hook NWR, sprained his ankle while stepping out of our auditorium. He was assisting with construction of an exhibit at Bombay Hook at the time of injury.

All staff members successfully completed a Red Cross CPR course during November. Maintenance Worker Arthur Straughn completed the State of Delaware's Safety Boating Correspondence Course during July.

New safety treads were placed on the steps of each of the observation towers. A monthly safety inspection of all public trails was instituted this year in conjunction with the monthly fire extinguisher and smoke alarm inspections.

The elevated platforms (stands) discussed in section H.8 were placed in the Regular Deer Hunt Area and the Headquarters/Fisher Tract Area with several objectives in mind. Foremost among these was safety; it being our conclusion that there is far less exposure to accidental shooting hazards when hunters are confined to stands than when they are roaming at will.

7. Technical Assistance

Paul Daly served on the Delaware Phragmites Control Advisory Committee which met twice during the year (January 30 and July 17). The most significant program to be initiated during 1986 was a cost-sharing system whereby the State and private marsh owners each would pay 50% of the cost of Rodeo (glyphosate) and its application on Phragmites infested marsh. The first treatments under this program were made in September and up to this point it has been a popular one with landowners, since many of them have observed the excellent results of such treatments on refuge and State marshes.

F. HABITAT MANAGEMENT

1. General

Over 12,000 of Bombay Hook's 15,122 acres consist of tidal salt marsh. The remainder includes freshwater impoundments (1,100 acres), croplands (980 acres), and various forest-type habitat including upland hardwoods, hardwood swamp and shrub communities. Active management of these habitats is performed where feasible and desirable to meet refuge objectives for waterfowl maintenance and nesting, endangered species, wildlife diversity and various public uses.

2. Wetlands

Most of the refuge tidal salt marshes are in a pristine condition, escaping the extensive grid-ditching for mosquito control which befell most of the coastal Atlantic marshes years ago. They receive heavy use by waterfowl and shorebirds; thus little active management is necessary; the exceptions being a prescribed burning program (Section F.9), a special snow goose hunt in certain areas (Section H.8) and fur trapping (Section H.10). Of particular value is the high use of these marshes by black ducks; probably 90% of our use-days by this species occur in the tidal areas.

Snow goose "eat-outs" in certain sections of Spartina alterniflora marsh continued this year. Close observations by the refuge staff during the period immediately after the autumn arrival of significant snow goose populations (basically the first three to four weeks in October) revealed that the greatest marsh damage occurred during that period of time. Snow goose hunting in Delaware typically begins in early November; therefore it will not be possible to completely control such damage through hunting unless we can persuade the Atlantic Flyway Council to approve an early season in Delaware. To make progress in that direction, contacts were made with the Delaware Division of Fish and Wildlife, which is supporting the proposal, and with Mr. Gerry Serie, the Flyway Representative, who was given a tour of the area to demonstrate the acute nature of the problem. Since the marsh loss began five to six years ago we estimate that about 600 acres have been turned into mud flat which revegetates either sparsely or not at all the following growing season. Hopefully an early season will be approved for 1987.

Each of the four freshwater impoundments is managed a bit differently in order to produce optimum conditions for a variety of wildlife. The drier than normal spring and summer made it more difficult to maintain desired water levels; however the situation was made less severe by the fact that our objectives have changed to call for generally lower pool levels to favor their use by puddle ducks.

Finis Pool (205 acres) lies at the lower end of Finis Branch, the primary source of fresh water inflow to all impoundments. The most abundant vegetation in Finis continues to be smartweed (Polygonum pennsylvanicum); however cattail (Typha latifolia) and swamp loosestrife (Decodon verticillatus) have made significant invasions in recent years. Cattail patches did not appear to spread during the 1986 growing season; but the loosestrife did show some increases. Some type of control will probably eventually be needed in Finis to favor the smartweed; however, at this point we are not certain as

to the most efficient way to effect such control. Finis is very valuable as a late-season feeding area for mallards, gadwall, black ducks and wood ducks.

Water flows through control structures under the Finis dike/road into Sheariness Pool, the largest on the refuge (560 acres). Sheariness was completely drawdown during June for the second straight year. The objective here is to make the fall and winter habitat as attractive as possible for puddle ducks. The pool was completely dewatered by the end of June and vegetation almost immediately volunteered on the mud flats. Predominant plants included Panicum sp., millet (Echinochloa spp.), and sedge (Cyperus sp.), all excellent waterfowl foods.

The large carp kill which occurred during drawdown in 1985 was not repeated this year. Evidently fish screens on the control structures prevented most carp from re-invading the impoundment.

The extremely dry summer resulted in a later than desired fall flooding of Sheariness; however enough rain arrived in early October to bring shallow water (6"-8") and thousands of hungry ducks. Duck use in Sheariness was dominated by pintails, greenwinged teal, and mallards.



#6 Excellent emergent waterfowl food plants volunteered on the Sheariness mud flats immediately after drawdown.

Johnson-Pohlman



#7 Large numbers of puddle ducks utilized Sheariness after it reflooded to shallow depths in October. Pintails were the predominant species.

Pelizza

Water control structures at the north and south ends of Sheariness Pool can divert water into Bear Swamp and Raymond Pools respectively. Bear Swamp Pool (240 acres) is the most difficult of our impoundments in which to maintain high enough water levels. For this reason, as well as the fact that there is a desirable interspersed of emergent vegetation and open water, we do not draw this pool down as a part of the normal management regime. In an average precipitation year, evaporation results in a steady decrease in water levels from early summer until autumn. This year water was very low by August and sufficient rainfall was not received until early December to refill Bear Swamp to objective levels. The problems associated with Phragmites invasion in Bear Swamp in prior years have been eliminated through treatments with Rodeo (glyphosate); current vegetation consists of cattail, millet, and sedge. Bear Swamp attracts a variety of waterfowl; this year green-winged teal probably were most numerous, although many snow and Canada geese also utilized the area. Most wood duck broods recorded were seen in Bear Swamp.

Raymond Pool (95 acres), in contrast to those impoundments previously mentioned, is quite brackish, due to its lower elevation and the fact that higher than average

tides will occasionally overtop the control structure, letting bay water into the impoundment. Because of this situation emergent vegetation is limited to the pool fringes. We have been unable to document submergent vegetation in Raymond; however a variety of waterfowl, herons, egrets and shorebirds use the pool. We are aware of consumption of amphipods by various duck species in Raymond. Shovelers made particularly high use of the area this year. Raymond is partially drawn down in May for shorebird use and further drawn down in early summer to completely expose the pool fringes. Good numbers of avocets and black-necked stilts made use of the pool during spring and fall migration periods.

A group of professional wetland managers representing Federal and State agencies from around the United States were given a tour of our managed impoundments on September 18. The group, which was attending a wetlands symposium in Wilmington, Delaware, was quite interested in our impoundment manipulation program.



- #8 Three busloads of professional wetlands management personnel were given a tour of the refuge with an emphasis on managed impoundments. It was a pleasure to talk to others in our field and have the opportunity for a free exchange of ideas.

Johnson-Pohlman

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 and 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 larger blocks. Management in 1986 was limited to prescribed burning of areas where damage to hardwood regeneration was not a problem, such as the former Delaware National Guard tract, where the objective was to remove large fuel loads and stimulate legume production.

4. Croplands

The same four cooperators worked refuge lands during 1986 as have for many years. The greatly reduced level of spring and summer precipitation lowered corn yields, but not nearly to the degree that they were lowered on the sandier soils to our west and south. Corn still averaged 106 bushels per acre. One cooperator, Harvey Carrow, tried no-till corn, a first for our program. His yields compared favorably with his conventionally tilled corn; however he reported that his dollar inputs were slightly higher.

The only corn received by the refuge as part of the farming agreements is that required for bait in the banding program. The remainder (595 acres) forms the cooperator's share. Refuge shares are based on the average land rental rate for similar land in this vicinity. During the 1986 growing season this rate was \$55. per acre, the same as the previous year.

Refuge shares amounted to the following:

Winter Wheat (goose browse)	368.2 acres
Buckwheat/Ryegrass	52.5 acres
Fescue/Clover	25.2 acres
Storable Corn delivered to Refuge Crib	600.0 bushels

Due to adequate fall rains, browse crops produced excellent stands. Early arriving Canada geese fed avidly upon the buckwheat/ryegrass and later switched to the winter wheat and waste corn. On rainy, cool days mallards, black ducks, and pintails made use of the buckwheat fields on the Dutch Neck Farm Unit.

A comprehensive farming program review was conducted in September by Gerry Atwell and Mark Sweeney of the Regional Office. Ross Harris of the University of

Delaware Extension Service participated in the review. The conclusions were quite favorable to the existing refuge program, as well as toward changes which our staff proposed for the future. Three of these modifications to be worked into the 1987 farm agreements include:

1) The establishment of dense nesting cover in selected fields proximate to impoundments or marsh areas utilizing various grass and legume species on an experimental basis.

2) Planting some acreage to milo in an effort to grow a supplemental food for field feeding puddle ducks which will not be attractive to geese. Usually by the time the critical winter period is upon us, geese have thoroughly cleaned up all buckwheat and waste corn.

3) One third of the cooperator's acreage will be planted to soybeans in order to provide a better rotation and break pest cycles.

5. Grasslands

Normally nothing is reported in this section since grass plantings have been entirely within fields which are eventually rotated back into crop production. Once dense nesting cover is established as mentioned in the preceding section, its management will be discussed here.

9. Fire Management

With the exception of one 5 acre prescribed burn on a small island off Sheariness Dike on January 8, we did not get decent weather for burning until mid-March this year. A dry period between March 12 and 25 enabled the crew to burn a total of 670 acres in various compartments according to our approved annual program. The dates and acreages were as follows:

<u>Date</u>	<u>Fire Management Unit</u>	<u>Acres</u>	<u>Habitat</u>
3/12/86	A. Air Force Tract	40	broomsedge, <u>Phragmites</u>
3/17/86	N. Bear Swamp	20	<u>Phragmites</u> (dike edges)
3/18/86	C. Kent Island	560	<u>Spartina patens</u> , <u>Distichlis spicata</u>
3/21/86	K. Raymond Pool	20	Fescue, broomsedge (old field)
3/25/86	L. Sheariness Pool	30	<u>Phragmites</u>

Objectives of the burning program vary by habitat. The Phragmites consisted of dead canes from a fall spraying with glyphosate. The fescue and broomsedge fields were burned to stimulate growth of young, tender fescue and legumes (Sericea lespedeza volunteered over a large portion of the field within Raymond Pool unit). The Kent Island tidal marsh unit was burned to provide an attraction to snow geese and thus take feeding pressure off our heavily grazed units. Results of all prescribed burns were excellent.

No wildfires occurred this year on Bombay Hook Refuge.

Paul Daly, Frank Smith and Charles Pelizza met the required Service physical fitness standards for fire fighting by completing the 1.5 mile run with time to spare on November 18 at the Smyrna High School track.

10. Pest Control

The following materials were applied on portions of the cropland management units during 1986:

<u>Material</u>	<u>Crop</u>	<u>Target Species</u>
Roundup	Spot Treatment all fields	Johnsongrass, Canada Thistle
Bicep	Corn	Annual Grasses, Broadleafed Weeds
Bronco	Corn (no-till)	Grasses, Broadleafed Weeds

Control of all target species was excellent. Application was by cooperative farmers with the exception of Roundup application on fields not included in the farming agreements. Control on the latter areas was by refuge staff. Manager Daly, Assistant Managers Smith and Pelizza and Maintenance Worker Straughn are Delaware Certified Pesticide Applicators.

Unlike 1985, there were no serious insect outbreaks in the crop fields and no need for insecticide applications. All pesticides utilized on the refuge must conform to the approved list of materials provided to cooperative farmers annually.

Rodeo was aerially sprayed under contract on common reed (Phragmites) patches around the edges of Raymond and Sheariness Pools. A total of 20 acres were sprayed in September with excellent results.



#9 The contractor made use of a field south of headquarters as a site for refilling during the spray operation.

Daly



#10 The use of helicopter rather than fixed wing aircraft is better for our purposes since Phragmites here is limited to scattered patches and the chopper can more accurately direct the spray on the target.

Daly

The dry weather this year resulted in lower than average populations of mosquitoes for most of the year. The exception was during September and October, following rains which caused large egg hatches. The Delaware Department of Natural Resources Mosquito Control Section has performed mosquito control work on Bombay Hook marshes for many years. The bulk of their control effort at present is by use of the larvacide Abate 4E (Temephos); although they have been experimenting with different formulations of BTI (Bacillus thuringiensia israelensis). Applications were made as follows on refuge salt meadow cordgrass (Spartina patens) marshes:

Abate 4E:	July 22, August 22
Dibrom 14:	July 26
Vectobac G(BTI):	August 22
Vectobac AS(BTI):	August 22

Manager Daly was appointed to a committee chaired by Regional Biologist Haas to meet with the Delaware Division of Fish and Wildlife Director and Mosquito Control Section personnel to discuss mosquito control alternatives and recommend a regional policy to the Regional Director. The committee met with State representatives on July 8 and thoroughly discussed all aspects of mosquito control. In order to reduce or eliminate the use of chemical larvicides or adulticides on our marshes and still retain acceptable control of mosquitoes (politically highly desirable in Delaware) in all probability there will need to evolve an effective method and formulation of BTI, which so far has shown erratic results; and/or some operational use of Open Marsh Water management (OMWM). The latter, a technique to encourage mosquito-eating fish by shallow ditching and pond creation, has been studied intensively on a 128 acre portion of our marsh for several years. It is very effective in controlling mosquitoes; however it is quite expensive to install the systems, and it would be years before significant portions of the breeding marsh could be treated. Another extremely important drawback to the use of OMWM at Bombay Hook is the fact that a large percentage of the marsh which breeds mosquitoes (total approximately 6,400 acres) has never been ditched previously. This is a very unique condition for marshes in the mid-Atlantic coastal region. Positive aspects of OMWM, other than its effectiveness, are that the marsh revegetates rapidly if the work is done properly; and that wildlife use of treated areas is basically either unchanged, or in some cases enhanced due to the creation of small shallow ponds in place of mosquito depressions.

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. Wildlife surveys by refuge staff were the only activities taking place this year on the predominantly salt meadow cordgrass and salt grass islands. Classification of the Marshall Island RNA is A-7 Tidal Salt Marshes.

The Service owns a historical residence in the Dutch Neck area which the Delaware Division of Historical and Public Affairs has operated for many years under long term special use permit. The Allee House, a country style brick structure dating back to the Queen Anne period, has been on the National Register of Historic Places since 1971. The occupants of the residence, who are State employees, open their home to visitors on weekend afternoons from 2:00 p.m. to 5:00 p.m.

G. WILDLIFE

1. Wildlife Diversity

Bombay Hook's habitat mixture supports a wide variety of animal species. There are documented records of 311 species of birds (41 being accidentals), 34 mammals and 27 reptiles/amphibians. All reptiles, amphibians and mammals (with the exception of the grey fox and several bat species) reproduce on the refuge. Of the bird species, 55 are confirmed nesters, and 31 are probable nesters.

2. Endangered and Threatened Species

a. Bald Eagle

The resident pair of bald eagles failed to nest for a second consecutive year. An unfortunate set of circumstances led to this year's nesting failure.

Beginning in late November, 1985 the eagles were active in the general area where they had historically nested. The mated pair was seen through January 9, 1986. On January 9, a refuge visitor reported sighting the eagles in what appeared to be a debilitated condition on ice floes in the salt marsh. Refuge personnel attempted a rescue by boat; however, by the time they reached the area one eagle had disappeared; and the other let the boat approach to

within about 20 yards, whereupon it flew approximately 100 yards away from the rescue craft.

The following day this remaining eagle was captured on the ice. Wing and tail feathers were crusted with ice and the bird was unable to fly. After its capture, the bird was brought to Tri-state Bird Rescue of Wilmington, Delaware.

While in their care, the female eagle was diagnosed as suffering from some type of toxicity, though not lead poisoning. It was also shown that the bird had been shot. The wounds were at least 30 days old and not presently affecting the bird. The bird recovered and was eventually released with much media fanfare.

Many newspaper articles covered the eagle's progress during its rehabilitation. The "Eagle Wing", an Air Force Unit from Dover Air Force Base adopted the bird and paid for its rehabilitation. During this time the refuge staff handled several calls per day from concerned citizens regarding the rehabilitation. Prior to its release the bird was banded by refuge staff with aluminum and plastic leg bands. Three TV stations, twelve newspapers and an entourage of volunteers from Tri-state were present for the bird's successful release on February 10.



#11 Bombay Hook was "the place to be" for the news media when the successfully rehabilitated eagle was released.

Johnson-Pohlman



#12 Although the general public was excluded from the release area, many volunteers from Tri-State Bird Rescue were present.

Johnson-Pohlman



#13 Headed for freedom, hopefully to avoid further contact with the toxin which got her into trouble in the first place.

Johnson-Pohlman

During this eagle's convalescence a second pair established their territory on the refuge. This pair was first seen on January 26 and continued to be sighted through March. On March 16, volunteer observer Don Dean observed a possible unsuccessful mating attempt. Other than this incident, there were no other indications that nesting was attempted this year.



- #14 An immature bald eagle with color coded wing tags was observed on the refuge on September 29. This bird had been banded and released in New York State six weeks earlier.

Robert Fraunfelter

b. Peregrine Falcon

For the first time since the peregrine tower was constructed in 1984, peregrines were observed using the structure. birds of each sex were seen together on the tower, and several times they were observed displaying territorial behavior. Refuge Managers Smith and Pelizza climbed the tower in May and June. Each time there was no evidence of a nest, eggs or egg fragments. Our theory is that these are young birds which are sometimes known to frequent potential nest sites for a year or two prior to an actual nesting attempt.

3. Waterfowl

Total waterfowl use-days for CY-86 were 9,050,739. This is an increase of just under 2,000,000 use-days over 1985. Snow geese again showed the largest increase, but duck and Canada goose figures also rose significantly. Table G.3.1 shows refuge use-day figures for 1984 through 1986 as well as the 10 year average (1976-1985).

Table G.3.1 Waterfowl Use-Days

	<u>1984</u>	<u>1985</u>	<u>1986</u>	<u>10 year average</u>
Ducks	1,447,971	1,821,744	2,078,186	2,054,636
Canada geese	1,718,890	1,737,107	2,233,270	2,792,475
Snow geese	2,871,650	3,497,726	4,739,283	1,885,524
Total	6,038,511	7,056,577	9,050,739	6,732,635

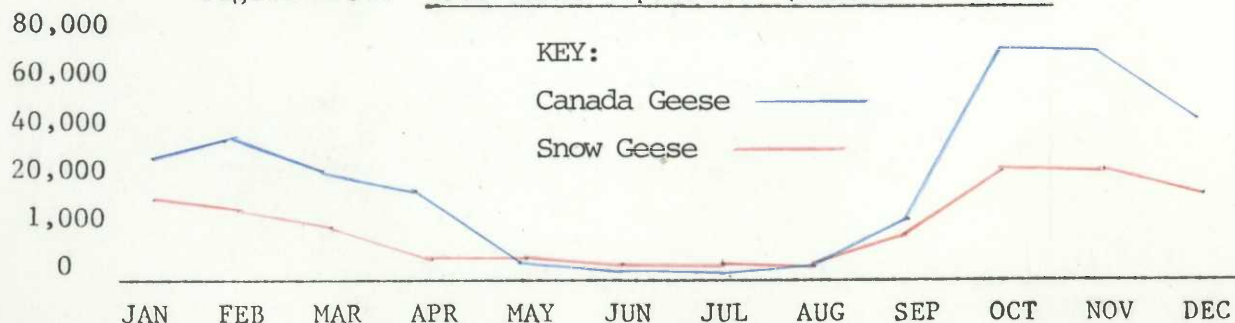
a. Canada Geese

Approximately 10,000 Canada geese were present during January. This population held up pretty well until late February when most geese departed. The remaining birds then began a gradual decline in numbers until the refuge hosted but 100 Canadas by mid-April.

Resident Canada geese number around 30 birds, which produced 15 young to flight stage. This population of resident geese is not considered to be at a nuisance level.

The first fall migrants began arriving at the end of September with 2,000 reported on September 30. Peak population was documented on October 21 with 32,000 Canadas present on the refuge. This is slightly higher than last year's peak figure of 29,730 on October 30. Canadas also stayed on the refuge longer in 1986 with 15,000 remaining at the end of the year. Please see figure G.3.1 for a comparison of Canada and snow goose populations.

Figure G.3.1 1986 Goose Population (Canada vs. Snow)



b. Snow Geese

The burgeoning Bombay Hook snow goose flock continues to increase on the refuge. Not only did the total numbers increase, but the birds stayed longer and with greater average populations.

Spring populations remained at 20,000 until April. There were no large increases during the spring as noted in previous years, rather we recorded a continuously high population figure.

The refuge supported its first documented summer population of resident greater snow geese. A flock of 25 birds were seen throughout the summer. No production was noted.

Fall migration began with a flock of 75 birds seen on August 27. There were slight increases in the population throughout September with 3,000 present at the end of the month. It was not until a mid-October cold front that large numbers (approximately 40,000) arrived. A record peak population was noted on November 4 with 72,000 snows counted on the refuge. Populations remained around 50,000 from mid-November throughout the remainder of the year.

Snow geese arrived in quantity approximately 3 weeks prior to the beginning of the Delaware waterfowl season. During this time, the birds were able to roost and feed in the Money Marsh/Leatherberry Flats areas; marsh sites which have been denuded of vegetation by the geese for the past several years. During this period, and prior to hunters dispersing the huge flock, more tidal salt marsh acreage was consumed than the total acreage consumed during the 1985-86 season. Once hunters were allowed on the marsh, the birds dispersed to other areas of the refuge.

Snow geese continued to make use of upland fields both on and off-refuge during the day. The only notable change in this pattern from previous years was the greater amount of time they spent in the fields. Large flocks of snows could often be heard leaving the refuge as early as 3:00 a.m. and returning after 10:00 p.m. to roost in the marsh.

Snows also began to use Shearneck Pool more as a roost site. Shearneck witnessed excellent plant growth during summer drawdown, and this food source was previously heavily utilized by ducks and Canada geese; however, snow geese were rarely observed feeding in the pool. As an added note, most film footage from the "World Safari" snow goose segment was shot on Shearneck Pool (Section J.3).

Lead poisoned snow geese continued to be a problem during the winter/spring of 1986. February saw the greatest number of sick birds with three or four per week being picked up. About 600 snows were lost to lead poisoning during the 1985/86 outbreak. The fall of 1986 did not see a recurrence of the lead poisoning problem in the same magnitude. Approximately 150 birds are estimated to have died, of which only 20 were snow geese and the remainder mostly Canada geese.

c. Swans

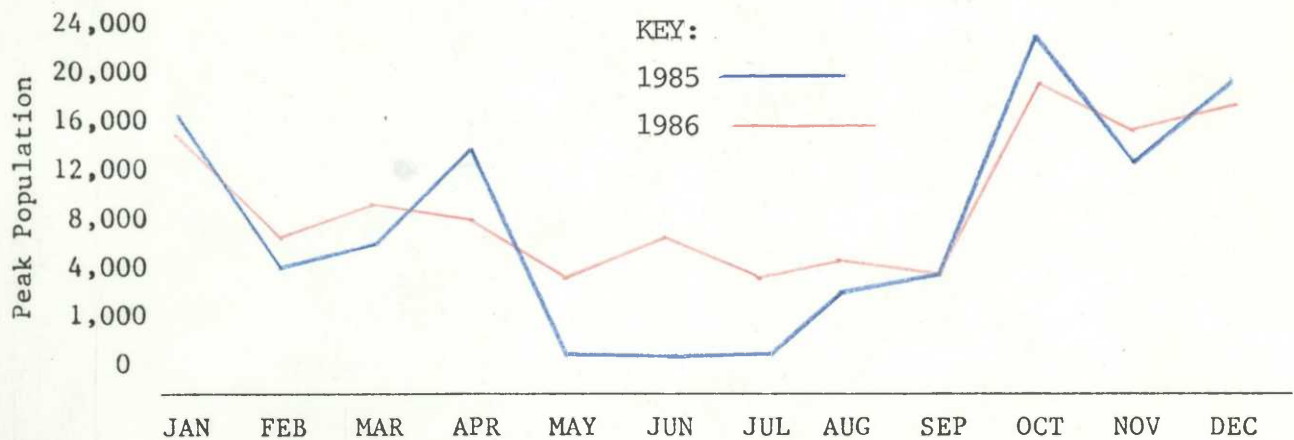
Peak population occurred January 25 with 100 swans counted. Use days increased to 4,334, up from 2,212 in 1985.

d. Ducks

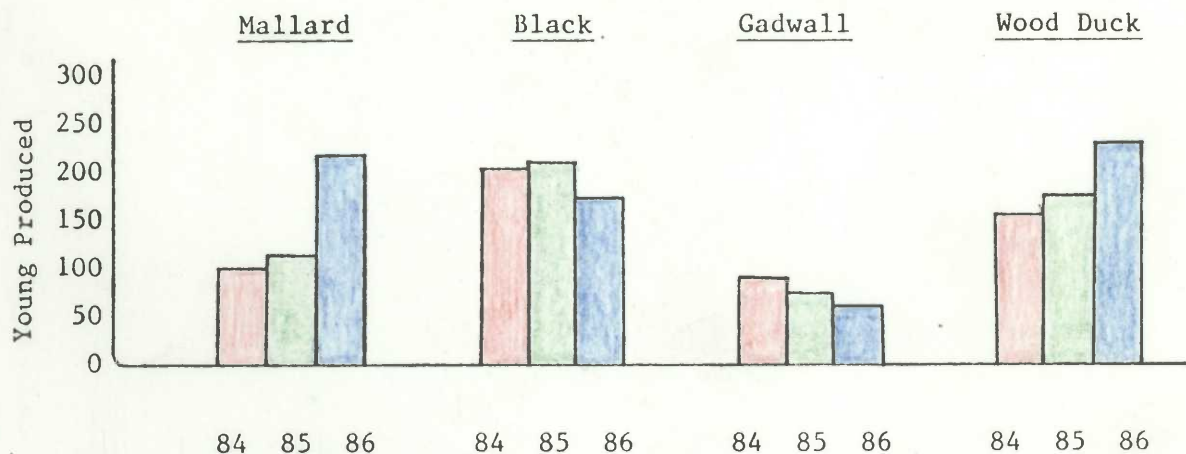
Total duck use was higher for the fourth consecutive year. Greater use of the refuge impoundments accounted for some of the use-day increase, as did the fact that populations of ducks remained on the refuge for longer periods throughout the year.

Pintails and mallards once again concentrated in Shearneck Pool to feed on the aquatic vegetation resulting from the pool's drawdown. Raymond Pool also received extensive use by shovelers and ruddy ducks.

During shorebird surveys of the Delaware Bay in May and June, refuge staff noted very unusual concentrations of ducks in the tidal creeks. The staff then began surveying the refuge more frequently by air throughout the remainder of the summer. As a result, we discovered populations of ducks, primarily mallards and blacks, in numbers not seen during summer for many years. On June 25 4,000 mallards and 1,600 black ducks were counted. No explanation for these concentrations can be offered at present. See figure G.3.2 for a comparison of annual population figures for 1985 and 1986.

Figure G.3.2 Annual Population Figures 1985-1986 Total Ducks

The larger summer duck populations did not contribute to any significant increase in waterfowl production. Gadwall continued to exhibit a gradual decline in number of broods observed; while mallard and wood duck production increased and black duck production remained relatively stable. Only one blue-winged teal brood of 8 was observed in Bear Swamp Pool. Figure G.3.3 compares duck production during 1986 with that of previous years.

Figure G.3.3 Waterfowl Production

Wood duck nesting occurs almost exclusively in maintained wooden nest boxes. Of the 69 boxes checked, 48 (70%) were used by woodies. Hatching rate was 45% of the total 824 eggs. Estimated production to flight stage was 226.

4. Marsh and Water Birds

Populations of wading birds normally do not vary greatly here from year to year. We have noted temporary increases in populations following drawdown of Shearneck and Raymond Pools. It is not uncommon to see 500 egrets, herons and ibis gathered around dwindling water holes as the pools dry up.

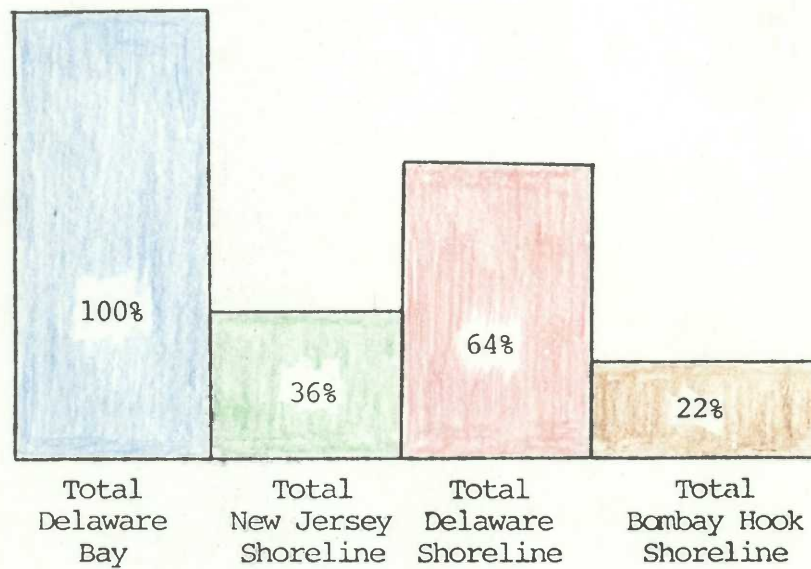
The most significant departure from the norm was that glossy ibis populations and use-days were higher than we could locate in refuge records. A peak of 723 ibis were counted in July, and very high numbers were present from May through September

5. Shorebird, Gulls, Terns and Allied Species

The importance of the Delaware Bay as a staging area for many shorebird species has just recently become publicized; though it has been documented in professional papers since the 1800's. The Delaware Department of Natural Resources formed a committee this year with the goal of encouraging better understanding of shorebirds; their migrational movements, dependence on horseshoe crab eggs as a food source and use of the Delaware Bay as a staging area. The committee's focus is directed at education, research and habitat preservation. Several private organizations, State agencies and Bombay Hook Refuge compose the committee. Bombay Hook personnel function in an advisory capacity and assist with population surveys.

Total shorebird populations utilizing the Delaware Bay do not usually exhibit large fluctuations, though there are differences in local areas of use. Bombay Hook holds approximately 8 miles of shoreline on the Delaware, with an even larger area composed of tidal creek shoreline. These sites are some of the most important places on the bay for the protection of horseshoe crabs and shorebirds. Shorebird migration figures comparing the Delaware Bay with Bombay Hook's population can be found in Table G.5.1. on the following page.

Table G.5.1 Delaware Bay Distribution of Shorebirds



This graph compares the percentage of shorebirds present on the Delaware Bay with New Jersey, Delaware and Bombay Hook shoreline during the 1986 migration. The data is based on 6 aerial surveys of the Delaware Bay. The cumulative total of all six flights is estimated at 900,000 birds.

Biologist Greg Sepik, Moosehorn NWR, met with refuge personnel on March 11 to discuss woodcock management potential on the refuge. Several areas were surveyed and birds were observed. One promising implication was our current patches of bicolor lespedeza. Sepik was unfamiliar with the plant regarding woodcock use, but it appears to have some of the positive attributes of woodcock habitat in more northern climates (e.g. similar stem densities). It is interesting to note that most of the singing males observed were in recently mowed openings in the lespedeza plantings.

6. Raptors

The most commonly observed raptors throughout the year are kestrels and northern harriers. During fall migration however, the most common species are red tailed and rough-legged hawks. Ospreys are seen throughout the year though none nest on the refuge. Three osprey nest platforms were erected on the Delaware Bay Shore in the hope of encouraging a breeding population.

The usual owl species of Bombay Hook include great-horned, barred, barn, screech and short-eared. Occasionally a stray migrant visits and causes quite a stir among the birding community. This was the case on December 2 when Maintenance Worker Straughn spotted a juvenile snowy owl. The bird apparently blew in with a strong cold front. From then until the end of the year, we received a daily barrage of visitors and phone calls asking for information and hoping for a glance of the rare (in this area) critter. The last confirmed report on the refuge was in 1954.

(See Photo #15 on the following page)



#15 This young fellow may be a long way from home, but there are many birders interested in his welfare, judging from the increase in phone calls and visits. Most of the owl's time was spent on the open fields (corn stubble) or around privately owned barns west of the headquarters area.

Johnson-Pohlman

7. Other Migratory Birds

Data collection for the Delaware Breeding Bird Atlas is drawing to a close, with just one more field season to record breeding birds. The refuge made every effort to complete grid blocks in areas which are not accessible to the general public. A summer assistant from DNREC assisted in the project by entering use figures for all our non-waterfowl species on computer for use in the Atlas publications.

8. Game Mammals

a. Big Game

The only big game mammal present on the refuge is the white-tailed deer. The refuge population is estimated at 225 animals. The herd uses the refuge as

safe haven during the day while making nightly raids on adjoining landowner's crop fields. The refuge conducts regulated deer hunts to provide wildlife-oriented recreation and to control the herd size.

Deer brought to the check station all appeared to have good fat content in their tissue and around their internal organs. Average weights per age class increased from last year. (see Section H.8) One deer was checked in which had several small, less than 1" diameter papillomas (skin tumors), on the lower jaw. This is the first reported instance of papillomas in the refuge herd. No other diseases were detected during deer check-in procedures.



#16 This deer in velvet exhibits what appeared to be a gross deformity in the right antler, probably caused by injury at a critical stage of development.

Mervil Anthony

Two pie-bald fawns were born from the same doe this year. One has just a white panel on its side while the other is almost completely white. Many visitors came out on summer evenings specifically to see the "white" deer, which are common in some areas but not around here. Neither was harvested during the refuge hunt.



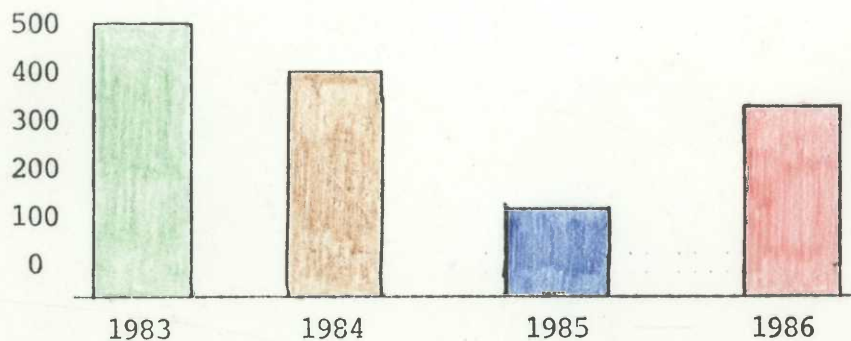
#17 This fawn was dropped in a fescue field approximately 50 yards north of the headquarters building.

Pelizza

b. Muskrat

We believe muskrat populations have remained relatively stable over the past 4 years. This assumption is based on winter aerial house counts which have varied between 135 and 502 but average 343. Houses counted in 1986 totaled 341. Several areas of the refuge support muskrat, but can not be censused aerially due to a predominance of bank nesters. No accurate survey technique is employed on these areas. See Figure G.8.1 for house count comparisons over the last 4 years.

Figure G.8.1 Aerial House Count Bombay Hook 1983 - 1986



c. Raccoon

No significant population change was detected from the previous year. Limitations on raccoon populations are achieved through our trapping program in the marsh edge and upland units.

d. Otter

Otter sign is common within the refuge impoundments and they are regularly seen in the salt marsh. We have no reliable estimate of the population size. One sighting is interesting to note this year. During November, an otter was spotted in a canal between Sheariness and Bear Swamp Pools. The animal would swim with its head out of the water and emit a loud "peep" at 10-30 second intervals. The animal would swim 5 feet up one shore line, cross the canal, swim 5 feet, cross the canal, etc. This continued for 15 minutes until the animal sounded and fled.

e. Other Mammals

Beaver were seen throughout the year but did not attempt to plug any of the water control structures.

Cottontail rabbit numbers are up from previous years as is the red fox population. Most red fox we see are small, thin and have sarcoptic mange. We have no legal way to control the fox population since it is unlawful to hunt/trap or possess a red fox in the State of Delaware.

No changes were noted in grey squirrel, opossum, and woodchuck populations.

9. Marine Mammals

The skull of a beaked whale was found near the refuge bay shore and was donated to us for use in the Visitor Center.

10. Other Resident Wildlife

Bobwhite and ring-necked pheasant are common on the refuge. Most pheasant are seen along field edges and dike roads. Several pheasant were observed this year in the salt marsh, at least 1/2 mile from upland habitat. Bobwhite broods were first noted on August 1, and broods were still being seen during October.

The Delaware Division of Fish and Wildlife has been engaged in an active wild turkey transplant program for the past few years. They have realized excellent success, with the birds spreading well from their release locations. They have been spotted at the Logan Lane Wildlife Management Area about 5 miles from our south boundary; and therefore we feel that it will not be many more years before we have another species to report.

15. Animal Control

The beaver control activity of 1985 eliminated all beaver activity at the water control structures through the end of 1986.

16. Marking and Banding

Our quotas for waterfowl banding are assigned jointly with the Prime Hook Refuge. Traditionally, Prime Hook has greater success during the pre-season while Bombay Hook does better during the post-season period.

This year the refuges had a generally successful banding season. Quotas and birds banded are found in the following table.

Table G.16.1 Banding Results 1986

	<u>Post-Season</u>		<u>Pre-Season</u>		<u>Total</u>
	<u>Quota</u>	<u>Banded</u>	<u>Quota</u>	<u>Banded</u>	
Black Duck	100	306	200	114	420
Black x Mallard	-	6	-	0	6
Mallard	200	302	-	204	506
Wood Duck	-	0	200	58	58
Blue-winged Teal	-	0	-	14	14
Green-winged Teal	-	8	-	10	18
Pintail	-	13	-	1	14
Wigeon	-	-	-	0	1
Total Ducks		636		401	1,037
Canada geese	as able	155	as able	0	155

The post-season banding was extremely successful with both quotas being exceeded. Cold weather and high water-fowl populations kept the site near Bear Swamp Canal active through February. A 3-way Montezuma style trap was successful at that location.

Pre-season banding was hampered by low water levels which kept birds away from banding sites. Warm temperatures and a large amount of natural food production did not encourage bait acceptance. Non-quota birds are also banded when captured while attempting to catch quota species.

Canada goose banding picked up during the fall of 1986. Even though the three year Atlantic Flyway Goose Collar Study is officially over, individual states may continue to band geese as they desire. Delaware opted to band more geese; therefore we cooperate with them as we are able. The year saw a total of 155 geese caught with two rocket net shots at a site near the maintenance area.

17. Disease Prevention and Control

The snow goose lead poisoning die-off continued into 1986. Efforts to collect sick or dead birds continued through the die-off in order to reduce the possibility of the bald eagle pair picking up and ingesting spent lead shot still in the gizzard of poisoned birds. The severe lead poisoning outbreak did not recur during the fall migration; however several geese were collected and analyzed at the National Wildlife Health Laboratory in Madison, Wisconsin to confirm the cause of death. These birds, mostly Canadas, were confirmed as succumbing to lead poisoning.

No other die-offs or disease outbreaks were noted this year.

H. PUBLIC USE

1. General

Total public use visits increased for the fourth consecutive year to an all time high of 81,987. This compares to total visitation of 77,752 in 1985, 59,890 in 1984 and 32,079 in 1983. Most individual use categories also increased. Wildlife observation accounted for 64% of all visitor activities, followed by interpretation (31%), hunting and trapping (4%), and environmental education (1%). Visitors came from all over the United States, with 40 of the 50 states represented, as well as from 18 other Nations.

2. Outdoor Classrooms-Students

All student groups visiting the refuge take an auto tour and approximately 70% of these also walk one or more of the wildlife trails. Close to 50% of these student groups also participate in outdoor classroom activities. The total number of students engaging in outdoor classroom studies this year was 1,551, a figure down slightly from the previous year. Quite probably this was due to the Outdoor Recreation Planner being on maternity leave during the two busiest months (September and October) and thus not being available to encourage the school groups to utilize the refuge for that extra hour or two for environmental studies. On most occasions either volunteers, student interns, or ORP Johnson-Pohlman provided assistance to the groups when needed. Of the various habitats studied, ponds were the most popular, followed by studies in wooded and meadow habitats. Students were provided the following upon request: aquatic nets, meadow sweep nets, trowels, jars, identification guides and water test kits.

The 135 groups that scheduled refuge visits for outdoor classrooms and interpretive tours and/or walks could be broken down into the following categories:

- 63 elementary and secondary school groups
- 13 handicapped (wheelchair, mentally retarded, emotionally etc.)
- 9 senior citizen groups
- 50 other (colleges, camps, nature centers, pre-school, professional organizations etc.)

(See Photo 18 on the following page)



#18 An enthusiastic group of wheelchair bound visitors made the first attempt to maneuver the boardwalk trail and had great success. Now other wheelchair groups include this trail as part of their tour.

Johnson-Pohlman

3. Outdoor Classrooms-Teachers

One twelve hour teacher workshop was held this year during April for 4/5 in-service credit. Twenty teachers and four volunteer field work students attended. One volunteer with a science background assisted at this workshop because initially 40 teachers registered for the program. When word got around that so many teachers had signed up, some teachers called and decided to attend the next workshop offered.



#19 Outdoor Recreation Planner Johnson-Pohlman demonstrates the use of field guides in identifying woodland plants and animals during the 12 hour teacher workshop.

Terri Fabean

Workshops include an orientation slide show and refuge tour; as well as sessions on wildlife management techniques and surveys, habitat studies, education resource review, simulated activities, and lesson plan preparation and evaluation. Attendees receive a packet of materials that includes workshop activities, all refuge brochures, and several of the Service-wide brochures. These packets are also available to any teachers wishing to bring their classes to the refuge and/or conduct Environmental Education (EE) activities on school grounds. EE equipment including jars, pans, trowels, water test kits and nets are available on advance request.

This year 235 teachers spent 682 activity hours with their students on the refuge, engaging in various environmental and interpretive type activities.

4. Interpretive Foot Trails

The boardwalk trail, which traverses the tidal salt marsh (our main habitat type), has interpretive signing and also a brochure available on request that corresponds with numbered posts. Two other trails (Bear Swamp and

Parson Point) have brochures in draft form which will be available next year if funds are available for printing. Posts for these trails will not be installed until we are in financial position to have the leaflets printed. Delaware State College will be assisting us by printing the boardwalk brochure for general distribution during 1987.



- #20 A new sign was erected at the head of Parson Point Trail. The seasonal closure is due to the area's use annually as either a nesting or feeding area by a pair of bald eagles.

Johnson-Pohlman

Two other short uninterpreted trails lead to 30' observation towers overlooking Raymond and Shearness impoundments

Conducted trail walks increased this year to accommodate 2,638 visitors, mainly school children.

5. Interpretive Tour Routes

A 12 mile (round trip) auto tour route is interpreted by signs and also by a brochure (available on request) that corresponds to numbered posts. We are fortunate that printing of this brochure has been done by the local Delaware State College. A total of 3,736 individuals were given conducted tours this year, an increase of over 1,000 from 1985. Conducted and self-guided tours emphasize wildlife management techniques utilized at this refuge, bird and plant identification and information on other wildlife using Bombay Hook.

6. Interpretive Exhibits/Demonstration

A large exhibit for the main display room of the Visitor Center was completed and installed just prior to Christmas. It is a back-lighted 6-panel exhibit with panels depicting the habitats, wildlife and management of Bombay Hook, as well as information on the National Wildlife Refuge System. The initial planning for this exhibit started several years ago, with the initial phase of the contract being awarded in 1985. It has been a long, tortuous road, but much experience has been gained in the overall process and the final product is quite pleasing and professionally done. (See Section K)



- #21 The front section of the 6-panel exhibit introduces the visitor to Bombay Hook and selected refuges around the United States. It also includes a visitor guide map showing the locations of all National Wildlife Refuges in the system.

Johnson-Pohlman



#22 The reverse side of the exhibit depicts the habitats of Bombay Hook: the tidal salt marsh (and its food web), freshwater marsh, forests and fields.

Johnson-Pohlman

The two ends of this display will be dioramas produced in-house. Dave Windsor of Prime Hook National Wildlife Refuge is assisting ORP Johnson-Pohlman with the dioramas. Dave is an artist by hobby and has to date completed the freshwater marsh mural backdrop. He will work on the salt marsh mural during early 1987.

(See Photos #23 and #24 on the following pages)



#23 Maintenance Worker and Artist Dave Windsor of Prime Hook Refuge cooperated in the production of a wetlands diorama by painting the background murals.

Hammond



#24 The completed freshwater marsh mural was installed in the wetlands diorama located at the winged end of our 6-panel exhibit.

Johnson-Pohlman

A Chesapeake and Delaware Bay exhibit was also completed for account this year. Refuges in the Bay Areas provided slides for print making. The text for each refuge was drafted by college student Shirley Cunningham as part of her project for a natural history interpretation course. ORP Johnson-Pohlman edited the text and the local school district printed the signs. The components were then mounted on a velcro display board purchased with end of fiscal year monies. This velcro exhibit folds and unfolds in a matter of seconds and is light weight enough for one person to handle. This is quite a change from the old style velcro exhibit boards that were quite heavy and in separate boards that took a long time to erect. This new style velcro exhibit was purchased from

"Outline" in Cheverly, MD. It will be quite handy for off-site exhibits and events. Velcro boards are particularly useful in that exhibit information can be changed on a regular basis. A wetlands exhibit was thus put together and utilized at the Waterfest in Wilmington, DE during July.



#25 A Chesapeake and Delaware Bay exhibit was produced in-house and on new velcro display boards.
Johnson-Pohlman

The System 70 exhibit was set up at the Delaware State Fair in Harrington during July. We included the "Take Pride" theme and encouraged individuals to buy the Federal Duck Stamp. Bombay Hook and Prime Hook personnel, YCC, and volunteers all took turns staffing this exhibit and providing information. Approximately 10,000 individuals viewed the exhibit and/or asked questions and received brochures during the ten day fair.

7. Other Interpretive Programs

Slide shows and movies were offered on a regular basis to the general public and school groups, as well as specialized talks, bird walks, and a few off-site wildlife programs. The Bombay Hook Field Day/Open House, which was such a success in 1984 and 1985, was not held this year. However, since 1987 is the 50th anniversary of refuge establishment an even bigger event will be planned this coming autumn.

8. Hunting

Bombay Hook Refuge represents the largest expanse of waterfowl habitat in the State of Delaware. This, plus the overall diminutive dimensions of the State and the fact that much of the quality privately owned hunting land is leased for a fairly high price, means that demand for most public hunting programs on the refuge is very high. Each year between September 1 and late January the staff devotes considerable time and effort to various hunt programs. Migratory waterfowl, upland game and big game (deer) hunts are conducted on certain days during regular State seasons in various refuge locations.

Waterfowl

Waterfowl hunting by permit continued on four separate areas. The South Waterfowl Area (Kelly Island) consists of 20 marsh edge blinds accessible only by boat. The harvest is primarily ducks. The West Waterfowl Area provides 16 blinds in upland fields for primarily goose hunting. The Young Waterfowlers Area combines field and water blinds; while the Snow Goose Hunt Area consists of open tidal marsh with no blinds provided.

South Waterfowl Area

Delaware again opted for a three-way split in their duck season this year. Black ducks, a species of special concern, were not legal birds during the first "split" from November 3 through November 8; and held a limit of one from that point through the end of the season. This is of importance since black ducks form a high percentage of the total duck population on the South Waterfowl Area. The following is a summary of success on the area for the past three years; hunting is conducted only on Monday, Wednesday, Friday, and Saturday.

SOUTH WATERFOWL HUNT AREA

	<u>Number of Hunters</u>	<u>Number of Ducks Harvested</u>	<u>Number of Black Ducks Harvested</u>	<u>% Kill Blacks</u>	<u>Ducks/ Hunter</u>
<u>1986/87 Season</u>					
Nov 3-8 (4 days)	172	150	0	0	0.87
Nov 25-29 (3 days)	92	91	21	23.1	0.99
Dec 6-Jan 3 (17 days)	442	280	88	31.4	0.63
Total (24 days)	706	521	109	20.9	0.74
<u>1985/86 Season</u>					
Nov 4-9 (4 days)	104	125	0	0	1.20
Nov 26-30 (3 days)	120	211	28	13.3	1.76
Dec 7-Jan 4 (16 days)	419	502	139	27.7	1.19
Total (23 days)	643	838	167	19.9	1.30
<u>1984/85 Season</u>					
Oct 1-3 (2 days)	58	93	0	0	1.60
Oct 29-Nov 3 (4 days)	117	87	0	0	0.74
Nov 22-Jan 1 (23 days)	504	337	3	21.7	0.67
Total (29 days)	679	517	73	14.1	0.76

Lower success rates on the South Area this year can be attributed to three main factors: (1) the autumn and early winter weather was generally milder than average; (2) scaup, which formed the largest portion of the bag last year - 23%, were way down in population and (3) manipulation of refuge impoundments to grow large quantities of emergents and maintain lower water levels attracted high populations of ducks, primarily pintails and green-winged teal, and kept them throughout the season.

The black duck (109 birds, 20.9%) formed the largest share in the hunters' bag this season, followed by mallard (97 birds, 18.6%), scaup (82 birds, 15.7%) and green-winged teal (79 birds, 15.2%).

West Waterfowl Area

A fee of ten dollars per blind is charged on this area, where hunting is permitted each Tuesday, Thursday and Saturday during the State goose season from legal shooting time until 12 noon. Two handicapped access blinds are available in addition to the other 16 blinds on the area. All blinds are reserved by a pre-season public lottery for the entire season; however standby hunters are permitted when parties with blind reservations do not show up.

The 1986-87 Delaware goose season ran from November 3-29, and again from December 6 through January 24. The limit on Canada geese was reduced this year; being two per day during the early "split" and three per day during the late season. Snow goose limits remained at four daily. Success on the West Waterfowl Area followed a rather typical pattern as the season progressed. Hunting was excellent the first week or two; followed by a much slower period in which only the most experienced parties (many decoys, good callers etc.) did well. Then about January 1 success improved dramatically and remained high until the season closed. The following is a summary of hunting success during recent years on the West Waterfowl Area:

<u>Year</u>	<u>Number of Hunters</u>	<u>Canada Geese Harvested</u>	<u>Snow Geese Harvested</u>	<u>Canada Geese Per Hunter</u>
1986/87	1,311	757	13	0.58
1985/86	1,542	770	80	0.49
1984/85	1,790	1,148	44	0.64
1983/84	1,586	1,159	20	0.73
1982/83	1,491	698		0.47
1981/82	1,453	496		0.34
1980/81	1,557	895		0.57
1979/80	1,371	366		0.27
1978/79	1,591	443		0.28

Snow Goose Hunt Area

Hunting for snow geese was permitted on Tuesdays and Thursdays throughout the State season on portions of the tidal marsh. This hunt has as its prime objective the dispersal of large concentrations of snows from areas where they have created approximately 600 acres of "eat-outs" in recent years. No blinds are provided, and permits are on a first come, first served basis, since we have never come close to capacity in hunter demand. Nevertheless, the presence of even a few parties hunting on the area a couple of days per week has slowed the rate of marsh deterioration. We would like to see an earlier opening of the State season, since a high percentage of the marsh damage occurs during the last two weeks of October; and prior to the November 3 opening date. We are working with the State and the Atlantic Flyway on this proposal.

A very high proportion of adult birds in the population probably was a factor in the lower success rate on snow geese this year. Hunt results for the past four years are as follows:

	<u>Number of Hunters</u>	<u>Number of Snow Geese Harvested</u>	<u>Birds/Hunter</u>
<u>1986/87 Season</u>			
Nov 3-29 Dec 6-Jan 24 (21 days)	241	139	0.58
<u>1985/86 Season</u>			
Nov 5-Jan 30 (24 days)	246	339	1.38
<u>1984 Season</u>			
Oct 29-Nov 2 Nov 15-Dec 20 (14 days)	187	268	1.43
<u>1983 Season</u>			
Nov 4-10 Dec 5-9 (12 days)	154	214	1.39

Young Waterfowlers Area

The Delaware Wildlife Federation (DWF) cooperates with the refuge in sponsoring this program, which was conducted for the 19th year. We provide guidelines on use of the area and provide logistical assistance to the group. Instructors affiliated with DWF help the youngsters place and grass the blinds and actually bring them to the refuge for their hunt. A maximum of two young hunters with non-hunting instructor is permitted per blind. Instructions in gun safety, waterfowl regulations, the ethics of proper waterfowl hunting and waterfowl identification are conducted by both DWF and refuge personnel. Assistant manager Pelizza acted as refuge coordinator for the program.

We mentioned in the 1985 narrative report that changes would have to be made in the program to bring it back up to the level of several years ago. It was our definite feeling that communication between the DWF instructors and refuge staff was not as good as it could have been; and also that the overall leadership of the sponsoring organization was missing. This year we did experience a big change for the better through re-kindling the interest of some DWF members who had been active in the program previously. Bob Streets and Jim Warren of DWF can be given much credit for pointing the program in a positive direction.

A total of 62 hunter visits by 34 different youths occurred on six different Saturdays this autumn. They took 49 ducks and 15 geese for an overall 1.03 birds per individual. This was the highest success rate since 1977 and the highest total harvest since 1978. Mallards, green-winged teal and shoveler formed the highest percentages in the bag. The best success was realized in the Bear Swamp water blinds.

South Upland Area

This tract of slightly over 300 acres consists of brushy habitat on the southwest edge of the refuge. It is our only hunt area which is open for all types of game in accordance with applicable State and Federal Regulations and without a special refuge permit. We therefore do not get much hard data on species harvested or amount of hunter participation; however the isolation of the area from other refuge units prevents us from arriving at a better system at this time.

One successful bowhunter on the South Upland Area checked in a 2.5 year old 85 pound doe at the refuge check station.

Deer

Bowhunting, primitive weapons hunting and shotgun hunting were permitted during portions of the regular Delaware seasons. Demand by deer hunters for refuge permits is generally quite high, due to the substantial herd size and the relative lack of public hunt lands off-refuge.

Bowhunting was again conducted on the Regular Deer Hunt Area during the first five Saturdays of the State season (September 6,13,20,27; October 4). Bowhunters do not realize a high success rate here; and we feel to some extent that this is due to the early scheduling of these hunts. This year our worst mosquito populations were in September and October; remaining on stand required a truly dedicated archer. Also, during this period vegetation is still quite lush, corn fields have not yet been harvested, and the rut has not begun; all conditions working against the early bowhunter. We are planning to switch two bowhunts to late October during 1987 in an attempt to correct these inequities.

The same area was open to primitive weapon hunting during the early portion of the State season (October 9-11). This year 40 elevated platforms, constructed by Delaware Division of Fish and Wildlife personnel, were placed on the area in strategic locations. The hunters were required, as a condition of their permit, to hunt from their assigned stands until 8 a.m. each morning and to be back on their stands at 4 p.m. until shooting hours were over. Shotgun hunters also were obliged to abide by the same regulation, which we instituted as a safety measure. Shotgun season on the Regular Area was the first Friday, Saturday, and Wednesday of the State season (November 7,8, and 12). Most hunters favored the new stands and the overall harvest increased on the area this year, although not necessarily due to the regulation change.

(See photo #26 on the following page)



#26 The elevated stands built by the Delaware Division of Fish and Wildlife are sturdy and provide a secure site from which to hunt.

Johnson-Pohlman

The Headquarters Area hunt was modified slightly this year to include 5 stands in the Fischer Tract. On these areas hunters must hunt from their stands at all times; no still-hunting is permitted due to the relatively small acreage and the proximity to refuge buildings and other facilities. Handicapped (non-ambulatory) hunters are accommodated during these hunts by assigning them (as well as a helper who does not carry a weapon) to special sites. The addition of the Fischer Tract stands resulted in a slight increase in the overall harvest during the Headquarters hunts as is reflected in the summary.



#27 The typical mid-day waiting line for a chance at a stand in the Headquarters Area attests to the popularity of this hunt.

Hammond

All deer are checked at the official State check station in our maintenance area. They all appeared to be in fine condition and the weights for the most part increased, giving evidence of a healthy herd. One all-white and one brown and white deer, both young of the year, were frequently seen around headquarters and somehow escaped being harvested. Such deer are more common in the southern part of Delaware, but are rare in this locale.

The following is a summary of deer hunting for the past five seasons on the Regular Deer Hunt Area and for the four years that the Headquarters Area has been open.

REGULAR DEER HUNT AREA

	<u>Hunter Visits</u>	<u>Number Days Open</u>	<u>Number Deer Harvested</u>	<u>% Success</u>
<u>1986</u>				
Archery	173	5	2	1.2
Muzzleloader	136	3	3	2.2
Shotgun	148	3	21	14.2
	<hr/>	<hr/>	<hr/>	<hr/>
Totals	457	11	26	5.7
<u>1985</u>				
Archery	199	5	1	0.5
Muzzleloader	108	3	3	2.8
Shotgun	128	3	16	12.5
	<hr/>	<hr/>	<hr/>	<hr/>
Totals	435	11	20	4.6
<u>1984</u>				
Archery	240	5	5	2.1
Muzzleloader	96	3	5	5.2
Shotgun	186	4	15	8.1
	<hr/>	<hr/>	<hr/>	<hr/>
Totals	522	12	25	4.8
<u>1983</u>				
Archery	218	5	2	0.9
Muzzleloader	110	3	4	3.6
Shotgun	170	4	18	10.6
	<hr/>	<hr/>	<hr/>	<hr/>
Totals	498	12	24	4.8
<u>1982</u>				
Archery	133	5	3	2.3
Muzzleloader	116	3	12	10.3
Shotgun	215	4	11	5.1
	<hr/>	<hr/>	<hr/>	<hr/>
Totals	464	12	26	5.6

HEADQUARTERS DEER HUNT AREA

	<u>Hunter Visits</u>	<u>Number Days Open</u>	<u>Number Deer Harvested</u>	<u>% Success</u>
<u>*1986</u>				
Elevated Stands	100	2	29	29.0
Non-Ambulatory	7	(same days)	1	14.3
Totals	107	2	30	28.0
<u>1985</u>				
Elevated Stands	80	2	24	30.0
Non-Ambulatory	8	(same days)	3	37.5
Totals	88	2	27	30.7
<u>1984</u>				
Elevated Stands	29	1	15	51.7
Non-Ambulatory	3	(same days)	0	0.0
Totals	32	1	15	46.9
<u>1983</u>				
Elevated Stands	55	2	27	49.1
Non-Ambulatory	8	(same days)	2	25.0
Totals	63	2	29	46.0

* Data for 1986 includes deer taken from new stands on the Fischer Tract (3 deer).

SUMMARY OF AGE AND WEIGHT DATA - 1986

<u>Age Class</u>	<u># Bucks</u>	<u># Does</u>	<u>Average Weight Bucks</u>	<u>Average Weight Does</u>
.5	13	11	56.7	51.2
1.5	11	5	126.7	99.0
2.5	2	9	162.6	104.5
3.5+	1	4	180.0	117.7
Totals	27	29		

All weights shown are field dressed.

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 impoundments are manipulated so as to encourage submergent and emergent vegetation for waterfowl use and this management is contrary to that which would provide for fish populations and sport fishing.

One special use permit was issued to allow the taking of snapping turtles in the impoundments; however the permittee, Richard Davis, of Pine Tree, Delaware expended only four days of effort setting 20 fike nets and removing 6 snappers (total 69 pounds).

10. Trapping

We feel that the fur market probably hit bottom during the winter of 1985-86 and that there will be some rebound this year. Harvest figures for the 1986-87 season will not be available, however, until after the preparation of this report and will be included in the 1987 narrative.

Following is a summary of trapping data for the past five years:

	<u>Total Rental On</u> <u>Trapping Units</u>	<u>Number</u> <u>Animals</u> <u>Trapped</u>		
		<u>Muskrat</u>	<u>Raccoon</u>	<u>Opossum</u>
1985-86	\$2,790.68	1,735	45	27
1984-85	\$5,516.10	2,671	46	20
1983-84	\$3,980.05	1,434	54	6
1982-83	\$4,014.00	1,552	31	27
1981-82	\$8,704.52	2,403	55	13

Six trappers were awarded 16 different trapping units based on sealed bids received for the 1985-86 season. Very little activity was realized during the early part of the season (late December and January) except on raccoon since the marshes were frozen up. Milder weather returned in February, and most of the Muskrat harvest occurred from then until the end of trapping on March 15.

An aerial spring muskrat house count revealed 341 houses on the trapping units, an increase of 206 over the previous year. This, plus the somewhat stronger fur market, resulted in trappers bidding a total of \$3,792.68 on the units for the 1986-87 season at the December 2 bid openings at refuge headquarters.

11. Wildlife Observation

This category accounts for the highest percentage of refuge public use. Most visits consisted of individuals driving their personal automobiles along the auto tour route, with fewer numbers taking walks along the trails and photographing wildlife. Peak public use is during the waterfowl season, particularly the months of October and November, with a secondary peak during spring shore-bird season from March through May. Visitation is low during the summer due to hordes of mosquitoes and biting flies.

12. Other Wildlife Oriented Recreation

The Delaware Bay Retriever Trial Club did not hold their usual October trial on Bombay Hook this year. The group, which has conducted trials on the refuge for over 40 years, acquired their own land in the vicinity of the Chesapeake and Delaware Canal and used it for their trial in 1986.

16. Other Non-Wildlife Oriented Recreation

Use in this category is quite low. We continued to get some joggers and runners plus an occasional cross-country skier. Hopefully they are enjoying wildlife while getting the physical benefits of their exercise.

17. Law Enforcement

During 1986 three of the refuge staff maintained law enforcement authority; the Refuge Manager and Assistant Managers Smith and Pelizza. Maintenance Worker Straughn, who came on duty June 8, will receive law enforcement credentials after completion of the basic training at Glynco, Georgia; however due to a limited number of slots allocated to the Region, this may not happen until 1988. The third Assistant Manager position, vacant at the end of 1986, also calls for law enforcement authority. All three refuge officers completed refresher training at Cape Charles, Virginia during February and March.

As can be seen in the summary tables at the end of this section, the refuge recorded a variety of violations this year, and the types of violations remained representative of those noted in prior years. About the same level of law enforcement effort was undertaken which was about all we could accomplish with three personnel utilizing staggered duty tours. The number of individuals apprehended and number of violations written also reflects this relatively constant effort.

A couple of cases were unique, and bear some discussion here. On May 26 at 7 a.m. the person responsible for opening the refuge gate informed us that the gate and surrounding fence had been vandalized sometime during the night. Investigation revealed that a vehicle had entered the refuge over a one-way treadle in the wrong direction. There were clear marks in the pavement on road 85 (which ends at the refuge and becomes gravel refuge road) of wheel rims. Assistant Manager Pelizza was able to follow the rim marks for several miles into Dover and to a mobile home park. The park maintenance employee related that a vehicle with only a rim was parked in front of one of the units previously. Interviews with the owner of the unit revealed that her son had a friend visit on May 25 and that they had been out in his friend's vehicle. Her son came by the refuge on June 3 and admitted to entering the refuge on the night in question. The two subjects became upset over puncturing their tires, whereupon they proceeded to wreak havoc on the refuge gate and fence.

The U.S. Attorney worked out an agreement with both subjects whereby they paid for damage to refuge facilities (\$296.00) and in turn were allowed to forfeit collateral of \$200.00 each on charges of trespassing after hours and destruction of Government property rather than requiring a mandatory court appearance and harsher penalty. The excellent investigatory work of Officer Pelizza was the principle reason that this incident reached a satisfactory conclusion.

(See Photos #28 and #29 on the following pages)



#28 After puncturing their tires by entering the refuge over a one-way treadle in the opposite direction, the night visitors vented their wrath on a sign post.....

Pelizza



#29and on the fence which extends on the south side of the entrance gate.

Pelizza

The other case of particular note involved a hunter who attempted to take (in fact, crippled) a tundra swan from one of the refuge blinds on the West Waterfowl Area. The reason we were able to prosecute this individual was that six hunters in other blinds on the area witnessed the violation and were willing to provide written statements to refuge officers. This sort of cooperation, which seems to be increasing, is most commendable and lessens the credence of those who believe that most hunters will violate the law if given the opportunity.

An individual who was responsible for a very bad hunting accident on the refuge in November, 1984, received sentencing this year. The subject shot a 19 year old youth, mistaking him for a deer and leaving him paralyzed from the waist down. The sentence levied in State Court was two years in prison with 6 months suspended, on charges of reckless endangerment of another's life. Although we did not expect the outcome to be as severe on the defendant in the case, it should give future deer hunters in this State pause to make sure of their target.

Summary of C.Y. 1986 Violations at Bombay Hook

<u>Violation</u>	<u>Warning</u>	<u>Collateral Forfeit</u>	<u>Pending</u>	<u>Total</u>
Take/attempt to take water- fowl with aid of bait			4	4
Hunt waterfowl without Federal Stamp		1 (\$25)	1	2
Hunt waterfowl without State Stamp		1 (\$25)	2	3
Hunt without license			1	1
Attempt to take migratory bird - closed season			2	2
Possession of lead shot shells in steel shot zone		1 (\$25)		1
Hunt waterfowl with unplug- ged shotgun			1	1
Possession of over limit shot shells - refuge hunt area	3			3
Drive vehicle-unauthorized area		1 (\$25)	1	2
Dog running at large on refuge			1	1
Trespassing (after hours)		2 (\$100 each)	2	4
Destruction of Government property		2 (\$100 each)		2
Exceed speed limit			1	1
Totals	<u>3</u>	<u>8</u>	<u>16</u>	<u>27</u>

Summary of Violations at Bombay Hook Since 1978

<u>Calendar Year</u>	<u>Number of Individuals</u>	<u>Number of Violations</u>
1986	20	27
1985	20	26
1984	20	22
1983	45	58
1982	28	38
1981	64	96
1980	44	78
1979	23	25
1978	27	32

I. EQUIPMENT AND FACILITIES

1. New Construction

New shelves and cabinets were built within storage room #1 in the Office/Visitor Center by Maintenance Worker Webster. They greatly increased our total storage capabilities and enabled us to better organize office supplies. A contract for rehabilitating our office heating and air conditioning system will involve conversion of our other headquarters storage room (#2) into a boiler room, thus making the room #1 storage space even more important.

(See Photos #30 and #31 on the following page)



#30 Although Maintenance Worker Richard Webster was only with us for a brief 3 month tenure, his talents were apparent and of great benefit to the station.

Johnson-Pohlman



#31 Richard did a fine job on installing a set of new cabinets in storage room #1 of the headquarters building.

Johnson-Pohlman

After two years and \$20,000 the "State-of-the-Art" six panel exhibit was completed and installed in the main Visitor Center display room. It is further described in section H.6.

Three osprey nesting structures were constructed and erected along the Refuge bay shore. Six blue bird boxes with predator guards were erected on selected upland sites.

Forty-eight elevated deer stands were erected within the areas open to deer hunting. The stands were constructed by the Delaware Division of Fish and Wildlife and placed by the Bombay Hook YCC enrollees on sites selected by the refuge staff.

2. Rehabilitation

A portion of Sheariness dike was stabilized by using stone rip-rap placed by the YCC. Five hundred and thirty tons (cost \$7,393.50) of stone were placed along the toe of the dike. This year marked our second year of rip-rap placement in these rapidly eroding areas. Unfortunately the quality of material supplied by this year's low bidder was inferior to that of the 1985 supplier.



#32 Placement of 530 tons of rip-rap will make Sheariness Dike less prone to erosion caused by high tides and wave action.

Fascia boards were repaired, replaced as needed and painted on the Office/Visitor Center and YCC building.

All three observation towers were painted; deteriorating wood was replaced; and new non-slip treads were placed on all steps.

Significant portions of the boardwalk's stringers and treads were replaced.

Six hundred and twenty-five tons of gravel (\$2,500) were distributed over the Refuge's road system during Calendar Year 1986.

New wooden walkways were constructed to cover portions of the water control structures at Raymond Pool, Shearneck, and Bear Swamp Canal.

3. Major Maintenance

All 36 waterfowl blinds were inspected and repairs made as needed (hinges, floor boards etc.) prior to hunt season.

A new sign was installed at the head of Parson Point Trail.

Efforts to improve the appearance in and around the Office/Visitor Center continued as a small contract (\$932) was let for more shrub plantings around the split rail fences, entrance road, and entrance sign.

(See Photos #33 and #34 on the following page)



#33 Tartarian Honeysuckle hedges were planted behind wood fences framing the headquarters parking lot.

Johnson-Pohlman



#34 Junipers were planted around the stone base of the refuge entrance sign.

Johnson-Pohlman

4. Equipment Utilization and Replacement

The Massey Ferguson 1085 tractor ate into the refuge budget to the tune of \$4,334.63 in repair costs, including major repairs to the hydraulic system and 3-point hitch.

A new Plymouth Reliant station wagon (\$7,957.00) was received to replace our 1979 Volare.



#35 The new Plymouth station wagon was outfitted with mobile radio, siren and red flashing lights in the grill for law enforcement purposes.

Johnson-Pohlman

A Ford F-600 diesel stake dump truck (\$25,000) was purchased to replace our dilapidated 1963 dump truck.



#36 The long overdue replacement for the old 1963 dump truck was received with pleasure; especially by Maintenance Worker Cottman. Smith

A salinometer was purchased (\$490.00) to monitor salinity levels within the pools and tidal creeks.

A new Caulkins boat trailer (\$1,092.00) was purchased for our 16 foot Boston whaler.

A portable spray rig was purchased from Agrotec (\$305.90) which attaches to our Honda ATV. This is a handy item for use in Johnsongrass, thistle, and Phragmites control in wet areas.

A John Deere 330 Diesel lawn and garden tractor (\$4,190.) was purchased for lawn maintenance.

A Bush Hog side mounted rotary mower (\$3,850) was purchased for ditch bank, dike slope, and woods edge maintenance.

(See photo 37 on the following page)



#37 We find this type mower to be very valuable for clearing ditch banks and other hard to reach sites of invading undesirable vegetation
Johnson-Pohlman

During the year we borrowed Eastern Neck's bulldozer, dump truck, and low boy trailer. While in our possession the trailer's axle broke while driving down the road and repairs totaling \$497.50 were incurred by this station.

5. Communications Systems

Several minor "in-town" repairs to our radios were necessary during 1986.

Our FTS number was changed to its present 487-6237 after closure of the Dover FTS operation. We are now homed through Wilmington, Delaware.

6. Computer System

A new Peachtree module (\$288.50) was purchased for the office Digital Rainbow 100 computer.

7. Energy Conservation

Gasoline useage decreased 263.1 gallons from that in 1985. This decrease most likely resulted from a combina-

tion of our conservation practices and staff vacancies. Diesel use increased by 93 gallons, primarily as a result of increased dozer time for brush control, and more road grading associated with gravel deliveries. Use of wood stoves as the primary heat source for the Refuge office and vehicle shop again resulted in significant energy savings.

<u>Year</u>	<u>Gasoline Use (Gallons)</u>	<u>Diesel Use (Gallons)</u>
1982	2,229.5	897.5
1983	2,217.7	889.5
1984	2,165.7	743.0
1985	2,725.9	956.9
1986	2,462.8	1,050.0

J. OTHER ITEMS

1. Cooperative Programs

Frank Smith continued to serve as Delaware's Fish and Wildlife Service Field Response Coordinator for oil and hazardous chemical spills during 1986. He was not involved in any recovery efforts during the year as fortunately no major spills were reported in our immediate vicinity. A small oil spill was reported off Prime Hook NWR on December 27th and one quarter mile of beach in the area was affected. Fortunately the Coast Guard had the area cleaned immediately with no apparent significant damage to wildlife resources.

3. Items of Interest

Manager Daly attended an interagency meeting in Annapolis, Maryland on February 19th, chaired by the EPA to discuss possible guidelines for development projects in wetlands.

Outdoor Recreation Planner Johnson-Pohlman attended a Volunteer management mini-course sponsored by AIN (Association of Interpretive Naturalists) at Brandywine State Park in Delaware on February 19th.

Paul Daly and Charles Pelizza attended the 40-hour Law Enforcement Refresher Course at Eastern Shore National Wildlife Refuge in Cape Charles, Virginia during the period February 10-14.

On March 10 Bombay Hook and Prime Hook staff met with Director Wagner and staff of the Delaware Division of Fish and Wildlife to discuss plans for 1986-87 hunts on both Refuges.

Frank Smith attended the 40 hour Law Enforcement Refresher Course at Eastern Shore National Wildlife Refuge in Cape Charles, Virginia during the period March 3-7.

A dinner party honoring Virginia Baughman upon her retirement was held at the Coral Reef Restaurant in Little Creek, Delaware on April 18. Thirty-six attendees enjoyed the festivities.



#38 A group of Virginia Baughman's friends, relatives and co-workers enjoyed her retirement dinner at the Coral Reef.
Hammond



#39 Virginia's retirement dinner.
Hammond

Charles Pelizza attended a shorebird seminar at Ashland Nature Center on April 2 and presented an explanation of the Refuge's efforts to encourage and monitor shorebird use. He also met with Delaware Division of Fish and Wildlife's non-game biologist Janis Thomas in an effort to come up with a coordinated shorebird inventory during the spring migration along the Delaware Bay.

On May 6 and 7 the refuge hosted several visitors affiliated with the British Broadcasting Corporation, Turner Broadcasting, and National Geographic Society who planned a fall telecast of a nature program which was to include footage from Bombay Hook.

Regional Office personnel Lynne Anderson and Tony Bocelle visited the Refuge on May 5th and conducted a Procurement Audit.

A real "first" for Bombay Hook occurred in May when an impromptu (at least from the refuge point of view) wedding was held near the flagpole on the west lawn of the headquarters building. As the guests gathered, the Justice of the Peace was queried by the refuge staff as to what was about to transpire. Her reply was a quite embarrassed "You mean nobody arranged this with you?" Fortunately "Rambo" and his bride did not bring a large entourage and we decided to let cupid's arrow find its mark. It wasn't your typical garden variety ceremony as the wedding party was attired in survivalist togs.



#40 The wedding begins as Manager Daly and Assistant Manager Smith ponder the age old question asked on most refuges "What in the world will they come up with next?....."

Pelizza



#41Rambo and the Mrs. plight their troth as
 the Justice of the Peace looks on dubiously.
 will the reception be at the bunker?
 Pelizza

The Delaware Division of Fish and Wildlife sponsored a Canada goose fact finding meeting on May 21. Scheduled speakers were Rich Malecki (Cornell University) and various State personnel involved in monitoring the Canada goose populations in Maryland and Delaware. Messrs. Daly, Smith and Pelizza attended the 7:00 p.m. meeting at the Grange Hall in Dover.

The Spring bird count was conducted on May 10, with ORP Pohlman participating. Over 90 species were recorded.

Assistant Manager Pelizza attended a meeting with State personnel on July 22 to discuss shorebird inventories and management efforts along the Delaware Bay.

Woodbridge High School teacher Robin Smith filled in for Secretary Hammond while she was on leave the week of July 21-25. Mrs. Smith worked under a program entitled "Business Teachers On the Job Internship" whereby she received teacher in-service credit but no pay.

Refuge Manager Daly attended the Project Leaders meeting at Cape Charles, Virginia August 12-14.

Emile Bishara from the Regional engineering Office visited the Refuge August 6 as part of the maintenance management program.

ORP Pohlman gave birth to a baby girl on September 2. Mother and the newest little ORP both did very well and Marian returned to work October 26.

Paul Daly, Frank Smith, and Charles Pelizza attended a Wetlands Symposium in Wilmington, Delaware during the period Spetember 16-19. On the 18th symposium attendees were given a tour of Bombay hook and an explanation of our water management program by Daly, Smith and Pelizza. Approximately 120 professional biologists were in attendance at the tour.

Manager Daly and Assistant Managers Smith and Pelizza qualified with their service revolvers at Blackwater NWR on September 15 and 24.

Robin Berkowitz, a reporter for the Delaware State News, visited on September 10 and interviewed the Manager. She produced a well written feature article on the refuge which appeared in the September 12 edition of the newspaper.

Bombay Hook was featured on a portion of the WTBS program "World Safari" on October 26. The one and one-half hour program, a cooperative effort between Turner Broadcasting, BBC, and National Geographic, featured live hookups from wildlife areas all over the globe including the Galapagos Islands, Moscow, New Zealand, Africa, and Bombay Hook. A crew of 38, including TV personality Tom Chapin, were on site at Bombay Hook for the production. The greater snow geese, which were near their peak (70,000) at the time of the broadcast, cooperated beautifully in providing some spectacular pictures of their concentrated populations.

Manager Daly gave a taped interview on the refuge snow goose hunt to WAFL Radio, Milford on October 23; and an in person interview to magazine writer Keith Walters (Waterfowl World) on the same date.

Refuge Manager Daly and Assistant Manager Pelizza assisted Eastern Neck NWR during their muzzleloader deer hunts on October 20 and 24 respectively.

Assistant Manager Frank Smith received a special achievement award in the amount of \$500. for his performance as Acting Refuge manager during the period July 9 through September 23, 1985 while manager Daly was attending FLETC basic training at Glynco, Georgia. Frank kept the refuge functioning very well during a busy time.



#42 Frank Smith received his special achievement award at a Bombay Hook/Prime Hook staff meeting
Johnson-Pohlman

Secretary Teresa Hammond received a special achievement award in the amount of \$250. for her performance while still a PPT clerk-typist during the 4 month period in 1985 when Secretary Virginia Baughman was recuperating from a serious automobile accident. Teresa's work was exemplary and far in excess of that required by her position description.



#43 Teresa Hammond's award was presented at the same meeting in the Visitor Center Auditorium Johnson-Pohlman



#44 Whoooooo's Responsible for
this Narrative??

4. Credits

Credits for this masterpiece are as follows:

Paul Daly (Sections A, F, H 8-10 & 17, K)
Frank Smith (Sections B, D, E 1,5,6 & 8, I, & J)
Marian Johnson-Pohlman (Sections E 10, H 1-7, 11, 12, & 13)
Charles Pelizza (Sections E 2-3, & G)

The report was typed by Teresa Hammond. Picture credits are listed for each photograph except #44 which was taken by Maintenance Worker Straughn. The entire report was edited by Paul Daly.

K. FEEDBACK

As noted in the Public Use and Equipment/Facilities sections of this report, we finally received a six-panel exhibit for our main visitor center display room during December. Several conclusions were obvious upon reflection after installation of this display. The two conclusions which I will detail are those with the biggest potential for affecting other stations; and which therefore may be of benefit to those perusing the report.

First, the process from the initial planning stages to final installation, simply took much too long. The exhibit was entered into the programming/budgeting cycle during 1984 and funds were available in FY 1985. A proposal was sent to the Regional Office early in January 1985 with our desires as to format, text etc. The estimated cost was based on a figure given us by a local design and production firm. The remaining time (almost 2 years) was spent by various levels and offices in the Service reviewing the plans (sometimes in excruciating detail); making changes; preparing and accepting bids and in actual construction of the exhibit by a contractor. Two main suggestions are offered for the benefit of other stations which would reduce the time required when they wish to have such a display constructed. Keeping the review process as streamlined as possible is essential. There should be a Regional Office staff person in Wildlife Resources who has expertise in exhibits and displays. This person should take a proposal package from a particular refuge and, working closely with the field station, be responsible for guiding it through the entire process. This would include working with other support services such as engineering and contracting as well as potential contractors. The final package would be reviewed and signed off by the Regional Supervisor prior to being sent out for bid. This would avoid the "too many cooks" situation which we encountered. The other suggestion which would expedite the entire process would be to require one contractor to bid on the entire package. The decision made in our case was to sub-contract various segments of exhibit construction to several vendors. One built the cabinets, one produced the photographs, another did the installation etc. The only efficient process would involve one contractor responsible to the refuge for the entire job; letting them sub-contract as they felt necessary.

The other conclusion reached was that the exhibit cost us much more than it should have, based on the final product. This was caused in part by the "segmented" approach to construction mentioned above and the fact that the choice of vendors given the opportunity to bid on certain segments, such as the photograph preparation, was limited to a few

firms in close proximity to the Regional Office. We could save money and come up with a quality product by requiring a vendor to bid on the entire package as suggested above; as well as ensuring that as wide a distribution as possible is made to potential vendors; including those relatively near the field station involved. Some firms declined to bid due to a 10 day deadline; the entire package should be offered with a minimum 30 day period for a firm to respond.

BOMBAY HOOK

NATIONAL
WILDLIFE
REFUGE

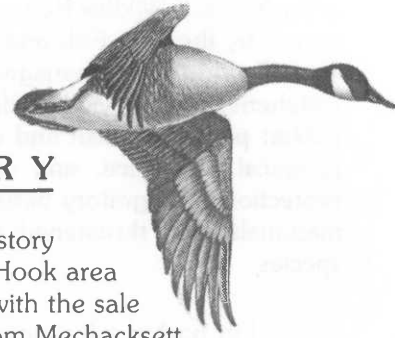
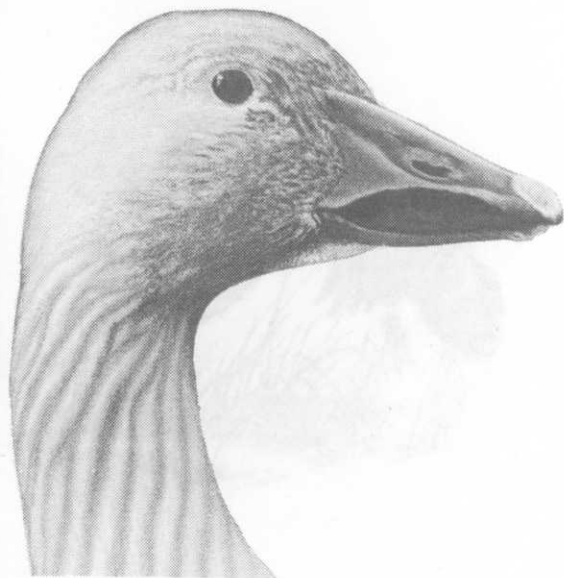


DELAWARE

WELCOME

Bombay Hook National Wildlife Refuge comprises 15,122 acres, approximately three-quarters of which is tidal salt marsh. It also includes 1,200 acres of impounded fresh water pools, brushy and timbered swamps, and 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.



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.

MANAGEMENT

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.

To complement the excellent production of aquatic food plants in the refuge pools upland agricultural crops are produced on approximately 1,000 acres to provide a supplemental food supply to waterfowl.

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 interests.

BIRDS

In the spring and fall, migrations provide an excellent opportunity for nature study. Organized field trips are regularly scheduled by ornithological clubs from nearby cities. More than 100 bird species have been reported during the annual Christmas Bird Count. In addition to the variety of waterfowl and shorebirds, many other birds are observed here. Over 270 species are listed in a separate leaflet, "Birds of Bombay Hook National Wildlife Refuge."

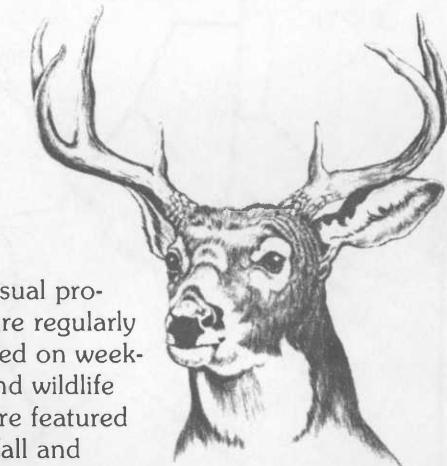
MAMMALS

Whitetail deer are easily observed feeding in the refuge fields just before sunset. The careful observer may occasionally see some of the more secretive mammals, such as the red and gray fox, river otter, muskrat, Virginia opossum, eastern gray squirrel, woodchuck, and beaver.

PUBLIC USE

The public is welcome to visit the refuge for wildlife observation, nature study, and photography year round. The period from October 1 through November 30 is generally the most interesting to the refuge visitor, as this is the period during which waterfowl populations are at their peak. During wet periods, the auto tour route may be closed to prevent deterioration of the road system. Visitor facilities include a visitor center, observation towers, nature trails, and restrooms.

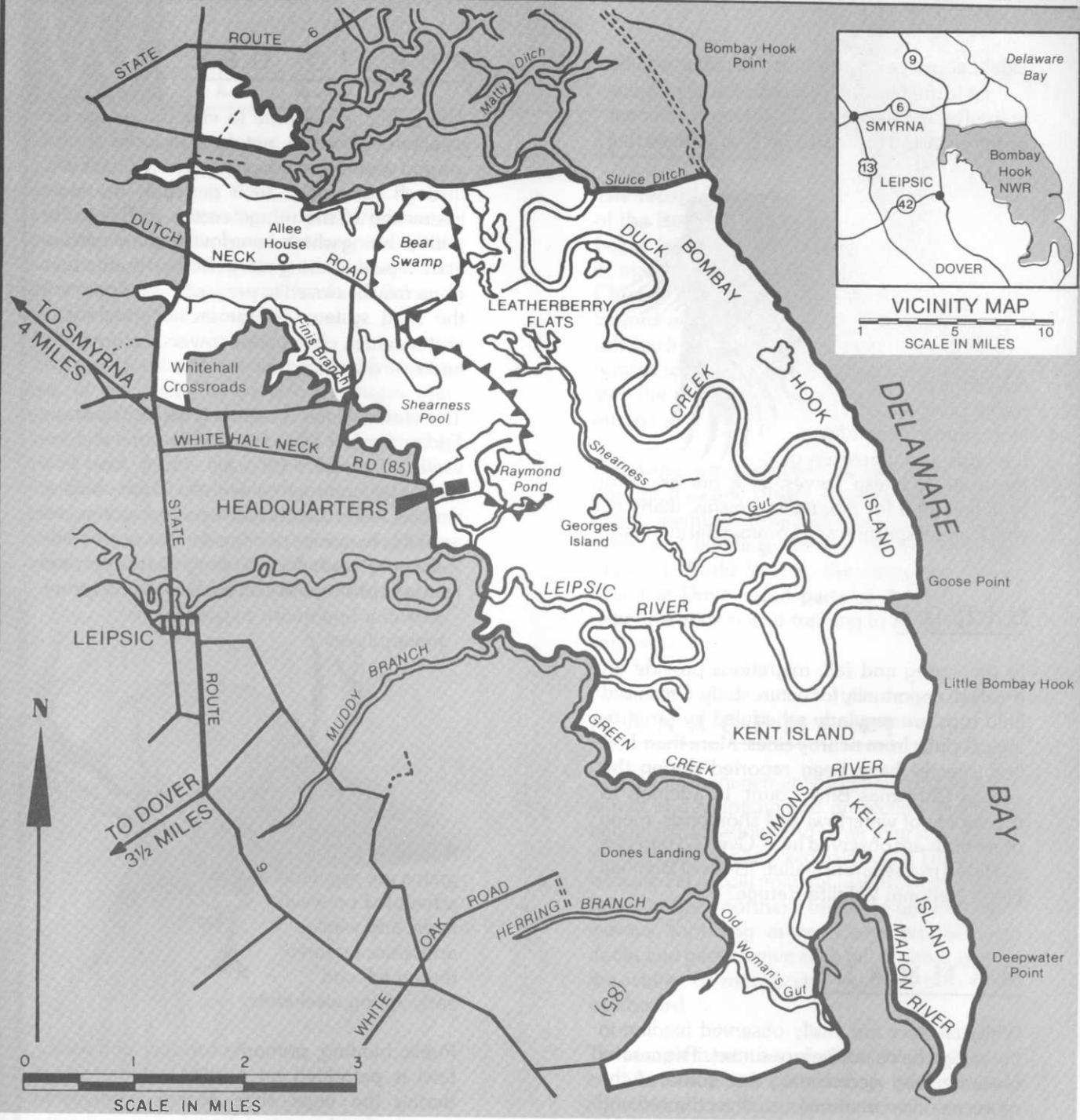
The visitor center is normally open Tuesday - Friday from 7:30 a.m. - 4:00 p.m. and on weekends from 9:00 a.m. - 5:00 p.m. It is closed on summer weekends. Tours, habitat studies, walks, and audiovisual programs are available to groups on request. Please schedule 2-4 weeks in advance. Volunteer, teacher, and leader workshops are offered in fall and spring.



Audiovisual programs are regularly scheduled on weekends, and wildlife artists are featured during fall and early spring weekends.

Public hunting, primarily for deer and waterfowl is permitted on portions of the refuge during the legal state seasons. Interested persons should contact the refuge manager for more details.

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.

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

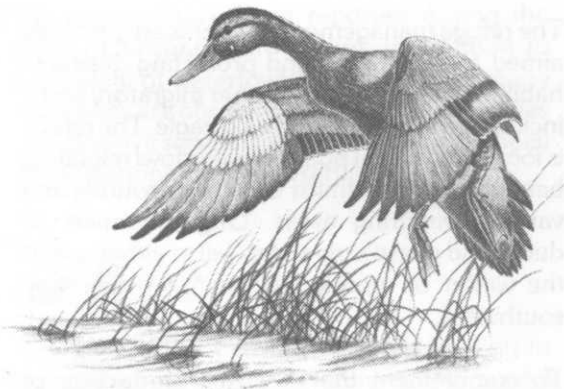
For further information contact:

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

Illustrations by Julien Beaugard.

***Take Pride in Bombay Hook
National Wildlife Refuge***

UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE



RL-51550-1
August 1986





MAMMALS
of
BOMBAY HOOK

National
Wildlife
Refuge

Delaware

MAMMALS of the BOMBAY HOOK National Wildlife Refuge

Bombay Hook National Wildlife Refuge is located in coastal Delaware. The 15,099-acre refuge is relatively flat with most elevations less than ten feet above sea level. The major habitat type, consisting of 12,257 acres, is tidal marsh intersected by winding rivers and creeks. Landward of the marsh are freshwater impoundments, timbered swamps, mixed deciduous woodlands, brushy thickets, grassy fields, and croplands.

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

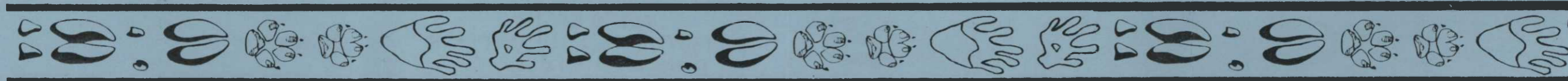
Because of a combination of small size, secretive habits, or nocturnal activity, many mammals are seldom seen. However, the careful observer will see tracks, trails, tunnels, burrows, nests, and other signs that reveal their presence.

The following list of 34 species was prepared by refuge personnel with the cooperation of Frederick A Ulmer, Jr. of the Philadelphia Zoological Garden. Order of listing and scientific names generally follow Hall, *Mammals of North America*. Common names are from Burt and Grossenheider, *A Field Guide to the Mammals*.

- **Opossum** (*Didelphis virginiana*).
Commonly found in all sheltered habitats. Normally active only at night.
- **Masked Shrew** (*Sorex cinereus*).
Common on all land areas. Hunts for insects and other food day or night.
- **Shorttail Shrew** (*Blarina brevicauda*).
Most abundant in damp woods with thick leaf mold.
- **Least Shrew** (*Cryptotis parva*).
Found in open, grassy areas.
- **Eastern Mole** (*Scalopus aquaticus*).
Inhabits moist, upland soils where it tunnels its way under the surface.
- **Star-nosed Mole** (*Condylura cristata*).
Prefers low, wet ground where it burrows for insects.

- **Little Brown Myotis** (*Myotis lucifugus*).
Present during the warm months. Seen in flight at dusk near the woods and over the pools.
- **Silver-haired Bat** (*Lasionycteris noctivagans*).
Found in the swamps flying among the flooded trees.
- **Eastern Pipistrel** (*Pipistrellus subflavus*).
Active during summer evenings. One of the smallest bats.
- **Big Brown Bat** (*Eptesicus fuscus*).
Active on warm evenings when beetles are flying.
- **Red Bat** (*Lasiurus borealis*).
A common woodland bat that roosts in trees all day, until deep dusk.
- **Hoary Bat** (*Lasiurus cinereus*).
The largest eastern bat, it is found in the woodlands; flies late, high and solitary.
- **Eastern Cottontail** (*Sylvilagus floridanus*).
Abundant. Lives in bushy areas and grassy fields. Often seen from the roads in the early morning and late afternoon.
- **Woodchuck** (*Marmota monax*).
Abundant. Lives in deep burrows excavated in fields, woods, and along dikes.

- **Eastern Chipmunk** (*Tamias striatus*).
Uncommon among logs and stumps in the hardwood areas.
- **Eastern Gray Squirrel** (*Sciurus carolinensis*).
Common in the oak-hickory woodlands.
- **Southern Flying Squirrel** (*Glaucomys volans*).
Inhabits hollow trees to emerge only after darkness fills the wetlands.
- **Beaver** (*Castor canadensis*).
Discovered during the fall of 1977 after an approximate twenty year absence. Presently beaver inhabit Finis and Upper Shearneck Pools.
- **Rice Rat** (*Oryzomys palustris*).
Common in the salt marsh areas. Chiefly nocturnal.
- **White-footed Mouse** (*Peromyscus leucopus*).
Abundant in wooded and brushy areas. Very white belly.
- **Meadow Vole** (*Microtus pennsylvanicus*).
Abundant in grassy, upland fields and among the grasses of the salt marsh.



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

— **Muskrat** (*Ondatra zibethicus*).
Common in the freshwater impoundments and in the salt marsh.

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

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

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

— **Red Fox** (*Vulpes vulpes*).
Common in the upland habitats.

— **Gray Fox** (*Urocyon cinereoargenteus*).
Uncommon in the upland areas. Normally active by night.

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

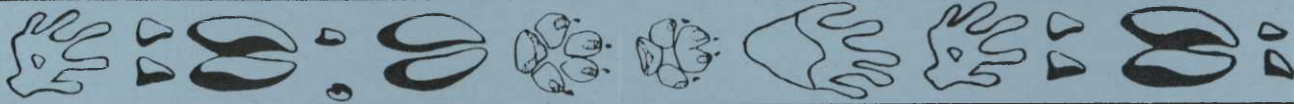
— **Longtail Weasel** (*Mustela frenata*).
A few are present in the upland areas.

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

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

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

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





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

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

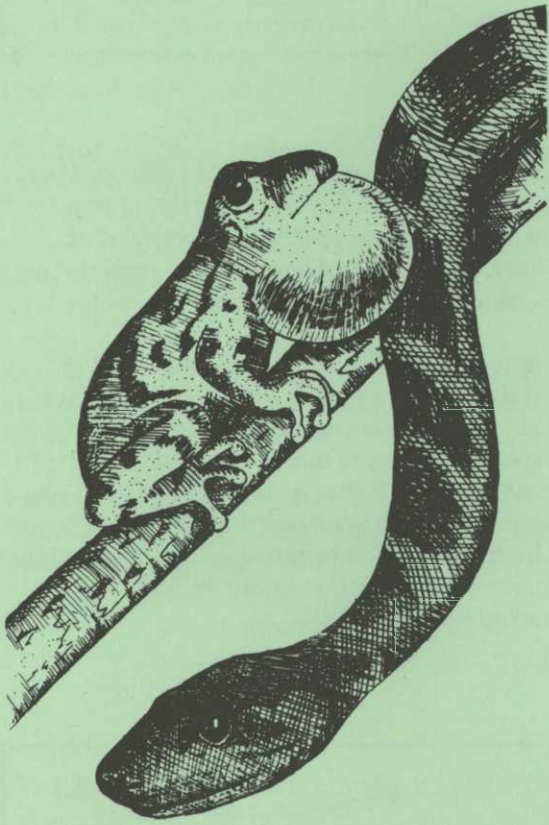


RL 51550-3
December 1984



**UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE**

REPTILES
and
AMPHIBIANS



BOMBAY HOOK

National Wildlife Refuge
Smyrna, Delaware

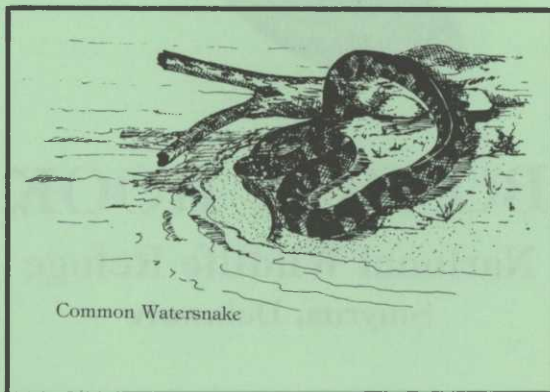
REPTILES

SNAKES



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

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



TURTLES

Snapping Turtle (*Chelydra serpentina*). Common in the freshwater pools. Also inhabits brackish waters. Lays eggs in the upland fields during the late spring.

Stinkpot (*Sternotherus odoratus*). Common. Lives in the freshwater pools.

Mud Turtle (*Kinosternon subrubrum*). More common than the stinkpot which it resembles. Inhabits fresh and brackish water.

Spotted Turtle (*Clemmys guttata*). Common. Inhabits shallow, freshwater in the pools, ponds, and ditches.

Box Turtle (*Terrapene carolina*). Common. This is a dry-land turtle most frequently seen in the woodlands.

Diamondback Terrapin (*Malaclemys terrapin*). Lives in the unpolluted salt marsh and brackish water habitats. Lays eggs on the dikes in late June and early July.

Painted Turtle (*Chrysemys picta*). The most frequently seen turtle. Basks in the warm sunlight on logs or stumps in the freshwater pools.

Red-bellied Turtle (*Pseudemys rubriventris*). Uncommon. Inhabits the freshwater pools. Basks like the painted turtle but is much larger.

LIZARDS

Five-lined Skink (*Eumeces fasciatus*). Lives in cut-over woodlands that have rotting stumps and logs. Mainly terrestrial, but can climb trees.

Water Snake (*Natrix sipedon*). Common in and about freshwater habitats.

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

Ribbon Snake (*Thamnophis sauritis*). A semi-aquatic snake found along the edges of the freshwater pools, swamps, and ditches.

Ringneck Snake (*Diadophis punctatus*). Secretive. Hides under stones and bark slabs in woodlands, especially near damp spots.

Racer (*Coluber constrictor*). A large snake, active during the day. Seen fairly frequently in the woods and along field edges.

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

Rat Snake (*Elaphe obsoleta*). A large, thick-bodied snake. Seen occasionally, usually in the upland woods or on field edges.

Kingsnake (*Lampropeltis getulus*). Uncommon. Often secretive, hiding under boards and logs. Hunts along the banks of freshwater pools and swamps.

Milk Snake (*Lampropeltis dolia*). Uncommon. Secretive about farm buildings and in fields and woods.

AMPHIBIANS

SALAMANDERS

Red-backed Salamander (*Plethodon cinereus*). A fairly common woodland salamander. Hides beneath logs, bark slabs, and stones during the daytime.

TOADS AND FROGS

Cricket Frog (*Acris crepitans*). Common. Inhabits the emergent and shoreside vegetation of the freshwater pools.

Spring Peeper (*Hyla crucifer*). Common. Congregate in early spring where shrubs stand in shallow water.

Chorus Frog (*Pseudacris triseriata*). Common. Congregate during the spring in low vegetation along the edges of freshwater pools and ponds.

Bullfrog (*Rana catesbeiana*). A common large frog of the freshwater pools.

Green Frog (*Rana clamitans*). Inhabits the shallow freshwater of the pools, ponds, and ditches.

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

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

Wood Frog (*Rana sylvatica*). Should be looked for in shallow, woodland pools during the early spring.

The 27 species on this list have been identified on the Bombay Hook Refuge by refuge personnel with cooperation from the staff of the Philadelphia Zoological Garden. Other species no doubt exist on the refuge and reports of their identification will be welcomed at the refuge headquarters.

JULY 1983

RL-51550-5

NOTES

For further information, contact:

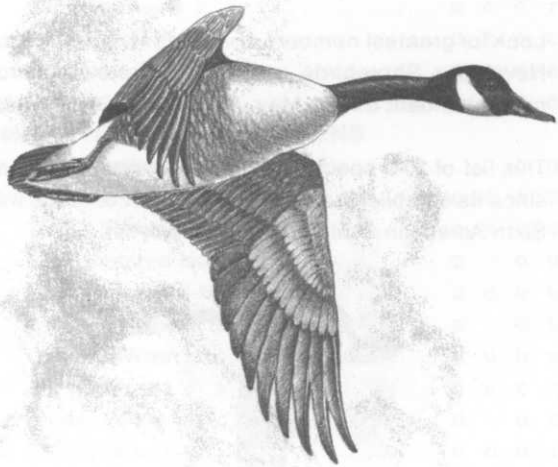
Refuge Manager
Bombay Hook National Wildlife Refuge
R.D. #1, Box 147
Smyrna, Delaware 19977
Telephone: (302) 653-9345

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interests of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in island territories under U. S. administration.



UNITED STATES
DEPARTMENT OF THE INTERIOR
Fish and Wildlife Service





BIRDS

of

BOMBAY HOOK

National Wildlife Refuge

Delaware

LARKS - SWALLOWS - JAYS and CROWS

Table listing bird species and their seasonal availability (S, F, W) for Larks, Swallows, Jays, and Crows.

TITMICE - NUTHATCHES - WRENS

Table listing bird species and their seasonal availability (S, F, W) for Titmice, Nuthatches, and Wrens.

KINGLETS - THRUSHES - THRASHERS

Table listing bird species and their seasonal availability (S, F, W) for Kinglets, Thrushes, and Thrashers.

WAXWINGS - SHRIKES - STARLING

Table listing bird species and their seasonal availability (S, F, W) for Waxwings, Shrikes, and Starlings.

VIREOS - WOOD WARBLERS

Table listing bird species and their seasonal availability (S, F, W) for Vireos and Wood Warblers.

Table listing bird species and their seasonal availability (S, F, W) for various warblers, parula, and other species.

TANAGERS - SPARROWS

Table listing bird species and their seasonal availability (S, F, W) for Tanagers and Sparrows.

Table listing bird species and their seasonal availability (S, F, W) for Fox Sparrow, Song Sparrow, and other species.

BLACKBIRDS - FINCHES

Table listing bird species and their seasonal availability (S, F, W) for Blackbirds and Finches.

A leaflet entitled "Accidental Birds of Bombay Hook" is available on request.

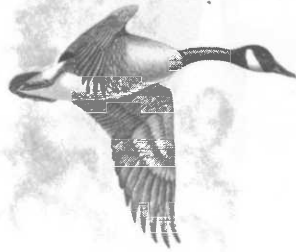
NOTES

Form for recording notes, including fields for Location, Date, Total, Observers, Weather, Wind, and Time.

BOMBAY HOOK NATIONAL WILDLIFE REFUGE lies low and flat on the Atlantic Coastal Plain along the western shore of Delaware Bay. Nearly two-thirds of its more than 15,000 acres spreads out into tidal salt marsh and cord-grass 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 list of 270 species of birds observed on the refuge since its establishment in 1937 is in accordance with the Sixth American Ornithologists' Check-list.



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

SEASON

s - Spring	March - May
S - Summer	June - August
F - Fall	September - November
W - Winter	December - February

† - Nesting has occurred on the refuge.

RELATIVE ABUNDANCE

a - abundant	a species which is very numerous.
c - common	certain 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	seen at intervals of 2 to 5 years.

LOONS - GREBES - COMORANT

___ 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 - IBISES

___ 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
___ White Ibis	r r
___ 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
___ Barnacle 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	u 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

LARKS - SWALLOWS - JAYS and CROWS

Table listing bird species and their status codes (s, S, F, W) for Larks, Swallows, Jays, and Crows.

TITMICE - NUTHATCHES - WRENS

Table listing bird species and their status codes (s, S, F, W) for Titmice, Nuthatches, and Wrens.

KINGLETS - THRUSHES - THRASHERS

Table listing bird species and their status codes (s, S, F, W) for Kinglets, Thrushes, and Thrashers.

WAXWINGS - SHRIKES - STARLING

Table listing bird species and their status codes (s, S, F, W) for Waxwings, Shrikes, and Starling.

VIREOS - WOOD WARBLERS

Table listing bird species and their status codes (s, S, F, W) for Vireos and Wood Warblers.

Table listing bird species and their status codes (s, S, F, W) for various Warblers, Parula, and other species.

TANAGERS - SPARROWS

Table listing bird species and their status codes (s, S, F, W) for Tanagers and Sparrows.

Table listing bird species and their status codes (s, S, F, W) for Fox Sparrow, Song Sparrow, and other species.

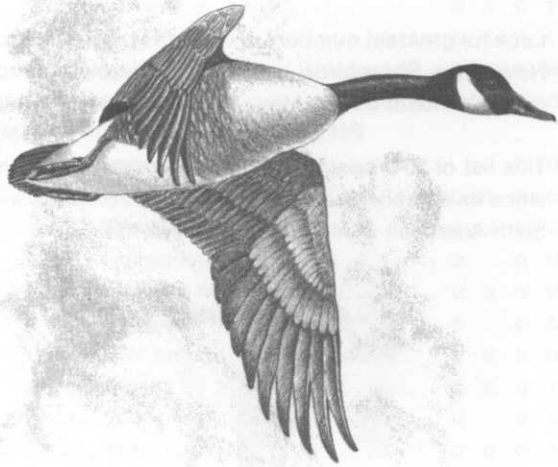
BLACKBIRDS - FINCHES

Table listing bird species and their status codes (s, S, F, W) for Blackbirds and Finches.

A leaflet entitled "Accidental Birds of Bombay Hook" is available on request.

NOTES

Form for recording notes, including fields for Location, Date, Total, Observers, Weather, Wind, and Time.



BIRDS

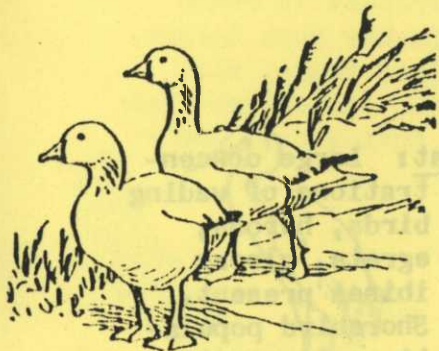
of

BOMBAY HOOK

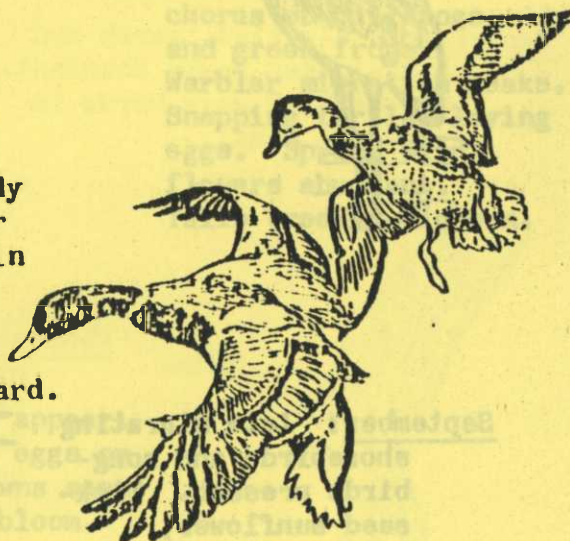
National Wildlife Refuge

Delaware

October: Best month for
avocets. Canada
geese arriving.
Daisy marigold in
blossom in fresh
water pools.



November: Fall peak of
migrant Canada
geese, snow geese
and ducks.



December: Numerous hardy
waterfowl and other
birds usually remain
all winter but the
first heavy freeze
speeds the less
hardy birds southward.

The refuge is open to visitors through daylight hours.
Further information is available from the Refuge Manager,
Rt. D. #1, Box 147, Smyrna, Delaware 19977, and the tele-
phone number is (302) 653-9345.

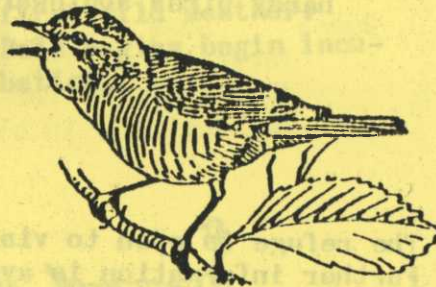


July: First shorebird migrants returning southward late in month. Many duck broods present in the impoundments.



August: Large concentrations of wading birds, herons, egrets, glossy ibises present. Shorebird populations increasing. Cardinal flower, rose mallow and meadow beauties in flower. First duck migrants.

September: Late migrating shorebirds and songbirds present. Tickseed sunflower, goldenrods and joe-pye-weeds in blossom.



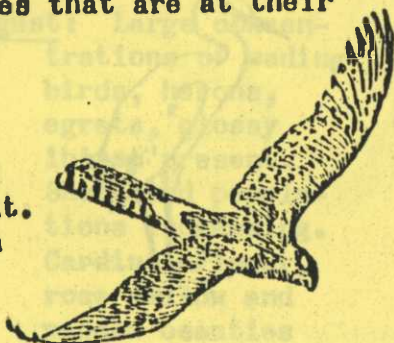


BOMBAY HOOK NATIONAL WILDLIFE REFUGE

CALENDAR OF NATURE EVENTS

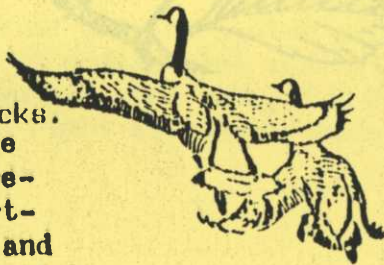
This calendar of the seasonal progression of the most interesting natural occurrences is meant to aid you in planning visits to Bombay Hook Refuge. The Tour Route, open through daylight hours, will provide an easy means of viewing the following--free of mosquitoes and greenhead flies that are at their worst June 15 to September 15.

January: Red-tailed, marsh and rough-legged hawks abundant. White-tailed deer herds in fields at dusk.

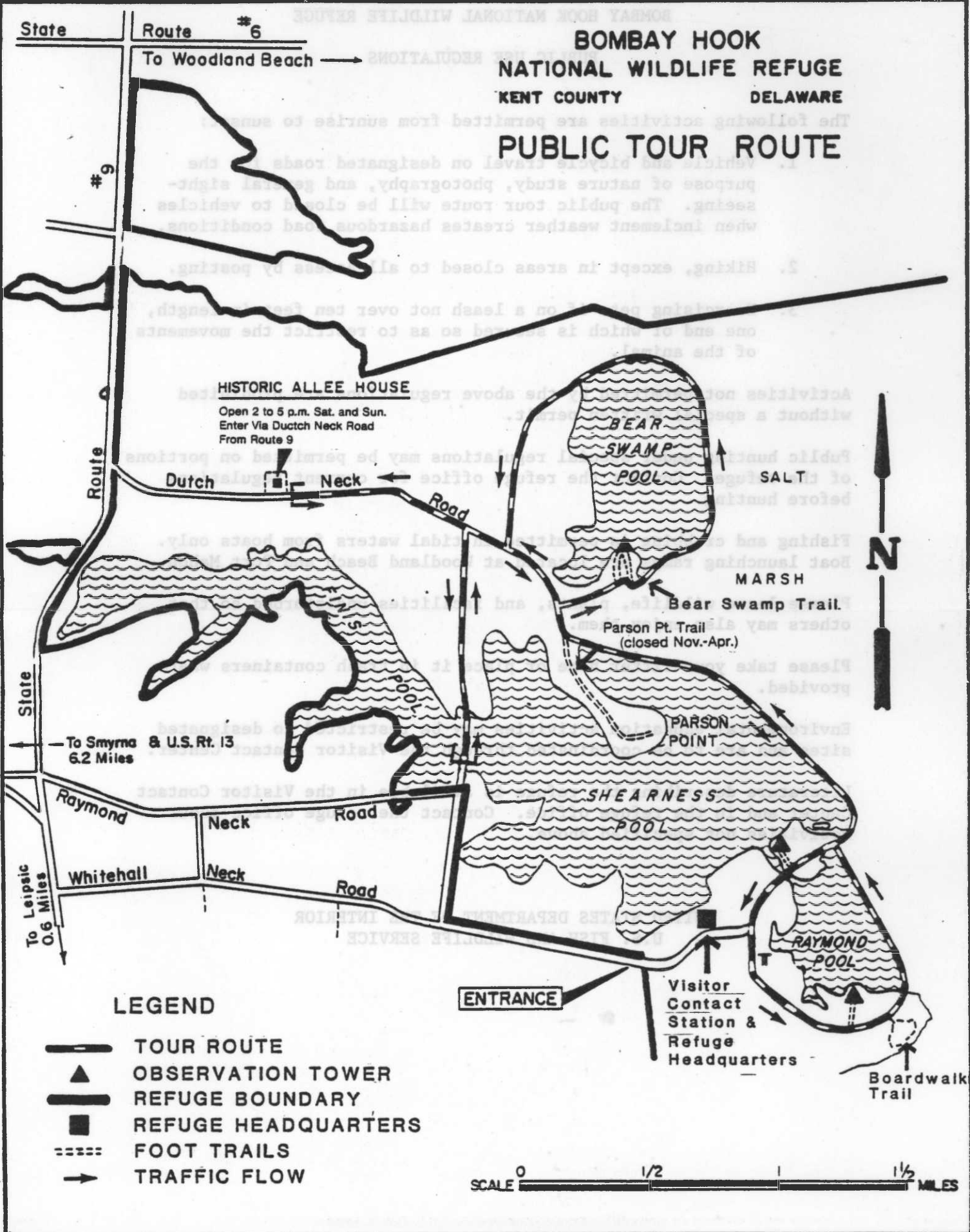


February: Large flocks of pintails arrive during first mild weather. Bald eagles begin incubation.







March: Spring peak of migrant Canada geese, snow geese, ducks. Woodchucks and turtles emerge from hibernation. Ospreys return to nest. Woodcock courtship flights occur. Alders and red maples flower.



**BOMBAY HOOK
NATIONAL WILDLIFE REFUGE
KENT COUNTY DELAWARE
PUBLIC TOUR ROUTE**



LEGEND

-  TOUR ROUTE
-  OBSERVATION TOWER
-  REFUGE BOUNDARY
-  REFUGE HEADQUARTERS
-  FOOT TRAILS
-  TRAFFIC FLOW



BOMBAY HOOK NATIONAL WILDLIFE REFUGE

PUBLIC USE REGULATIONS

The following activities are permitted from sunrise to sunset:

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

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

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

Fishing and crabbing is permitted in tidal waters from boats only. Boat launching ramps are located at Woodland Beach and Port Mahon.

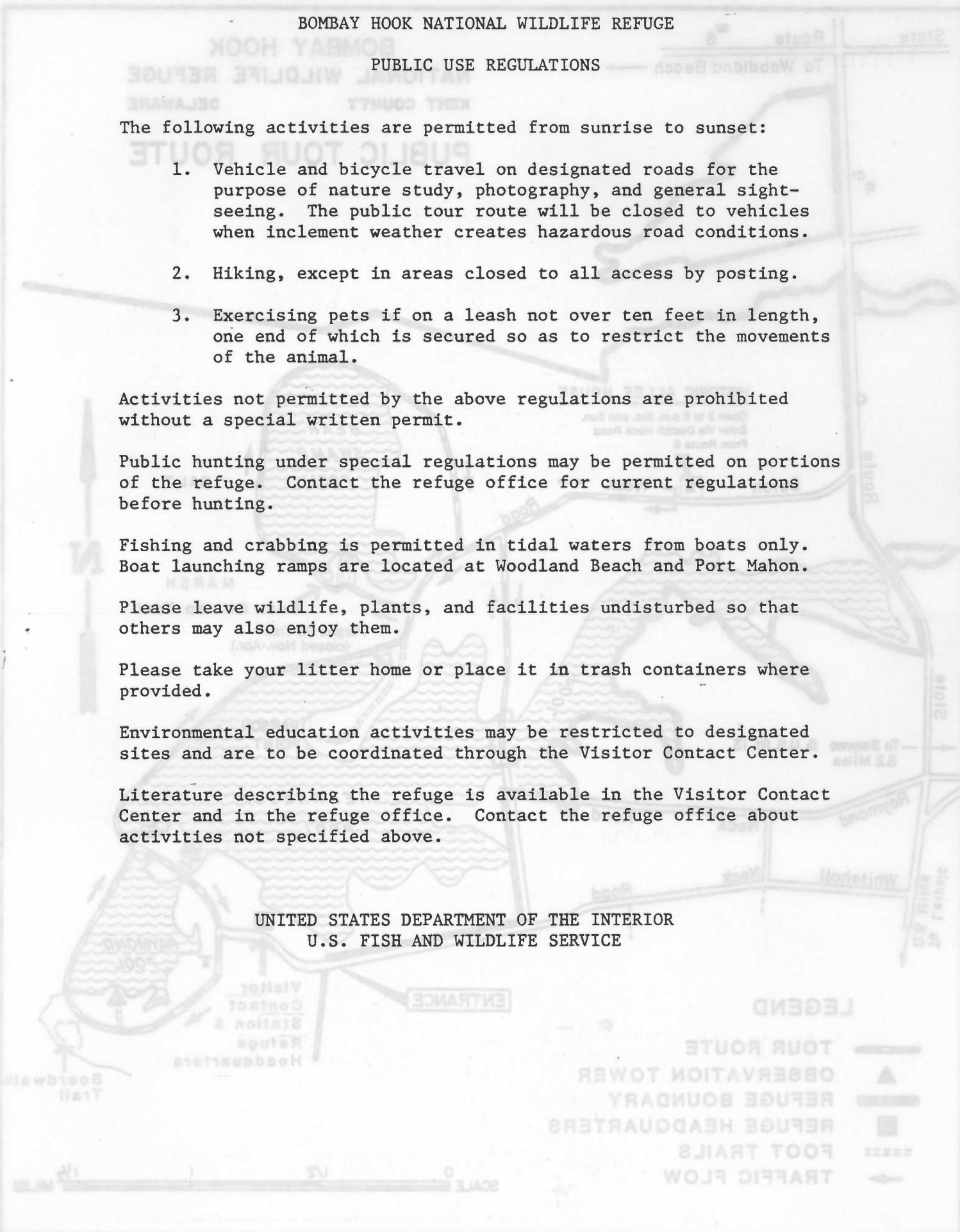
Please leave wildlife, plants, and facilities undisturbed so that others may also enjoy them.

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

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

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

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



LEGEND

- TOUR ROUTE (solid line)
- OBSERVATION TOWER (triangle)
- REFUGE BOUNDARY (dashed line)
- REFUGE HEADQUARTERS (square)
- FOOT TRAILS (dotted line)
- TRAFFIC FLOW (arrow)

SCALE 0 1/2 1 1 1/2 MILES

PROPOSAL TO TEACH

TITLE: Outdoor Environmental Education Workshop for Teachers

Course No. _____ 12 Hours 4/5 Inservice Credit

Course Description

Course will provide examples of environmental education activities and techniques that teachers can use with students on field trips to the Refuge or on school grounds. A refuge slide show, wildlife management tour, and birding will be included to acquaint teachers with Refuge. Course will cover basic ecology concepts through simulated activities and habitat studies. Workshop will also include plant and animal identification and classification techniques and use of field guides, techniques for studying pond-marsh-meadow-woodland habitats, use of sampling equipment and water test kits. Course will demonstrate how to learn about the environment with your students. A science background is not required. Ways of incorporating these activities into your present curriculum will be discussed. Teachers will also prepare short group activities during the last session. Please dress for outdoor activities. Bring a bag lunch. Meet at the Visitor Center.

Group: Delaware Teachers K-12 all curriculum areas welcome

Instructor(s): Marian Johnson Pohlman, Outdoor Recreation Planner

Bombay Hook National Wildlife Refuge, Smyrna, DE 19977

Date(s): April 19, 22, & 23, 1986

Time: Saturday 9:30-4:30, Tuesday & Wednesday - 4:00-7:00 p.m.

Location: Bombay Hook National Wildlife Refuge, Road 85, Smyrna, DE 19977

Submitted by: Marian Johnson Pohlman

Note: This form may be used for proposing courses of 1 credit or less. For proposing courses of more than 1 credit, forms may be obtained from the office of the Director, Certification and Personnel Division. Please offer courses of 3 hours or multiples thereof for 1/5, 2/5, 3/5, 4/5, or 1 credit hour. One credit equals 15 hours.

Approved: .

Supervisor, Cert. & Personnel Div.

Date: _____



UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
BOMBAY HOOK NATIONAL WILDLIFE REFUGE
R.D. #1, Box 147
Smyrna, Delaware 19977

Marian Johnson-Pohlman
Outdoor Recreation Planner
302 653 9345

ENVIRONMENTAL EDUCATION WORKSHOP AGENDA

April 19, 1986

- 9:30-10:30 Introduction to Course
Bombay Hook Slide Show
Activity: What Animal Am I
- 10:30-12:30 Meadow Study (Insect Sweep & ID, Plant ID,
Activities: Oh Deer, Sound Off, Population
Game, Seed Dispersal, Roots & Shoots)
- 12:30-1:30 Lunch
- 1:30-3:00 Forest Study (Search leaf litter & soil & under
logs for animals; Tree & Flower Identification)
- 3:00-4:30 Marsh Study (Netting of animals & identification;
water tests)

April 22, 1986

- 4:00-6:00 Spring Slide Show; Tour of Refuge and 1 trail;
Bird Identification
- 6:00-6:30 Clue Finder Activity
- 6:30-7:00 Review Resources

April 23, 1986

- 4:00-5:00 Divide into grade level groups and plan activity
- 5:00-6:30 Present activity to group
- 6:30-7:00 Wrap up and Evaluation

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

BOMBAY HOOK NATIONAL WILDLIFE REFUGE
SMYRNA, DELAWARE

WEST WATERFOWL HUNTING AREA

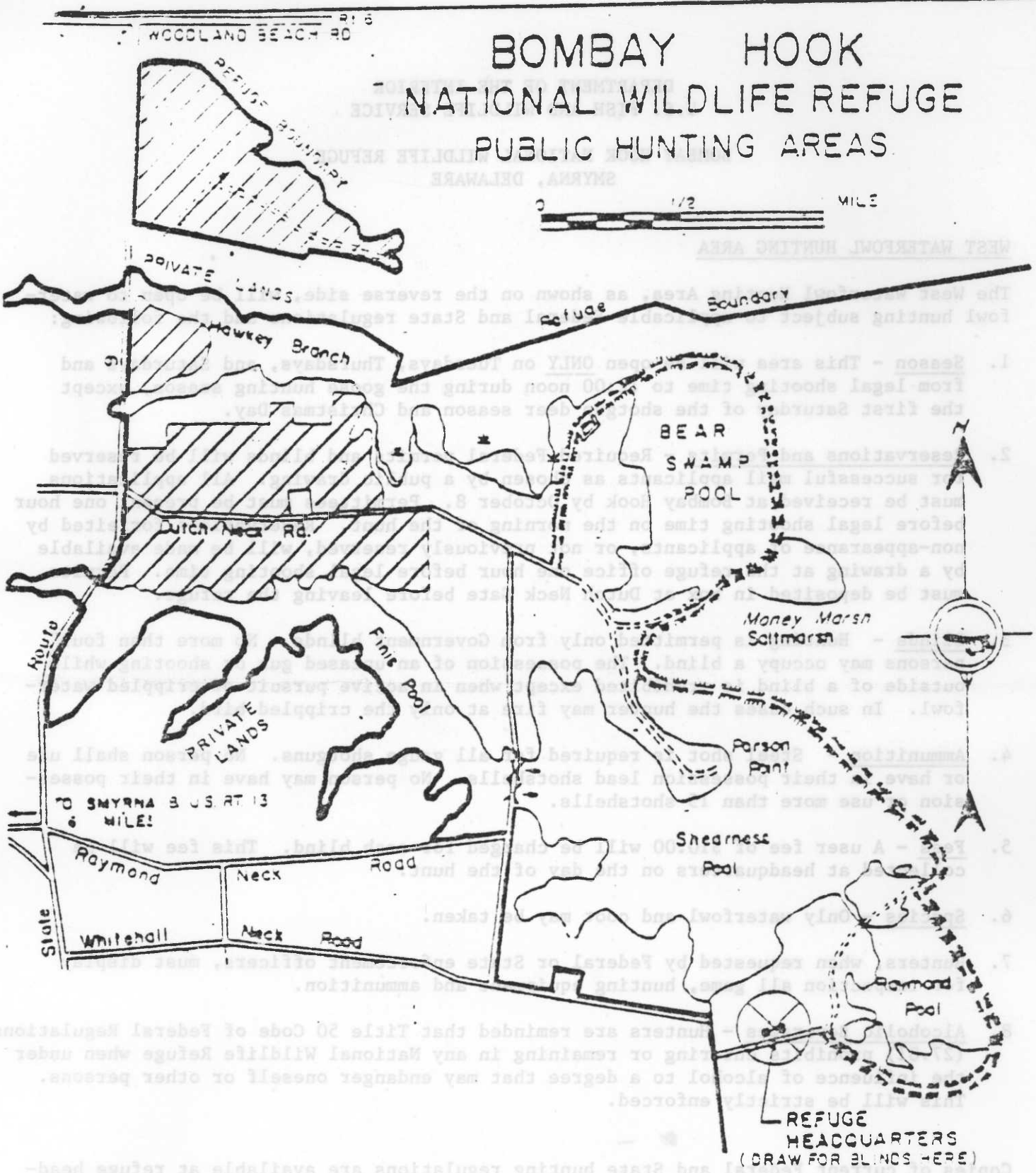
The West Waterfowl Hunting Area, as shown on the reverse side, will be open to waterfowl hunting subject to applicable Federal and State regulations and the following:


1. Season - This area will be open ONLY on Tuesdays, Thursdays, and Saturdays and from legal shooting time to 12:00 noon during the goose hunting season, except the first Saturday of the shotgun deer season and Christmas Day.
2. Reservations and Permits - Required Federal permits and blinds will be reserved for successful mail applicants as chosen by a public drawing. All applications must be received at Bombay Hook by October 8. Permittees must be present one hour before legal shooting time on the morning of the hunt. Reservations forfeited by non-appearance of applicants, or not previously reserved, will be made available by a drawing at the refuge office one hour before legal shooting time. Permits must be deposited in box at Dutch Neck Gate before leaving the refuge.
3. Blinds - Hunting is permitted only from Government blinds. No more than four persons may occupy a blind. The possession of an uncased gun or shooting while outside of a blind is prohibited except when in active pursuit of crippled waterfowl. In such cases the hunter may fire at only the crippled bird.
4. Ammunition - Steel shot is required for all gauge shotguns. No person shall use or have in their possession lead shotshells. No person may have in their possession or use more than 15 shotshells.
5. Fees - A user fee of \$10.00 will be charged for each blind. This fee will be collected at headquarters on the day of the hunt.
6. Species - Only waterfowl and coot may be taken.
7. Hunters, when requested by Federal or State enforcement officers, must display for inspection all game, hunting equipment and ammunition.
8. Alcoholic Beverages - Hunters are reminded that Title 50 Code of Federal Regulations (27.81) prohibits entering or remaining in any National Wildlife Refuge when under the influence of alcohol to a degree that may endanger oneself or other persons. This will be strictly enforced.


Copies of current Federal and State hunting regulations are available at refuge headquarters. For further information contact Refuge Manager, Bombay Hook National Wildlife Refuge, R.D. #1, Box 147, Smyrna, Delaware 19977, Telephone No. (302) 653-9345.

BOMBAY HOOK NATIONAL WILDLIFE REFUGE PUBLIC HUNTING AREAS.

0 1/2 MILE



 West Waterfowl Hunting Area

 Refuge Boundary

REFUGE HEADQUARTERS
(DRAW FOR BLINDS - HERE)

U.S. DEPARTMENT OF THE INTERIOR
U.S. FISH AND WILDLIFE SERVICE
BOMBAY HOOK NATIONAL WILDLIFE REFUGE
SMYRNA, DELAWARE

SOUTH WATERFOWL HUNTING AREA

THE SOUTH WATERFOWL HUNTING AREA AS DESIGNATED ON THE MAP ON THE REVERSE SIDE WILL BE OPEN TO HUNTING OF MIGRATORY WATERFOWL BY WRITTEN PERMIT SUBJECT TO APPLICABLE CURRENT STATE AND FEDERAL REGULATIONS AND THE FOLLOWING SPECIAL REGULATIONS AND PROVISIONS:

1. Season - Open only during duck season, on Mondays, Wednesdays, Fridays and Saturdays, except Christmas Day.
2. Permits - Permits will be issued at the checking station by a ticket-lottery system 1½ hours before legal shooting time until 3:00 p.m. each hunting day. Hunters arriving after the lottery will be issued permits on a first-come, first-served basis until 3:00 p.m.

All persons must leave the hunting area and turn in their permits at the checking station prior to one hour after sunset each hunting day.

3. Ammunition - The use of only steel shot is required in all gauge shotguns. No person shall use or have in their possession lead shotshells.
4. Blinds - Hunting is permitted only from Government blinds. No more than 3 persons may occupy a blind. To change blinds a new permit must be completed and another hunter fee paid at the checking station. The possession of an uncased gun or shooting while outside of a blind is prohibited except when in active pursuit of crippled waterfowl. In such cases the hunter may fire at only the crippled bird.
5. Boats - A boat is necessary to reach the blinds. Boats with motors are recommended.
6. Species - Only waterfowl and coot may be taken.
7. Closure - The area may be closed, completely or in part, without notice when wind, ice, abnormal tides, etc. make entry onto the hunting area hazardous.
8. Fees - A fee of \$2.00 per hunter will be charged. This fee must be paid prior to use of the blind.

SOUTH UPLAND HUNTING AREA

The South Upland Hunting Area is designated on the reverse side and as posted by signs, will be open to hunting without a permit in accordance with all applicable State and Federal Regulations. No hunting is permitted from March 1 through August 31. Lead shotshells are prohibited for use by waterfowl hunters. Copies of current State and Federal Regulations are available at the checking station at Port Mahon and at Refuge Headquarters. For further information contact Refuge Manager, Bombay Hook National Wildlife Refuge, R.D. #1, Box 147 Smyrna, Delaware 19977, Telephone No. (302) 653-9345

Hunters are reminded that Title 50 Code of Federal Regulations (27.81) prohibits entering or remaining in any National Wildlife Refuge when under the influence of alcohol to a degree that may endanger oneself or other persons. This will be strictly enforced.

BOMBAY HOOK National Wildlife Refuge

PUBLIC HUNTING AREAS

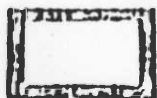
10 BLIND SITE & NO.



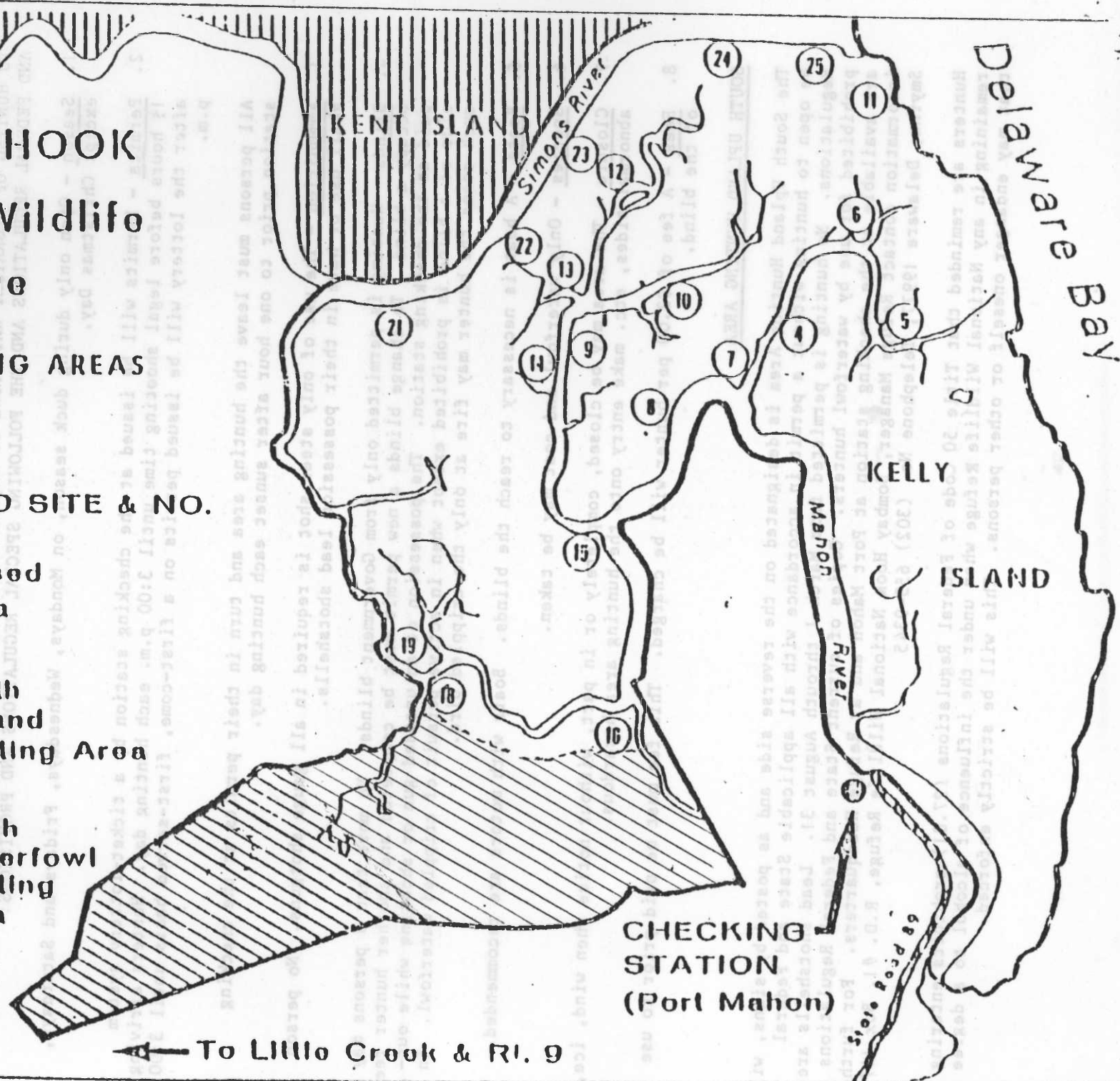
Closed
Area



South
Upland
Hunting Area



South
Waterfowl
Hunting
Area



U.S. DEPARTMENT OF THE INTERIOR
U.S. FISH AND WILDLIFE SERVICE
BOMBAY HOOK NATIONAL WILDLIFE REFUGE
SMYRNA, DELAWARE

SOUTH WATERFOWL HUNTING AREA

THE SOUTH WATERFOWL HUNTING AREA AS DESIGNATED ON THE MAP ON THE REVERSE SIDE WILL BE OPEN TO HUNTING OF MIGRATORY WATERFOWL BY WRITTEN PERMIT SUBJECT TO APPLICABLE CURRENT STATE AND FEDERAL REGULATIONS AND THE FOLLOWING SPECIAL REGULATIONS AND PROVISIONS:

1. Season - Open only during duck season, on Mondays, Wednesdays, Fridays and Saturdays, except Christmas Day.
2. Permits - Permits will be issued at the checking station by a ticket-lottery system $1\frac{1}{2}$ hours before legal shooting time until 3:00 p.m. each hunting day. Hunters arriving after the lottery will be issued permits on a first-come, first-served basis until 3:00 p.m.

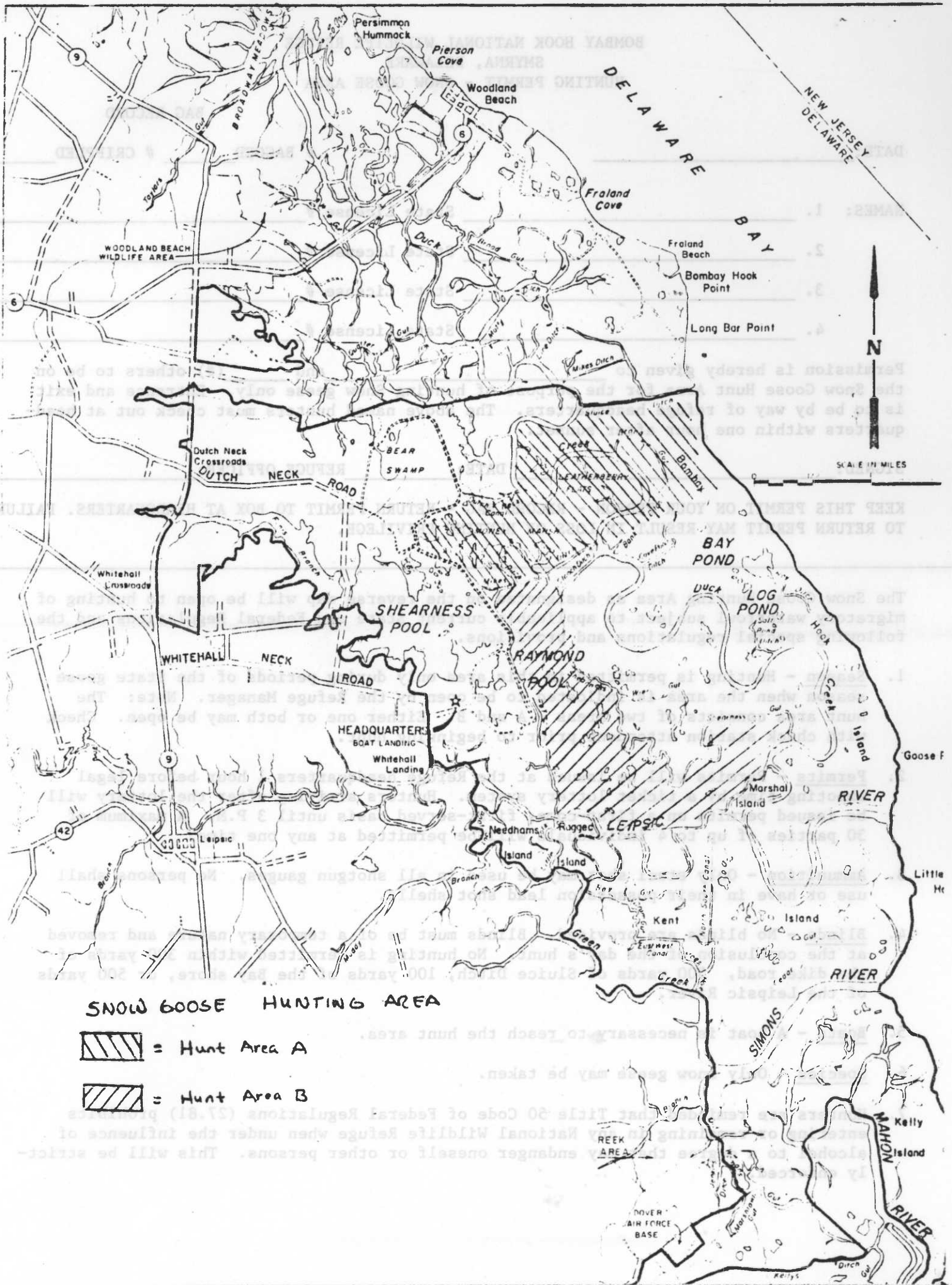
All persons must leave the hunting area and turn in their permits at the checking station prior to one hour after sunset each hunting day.

3. Ammunition - The use of only steel shot is required in all gauge shotguns. No person shall use or have in their possession lead shotshells.
4. Blinds - Hunting is permitted only from Government blinds. No more than 3 persons may occupy a blind. To change blinds a new permit must be completed and another hunter fee paid at the checking station. The possession of an uncased gun or shooting while outside of a blind is prohibited except when in active pursuit of crippled waterfowl. In such cases the hunter may fire at only the crippled bird.
5. Boats - A boat is necessary to reach the blinds. Boats with motors are recommended.
6. Species - Only waterfowl and coot may be taken.
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8. Fees - A fee of \$2.00 per hunter will be charged. This fee must be paid prior to use of the blind.

SOUTH UPLAND HUNTING AREA

The South Upland Hunting Area is designated on the reverse side and as posted by signs, will be open to hunting without a permit in accordance with all applicable State and Federal Regulations. No hunting is permitted from March 1 through August 31. Lead shotshells are prohibited for use by waterfowl hunters. Copies of current State and Federal Regulations are available at the checking station at Port Mahon and at Refuge Headquarters. For further information contact Refuge Manager, Bombay Hook National Wildlife Refuge, R.D. #1, Box 147 Smyrna, Delaware 19977, Telephone No. (302) 653-9345

Hunters are reminded that Title 50 Code of Federal Regulations (27.81) prohibits entering or remaining in any National Wildlife Refuge when under the influence of alcohol to a degree that may endanger oneself or other persons. This will be strictly enforced.



BOMBAY HOOK NATIONAL WILDLIFE REFUGE
SMYRNA, DELAWARE
HUNTING PERMIT - SNOW GOOSE AREA

BAG RECORD

DATE: _____ # BAGGED _____ # CRIPPLED _____

NAMES: 1. _____ State License # _____
2. _____ State License # _____
3. _____ State License # _____
4. _____ State License # _____

Permission is hereby given to _____ and _____ (#) others to be on the Snow Goose Hunt Area for the purpose of hunting Snow geese only. Entrance and exit is to be by way of refuge headquarters. The above named hunters must check out at headquarters within one hour after sunset.

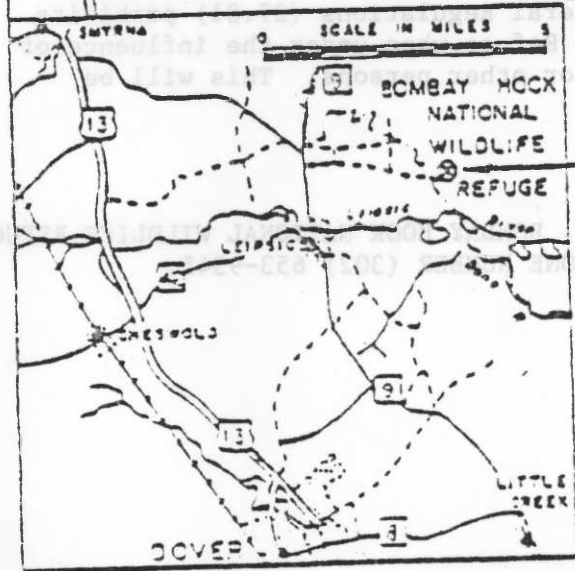
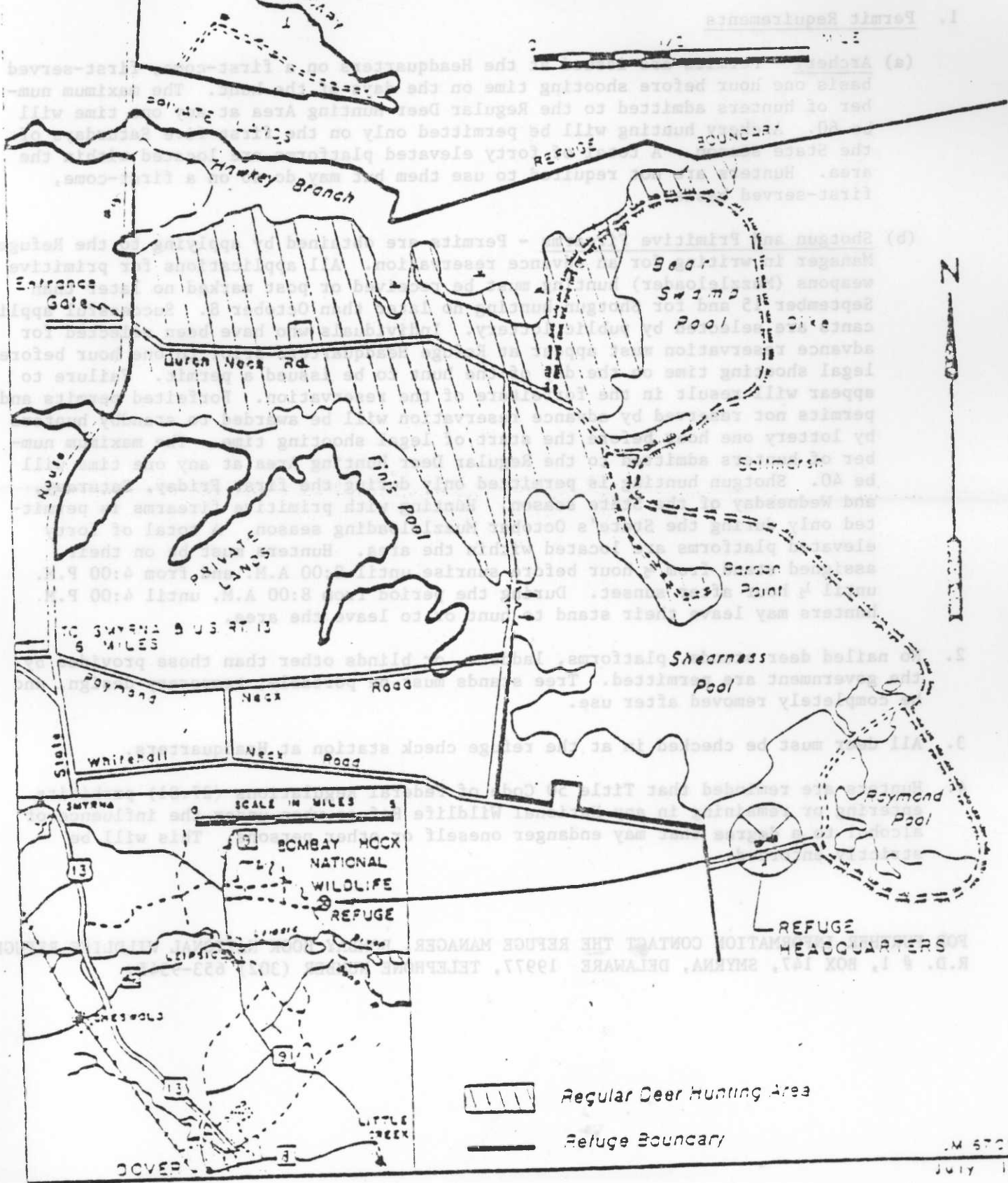
SIGNED: _____ DATE: _____ REFUGE OFFICER: _____



KEEP THIS PERMIT ON YOUR PERSON - RECORD BAG - RETURN PERMIT TO BOX AT HEADQUARTERS. FAILURE TO RETURN PERMIT MAY RESULT IN LOSS OF HUNTING PRIVILEGE.

The Snow Goose Hunting Area as designated on the reverse map will be open to hunting of migratory waterfowl subject to applicable current State and Federal Regulations and the following special regulations and provisions.

1. Season - Hunting is permitted in this area only during periods of the State goose season when the area is indicated to be open by the Refuge Manager. Note: The hunt area consists of two areas - A and B. Either one or both may be open. Check with check station attendant prior to beginning hunt.
2. Permits - Permits will be issued at the Refuge headquarters 1 hour before legal shooting time by a ticket lottery system. Hunters arriving after the lottery will be issued permits on a first-come, first-served basis until 3 P.M. A maximum of 30 parties of up to 4 individuals will be permitted at any one time.
3. Ammunition - Only steel shot may be used in all shotgun gauges. No persons shall use or have in their possession lead shot shells.
4. Blinds - No blinds are provided. Blinds must be of a temporary nature and removed at the conclusion of the day's hunt. No hunting is permitted within 300 yards of the dike road, 500 yards of Sluice Ditch, 100 yards of the Bay shore, or 500 yards of the Leipsic River.
5. Boats - A boat is necessary to reach the hunt area.
6. Species - Only snow geese may be taken.
7. Hunters are reminded that Title 50 Code of Federal Regulations (27.81) prohibits entering or remaining in any National Wildlife Refuge when under the influence of alcohol to a degree that may endanger oneself or other persons. This will be strictly enforced.

BOMBAY HOOK NATIONAL WILDLIFE REFUGE DEER HUNTING AREA



 Regular Deer Hunting Area
 Refuge Boundary

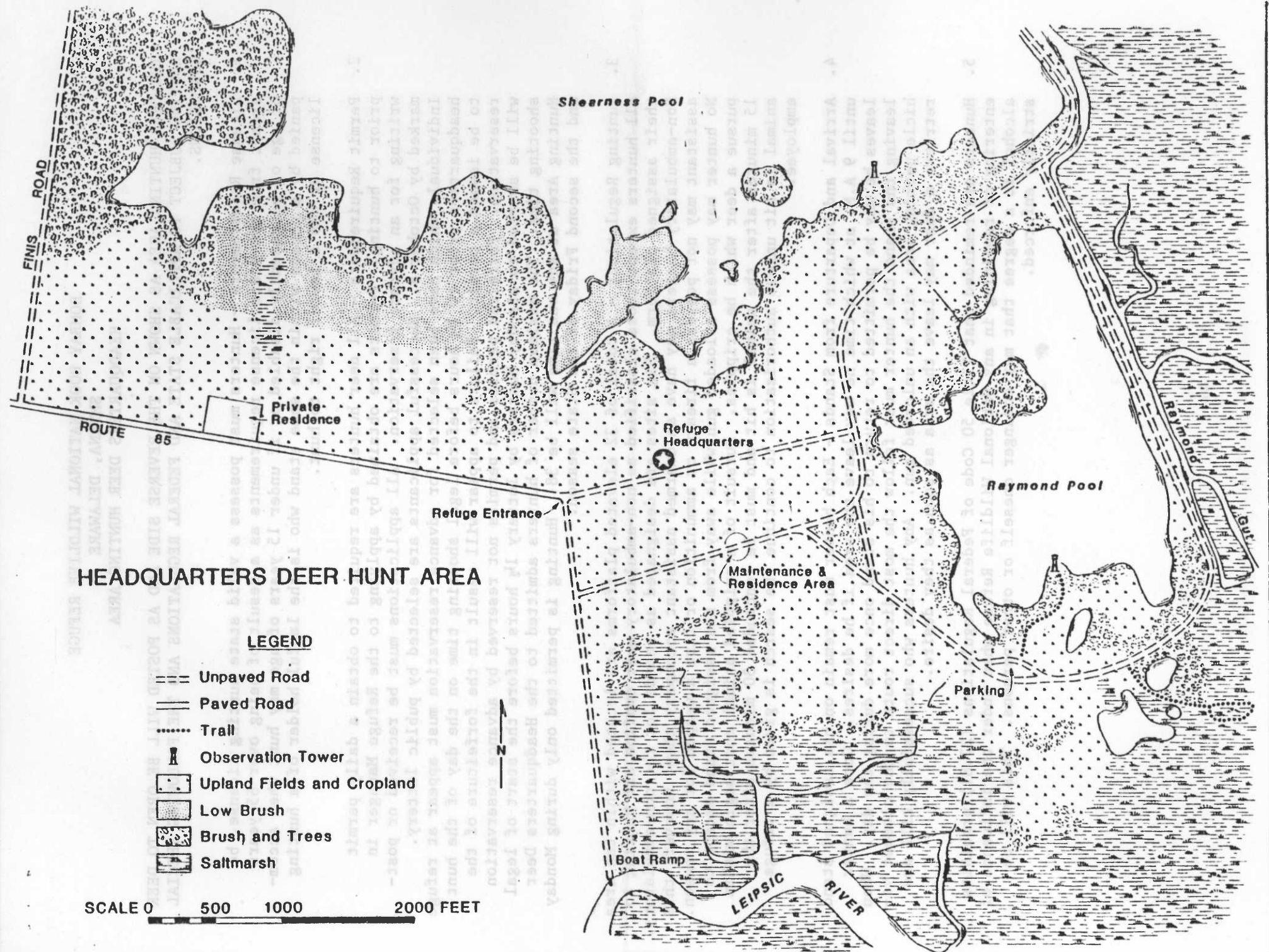
BOMBAY HOOK NATIONAL WILDLIFE REFUGE
SMYRNA, DELAWARE
REGULAR DEER HUNTING AREA

THE DEER HUNTING AREA AS SHOWN ON THE REVERSE SIDE AND AS POSTED WILL BE OPEN TO DEER HUNTING SUBJECT TO APPLICABLE STATE AND FEDERAL REGULATIONS AND THE FOLLOWING SPECIAL CONDITIONS.

1. Permit Requirements

- (a) Archery - Permits are issued at the Headquarters on a first-come, first-served basis one hour before shooting time on the days of the hunt. The maximum number of hunters admitted to the Regular Deer Hunting Area at any one time will be 60. Archery hunting will be permitted only on the first five Saturdays of the State season. A total of forty elevated platforms are located within the area. Hunters are not required to use them but may do so on a first-come, first-served basis.
 - (b) Shotgun and Primitive Firearms - Permits are obtained by applying to the Refuge Manager in writing for an advance reservation. All applications for primitive weapons (Muzzleloader) hunting must be received or post marked no later than September 15 and for Shotgun hunting no later than October 8. Successful applicants are selected by public lottery. Individuals who have been selected for advance reservation must appear at Refuge Headquarters prior to one hour before legal shooting time on the day of the hunt to be issued a permit. Failure to appear will result in the forfeiture of the reservation. Forfeited permits and permits not reserved by advance reservation will be awarded to standby hunters by lottery one hour before the start of legal shooting time. The maximum number of hunters admitted to the Regular Deer Hunting Area at any one time will be 40. Shotgun hunting is permitted only during the first Friday, Saturday, and Wednesday of the State season. Hunting with primitive firearms is permitted only during the State's October Muzzleloading season. A total of forty elevated platforms are located within the area. Hunters must be on their assigned stand from $\frac{1}{2}$ hour before sunrise until 8:00 A.M. and from 4:00 P.M. until $\frac{1}{2}$ hour after sunset. During the period from 8:00 A.M. until 4:00 P.M. hunters may leave their stand to hunt or to leave the area.
2. No nailed deer stands, platforms, ladders, or blinds other than those provided by the government are permitted. Tree stands must be portable, temporary design, and be completely removed after use.
 3. All deer must be checked in at the refuge check station at Headquarters.
 4. Hunters are reminded that Title 50 Code of Federal Regulations (27.81) prohibits entering or remaining in any National Wildlife Refuge when under the influence of alcohol to a degree that may endanger oneself or other persons. This will be strictly enforced.

FOR FURTHER INFORMATION CONTACT THE REFUGE MANAGER, BOMBAY HOOK NATIONAL WILDLIFE REFUGE, R.D. # 1, BOX 147, SMYRNA, DELAWARE 19977, TELEPHONE NUMBER (302) 653-9345.



Shearness Pool

FINIS ROAD

ROUTE 85

Private Residence

Refuge Headquarters

Refuge Entrance

Raymond Pool

Raymond

HEADQUARTERS DEER HUNT AREA

LEGEND

- Unpaved Road
- Paved Road
- Trail
- 🗿 Observation Tower
- Upland Fields and Cropland
- Low Brush
- Brush and Trees
- Saltmarsh



SCALE 0 500 1000 2000 FEET

Boat Ramp

LEIPSIC RIVER

Parking

Maintenance & Residence Area

BOMBAY HOOK NATIONAL WILDLIFE REFUGE
SMYRNA, DELAWARE
HEADQUARTERS DEER HUNTING AREA

THE DEER HUNTING AREA AS SHOWN ON THE REVERSE SIDE AND AS POSTED WILL BE OPEN TO DEER HUNTING SUBJECT TO APPLICABLE STATE AND FEDERAL REGULATIONS AND THE FOLLOWING SPECIAL CONDITIONS.

1. License Requirements - Hunters must possess a valid state hunting license, be exempt from the state license requirements as a result of being over 65 years of age or permanently disabled or if under 15 years of age may hunt when accompanied by a person within the same stand who is the lawful holder of a hunting license or has a lawful right to hunt.
2. Permit Requirements - All deer hunters are required to obtain a daily permit prior to hunting. Permits are obtained by applying to the Refuge Manager in writing for an advance reservation. All applications must be received or post-marked by October 8. Successful applicants are selected by public lottery. Individuals which have been selected for advance reservation must appear at refuge headquarters prior to 1½ hours before legal shooting time on the day of the hunt to be issued a permit. Failure to appear will result in the forfeiture of the reservation. Forfeited permits and permits not reserved by advance reservation will be awarded to standby hunters by lottery 1½ hours before the start of legal shooting time. The maximum number of hunters admitted to the Headquarters Deer Hunting Area at any one time will be 38. Hunting is permitted only during Monday and the second Friday of the State season.
3. Hunting Regulations - A total of 32 elevated platforms are located within the area. All hunters except those classified as non-ambulatory must confine all hunting to their assigned platform. Six sites are designated as stands for the non-ambulatory. Non-ambulatory hunters may have an unarmed assistant accompany them, however, this assistant may not possess a firearm or ammunition or fire a weapon for any reason. No hunter may possess a loaded gun while away from his assigned stand except to pursue a deer which he cripples. Pursuit of a crippled animal must begin within 15 minutes after the animal is hit and must be concluded 30 minutes after the animal is hit unless authorization to continue the search is given by a refuge employee.
4. Arrival and Departure from Stands - Each hunter must remain on his assigned stand until 9 A.M. at which time he may leave the area if he desires. Once a hunter leaves he may be permitted to return to his stand once more during the day. When leaving the stand the hunter must follow the most direct route to the closest vehicle parking area with an unloaded gun. Any hunters who successfully kill and retrieve a deer may leave the area as soon as they desire.
5. Hunters are reminded that Title 50 Code of Federal Regulations (27.81) prohibits entering or remaining in any National Wildlife Refuge when under the influence of alcohol to a degree that may endanger oneself or other persons. This will be strictly enforced.