REVIEW AND APPROVALS

MACKAY ISLAND NATIONAL WILDLIFE REFUGE

CURRITUCK NATIONAL WILDLIFE REFUGE
Currituck County, North Carolina
and
Virginia Beach, Virginia

ANNUAL NARRATIVE REPORT

Calendar Year 1993

Kenneth F. Merritt — Refuge Manager — 4/29/94 — Date

Bill A. Gabriel — Associate Manager Review — 5/10/94 — Date

James A. Hales Jr — Regional Office Approval — 6-3-94 — Date

INTRODUCTION

Mackay Island National Wildlife Refuge (NWR) was established in 1961 as a wintering area for greater snow geese and feeding habitat for other migratory birds - primarily waterfowl. It is located on the north side of Currituck Sound which has been long recognized for supporting significant migratory waterfowl populations and tremendous sport fisheries resources.

Major land acquisition (approximately 7,111 acres) for the refuge was completed in the early 1960's. A Boundary Expansion Project initiated in 1989, promised to add another 1,340 acres through donation and matching grants. In 1989, the refuge entered a lease with The Conservation Fund and The Knapp Foundation to manage 760.18 acres. In 1993, 637 of the leased acres were donated to the Refuge by the Knapp Foundation. The remaining leased lands are to be donated to the Service at a future date. Additionally, a 72 acre parcel (which is part of the boundary expansion plan) was acquired in 1992 from The Conservation Fund. To date, the refuge land size is 8,565 acres. Approximately 85% of the refuge is situated in North Carolina with the remainder in Virginia. Virtually all acreage is under active management.

Mackay Island NWR is actually a composite area consisting of Mackay Island and parts of Knotts Island west of Highway 615. The refuge is bounded on the north by Back Bay and to the east by the North Carolina Outer Banks. Connection to the mainland from Knotts Island is by Highway 615 (the Causeway) that cuts east to west through the refuge. The refuge maintains a gravel road connecting Knotts Island and Mackay Island. Elevations range from 0 to 10 feet above sea level. Table 1 shows the acreage of each habitat type/land use.

TABLE 1

HABITAT TYPE	APPROXIMATE ACRES	PERCENTAGE
Wetland-Estuarine	6,362	72.2
Woodland	1,507	19.0
Buildings, Roads, Etc.	289	3.6
Cropland	220	2.8
Brush	187	2.4
TOTAL	8,565	100.00%

Historically, salinity levels in the surrounding waters of Back Bay and Currituck Sound have fluctuated between 1-10% sea strength. Most often they were below 10% and normally between 3-8%. In the early 1980s salinity levels had exceeded 10% but more recently, salinity has ranged between 1-3%. Submerged aquatic vegetation (SAV) had been abundant in these waters but this is no longer true. The declines in SAV (Miriophyllum, Potomogeton, Vallisneria, Ruppia, etc.) are not fully explained but speculative causes range from salinity to agricultural and urban effluent.

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A. HIGHLIGHTS

Storm of the Century (Section B.).

Migratory Bird Conservation Commission awards $350,000 for land acquisition after selection of Mackay Island Boundary Expansion Project; this project was funded by the North American Wetlands Conservation Act (NAWCA). The Knapp Foundation donates 637 acres of land in December as a contribution to the Refuge Expansion Project (Section C.1.).

Refuge Manager Elizabeth Souheaver transfers and is replaced by Ken Merritt (Section E.1.).

3,100 hours of volunteer time donated to the refuge. (Section E.4.).

B. CLIMATIC CONDITIONS

It was not a typical weather year. The 1992-93 winter temperatures, however, were similar to those of the last few winters - mild with only 13 freezing days occurring in January and February. The middle of the summer was quite hot and dry with only about 3 inches of rain recorded during July and August. Annual precipitation was below average with 38.19 inches of rain falling on the refuge.

TABLE 2
MACKAY ISLAND NATIONAL WILDLIFE REFUGE
ANNUAL WEATHER REPORT - 1993

MONTH	PRECIPITATION	TEMPERATURE HIGH	TEMPERATURE LOW	FREEZE DAYS
January	5.96	67	27	4
February	2.0	66	20	9
March	4.79	65	23	6
April	3.04	74	40	0
May	1.29	85	49	0
June	3.79	96	52	0
July	1.28	97	66	0
August	1.60	95	62	0
September	4.95	94	55	0
October	4.84	82	44	0
November	1.30	80	38	0
December	3.35	65	17	9

The refuge experienced a severe winter wind storm on March 13 that was generally referred to as the "Storm of the Century" along the Atlantic seaboard. While other areas further north were blanketed in snow, most of the storm at Mackay Island consisted of high winds that lasted a day and one-half with strong sustained winds blowing from the southwest.

Local area wind speeds were recorded as high as 85 mph. The sustained high winds brought forth 100 year high tides that measured double (3.0 above mean sea level-msl) the height of our mean annual high tide (1.5 msl) level. These high winds and tides caused wide spread flooding in low areas and roads, caused significant erosion behind refuge bulkheads, blew substantial numbers of shingles off of the refuge quarters and office buildings, and uprooted and blew over trees throughout the refuge. Residents of Knotts Island lost power for approximately two days due to powerline poles being blown down along the Knotts Island Causeway.

There's a road next to this pump house. A high wind tide from the Storm of the Century covered Mackay Island Road in many spots. 3/93 MP

Recovery from the storm included a large patch job on the roof of the refuge quarters and clearing of refuge roads and grounds of numerous trees and limbs.

C. LAND ACQUISITION

1. Fee Title

After being selected by the North American Wetlands Conservation Council in late 92 the land acquisition proposal was forwarded to the Migratory Bird Conservation Commission. $350,000 was awarded in 93 for the purchase of lands identified in the Mackay Island Boundary Expansion Project. The Knapp Foundation and Ducks Unlimited were recognized as cooperative partners in the NAWCA proposal due to a generous land donation and marsh money contribution.

636.73 acres belonging to The Knapp Foundation, Inc. were donated to the Service on December 23, 1993. This parcel is located near the headquarters and consists of valuable marsh, pine woodlands, and croplands.

High appraisals completed by The Conservation Fund's Contractor slowed progress on acquiring land within our expanded acquisition boundary with our reality office asking for a review. No purchases were made with the NAWCA funds by the end of the year.

D. PLANNING

4. Compliance with Environmental and Cultural Resource Mandates

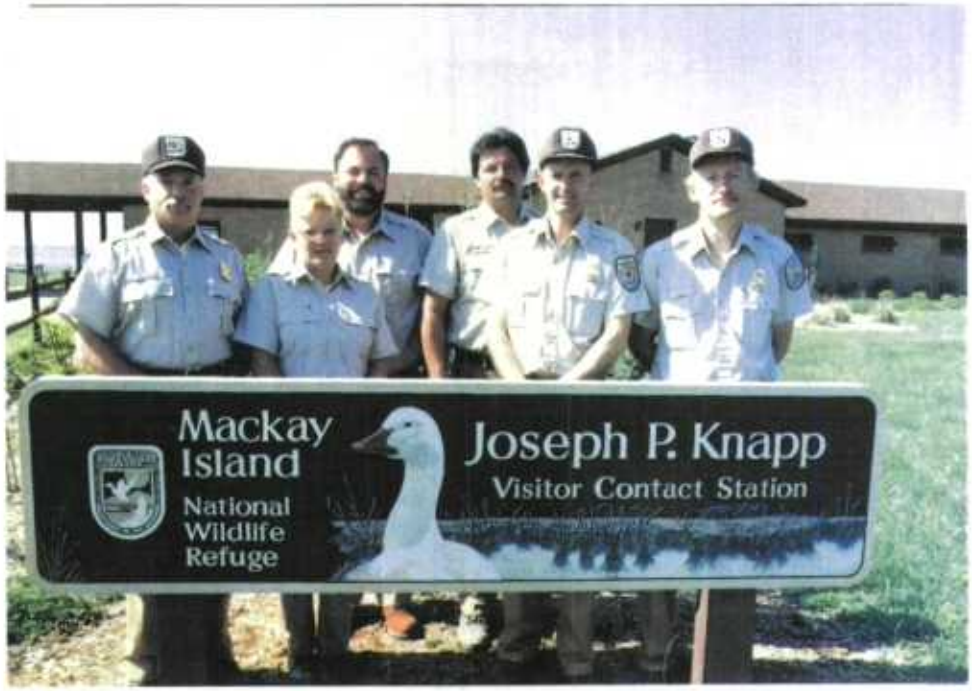
In November 1990, an Environmental Assessment for dike rehabilitation at the Kitchin Tract was prepared, submitted to the Regional Office, and approved by the Regional Director. The assessment was included with an application to the U.S. Army Corps of Engineers (COE) for permission to rehabilitate a 110-acre water impoundment. In February 1991, a denial for the permit was issued by COE due to unfavorable reviews by North Carolina Division of Coastal Management (CAMA), National Marine Fisheries Service (NMFS), and Environmental Protection Agency (EPA). The review agencies concerns focused on the project's negative impacts to the fisheries resource, degradation of water quality, and the loss of 8.2 acres of wetland habitat. During 1993, numerous consultations took place between the refuge staff and commenting agencies including: North Carolina Division of Coastal Management, North Carolina Department of Environmental Management, U.S. Army Corps of Engineers, National Marine Fisheries Service, and North Carolina Division of Marine Fisheries. After receiving the various comments the proposed action listed in the Environmental Assessment was changed from Alternative number 4 to number 3. This change results in moving the management of the impoundment from a moist soil regime to a permanent water (SAV) environment. Several other changes were also made in facility design to satisfy the various agencies concerns. A revised permit package was completed in early 1994.

E. ADMINISTRATION

1. Personnel

1. Kenneth L. Merritt	Refuge Manager EOD 08/22/93	GS-11 PFT
1a. Elizabeth A. Souheaver (Not Pictured)	Refuge Manager Transferred 03/21/93	GS-11 PFT
2. Ben G. Nottingham	Ass't Refuge Manager EOD 08/11/91	GS-09 PFT
3. Peggy VanZant	Office Assistant EOD 01/13/92	GS-05 PFT
4. Timothy G. Williams	Engr. Equip. Operator EOD 04/21/85	WG-08 PFT
5. Michael R. Panz	Law Enforcement Officer EOD 09/28/86	GS-07 PFT

6.	Robert Futrell	Maintenance Mechanic EOD 07/01/90	WG-10 PFT
7.	Jason Davenport (Not Pictured)	Forestry Technician Terminated 10/04/93	GS-04 TFT
8.	Wayne Cason (Not Pictured)	Forestry Technician Terminated 11/09/93	GS-04 TFT
9.	David H. Wales (Not Pictured)	Forestry Technician EOD 11/08/93	GS-04 TFT



Right to Left: (5) Mike Panz, (3) Peggy VanZant, (4) Timothy Williams, (6) Robert Futrell, (2) Ben Nottingham, (1) Kenneth Merritt 4/94 BN

The staffing pattern for the past four years is depicted below:

TABLE 3

	PFT	PT	TEMP	VACANT (PFT)	TOTAL FTE's
1993	6.0	-0-	.85	-0-	6.85
1992	6.0	-0-	.85	-0-	6.85
	4.9	-0-	.5	1.1	6.50
1991	5.8	-0-	1.4	.20	7.40
1990	6.0	-0-	-0-	-0-	6.0

Refuge Manager Elizabeth Souheaver transferred in March to the Southeast Louisiana Refuge Complex to take the position of Deputy Project Leader. Ken Merritt replaced Elizabeth in August after transferring from Lake Ophelia Refuge Complex where he was Project Leader. Personnel problems continue to plague our firefighting program. Wayne Cason returned this year on November 1 but resigned shortly thereafter due to family reasons. Jason Davenport decided not to return after completing his appointment in the spring. David Wales was hired in November to replace Jason. As in the past, we had difficulty finding willing candidates to fill open positions and did not replace Wayne this year.
Assistant Manager Ben Nottingham is now certified to take samples for drug testing and this has been a big help in reducing the time it takes to get someone on board after selection.

2. Youth Programs

The YCC program was again successful this year with two enrollees performing tasks including: general maintenance, brush control, wood duck banding, vehicle maintenance, boundary posting, piping plover surveys, and office support.

Amy Ruffin and Timothy Williams performed admirably during their 1993 YCC tour. 8/93 BN

3. Other Manpower Programs

The refuge participated in the State Community Service Program for the first time in several years. Between April and November, 72 hours of work were received from two individuals who were required to perform community service as part of their sentencing - Ground maintenance, general labor and custodial services at the office headquarters and check station were received.

4. Volunteer Program

The volunteer program continued to operate at a high level of participation. Though down somewhat from the hours contributed last year, more than 3,100 hours were donated in 1993. Fifty-six individuals volunteered their time in a variety of jobs including public use, maintenance, administration, and resources management.

Most notable was the volunteer assistance provided by the Currituck Chapter of Ducks Unlimited in co-sponsoring the annual kids fishing day. Twenty-one volunteers accumulated approximately 2,500 hours from January to June. Take Pride in America awards were presented to the Currituck DU Chapter and the Kids Fishing Day Coordinator, Mr. Jackie Simmons, for their contributions.

Volunteers also helped with six outreach events including the Knott's Island Peach Festival, Soil Conservation Environmental Field Day, Currituck Wildfowl Festival, Open Roads Day and tours and slide shows to various groups.

Mr. Larry Wales continued to provide considerable hours photographing wildlife and habitat which have been incorporated into the refuge slide collection.

5. Funding

Funding levels increased slightly over the last four years which basically further reduced our ability to operate due to rises in fixed costs such as salaries and benefits - again, the DU contribution was held over due to our inability to obtain the proper permits to proceed with the Kitchin Impoundment Project. Fire funding remained sufficient to maintain the refuge burning program. Increases in 9120 were largely attributable to extra funds provided for the purchase of a tracked marsh vehicle ($159,155). 1262 small maintenance funding was used to rehabilitate the Long Dike at the East Pool.

	FY-93	FY-92	FY-91	FY-90
Base Funding (1261 & 1262)	$254,200	$245,900	$239,900	$236,600
DU Reimbursable Account (1971)	$143,300	$143,800	$145,000	$167,000
Fire Funding (9120)	$182,855	$28,100	$27,300	$74,000
Private Lands (1120)		$9,600		
Small Maintenance Funding (1262)	$20,000		$11,300	
RO Matching Funding (1261)				$33,000

6. Safety

Bob Futrell started the year as safety officer and was replaced by Ben Nottingham in September. Bob Futrell, Ben Nottingham and Mike Panz served on the refuge safety committee.

Safety meetings were conducted throughout the year covering a variety of topics.

Engineering Equipment Operator Tim Williams was injured responding to a house trailer fire adjacent to the refuge. Tim suffered irritation of the eyes, throat and lungs after being

exposed to heavy smoke. Tim's response saved the trailer from total destruction and received a letter of recognition from the Knotts Island Volunteer Fire Department.

Refuge staff received annual hearing tests in December.

Nottingham and Panz attended OAS refresher safety training in Manteo, NC on July 2.

8. Other Items

A revenue sharing check was distributed to Currituck County in the amount of $39,018.00. This years check was 81.1 percent of total entitlement, a decrease of about 8 and one half percent from last years payment. A continued decline over the last three years makes it difficult to maintain a healthy relationship with county officials.

The City of Virginia Beach was also handed a revenue sharing check in the amount of $1,159.00 for lands on the Virginia side of the refuge.

Assistant District Manager Cal Garnett visited the refuge on November 11 for orientation purposes. District Manager Bill Grabill visited the refuge on November 30 to conduct a refuge inspection.

F. HABITAT MANAGEMENT

1. General

Habitat management at Mackay Island NWR has been accomplished by a variety of techniques. Management practices have consisted of: (1) water level manipulation in four impoundments, ranging in size from 26-550 acres (2) prescribed burning, and (3) mechanical treatments such as disking and mowing to control undesirable vegetation or to promote selected vegetation in moist soils (e.g., West Pool). A cooperative farming program is employed which enables the refuge to provide supplemental green browse, and to a lesser extent cereal grains for wintering Snow and Canada Geese.

Habitat monitoring has been accomplished with vegetative transects and seasonal spot checks to evaluate management practices. Vegetation transects in the West Pool, Middle Pool, and East Pool impoundments have not been sampled in several years. Spot checks conducted in 1993 revealed a mixed bag of vegetation which has responded to various environmental conditions and management actions in these main impoundments (see following sections).

Water elevations in the open marshes are influenced by wind direction and velocity, and to a lesser extent by precipitation. Because the salinity of Currituck Sound has changed considerably over the last decade, the refuge employed a monitoring program beginning in 1987. The results of salinity testing have showed a salinity range of 6-9% in 1988, 1-4% in 1989, 1-3% for 1990, 1-2% for 1991, and 1-3% in 1992 and 1993. The discontinued pumping of saltwater into Back Bay and above normal precipitation have caused a decrease in salinity over the past few years. Since monitoring began, salinity levels have been more representative of recent historic measurements - less than 7%.

2. Wetlands

West Pool

The West Pool is a 26-acre moist soil unit which has been managed for a longer period than any other impoundment on the refuge. Water levels are managed by pumping or capturing tides. Typically, the water level in this pool is drawn down by gravity flow and/or by pumping to below 1.00 feet msl in May or June. As a part of the normal management practice, one-third of the impoundment's ground surface was tilled as a part of a rotational plan to allow moist soil species to regenerate. Only a modest response by moist plant species (Juncus spp. and Polygonum spp.) occurred this year. This less than desirable response may have been due to dryer soil conditions caused by low rainfall in the middle of the summer and infrequent high tides normally used for irrigation. Part of the tilled impoundment that had shown poor response was seeded with browntop millet in late August to augment natural seed production.

Middle Pool

The Middle Pool is approximately 550 acres in size and is now managed largely as a green-tree impoundment. Virtually all of the trees within the impoundment are of non-commercial value; growth is second and third generation. The forest canopy is composed mainly of loblolly pine, sweetgum, blackgum, red maple and willow. Wax myrtle is dominant in more open areas and in the understory of the impoundment.

A spot check of moist soils vegetation response in October indicated a relatively good representation of waterfowl foods. Juncus spp., Scirpus spp., and Eleocharis spp. were common as were Polygonum spp. and Sagittaria species. This same survey also revealed the undesirable presence of rank J. romerianus and woody vegetation (pines, wax myrtle) encroaching into open areas.

Nice stands of Scirpus matured in the Middle Pool. 9/93 KM

East Pool

Approximately 350 acres, this impoundment was formed by the construction of a cross dike and the joining of a second marsh dike (Long Dike) that connects to the original Mackay Island Road. The south, southeast and east quadrants of this Pool are mainly open. The northern section of the Pool was forested with loblolly pine, sweetgum, blackgum and red maple but since water levels have been kept high for a number of years (encouraging SAV) most of the timber has died. Dominant SAV is composed of eurasian water milfoil (Myriophyllum spicatum), bladderwort (Utricularia spp.), naiad (Najas spp.), coontail (Ceratophyllum spp.), and muskgrass (Chara spp.). Reedgrass (Phragmites spp.) is the most dominant emergent. Good waterfowl concentrations of 3,000-4,000 birds were seen in the East Pool again during the 1992-93 winter. Common species observed were black ducks, mallards, coots, and green-winged teal.

Kitchin Upland Impoundment

First constructed in 1990, this 26-acre impoundment operated in less than optimal conditions during the 1993-94 waterfowl season. The clutch on the Couch pump was replaced in February and this down time combined with the impoundment's problem of not holding water securely made water management difficult again. Despite these problems the impoundment received fair use by 250-450 mallards, black ducks, green-winged teal, and pintail which aggressively fed on planted and volunteer millet. A small group of 15-20 migrant Canada geese used the grass and millet strips in February.

A variety of management efforts were made to improve the habitat management capability for this impoundment in 1993. Water management continued to be the major concern. In April, Acting Manager Nottingham measured the rate of water loss to be 0.4 in./day. This was reported to Dwayne Hinson, the SCS agent that had helped with the layout of the dike and an on-site inspection with him and Biologist Otto Florschutz was held when the impoundment's interior was still 75% covered with water. Core samples were taken through the dike facing the sound (low end) and these samples showed the dike was properly functioning. Dwayne attributed the water loss to the permeability of the base soils which he had pointed out when the project was originally laid out. The best approach seemed to be to try and make the best use of the existing structure conceding some extra cost to pumping. Since the Couch pump was 30 years old and it was pumping against an eight foot head, a DU MARSH proposal was developed to acquire a new higher velocity pump and to decrease the head by installing delivery pipe through the dike. This proposal was presented for review and was approved by DU in June.

In July, coop farmer Bonney Bright was contracted to apply round-up on nine acres of the impoundment interior to control bermuda grass across several strips where millet was to be planted. After this treatment, the dead grass was burned, and tilled under. The treated area was broadcast seeded in early August with brown-top millet but scarce rain at this time hampered successful maturity of this seed and consequently only about three acres produced. An additional five acres of volunteer millet also matured in the low section of the impoundment. Scattered pockets of fall panicum seeded out in the higher spots of the impoundment.

Not having immediate funds to cost-share with the MARSH funds on a new pump, the couch pump was again cranked up in the fall to flood the millet and panicum for early duck migrants. Flooding progressed slowly, however, as fall tides were generally low hampering pumping.

Great Marsh

The Great Marsh is a heterogeneous 5,000 acre tract of emergent marsh that comprises most of the refuge. Water levels are largely uncontrolled in this slightly brackish water marsh. This year, water levels ranged between -1.00 to +1.90 feet msl. There are two fixed crest weirs that control a minimal water level in two very small ponds (Fish Ponds). The only significant habitat management tool available to us in this marsh has been prescribed fire. Fire is used to control encroachment by woody vegetation, reduce residual fuels, improve greater snow goose foraging conditions and subsequently encourage the growth of emergent plants, such as wild millet, smartweed, and bulrush (see Section F.9).

Bays and Canals

Buck Island Bay (NC), Bellows Bay (NC), Flynn's Folly (VA) and Bull's Bay (VA) are within the refuge boundary. They have historically supported significant growths of aquatic vegetation, including Eurasian milfoil, chara, naiads, sago pondweed, and wild celery. High salinity and siltation in the 1980's severely decimated these aquatic food beds, especially those on the Virginia end of the refuge. However, during this summer, expanded beds of milfoil were found not only in Bellows Bay but in Flynn's Folly, Bull's Bay and in Barley's Bay.

New "grass" (Eurasian milfoil) bed emerged in Barley's Bay in the summer. 9/93 BN

Crawfish Impoundment

The management study to evaluate the compatibility of crawfish production and habitat for wintering waterfowl was continued in a 1 1/2 acre pond at the Refuge headquarters. Our suspicions that the crawfish initially stocked had been lost (emigration and predation) were confirmed in April and May when the pond was drawn down and trapped. Since this brood stock had been lost as had the initial planted crop (deer depredation) from the previous fall, we decided to start the evaluation over again with a new stocking of crawfish. In early June, 100 pounds of crawfish were stocked and the pond was slowly drawn down for a month. It was not until mid-July that a few moist soil species began to grow. By the end of October, a nice mix of smartweed, fall panicum, millets, and other grasses had emerged and produced mature seed. In early November, the pond was pumped up and an immediate response of puddle ducks was observed. Periodic surveys were underway at year's end and food usage by mallards and black ducks was heavy by Christmas.

3. Forests

There are approximately 1,500 acres of forest on the refuge, of which an estimated 350 acres have commercial value. In the Fall of 1992, a pine beetle infestion was salvage cut in a 20-acre loblolly pine stand on the old Corbell Tract. Revenues received from this salvage cut had previously been set aside to pay for tree planting service. In late January, a forestry consulting firm, Timberlands, Inc. was contracted to reforest 10 acres of this clearcut area with mast producing hardwoods.

Contract workers planted a pine beetle cutover area. 2/93 BN

Several small sites of pine beetle outbreaks (< 1 acre) were identified and monitored during the summer but none appeared to develop beyond one acre.

4. Croplands

The refuge farmland acreage measures 220 acres which are farmed under a cooperative farming agreement with Mr. Bonney Bright, the only farmer that operates on Knotts Island.

In February, a cooperative agreement was signed to cover the Knotts Island-Mackay Island area (170 acres). The balance of the cropland (50 acres) has been handled under a separate agreement. Mr. Bright provides all equipment, seed, fertilizer,pesticides, and labor to farm the total 170 acres. The refuge receives 50 acres of wildlife planting (22.7% of the total acreage) in lieu of rent. In 1993, we took the 50 acres in the same shares as was done in 1992 with 20 acres of corn and 30 acres of winter wheat planted on the Live Oak Point (LOP) farmfield.

With the intent of improving the corn yield at LOP, Mr. Bright tested the soil at the refuge's expense and determined needed supplements. These tests revealed a need for lime, nitrogen, and copper. Copper and lime supplements were applied before planting at the refuge's expense and the farmer applied the nitrogen at his expense.

The corn was planted in mid-May at the end of the farmer's corn planting schedule. A mix of tropical and common hybrid corn was planted. In late June, a late application of ACCENT was applied to control broadleaf weeds and Johnsongrass. This application performed well killing Johnsongrass and dense mustards, yet it was too late since weeds had already outcompeted the corn. Poor growth was compounded by a lack of rain in the middle of the summer. The end result was no corn produced.

The corn at LOP was disked under in October and planted in winter wheat under a contract with Mr. Bright. This 50 acres of wheat did end up providing browse to 1,000-4,000 snow geese in November.

The coop farmer received a mixed return on his crops across his 120 acres of cropland on the Knotts Island tracts. Winter wheat produced well on 120 acres; soybean yield was moderate on roughly 26 acres; and milo planted on 94 acres produced roughly 45 bu/acre. Milo was planted instead of soybeans to see if deer depredation could be minimized and to reduce soybean nematode damage which had occurred in recent years.

The 50-acre Kitchin Tract was planted in a soybean rotation as a part of the second year of a separate cooperative agreement. The refuge's share of crops at this site included 50 acres of wheat that were to be aerially seeded before the soybean harvest. Due to the wet weather in October, Mr. Bright was unable to harvest beans until early December. Thus, the wheat was not available to geese late in the year while the refuge was experiencing relatively high snow geese use during that time. In fact, the wheat field on Live Oak Point was over grazed after the first week of November and had alternate wheat been available, such as that on the Kitchin Tract, then less impact may have occurred on LOP.

9. Fire Management

Mackay Island NWR has an active fire management program and attempts to burn roughly 2,000 of 6,000 acres under prescription each year. The objectives of burning are to discourage woody vegetation in marshland, reduce hazard fuel levels, promote nutrient exchange, and improve conditions for snow geese feeding on marsh grasses. Burning makes the roots of giant cordgrass more available and it is not unusual to find geese on the burned areas immediately following the fire.

The annual prescribed fire plan was submitted for Section 7 and Regional Office approval in July.

Special fire management funding allowed us to hire two Forestry Technicians who assisted with prescribed burning and maintenance projects. Four of six burn prescriptions were accomplished this year; this resulted in 1,544 acres of marsh being burned. Road shoulders and brush piles were also burned in accordance with the annual plan.

Emergent marshes at Mackay Island are burned to promote Snow Geese feeding on marsh grasses. 12/93 MD

Refuge staff responded to only one arson fire this year near the Great Marsh Trail in January and this fire burned itself out with less than one acre burned. This is a big change since several arson fires each year are normal.

10. Pest Control

Pest control is used in cooperative farming, marsh management, and trapping programs.

Because the coop farmer often employs a no-till farming strategy several pesticide applications are depended on each year. The refuge is attempting to work with this farmer to reduce the number and quantity of pesticides used.

TABLE 4

Pesticide	Used To Control
Basagran	Nutgrass & cocklebur in milo & soybeans
Weedar 64 (2,4-D)	Broadleaf weeds in wheat, corn
Blazer (Actifluorfen)	Broadleaf weeds in soybeans
Accent	Johnsongrass in corn
Duel 8E (Metochlor)	Grasses, broadleaf weeds in corn, soybeans
Roundup	Johnson grass in uncropped field
Sevin XLR Plus	Earworms in soybeans

To deal with a heavy infestation of Johnsongrass at Live Oak Point, the refuge first contracted with cooperative farmer to spray this pest with Roundup and later burned roughly 25 acres of Johnsongrass. Nineteen acres were treated.

Nutria, raccoon and muskrat were selectively controlled during the winter of 1992-93 through the combined efforts of a cooperative trapper and trapping by staff (see Section H. 10).

G. WILDLIFE

2. Endangered and/or Threatened Species

Mackay Island NWR is seasonally used by bald eagles during the late fall-winter period and a number of sightings were recorded this year. In January, one mature and one immature bald eagle were seen frequenting the East and Middle Pool impoundments. It was not until November when eagles were again sighted; at this time two immature and two mature bald eagles were seen around the East, Middle and West Pool impoundment system. In December, the numbers decreased to one adult and one juvenile which were seen consistently till the year's end.

A small number of peregrine falcons are typically seen during the fall migration. One to two birds were regularly seen in January hunting over the East Pool.

3. Waterfowl

A description of the wintering waterfowl use of Mackay Island in recent years is, as in most areas along the mid-Atlantic Region, very dependent on winter severity and habitat condition. November through February are typically the highest use months. Monthly aerial surveys were conducted in conjunction with weekly ground surveys to assess use. During the 1992-93 winter, the overall waterfowl use was down again from the previous year (Table 5) and was only half of the previous 5-year average. This decline was probably due to another mild winter because habitat conditions were reasonably good. Overall waterfowl use is easily influenced by the distribution of snow geese around Currituck Sound and Back Bay.

A. Snow Geese

This winter's snow goose use was low and represented a 76% decline from the previous year. Snow geese use peaked in mid-January (1993) with 7,500 birds estimated on the refuge. A flock of 3,000 to 5,000 snow geese used a single burn area in the North Marsh from mid-January into February. The wheat field on Live Oak Point received consistent use in early November.

Nottingham conducted several age surveys of snow geese during November and December.

B. Tundra Swan

Swan use was up slightly from the previous year (Table 5) for the third consecutive year. The peak of swan use was in late December- early January. Most swans used the waters off the southern shoreline of Mackay Island and ponds in the Great Marsh.

C. Canada Geese

Migrant Canada geese use remained low. Several small flocks totalling 65-80 geese used the refuge regularly through the winter and a small peak occurred in late February.

Over the last couple of years, the refuge received increased use by native Canada geese during the nesting season. Marshes around Mackay Island and the impoundments are the primary areas of nesting use. It is estimated that 6-8 broods of goslings were seen during the summer in and around Mackay Island. Toward the end of July, congregations of family groups and immature geese were observed in the West Pool and southern shores of Mackay Island; the total number of geese in these groups ranged from 40-50 birds.

D. Ducks and Coots

Overall duck use in 1992-93 increased 21.5% from the previous year (Table 6). Duck habitat was in reasonably good shape and virtually all impoundments were fully watered. Despite the modest increase in ducks, the 491,197 use-days is still less than half of the long-term historical averages. This general decline in duck use is probably mostly attributable to the mild winter of 1992-93 and the scarcity of SAV in the Currituck and Back Bay area.

TABLE 5
WINTERING WATERFOWL OCCURRENCE ON MACKAY ISLAND NWR
1992-1993

GROUP	*PERCENT*	*NUMBER OF USE-DAYS*	*PERCENT DIFFERENCE FROM 1991-92*	*PEAK NUMBER*	*PEAK PERIOD*
Tundra Swans	5.0	45,220	+17.1	800	Dec 14 - 20 & Jan 3 - 9
Canada Geese	1.3	12,054	+22.8	150	Feb 14 - 20
Snow Geese	29.3	264,600	-75.7	7,500	Jan 17 - 23
Ducks	54.4	491,197	+21.5	5,450	Jan 3 - 9
Coots	10.0	90,230	+29.4	1,150	Dec 1 - 7
All Waterfowl	100.0	903,301	-44.0	11,400	Jan 17 - 23

TABLE 6
COMPOSITION OF DUCKS WINTERING ON MACKAY ISLAND NWR
1991-1992

SPECIES	PERCENT	NUMBER OF USE-DAYS	% DIFFERENCE FROM 1991-1992	PEAK NUMBER	PEAK PERIOD
G. W. Teal	20.8	102,270	+0.5	1,550	Nov 24 - 30
Gadwall	15.2	74,459	+101.5	1,250	Dec 1 - 6 & Jan 3 - 9
Mallard	34.3	168,630	+94.0	3,000	Jan 3 - 9
Black Duck	13.6	66,934	+53.6	900	Jan 17 - 23
Wood Duck	3.6	17,430	-17.8	400	Nov 24 - 30
B. W. Teal	1.5	7,350	-30.2	165	Mar 21 -27
Shoveler	1.4	6,720	-15.9	110	Feb 7 - 13
Wigeon	4.1	20,335	-63.8	400	Jan 3 - 9
Pintail	4.2	20,685	+86.4	230	Dec 14 - 30
Ruddy Duck	0.7	3,605	+80.7	70	Nov 24 - 30
Bufflehead	0.2	875	-34.2	20	Dec 14 - 20
Merganser	0.1	735	-47.5	15	Jan 3 - 16
Scaups	0.2	980	+17.9	25	Oct 5 - 11 & Jan 3 - 9
Ring-necked Duck	Trace	175	-88.4	10	Jan 3 - 9
All Ducks	99.0	491,197	+25.5	5,450	Jan 3 - 9

Most duck use is by dabblers feeding in SAV or moist soil waters. This winter, mallards replaced green-wing teal as the most abundant duck species. Other common dabblers included black duck, gadwall, pintail, wigeon and wood ducks (Table 6). Notable changes from the previous year included a doubling of gadwall numbers, substantial increases in black duck and pintails, and a sizeable drop in wigeon numbers.

Coots comprised 10% of the overall waterfowl use and use increased nearly 30% over the previous year. Coots spent nearly all of their time in the East Pool where they fed heavily on the abundant SAV present there.

Diving duck use was scant again and was characterized by small numbers of ruddy ducks, ring-necked ducks, bufflehead, hooded and red-breasted mergansers. Ruddy duck use increased with activity centered around the East Pool and surrounding waters around Mackay Island.

Wood Duck Production

The wood duck nesting box program began in 1970 when thirty-seven pairs of wood ducks from Patuxent Wildlife Research Center were released at the refuge and the first nest boxes were erected. Since then, 139 nesting boxes have been installed.

Wood duck production increased substantially in 1993 compared to last year when production fell due to extensive predation which was probably caused by a permitted study which resulted in an intensive check of the boxes. Eighty of 137 functional boxes were used by wood ducks; this yielded a 59% rate of use which was very comparable to 1992 use rate. However, this use rate was appreciably lower than the 10-year average of 77%. Successful nests per number of available boxes was 47% which is still lower than the 10-year average of 61% during the 1980s and early 1990's. The rate of nesting success (ratio of number of successful nests/number of boxes used by wood ducks) was 80% which was much improved over the 44% measure from 1992. This was also on track with the 1980-89 average of 81%.

ANNUAL NARRATIVE REPORT FORM
WOOD DUCK BOX PROGRAM INFORMATION

REFUGE: MACKAY ISLAND

NESTING YEAR: 1993

	NUMBER	PERCENT
Total usable boxes	137	
Estimated boxes used by wood ducks	81	59
Number of boxes with dump nests	7	8.6
Estimated boxes used by other ducks	0	
Estimated boxes used by other wildlife	11 (starling nests after wood duck hatch)	
Estimated wood duck broods produced	65	
Estimated wood ducks hatched	650	
Estimated WD's surviving to flight stage	325	

Plans for next year (Indicate number):

__8__ More boxes

_____ Fewer boxes

_____ No change

4. Marsh and Water Birds

More than 20 species of marsh and waterbirds inhabit the refuge at some part of the year. Several are year-round residents and nesters.

Sightings of little blue and green-backed herons in the Middle Marsh and Pools, and the year-round presence of several other heron and egret species led us to believe that these species are nesting on or near the refuge. No documentation of nesting activity by wading birds was found this year on the refuge.

5. Shorebirds, Gulls, Terns and Allied Species

Most observations of shorebirds occur along the shorelines of bays and sounds when wind tides expose mudflats, still other sightings occur in temporary wetlands and moist soil units. Killdeer, snipe, woodcock, spotted sandpipers and greater yellowlegs are common at the refuge. Common, least, sandwich, and royal terns are observed over the marshes from spring till fall. Greater black-backed, herring and ring-billed gulls are present year-round. Laughing and Bonaparte's gulls are more seasonal occupants.

6. Raptors

Three species of owls, two hawks and ospreys are verified nesters at Mackay Island. Over 20 species of raptors use the refuge at one season or another. Bald eagles and peregrine falcons are the most noteworthy while turkey vultures are the most obvious with sizable numbers roosting in the pines at several locations on the refuge.

Ten osprey platforms have been erected on the refuge. In 1993, eight platforms were used by osprey as nest sites. This use rate may have been partly influenced by many duck blinds having been leveled during the March storm. Additionally, several new osprey nests in snags appeared in the Middle Pool further suggesting the search for alternative nest sites prompted by the loss of duck blinds as viable sites. By July, young birds had successfully fledged at four sites.

Screech owls are commonly found in wood duck nest boxes when boxes are inventoried and cleaned in mid-winter. Their use of the boxes does not appear to conflict with wood ducks, since most of the owls leave before duck nesting begins. In 1993, only two boxes were used by screech owls.

7. Other Migratory Birds

Refuge woodlands, fields, and wetlands provide habitat for a variety of neotropiccal migrants. Seventeen warblers make up the majority of this use. This year, bobolinks spent considerably more time on the refuge on their return migration to South America. During late July and August about 200-400 bobolinks and 200 red-winged blackbirds fed heavily on milo fields near the shop. On one occasion, a rare bird was seen among the red-wing blackbirds. This bird was identified as a yellow-headed blackbird which is normally a western species; it was a new listing for the refuge list.

Migrant bobolinks got a wildlife share from the coop farmer's milo when the farmer's seed supplier slipped and gave him non-bird resistant seed. 9/93 LW

8. Game Mammals

The white-tailed deer herd on the refuge and Knotts Island appears to be stable or increasing slightly based on observations of deer in early evening and cursory examination of age ratios of harvested deer (see Section H.8.). Refuge personnel observed 60-80 deer during pre-hunt season evenings in croplands adjacent to the office and the shop on Knotts Island.

In July, Dr. Randy Davidson of the Southeastern Cooperative Wildlife Disease Study and six wildlife graduate students from the University of Georgia conducted a deer herd health examination on Mackay Island and the Knotts Island. This examination was based on five deer that were harvested and necropsied for parasitologic, serologic, and pathologic data. One deer was found to be obviously diseased and the other four deer showed significant levels of parasitism. The collective parasite assessment (including APC results) indicated that the herd was exceeding the nutritional carrying capacity and that the potential for the heard's health could further decline without population management. The refuge will continue to employ deer hunting strategies that increase the harvest.

10. Other Resident Wildlife

Occasional daytime sightings of gray foxes lead us to speculate that this species is maintaining a stable population on the refuge and Knotts Island.

Bob-white quail are common at the refuge on agricultural field edges and wooded areas.

The Refuge and its adjacent wetlands protect productive habitat for a diverse herpetological fauna. Impoundments on Mackay Island, other adjacent wetlands and uplands provide habitat for 26 documented species of amphibians and reptiles.

11. Fisheries Resources

Salinity in the adjoining Currituck Sound has varied over the last 25 years. More recently, salinity readings have declined due to discontinued pumping of saltwater into Back Bay, normal rainfall, and no storm overwashes from the Atlantic Ocean. This decline in salinity has allowed a partial recovery of SAV and some fishery resources including largemouth bass, crappie, bowfin, carp, yellow perch, channel catfish, and a variety of sunfish. This year, NC Wildlife Resources Commission biologist Pete Kornegay found exceptional numbers of young-of-the-year largemouth bass during his electroshocking surveys throughout Currituck Sound.

It was anticipated that the sport fish population in the East Pool was going to be depleted with the drawdown for the rehabilitation work on the Long Dike. The drawdown still left some water in the canals and when the impoundment was partially filled for the kids fishing day there were good numbers of fish (largemouth, bream, crappie, bowfin) caught.

The East Pool was reopened for fishing in July but a special refuge regulation was implemented; this established a catch and release provision for bass which was hoped would assist the recovery of the population.

In September, personnel from McKinney Lake National Fish Hatchery stocked 170,000 bluegill fingerlings in the East Pool to augment the forage fish base altered from the drawdown.

Bluegill fingerlings were stocked into the East Pool to help rebuild the fish population. 9/93 BN

15. Animal Control

Mackay Island employs a trapping program to aid in the control of muskrat and nutria populations on the refuge (Section H.10). The burrowing activities of these furbearers have caused damage to the dikes and marsh roads of the refuge.

Free roaming dogs continue to be the most arduous animal control problem at the refuge. Despite our continuous pleas, Knotts Island residents see it as their constitutional right to allow pets to be free roaming. Unfortunately for us, the refuge, and its wildlife are the outlet for these "pets."

16. Marking and Banding

Prebaiting for wood duck banding was started in June on the cross dike. Banding was approached differently this year since we attempted to rocket net woodies. These efforts were begun in July. Over at least a dozen sessions refuge staff were baffled by how apprehensive woodies were in coming to the bait. Where there were about 30-45 woodies present in the area of the bait we never observed more than 6-15 come close. After prolonged waiting and hoping for more to come to the bait, we finally gave up and put out the swim-in trap which also was unsucccessful due to nutria eating all of bait and finally busting the trap. This marked the first year no woodies have been banded since banding was undertaken.

In February, Mackay Island NWR staff collaborated with Back Bay NWR and NC Wildlife Commission staff to rocket net migrant Canada geese on the ag field at Refuge Office. This effort provided a small success with nine geese being captured on the only shoot that was made for the whole winter.

H. PUBLIC USE

1. General

Mackay Island NWR provides a variety of wildlife oriented public use and recreational opportunities. These include wildlife observation, hiking, bicycling, fishing, crabbing, boating and deer hunting. Most of the refuge is closed to public use from October 16 through March 14 to avoid conflicts with wintering waterfowl.

6. Interpretive Exhibits/Demonstrations

The refuge maintains an informational display at the office. A kiosk is located at the entrance to Mackay Island Road displaying a color map and a panel dedicated to Joseph Knapp. Regulations are posted at the causeway bridge, Great Marsh Trail, Mackay Island Road, and on the dikes.

7. Other Interpretive Programs

Refuge staff members have responded to a variety of groups requesting presentations and tours. The following programs and tours were given:

1/7 Souheaver conducted a refuge wildlife presentation to the Knotts Island Elementary School fourth graders.

1/30 Souheaver and Nottingham operated a booth with Back Bay NWR folks at the Virginia Beach Wildlife and Wildfowl Festival, over 1500 visitors were contacted.

2/10 Souheaver provided a refuge slide show for Chesapeake, VA, Kiwanis.

2/15 Nottingham and Volunteer Larry Wales gave a slide show to 50 people to the Virginia Beach Virginia Audubon Chapter.

3/4 Volunteer Larry Wales showed slides to 8 women from the Pinewell Garden Club (Norfolk, VA) at the refuge office.

3/7 Panz held a tour for 12 Weeblo Scouts and 10 adults from Knotts Island.

3/10 Nottingham gave a refuge slide show to 20 first graders at the Knotts Island Elementary School.

4/23 Nottingham conducted a refuge tour for 55 kids from Weeksville Elementary School of Elizabeth City, NC.

6/19 Nottingham and VanZant assisted Back Bay NWR with their Partners Recognition Day.

6/24 Third annual Ducks Unlimited Greenwing Fishing Tournament held around East Pool, 350 kids & 150 parents attended, 30 volunteers, three NC Wildlife Officers and refuge staff contributed to a hugely successful event.

8/1 Panz and TNC representative Barbara Blonder gave an interview with National Public Radio DJ Adam Hochberg on The Nature Conservancy's preservation of the North Carolina's Outer Banks for the Currituck Refuge and NC Marine Estuarine Reserve.

8/7 & 8 Refuge staff operated a booth and gave refuge tours at the Knotts Island Peach Festival.

9/10 & 11 Nottingham, VanZant and Volunteer Wayne Gilbert hosted a refuge and duck stamp exhibit at the Currituck Waterfowl Festival, approximately 800 persons attended.

10/9
& 10 Nottingham led four walking tours during a birding festival at Eastern Shore of Va NWR for about 80 people.

10/14 Nottingham presented a mini-talk to 225 seventh graders from Knapp Junior High at an SCS Environmental Field Day at the former Bells Island Hunt Club.

11/16 Equipment Operator Tim Williams toured Ledger Star writer Mary Reid Barrow and a photographer in preparation for a story she wrote on the refuge and the December Open Roads Day.

12/11 Refuge Open House was held with bus and van tours being given to 265 visitors. Over 500 visitors toured the refuge throughout day.

12/7 Nottingham presented a slide show to the Knotts Island Ruritians on wildlife research.

8. Hunting

White-tailed deer hunting is permitted each fall. Interested hunters applied for the reserved hunt by mailing the postcard attached to the hunt brochure. A lottery was held to fill 55 slots for the first two days. Selected hunters received two days of hunting for one $10 fee. The other ten days were open to public hunting and no reservation was required. A separate bow hunt was held the first week of November.

The gun hunt dates were October 18--23, October 28--30, and November 4--6. Bow hunting was allowed November 8--13. Gun hunters are required to check-in and out and are limited to stand areas while bow hunters are permitted to enter and roam freely throughout the entire hunt area.

The 399 gun hunters killed 106 deer over 12 days. Six others were found dead by gun hunters. Of the 21 bow hunters counted, only 1 deer was killed all week. A total of 107 deer were harvested by 420 hunters in 18 days. The sex ratio was 45 does and 62 bucks, with the largest buck weighing 192 pounds and sporting a nice 10 point rack.

TABLE 7. DEER HARVEST STATISTICS

DEER AGE COMPOSITION BY SEX						
	< 1/2 YR	1½ YR	2½ YR	3½ YR	4½ YR	TOTALS
BUCKS	25	12	14	9	2	62
DOES	18	6	14	5	2	45
TOTALS	43	18	28	14	4	107

AVERAGE LIVE WEIGHTS BY AGE AND SEX					
	< ½ YR	1½ YR	2½ YR	3½ YR	4½ YR
BUCKS	46	98	123	143	157
DOES	44	75	84	89	98

9. Fishing

A large part of our visitation comes from fishing. More than 20,000 visits are estimated annually for this activity. Fishing is permitted on the dikes and in the marshes from March 15--October 15. However, due to the water drawdown and dike rehabilitation, the East Pool was closed until June 26. The Knotts Island Causeway, Great Marsh Trail and the first mile of Mackay Island Road are open to fishing throughout the year. Boat launching and access to the marsh is only permitted from March 15 through October 15 to minimize waterfowl disturbance.

The annual Greenwing fishing event was held on June 26. The Currituck County Chapter of Ducks Unlimited sponsored the event for 350 kids and 150 parents at the East Pool. This year, families were allowed to drive to the impoundment, which alleviated the difficulty of transporting 500 people to and from the area, as was done in previous years. Participants received a fishing rod, tackle box and supplies, T-shirt and cap, lunch and a goody bag for their $15 registration fee. Most supplies were donated for the event with 30 volunteers and refuge staff providing assistance with check-in, feeding, refreshments and first aid.

Another large crowd of families showed up for the annual kids fishing event. 6/93 LW

Because the East Pool had been drawn down for the Long Dike rehab, we were concerned that few fish would be caught. Consequently, the refuge arranged for 1,000 one-pound channel catfish to be stocked in the canal by the cross-dike. To enhance the kids catching these fish, the refuge borrowed two nets from the Wildlife Commission and these were located at each end of the cross-dike canal to confine the hungry catfish. This set-up worked very well with lots of kids catching catfish.

These young boys scored some good catches of the stocked catfish. 6/93 BN

10. Trapping

The abundance of nutria, muskrat, raccoon and snapping turtles at the refuge and damage to roads and dikes have provided the continued impetus for controlling these populations. Due to depressed fur prices ($2/rat, $.50-$1/nutria and $5-7/raccoon) only one island trapper worked from his truck around the impoundments. This trapper trapped for only three weeks. To augment this poor trapping effort, the refuge used 50 traps from a local trapper and the seasonal firefighters trapped for four weeks along the refuge road. The combined effort took 74 muskrat, 245 nutria and 17 raccoons. No one was interested in trapping turtles this year.

TABLE 8. TRAPPING HARVEST 1980 - 1993

	80	81	82	83	84	85	86	87	88	89	92	93
N	57	116	34	95	102	99	352	431	464	527	646	245
R	15	40	22	67	17	17	56	46	109	17	49	17
M	768	1065	1385	629	551	1461	665	509	1029	90	323	74

11. Wildlife Observation

Bird watching and general wildlife observation is an important recreational opportunity for refuge visitors. State Highway 615, which stretches 3.5 miles through the middle of the refuge to Knotts Island, treats winter motorists to the sight of tens of thousands of snow

geese foraging in the marsh. Parking areas are provided at the entrance sign, the bridge over Coreys Ditch and the Great Marsh Trail, but visitors may stop anywhere along the shoulder. Over 100,000 vehicles use the causeway each year.

The Great Marsh Trail, at the east end of the causeway, winds 1/3 mile around a horseshoe shaped pond and is open all year during daylight hours.

Mackay Island Road was opened to vehicles all winter for the first time in many years and provided additional opportunites for fishing and wildlife observation.

The Mackay Island Trail circles the east pool for 3.8 miles and the Live Oak Point Trail follows 6.5 miles of dikes around all three impoundments. They are open to the public from March 15 through October 15 from sunrise to sunset.

The annual "Open Road Day" was held on December 11. The headquarters was open all day and provided refreshments, information, and displayed photos taken by volunteer photographer, Larry Wales and portraits by artist Suzanne Stevens. Refuge staff and volunteers provided bus and van tours of the impoundments to 265 people in the morning. The dikes were open to driving all afternoon and over 150 cars were counted. Despite poor weather, the day was declared a resounding success as over 500 people took the time visit the refuge.

14. Picnicking

Picnicking, along with fishing at the refuge is an activity on the increase at Mackay Island. April, May, September and October are preferred months--over 400 visits for this activity were recorded. No facilities are provided expressly for picnicking, but visitors may lay a blanket down at any of the public use areas.

17. Law Enforcement

Mackay Island has three employees with law enforcement authority--one full time and two collateral duty officers. The full time officer splits his responsibility between Mackay Island and Currituck Refuges and assists other refuges, FWS agents and state officers as requested. One collateral duty position was vacant from March through August with the transfer of the manager.

Mackay Island officers work independently with little or no readily available back-up assistance. Currituck County Sheriff's Department has a deputy on duty at night for Knotts Island, however, they cover all of the north end of the county, and are often not close by. One Currituck deputy, with a 4wd truck, covers a 25 mile long section of the Outer Banks, which includes all of the Currituck Refuge tracts. NC Wildlife and NC Highway Patrol Officers live on the mainland and are a minimum of one hour away. Virginia Beach Police Department and officers of the Virginia Game Commission have at least a 30 minute response time. Virginia State Police are an hour away.

STATISTICS

The total numbers for 1993 were as follows:

Incident Reports filed	97
Violation Notices issued	30
Written Warnings given	48
Verbal Warnings	116
Visitor Assists	296
Cases made by state officers	3

A breakdown of incidents by category:

Type of incident	# reported	# violation notices	# written warnings
Accident:Motor Vehicle	1		
Aircraft Incidents	3		
Arson: Marsh	1		
Assist Citizen	3		
Assist Other Agency	11		
Dogs at large	7		4
Firearms	3	4	4
Fishing:Commercial	1		2
w/o license	18	12	14
Hazardous Area	1		
Hunting:MBTA	5	9	3
Refuge	4	1	3
Littering	4		1
Property Found	3		
Traffic	1		1
Trespass:Boat	3	2	2
Camping	3		3
Cattle	8		
Motor Vehicle	8	2	9
Vandalism	4		2
Wildfire:Undetermined Origin	2		
Wildlife Incidents	3		

**These statistics include Currituck NWR incidents

I. EQUIPMENT AND FACILITIES

2. Rehabilitation

Small maintenance funding was provided this year to rehabilitate the 1.4 mile Long Dike on the East Pool. This section of dike was badly eroded from wave action and nutria activity. The original contract for 220 hours of dragline operation was completed by Tate Construction on May 30. Since the work was incomplete, a modification to the contract was done to allow enough hours to finish the job. 24.5 hours were needed to complete the work.

A contract dragline worked to re-core the inside shoulder of the Long Dike and add six feet of width to the dike. 5/93 BN

3. Major Maintenance

128 tons of crush and run gravel was delivered and placed on the Long Dike and Headquarters Entrance Road in October.

48 tons of rip rap were delivered in July and placed on the east side of the inlet canal of the Kitchin Upland Impoundment.

4. Equipment Utilization and Replacement

A surplus front-end loader backhoe was acquired on excess from DRMO in Norfolk in March. The backhoe needed extensive work totaling approximately $3,000.00.

Major equipment and vehicle maintenance this year included; repairs to the Cat D-4 involving replacement of two idlers and one roller, the S-10 exhaust system had to be completely replaced, and the engine on the JD 2010 was torn down and head gaskets replaced.

In November, a 1989 Chevrolet Blazer was acquired on excess from the Service Law Enforcement Office in Cambridge Maryland. This vehicle will replace the 1985 Blazer assigned to Mike Panz which was constantly in for repairs.

A 1989 Chevrolet Astro Van was also acquired from Law Enforcement in Cambridge, Maryland which will serve on refuge tours and transporting visitors from the Regional Office, etc.

5. Communication Systems

A Nokia cellular telephone was purchased to upgrade our law enforcement communication capabilities.

8. Other

Notable property acquisiton this year included; a slide storage cabinet, television set, J.P. Knapp sign, 5 ton floor jack and pressure washer.

J. OTHER ITEMS

1. Cooperative Program

During the year, Souheaver, Merritt, and Nottingham attended three different meetings of the Joint Venture Committee for the Back Bay - North Landing River - Northwest River Focal Area. Souheaver and Nottingham continued work on the gathering information to develop an information brochure on existing conservation areas within this Focal Area.

The refuge participated in the Wood Duck Study Initiative led by Jim Kelley of the Patuxent WRC in conducting a hen call count. Not enough staff time was available to check nest boxes during the peak of nesting to provide Jim with data to evaluate the call count. Plans were made toward year end to allocate time in CY 1994 to do nest checks.

4. Credits

K. Merritt	- Sections A, C, D, E, I
B. Nottingham	- Sections B, F, G, J
M. Panz	- Section H
P. VanZant	- Typing, Colating

Photo Credits

BN - Ben Nottingham
JM - Jessie McCleskey
KM - Ken Merritt
MP - Mike Panz
MD - Mike Doxey

CURRITUCK NWR

INTRODUCTION

The Currituck NWR is located in northern Currituck County, North Carolina along the Outer Banks barrier island chain. The Currituck Banks are part of an extensive coastal lowland that stretches from Newfoundland southward to Florida, and westward into the Gulf of Mexico. Along the Currituck Banks, inlets have periodically formed and reformed depending on storms, amount of sedimentation, the tidal heights, and degree of vegetation on the barrier beach.

Acquisition of Currituck NWR was intended to preserve and protect a part of the NC Outer Banks, one of the largest undeveloped coastal barrier ecosystems remaining on the East Coast. Service ownership ensures perpetuation of basic wetland functions, including nutrient cycling, floodplain and erosion control, and will help preserve the role of Currituck Sound estuaries as nurseries. The sound is an important black duck wintering area. Ownership of the protective buffer east of the productive marshes bordering the sound protects the marsh from direct pollution sources associated with development.

The Outer Banks remained isolated from the mainstream of activity in early America, and those few people who lived there relied heavily on activities associated with the area's natural values for their subsistence. Activity in the Currituck Sound area reached a peak in the late 1800's when commercial fishing and market hunting were at an all time high. A number of hunting clubs were established for sport hunting of waterfowl and drew much of their membership from affluent northern businessmen and professionals.

The navigation hazards along the Outer Banks resulted in numerous shipwrecks along the coast. Lifesaving stations were established along the beach of which several still exist. One station is located on an inholding within the Swan Island Tract (SIT) and is used as a seasonal residence by a private citizen. The Currituck Lighthouse at Corolla still functions throughout the year.

During 1975 and 1976, The Nature Conservancy (TNC) acquired several parcels of land on the Currituck Outer Banks. The two major tracts of land were being utilized by the Swan Island and Monkey Island Hunting Clubs. Funds to purchase these areas were provided by the Melon Foundation, a sponsor of the National Wetlands Project. TNC transferred approximately 500 acres of the Monkey Island Tract to the State of North Carolina for inclusion in the National Estuarine Sanctuary System as the Currituck Banks component. A narrow strip from sound to sea of about 50 acres was retained by TNC between the Sanctuary and the Monkey Island Tract.

The Migratory Bird Conservation Commission (MBCC) met to consider the Currituck Refuge on August 2, 1983. The MBCC approved the boundary of the refuge in two parcels: the Monkey Island Tract, which is 1.5 miles north of Corolla, NC, and the SIT some 3.5 miles further north. Two phases of acquisition resulted in 1,770 acres in fee title, 166 acres in conservation easement and some hunting blind rights at a cost of $3.9 million. A third tract, 54 acres of marsh and low shrub and hardwood woodland, was acquired in 1988, through a trade with Currituck County, NC, for Monkey Island and is located along the west side of Corolla village. All three tracts comprise about 1,824 acres and have been administered by Mackay Island NWR at Knotts Island, NC, since July of 1990.

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A. HIGHLIGHTS

Survey of piping plovers completed, 80 surveys conducted totaling 175 survey hours. (Section G.15).

Feral Horse issue surfaces again; local, county, and state officials announce solution to management of horses on the Outer Banks north of Corolla NC. (Section G. 15).

C. LAND ACQUISITION

1. Fee Title

Currituck Refuge, which was once thought to have potential for about 15,000 acres of the North Carolina Banks is a fragment of what was envisioned in the final Environmental Impact Statement (EIS) proposing its establishment in 1980. The main reason for the scaled back version of about 1,800 acres, which now exists, is easy to comprehend with land prices skyrocketing north of Corolla NC due to development.

The reasons for the establishment of the refuge and the importance of this fragile coastal barrier island ecosystem were clearly established in the original EIS. These reasons are magnified with the listing of the piping plover in 1986 which is now protected under the Endangered Species Act. In fact, the Swan Island Tract and areas north of the refuge have been identified as the best piping plover nesting habitat in North Carolina.

Small tracts of land such as the Covington Tract need to be given serious consideration for acquisition before they are subdivided and developed. These smaller tracts have great value for migratory birds, endangered species, bio-diversity, water quality, dune protection, and will lessen the indirect affects of increased human activity associated with development.

F. HABITAT MANAGEMENT

1. General

Currituck NWR is located on the Currituck Banks stretch of North Carolina's Outer Banks barrier island. This island chain was formed when melting glaciers caused a world-wide rise in the sea level. Later, when sea level rise slowed, a combination of factors were set in motion to create barrier islands on the continental shelf. The bays and estuaries that formed behind these barriers became shallow, due to sedimentation from rivers draining the coastal plain and storm overwash. Currituck Spit and the other Outer Banks islands are primarily perpetuated by the following processes: long shore currents, tides and tidal currents, wave action, storm surges and wind action. These dynamic forces cause shorelines to undergo constant change. The adaptability of these islands to constant physical change is a major part of their natural ecology. The approximate size of the habitat types are: 13% sand and dune, 48% brush and woodlands and 39% marsh.

2. Wetlands

There are basically two types of wetland areas situated across the three major land tracts of the refuge; these include the brackish water marshes that border the Sound on the back side of the refuge and the wetland flats between the primary dunes and the ancient secondary dunes. The most extensive area of these interdunal flats (the "Flats") are found on the SIT where the refuge operates a water control structure. This structure is situated in the middle of an old dune line where these wetlands drain into Ferebee's Creek. The structure is adjusted to maintain moist soil conditions by trapping rainwater through the summer to promote moist soil species such as Eleocharis spp., Bacopa, spp., Cyperus spp. and Hydrocotyle spp. Rain was meager during the mid summer and consequently vegetation response was largely restricted to the headwater shallows just inside the structure. Normally, stoplogs in this structure are added in the fall to capture rainfall for migratory waterfowl. Because of low rainfall in the spring - summer, the stoplogs were held at the same position throughout the year and toward year's end rainfall had filled the Flats.

During May, the refuge gained the opportunity to use a "hydroaxe" hydraulic mower that is shared among Region 5 refuges. This was assigned to Back Bay NWR for a month and they allowed us to borrow it to mow down bayberry, bacharis, and wax myrtle that are encroaching into the Flats and competing with moist soil plants. Equipment Operator Tim Williams drove this heavy-duty cutting machine for three days across the Flats resulting in 20 acres of ground being opened for desirable species.

The hydroaxe borrowed from Region 5, proved to be very effective in mowing wax myrtle and small live oaks. 5/93 BN

The Currituck marshes along the western side of the refuge represent the most extensive wetland area on the Currituck Banks and Currituck NWR. The emergent marshes are dominated by Juncus roemerianus, Typha spp., and Spartina cynosuroides. Hydrologic

influence to these sizeable marshes is influenced primarily by wind tides. Management on marshes include placement of wood duck nest boxes through cooperation with the former owners, the Swan Island Gun Club, and prescribed burning on the Swan Island Tract marsh. No prescribed burns were conducted this year.

3. Forests

Forty-eight percent of the total refuge acreage is comprised of maritime shrub and forest habitat. A dense shrub thicket occurs on the protected west side of the primary dune system. Dominant species in these thickets include American holly yaupon, holly, wax myrtle, and live oak. Farther west from the dunes and shrub thickets, one finds a low, laterally branching maritime forest dominated by live oak and red cedar. Still farther west beyond ancient secondary dunes the forest becomes taller and exhibits a more open canopy; loblolly pine is dominant here, often occurring in pure stands at the backside marsh edge. All of these shrubs and woodland areas provide important resting and cover habitat for neotropical passerines and raptors.

6. Other Habitats

Approximately 243 acres of beachfront and sand dune are contained within the Swan Island and Monkey Island tracts. The refuge's fee title ownership extends along the beachfront out to the mean high water line. The intertidal zone falls within the state's ownership according to state law. The beach and dunal strand are a changing habitat shaped by natural processes including tidal erosion and deposition, and the onslaught of severe storms.

Currituck NWR escaped severe damage when Hurricane Emily turned off from the Mid-Outer Banks on August 31. This hurricane came ashore some 75 miles south of the refuge. Had its' 115 mph winds swept through the Currituck Banks significant dune and forest damage would have occurred. By contrast, the refuge experienced only moderate winds and little rain, because Emily turned out to sea south of Oregon Inlet.

G. WILDLIFE

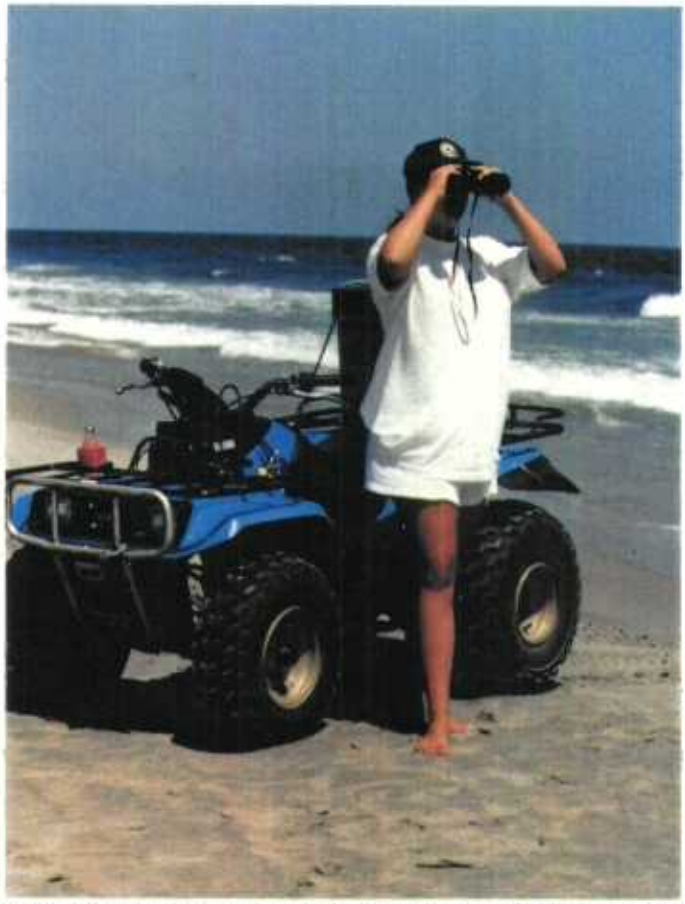
1. Wildlife Diversity

A relatively rich wildlife diversity occurs across the Currituck Outer Banks, in part, due to the diversity of habitats along this area. The avian species comprise the bulk of the wildlife diversity as indicated by over 240 species having been documented at nearby Back Bay NWR. The Currituck Outer Banks serves as a migration corridor for a variety of birds such as acciptors, falcons, neotropical warblers, shorebirds, gulls, terns and numerous waterfowl species. Periodic monitoring addresses waterfowl and the threatened piping plover.

2. Endangered Species

Several endangered and threatened species utilize the Currituck Outer Banks including the major refuge tracts. Piping plovers utilize the refuge and its' adjoining beach for the longest period of the year. Piping plovers have used the beach habitat from the area of Penny's Hill to South Carova Beach from April through September to breed and rear young. This

year, three thousand dollars was obtained from the Asheville, NC Enhancement Office (Endangered Species) to monitor breeding production of piping plovers on the Currituck Banks. The bulk of this funding was used to employ a person to survey plover production. Having had prior survey experience as a refuge volunteer, Ms. Jessie McCleskey was contracted to survey from May - August to obtain detailed data similar to that gained in 1992 from an extensive volunteer effort. This arrangement provided for the most extensive survey work yet done on plovers in this area. Eighty surveys were conducted totaling 175 survey hours. While Ms. McCleskey performed the vast majority of these surveys, refuge staff, YCC enrollees, volunteers and a visiting FWS biologist also contributed to these surveys.



Ms. Jessie McCleskey very capably surveyed piping plover and least terns. 8/93 JM

Piping plover production did not fair well this year. Two plover nests were found in late May; both were located on private lands off the refuge just north and south of the SIT. The nest located north of SIT was destroyed by cattle trampling as evidenced by tracks in and around the nest. The plover pair that lost this nest renested south of the old Coast Guard Station in North Swan Beach but again lost their nest of three eggs to red fox in late June. The second nest (South Swan Beach) also suffered red fox depredation in late June but not before one egg hatched and this chick survived to the fledgling stage.

Refuge staff attempted to gain permission to use a predator exclosure around the nest that was subsequently trampled. However, when landowner (Riggs Realty) permission was sought, it was denied out of fear that the exclosure would present a potential hazard to beach drivers and result in landowner liability. Unfortunately, the renest attempt was made on another tract of the same landowner's property and permission could not be gained to install

an exclosure. Based on a suggestion by Janice Nichols (Asheville Field Office) and realizing that fox depredations were increasing, the refuge installed a "dummy" predator exclosure on SIT in early July to determine what type of disturbances would occur to a "real" exclosure should these be erected in the future. The structure was evaluated for two months. The only significant disturbance (n=6) was from Ernie Bowden's cattle that used the exclosure stakes as rubs. With these observations, the refuge has learned it will need to either actively enforce cattle trespass or erect a second outside fence around the exclosure to ensure that the fence is not damaged and/or plovers are not disturbed.

On October 1, Merritt and Nottingham met with Mr. Larry Riggs of Riggs Realty to show him the refuge's experimental predator exclosure (i.e. pig wire fence) for piping plover nests on Currituck NWR. Based on previous discussions with Mr. Riggs he had expressed reservations about allowing a "fence" on some of his real estate sales tracts where two piping plovers had nested during the summer. The refuge staff thought that an inspection of the exclosure was needed to alleviate some of Mr. Riggs' concerns over a fence being a liability item on his beachfront tracts. Upon showing him the refuge's exclosure, he did in fact see and agree that it was a very small structure that would not present much of a hazard.

While conducting plover surveys, Ms. McCleskey also examined the beachfront for specimens of the newly-classified (threatened listing) seabeach amaranth. Ms. McCleskey found two specimens side by side in a low dune on private land south of SIT and .25 miles from where the last specimens were found on the refuge. Intensive surveying of SIT revealed no seabeach amaranth during the summer.

Seabeach amaranth south of Swan Island Tract. 7/93 JM

Loggerhead sea turtles use the Currituck Outer Banks for nesting although no nests have been documented in the recent past. Five nests were found at Back Bay NWR (10 miles north) in 1993 and only one nest was reported South of Corolla in 1992. This low use is and has been likely influenced by the Currituck Beach (Corolla) development, commercial fishing, and the increased traffic on the beach North of Corolla to the state line.

Modest numbers of Peregrine falcons pass over the refuge coastline during their fall migration; some occasionally feed and roost in various refuge habitats during this time. To a lesser extent, bald eagles also seasonally pass through the refuge in the fall-winter period.

3. Waterfowl

Aerial surveys were conducted on a monthly basis to assess waterfowl use during the 1992-93 winter. Winter waterfowl use again was dominated by Greater Snow Geese which contributed 51.2% of the total waterfowl use (Table 1). While some use was recorded in the Flats, the greatest use occurred on the north refuge boundary and in the Hay Pond. The peak of the use followed the same pattern as in 1991-92 where 3,500 - 4,000 snow geese frequented the Hay Pond and North Swan Island Tract marshes from mid - February until they leave sometime in March.

Canada Goose use was down slightly from 1991-92 and certainly off from the historical use levels where Canadas frequented the Currituck Sound in the tens of thousands. The Hay Pond at the refuge boundary received the only use by Canadas and this was only a peak of 100 geese. Tundra Swan use was also down compared with the previous winter yet 1,200 swans used the Hay Pond and south Currituck Marshes during the peak use period in late February.

Table 1
Wintering Waterfowl Occurrence on
Currituck NWR
1992-1993

Group	Percent	Number of Use- days	% Diff. from 1991-1992	Peak Number	Peak Period
Tundra Swans	18.9	46,935	-61.1	1,200	Feb. 21-27
Canada Geese	1.2	3,010	-9.7	100	Dec. 22-28 2
Snow Geese	51.25	126,875	-54.0	5,000	Feb. 21-27
Ducks	28.7	71,008	-21.5	850	Feb. 14-20
All Waterfowl	100.0	247,828	-49.4	7,000	Feb. 21-27

Overall duck use was low this winter compared to the previous year and to the historical trends in the Currituck Sound when tens of thousands of ducks over wintered in the sound and adjacent marshes. Habitat conditions during the haydays of the Currituck waterfowl populations were vastly different from the present where abundant and dense mats of SAV spanned the open water areas. Habitat conditions today are only fair at best since only small expanses of SAV have recovered and moist soil vegetation in the Flats is impacted by feral horses, trespass cattle, and encroaching woody vegetation.

Most duck use is comprised of puddle ducks that occupy the slightly brackish ponds in the marshes, the Flats, the marsh creeks, and open sound waters. Black ducks replaced greenwinged teal as the most abundant duck this year (Table 2). Other common dabblers

consist of mallards, pintail, and gadwalls all of which increased their use on the refuge tracts towards late February. The balance of the duck use is made up from various diving species including bufflehead, greater scaup, ruddy ducks, and hooded and red-breasted mergansers.

Table 2
Composition of Ducks Wintering on
Currituck NWR
1992-1993

Species	Percent	Number of Use- days	% Diff. from 1991-1992	Peak Number	Peak Period
G. W. Teal	21.8	15,379	-36.1	475	Oct. 20-26
Black Duck	35.1	24,745	10.2	260	Feb. 21-27
Mallard	13.3	9,380	-26.7	150	Feb. 21-27
Wigeon	2.3	1,610	-82.1	35	Jan. 17-Feb. 6
Pintail	13.0	9,135	32.9	200	Feb. 14-20
Gadwall	10.3	7,245	19.0	200	Feb. 14-20
B. W. Teal	0.7	490	-77.4	10	----
Bufflehead	1.5	1,099	-13.3	20	Dec. 22-28
Wood Duck	1.4	980	-3.4	20	Oct. 13-19
Mergansers	0.6	420	-60.3	10	Jan. 10-30
All Ducks	100.0	70,483	-21.5	850	Feb. 14-20

4. Marsh and Water Birds

Many of the 20 species of marsh and water birds that use Mackay Island also frequent wetlands of Currituck NWR either yearround or seasonally. Most heron use is by great blue, little blue and green-backed herons. Common egrets, snowy, and cattle egrets are found on the refuge throughout the year. Glossy ibises and tri-colored herons seasonally frequent refuge marshlands. Other seasonal water bird use is derived from coots, pied-billed grebes, and double-crested cormorants. King and Virginia rails, are the most common rails on most refuge tracts. Infrequent marsh birds include sora, clapper rails and least bitterns.

5. Shorebirds, Gulls, Terns, and Allied Species

The coastline of the Currituck Banks provides important migratory habitat for a variety of shorebirds during their spring and fall passages. The beach of the Currituck Outer Banks are especially valuable during shorebird migrations due to the lack of regularly exposed tidal (i.e., lunar) mudflats in Currituck Sound and Back Bay where irregular wind tides infrequently expose mudflats in these areas. Several species using this beachfront such as sanderling, least sandpiper, and black-bellied plovers are recognized by the Service as species

of special concern which have probably suffered recent declines in their continental populations. Sanderling, ruddy turnstone, semipalmated plovers, and black-bellied plovers are among the most abundant migrants along the Currituck Banks during both migrations.

The Flats, high refuge marsh, and irregularly exposed mudflats on the Currituck Sound are foraged over by greater and lesser yellowlegs, solitary and spotted sandpipers, and by willet during spring and fall migrations. Exposed mudflats on the east side of Currituck Sound are heavily used by yellowlegs, semipalmated plovers, and other shorebirds for protection and forage zones during spring Nor'easter storms.

A variety of gulls and terns use the beachfront and other water areas of the refuge tracts. Ring-billed, herring, great black-backed, and laughing gulls are the most common gulls. Common, royal, sandwich, Forester's and least terns frequent the refuge beachfront from spring through fall. Least tern nesting activity was again monitored at the same time piping plover nests were surveyed. Four nesting areas were found with three occurring on private lands and one small group of nests was found at the south end of the SIT. Usually these nest sites were only made up of 3-4 nests. Nest sites were checked weekly but no chicks were thought to have been fledged from any one of the nesting areas.

6. Raptors

Moderate numbers of raptors use the refuge during the fall migration. Stopovers are made by American kestrels, sharp-shinned hawks, merlin, and cooper's hawks. In early October, 3-5 peregrine falcons were witnessed on a daily basis passing over the SIT. Bald eagles are occasionally spotted over the marsh wetlands from late fall to early winter. Northern harriers are commonly seen over marshlands from December through March.

15. Animal Control

Unfortunately several types of non-native animals including feral horses, feral pigs, and domestic cattle have been left to range over refuge tracts. Their histories on the Currituck Banks are somewhat debatable yet little has been done to control their numbers and competition with native plants and wildlife has been apparent in recent years. Feral horses were commonly found in the Flats and beachfront of SIT grazing on grasses and herbs; their numbers generally ranged from 3-10 on this unit. Rooting by small numbers of feral pigs was very obvious in the late winter - spring period on the Flats.

Feral horses concentrate their feeding on grasses and forbs in the Flats. 9/93 KM

Free roaming cattle and horses continue to consume wetland and dunal vegetation and impact refuges resources. Eight separate incidents of cattle trespassing and 20 more notations of horses wandering on the SIT impoundment were recorded. As many as 14 head of cattle and 11 horses have been counted at one time feeding on the lush grasses.

On March 31, Acting Manager Nottingham attended a "wild" horse coordination meeting in Corolla called by the Corolla Wild Horse Fund and Currituck County officials. Although not present at the meeting, State Senator Marc Basnight had asked Jonathan Howes, Secretary of the Department of Environment, Health, and Natural Resources to meet with the horse advocates to explore prospects of moving the Corolla Wild Horse herd to the Currituck Banks to avoid any more horse fatalities on the Corolla roads. Secretary Howes explained that horses on the Estuarine Reserve would not serve the purposes for which it was established. Nottingham also explained that the horses would be incompatible with Currituck NWR purposes. In short, when other suitable areas were examined there were none readily apparent. Needless to say, they horse advocates as well as county officials left the meeting rather disappointed.

On October 1, Merritt and Nottingham met with local, county, state and federal officials in Corolla, NC to hear short-term and long-term proposals for managing wild horses on the Currituck Banks. This meeting was carefully orchestrated by leaders of the Corolla Wild Horse Fund and the Currituck County Commissioners who had met just before the meeting.

As the afternoon meeting progressed it became apparent that the Corolla Wild Horse Fund had made an agreement with the Commissioners to accept a partial management interest in the horses and get input on solutions to correct horse - people conflicts in Corolla. The short-term solution included extending the fence between Ocean Hills subdivision and the Estaurine Reserve out into the ocean where 15 of 25 horses in Corolla would be relocated above the fence. Ten horses would be corralled in a small pasture by the county's

Whalehead Club. The long-term solution included managing the free roaming herd above Corolla within some carrying capacity that was to be determined from a study that would examine the horses impact on the Estuarine Reserve. Options mentioned included herd size management that supposedly would be done with monies from the Wild Horse Fund.

The meeting turned out to be nothing short of a press conference as a sizeable number of newspaper reporters and local, state, and federal representatives on hand to hear the release of these proposals. Representatives of Congressman Martin Lancaster were also present as was State Senator Marc Basnight. Mr. Steve Levitas, Deputy Secretary of the NC Department of Health, Economic Development and Natural Resources represented the State and reversed a previous position of not allowing horses on the Estuarine Reserve. The refuge did not challenge the solution at this time but expressed a view that problems remained.

On October 19, Merritt attended an annual meeting for the Currituck Banks Local Advisory Committee to the North Carolina National Estuarine Research Reserve on the Currituck Outer Banks. Several issues were discussed including discussion by members of the Corolla Wild Horse Fund who were present to comment on the recent proposals to relocate horses out of Corolla (& onto the Reserve) and conduct an impact study on the horses on the Reserve.

In late November, the county had submitted an application to the Division of Coastal Management for a CAMA permit to construct a fence to maintain the Corolla horses north of Corolla. In December, Merritt submitted comments to the Division of Coastal Management expressing opposition to the fence proposal as it would promote more horse use on Currituck NWR which would negatively impact native plants and animals.

Merritt met Rowena Dorman of the Corolla Wild Horse Fund at Corolla, NC on December 9 and showed her where the proposed horse fence would meet the refuge boundary. Ms. Dorman was then given a tour of the refuge to see the damage caused by feral horses on the Swan Island Tract.

H. PUBLIC USE

1. General

The refuge is open to hiking, birdwatching and photography. Vehicular access is prohibited. Visitation is estimated at 2,000 persons, most of whom beachcomb on the SIT. North Carolina Highway 12 ends at Corolla and all traffic north of there uses the beach strand, which is regulated by the county and is not on the refuge. The refuge boundary extends only to the mean high water mark on the beach. About 30,000 vehicles use the beach each year to access the communities of Ocean Beach, Seagull, Swan Beach, North Swan Beach and Carova Beach. It is also the only route for surfers, sunbathers and surf-fishermen. Licenses, tags, inspection and insurance are not required north of the Corolla ramp so just about anything that moves is driven on the beach by anyone tall enough to reach the pedals.

8. Hunting

The refuge is closed to all hunting by the general public. Waterfowl hunting blind rights were retained by the Swan Island Hunt Club when the SIT was purchased and are used each year.

Hunting blind rights were acquired by the Service with the purchase of the Monkey Island Tract. Each year the refuge buys the blind licenses from the county game commission and builds duck blinds along the shore. County regulations restrict hunting within 500 yards of a licensed blind, thereby providing a rest area between the refuge and hunters. Ten blinds were built this year by refuge staff.

17. Law Enforcement

Mackay Island Refuge Officers patrol on an irregular basis due to demands at Mackay Island and logistics of getting to Currituck. North Carolina Wildlife Resources Officers occasionally patrol the area and assist as requested, but are nearly an hour away and cannot enforce refuge regulations. County Deputies enforce state and county laws along the beach strand and have been most cooperative in reporting violations of vehicular trespass. A total of 58 patrols were made this year which resulted in 38 reported incidents and the issuance of 8 violation notices and 18 written warnings. NC Wildlife Officers provided information on two of the violation notices and prosecuted one charge through state court.

The most often encountered violations are cattle trespass, free roaming dogs, motor vehicle trespass, hunting and possession of firearms, dumping of refuse and camping. Enforcement efforts are hampered by the 1 1/2 hour drive to the refuge from Knotts Island and the lack of a storage facility for an ATV.

NOTABLE INCIDENTS

During a patrol on September 3, Officer Panz heard Currituck County Emergency Management Officer Donny Beacham discussing unexploded ordnance on the county radio. Panz proceeded to the site on the Monkey Island Tract. Mr. Beacham had been informed of the problem by a visitor who reportedly found a live round on the beach. A pile of rusted metal was exposed in the dune area by a recent storm and investigation revealed the site had been a gunnery range during World War II. A DOD Demolitions Removal Team conducted a survey and determined it posed no immediate hazard. The area was posted with "Area Closed" signs and flagged with yellow barrier tape. A request for removal of the site was submitted to the Army Corps of Engineers in coordination with the regional office.

The state opened a deer hunting season on the Outer Banks (within poplar branch township) for the first time in 20+ years. The refuge tracts and the rest of the Outer Banks north to the Virginia line remained closed. Nonetheless, on October 18, NC Wildlife Officers Earl Brinkly and Steve Jarvis discovered drag marks and a dead deer on the SIT. They set up surveillance and a man was apprehended just after dark as he returned to the deer. The officers followed his footprints back to where he hid his rifle and he was charged for hunting deer in closed season. He plead guilty in state court, was fined $250, $60 court cost, $279 replacement cost and lost his license for a year. The rifle, valued at $800, was returned under the plea agreement.

STATISTICS

Type of Incident	# reported	# violation notices	#written warnings
Assist Citizen	1		
Assist Other Agency	4		
Camping	3		3
Cattle Trespass	8		
Dogs at large	2		2
Firearms Possession	2	4	4
Hazardous Area	1		
Hunting on Refuge	2	2	2
Littering/dumping	3		
Property Found	2		
Motor Vehicle Trespass	7	2	7
Vandalism	1		
Wildfire:Undetermined	1		
Wildlife Incident	1		
*Totals	38	8	18

*These are included in the Mackay Island Summary

J. OTHER ITEMS

4. Credits

K. Merritt	- Sections A, C, D, E, I
B. Nottingham	- Sections B, F, G, J
M. Panz	- Section H
P. VanZant	- Typing, Colating

Photo Credits

BN - Ben Nottingham
JM - Jessie McCleskey
KM - Ken Merritt

MACKAY ISLAND NATIONAL WILDLIFE REFUGE
POST OFFICE BOX 39, STATE ROUTE 615
KNOTTS ISLAND, NORTH CAROLINA 27950-0039
(919) 429-3100

GENERAL REGULATIONS

The refuge office is open all year, Monday through Friday, from 8:00 am to 4:00 pm. Visitors are permitted to drive on the Mackay Island Road and to walk or bicycle the 4 mile Mackay Island Trail or the 6.5 mile Live Oak Point Trail from **March 15 through October 15, from sunrise to sunset.** Mackay Island Road is open to driving walking, and bicycling up to the second gate from **October 16 through March 14, from sunrise to sunset.** The trails and marshes are closed during this time to protect resting areas for migratory birds.

Designated areas of the refuge are closed during Deer Hunts.

Firearms bows, air guns, off-road vehicle use, airboats, camping, fires, littering and disturbing or collecting of plants, animals or human artifacts are **NOT** permitted within the refuge boundary.

SPORT FISHING REGULATIONS

Sport fishing is permitted in all canals and bays between **March 15 and october 15,** with the following conditions:

a. The use of boats or other flotation devices in not permitted within the refuge impoundments. **Bank fishing only.**

b. Sport fishing is permitted from **sunrise to sunset.**

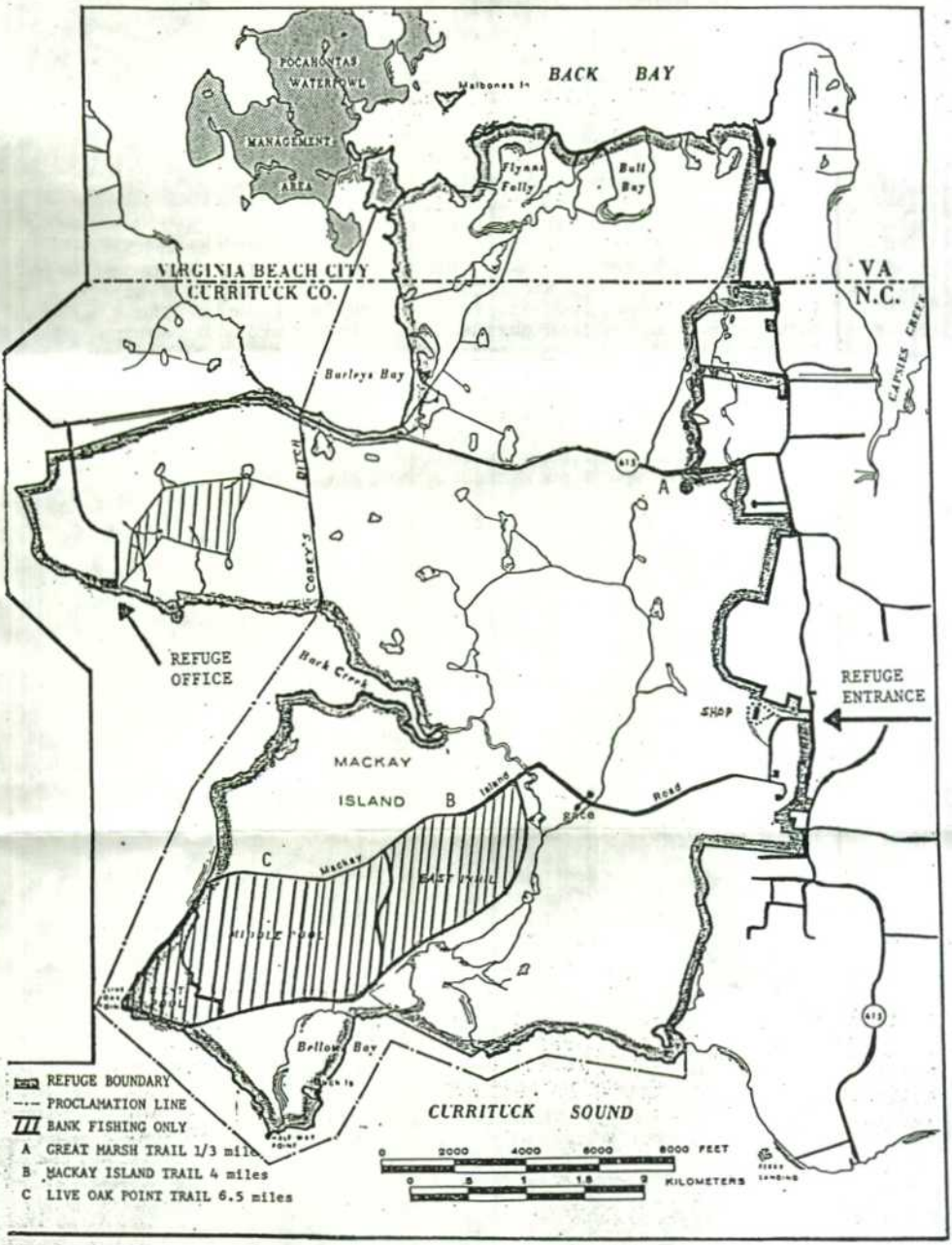
c. Commercial fishing, trot lines, eel and crab pots, bait traps and nets are **not** permitted.

d. Launching of small boats from the Knotts Island Causeway (Rt. 615) is permitted from **March 15 through October 15 from sunrise to sunset.** Airboats are prohibited.

e. Corey's Ditch, the Marsh Trail and the canal adjacent to the north bank of the Knotts Island Causeway are open to fishing throughout the year, or as indicated by signs. Canals and ponds at the refuge office are open to fishing year-round only when the refuge office is open.

In addition to these provisions, all County codes, State laws and Title 50 of the Code of Federal Regulations are enforced on the refuge. Should you have any questions regarding the legality of any activity, consult a refuge officer before engaging in the activity. The refuge manager may be reached at the refuge office.

MACKAY ISLAND NATIONAL WILDLIFE REFUGE



MACKAY ISLAND NATIONAL WILDLIFE REFUGE

The Mackay Island National Wildlife Refuge, along with over 470 other refuges scattered throughout the country, was established to protect our wildlife resources now and for future generations. Here, wildlife is provided the habitat needed for its survival because wild creatures, like humans, must have a place to live.

The refuge, located in the extreme northeast corner of North Carolina on Knotts Island, invites nature lovers both fowl and folk to a respite of quiet beauty. Of the nearly 8,000 acres of marsh, timberland and cropland, 874 lie in Virginia.

The U.S. Fish and Wildlife Service bears the Federal responsibility for the protection and management of many wildlife forms, including migratory birds and endangered species and their habitats. Mackay Island is fulfilling this responsibility by providing a habitat for transient and overwintering ducks, geese, swans and coots as well as for several endangered species. Many other species of wildlife find food, cover and nesting opportunities on the refuge.

A former private owner of Mackay Island played a significant role in the history of private wildlife conservation. In 1934, Joseph P. Knapp founded the organization known as More Game Birds in America. In 1937, this organization was incorporated as the modern day private conservation group known as Ducks Unlimited, Inc. Mackay Island and and a large portion of the surrounding marsh was owned by Mr. Knapp from the early 1900s until his death in 1951. Mr. Knapp had used this land as his private duck hunting retreat. After a period of logging by a subsequent private owner, Mackay Island was purchased by the Department of the Interior to establish a National Wildlife Refuge (NWR). The Knapp Foundation established by Mr. Knapp has recently donated sizeable land acreage to Mackay Island NWR to bolster migratory bird conservation in the Currituck Sound.

WILDLIFE

The refuge abounds with wildlife throughout the year - some species just passing through at a particular time in the year and others calling the area home for their entire lives.

Mackay Island Refuge is strategically located along the Atlantic Flyway, making this an important wintering area for thousands of ducks, geese and swans during the fall and winter months. In September, after Snow geese have completed their nesting, they move down through northeastern Canada where they are joined by Canada geese and many other species of ducks as they travel to the Mid-Atlantic coastal marshes, including Back Bay, Currituck Sound and Mackay Island National Wildlife Refuge to spend the winter.

This refuge plays an important role in the conservation of the Greater Snow Goose. At times 40,000 of these birds may use the area. In the early 1970's, one-half of the entire Greater Snow Goose population could often be observed on the marsh at Mackay Island Refuge. In the mid 1970's, Snow Geese began feeding in nearby farm fields, thus the value of Mackay Island Refuge became more pronounced as the refuge served to minimize crop depredations on winter crops. Many species of ducks also make use of the refuge, including Mallards, Black Ducks, Green and Blue-winged Teal, Pintails and others.

The refuge also attracts many wading birds such as Great Blue Herons, Little Blue Herons, Snowy, Great and Cattle Egrets, Green-backed Herons and Glossy Ibises. On occasion the endangered Bald Eagle and Peregrine Falcon are spotted hunting over the refuge.

In addition to bird life, other forms of wildlife call the refuge home. This list includes Muskrat, Nutria, River Otter, Mink, White-tailed Deer, Gray Squirrel, Gray Fox and Raccoon. There are many kinds of turtles and snakes on the refuge. The Cottonmouth Moccasin, a poisonous snake, is abundant in the area and the visitor should be aware of this. All of the wildlife is protected in order to provide an opportunity for people to see them in their natural environment.

MANAGEMENT

Management of wildlife resources can take many forms. Maintaining healthy populations of wildlife is a primary objective and focuses on habitat modification, maintenance and population monitoring and management. Habitat for wildlife can be broken down into food, water and shelter and sound wildlife management activities consider all these aspects.

The natural food supply (submerged aquatic vegetation) offered by Currituck Sound and the adjoining marshes is supplemented by 122 acres of corn, wheat and other grains which are planted on the Live Oak Point and Headquarters fields.

Prescribed burning of certain marsh areas is used as a management tool. These controlled fires prevent trees from invading the marsh, stimulate desirable vegetation and provide accessible and attractive feeding areas for Snow Geese.

Wood Duck nesting boxes and Osprey nesting platforms are erected on the refuge to supplement natural nesting sites. The Wood Duck population was at one time a critical concern due to habitat destruction, however, through changes in the hunting regulations, habitat restoration and public

support, the species has rebounded. The refuge annually produces approximately 1,000 birds. The Osprey population, nationwide, has made a comeback as well since persistent and toxic pesticides were banned.

Water impoundments are another management effort to provide ample food for the wildlife. Controlling the water levels in the impoundments not only allows the desired waterfowl foods to grow, but also makes it readily available to the ducks and geese. They also provide primary foraging sites for wading birds such as herons, egrets, and rails.

HISTORY

Evidence of Indian activity around Mackay Island has been found by the type of artifacts unearthed. In addition, a mass burial site was discovered on adjoining Knotts Island in 1989. It was determined to be 600--900 years old. An unsubstantiated account shows that Captain James Knotts of England, sailed through the ocean inlet, which has since closed over, in 1594 and named Knotts Island for himself.

The original English land grants prior to 1680 show lower and upper "Norfolk," but they were assigned before the state and counties were delineated.

The first recorded history of Mackay Island began in 1761 when John Mackie acquired a parcel of land from John Jones, owner of Mackay Island, then known as "Orphan's Island." It is unknown how the name was changed to "Mackay" from "Mackie." John Mackie reportedly resided on the island until his death in 1823. Local rumor reveals that Mr. Mackie was buried on the island in an upright position so he could "keep watch over his fields."

Ownership of the island changed hands several times during the 1800's and was sold in 1906 by Cornelius Jones and Elizabeth Beasley to the George Roper Lumber Company for the standing timber. Mr. Roper sold it to Thomas Dixon, author of "The Birth of a Nation," in 1916.

Wealthy New York printing magnate and philanthropist Joseph P. Knapp purchased the island in 1918 for $39,211. From the first moment he visited Mackay Island Mr. Knapp saw the potential of this beautiful area. He proceeded to make it into a private resort and built a mansion on Live Oak Point along with boating facilities, barns, greenhouse, swimming pool, golf course and hunting ponds. Mr. Knapp, a noted duck hunter, was so taken by the ideas of game management, that he formed the "More Game Birds in America Foundation" in 1930. He, along with political cartoonist J.N. "Ding" Darling, J. Pierpont Morgan, Arthur W. Bartley and John C. Huntington served as directors.

Mr. Knapp, now known as the father of "Ducks Unlimited," experimented with many of the newly emerging management practices, such as maintenance of water levels to attract certain types of aquatic grasses, on his estate at Mackay Island. Unlike many sportsmen, Mr. Knapp helped push legislation through that required fees for nonresident sportsmen, providing revenues that helped develop a system of county roads. When the locks on the intercoastal waterway were removed from the northern end of Currituck Sound at the end of World War I, Mr. Knapp paid the federal government $250,000 to have the locks restored to prevent the flushing of pollutants into the sound.

Throughout the 1920's and 30's Mr. Knapp made sizeable donations to the Currituck schools, allowing the county to become the first in the state to provide free textbooks and lunches. He also gave $250,000 to the University of North Carolina for a statewide public school survey, fisheries research and other projects.

After his untimely death in 1951 the island was sold to a Mr. James Standing in 1952. The island was logged through the 1950's and the Knapp estate fell into disrepair and vandalism. The island was acquired by the U.S. Fish & Wildlife Service in 1961 to provide habitat for transient and over-wintering waterfowl, particularly greater snow geese.

Mackay Island National Wildlife Refuge is strategicly located for birds migrating along the Atlantic Flyway. The old home has since been removed, but the magnificent magnolias, pecans, hackberries, hollies and numerous exotic tree species and shrubs still beautify the landscape. The former golf course is now planted to corn and winter wheat for use by wintering waterfowl and the old swimming pool is now used by wood ducks.

The refuge is visited by hundreds of thousands of migratory birds throughout the year and is home to many species of songbirds, wood ducks, geese, rails and osprey. Bald eagles are occasionally sighted. The area is rich with mammals, reptiles and amphibians which are protected from disturbance within the refuge boundaries.

Since 1961, the refuge has expanded to nearly 8,000 acres and includes numerous islands, marsh, uplands and open water embayments. Each area is managed intensively for the protection of habitat that is most suitable for migratory birds.

CURRITUCK NATIONAL WILDLIFE REFUGE
MACKAY ISLAND NATIONAL WILDLIFE REFUGE
POST OFFICE BOX 39
KNOTTS ISLAND, NORTH CAROLINA 27950-0039

Currituck National Wildlife Refuge, on North Carolina's Outer Banks, was authorized in 1983 and is managed by the U.S. Fish and Wildlife Service. The first refuge tract, a previous holding of the Monkey Island Hunt Club, was purchased in August 1984. Mainland marshes and dune areas of the Swan Island Hunt Club were donated by The Nature Conservancy to the Service in March 1985. A third tract of land was acquired in 1988, through a trade with Currituck County, NC for Monkey Island and is located at the village of Corolla, NC. All three tracts comprise about 1,824 acres and are administered by the Mackay Island N.W.R. from their office on Knotts Island, NC.

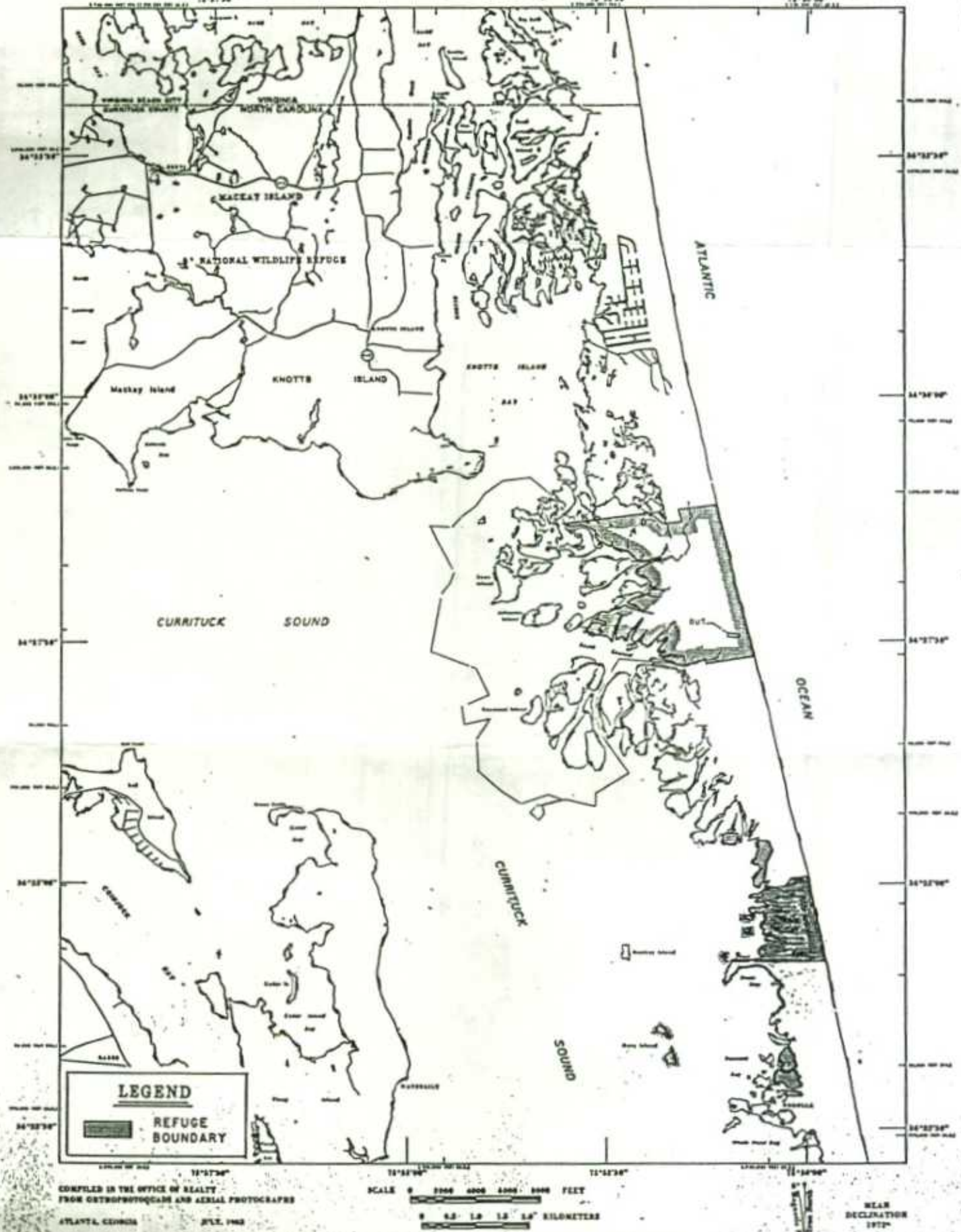
Currituck Refuge is open throughout the year for hiking, bird watching and photography. Vehicular access is prohibited. Some portions of the dune flats area, above the high tide line, may be closed to all public use during the spring and summer for protection of nesting sites of the endangered Piping Plover shorebird. Watch for "AREA CLOSED" signs that outline these areas. Please refrain from trespassing beyond those signs as the Piping Plover does not tolerate human intervention and may abandon their nests. Free roaming dogs present an extreme danger to the recovery of these tiny birds so the use of leashes is mandatory. Help us restore these birds by leaving them alone.

Hunting, firearms, air guns, bows, camping, fires, all terrain vehicles, littering and collecting of plants or animals are <u>not</u> permitted. The refuge is open during daylight hours only, any night time use is prohibited.

In addition to these provisions, all County codes State laws and Title 50 of the Code of Federal Regulations are enforced on the refuge. If you have any question regarding the legality of any activity, consult the refuge manager before participating in the activity.

CURRITUCK NATIONAL WILDLIFE REFUGE

CURRITUCK COUNTY, NORTH CAROLINA



As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationallly 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.

DEPARTMENT OF THE INTERIOR
U.S. Fish and Wildlife Service
RF-41660-2 - December 1989

BIRDS
of
Mackay Island
National Wildlife Refuge

Virginia/North Carolina

MACKAY ISLAND NATIONAL WILDLIFE REFUGE is located in the extreme northeast corner of North Carolina, with 842 of its 7,800 acres lying in adjacent Virginia. It was established in 1960 as a wintering ground for migratory waterfowl, particularly greater snow geese. Thousands of ducks, geese, and swans flock to Mackay Island marshes and water areas for the winter. They are just a few of the many groups of birds which visit the refuge during the year.

The Knotts Island Causeway (State Rt. 615) which crosses the refuge, offers some good look-out points for viewing most of the species of waterfowl and marsh birds that occur in the Back Bay/ Currituck Sound Area.

During the spring and summer the woodlands contain a variety of nesting songbirds. Most common are the cardinal, brown thrasher, Carolina wren, prothonotary warbler, prairie warbler, and mockingbird. Many species in the following list are only spring or fall migrants and may be missed easily on any one visit.

Refuge headquarters is reached by driving south on Virginia State Highway 615 toward the community of Knotts Island, North Carolina.

HOW TO USE YOUR CHECKLIST

The bird checklist was designed to be informative and simple to use. The birds under major headings are arranged in alphabetical order. Symbols which appear in this checklist represent the following:

SEASONAL APPEARANCE

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

SEASONAL ABUNDANCE

a - abundant (a common species which is very numerous)
c - Common (certain to be seen 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)
* - nesting has occurred on the refuge.

This checklist includes 182 species of birds and is based on observations by refuge personnel and visiting ornithologists. If you should find an unlisted species, please let us know at Refuge Headquarters. We will appreciate your help in updating our records.

	SP	S	F	W
LOONS AND GREBES				
___Common Loon			o	o
___Horned Grebe	o			
___Pied-billed Grebe	o	o	c	c
___Red-necked Grebe				r
___Red-throated Loon			r	r
PELICANS AND CORMORANTS				
___Double-crested Cormorant	o	o	c	c
BITTERNS, EGRETS AND HERONS				
___American Bittern*	u	u	u	u
___Black-crowned Night-Heron		o	o	o
___Cattle Egret	c	c	o	
___Great Blue Heron	c	c	c	c
___Great Egret	c	c	c	c
___Green-backed Heron*	c	u	u	r
___Least Bittern*	u	u	u	u
___Little Blue Heron	u	u	o	
___Snowy Egret	u	u	o	o
___Tricolored Heron		o	o	o
___Yellow-crowned Night-Heron		r	r	r
IBISES AND STORKS				
___White Ibis		r		
___Glossy Ibis	u	u	o	o
DUCKS, GEESE AND SWANS				
___American Wigeon	u		c	c
___Black Duck*	c	o	c	c
___Blue-winged Teal	c		c	c
___Bufflehead			o	u
___Canada Goose*	o	o	u	u
___Canvasback	o		o	o
___Common Goldeneye			r	r
___Common Merganser			u	u
___Eurasian Wigeon			r	r
___Gadwall			a	a
___Greater Scaup			r	r
___Green-winged Teal	c		c	c
___Hooded Merganser*	r	r	u	u
___Lesser Scaup	o		u	u
___Mallard*	c	u	c	c
___Northern Pintail	o		c	c
___Northern Shoveler	u		u	u
___Redhead			u	u
___Red-breasted Merganser			u	u
___Ring-necked Duck			u	u
___Ruddy Duck			c	c
___Snow Goose	c	r	c	a
___Whistling Swan	r	r	c	c
___Wood Duck*	c	c	c	u
VULTURES				
___Black Vulture	r	r	o	o
___Turkey Vulture	c	c	a	a
OSPREYS, KITES, EAGLES, HAWKS AND FALCONS				
___American Kestrel	c		c	c
___Bald Eagle	o		o	o
___Broad-winged Hawk		u	u	
___Cooper's Hawk	o		u	u
___Golden Eagle			r	r
___Northern Harrier	c		c	c
___Merlin			o	o
___Osprey*	c	c	c	
___Peregrine Falcon			o	o
___Red-shouldered Hawk	o	o	o	o
___Red-tailed Hawk*	u	u	u	u
___Rough-legged Hawk			r	
___Sharp-shinned Hawk		u	u	u
GALLINACEOUS BIRDS				
___Northern Bobwhite*	c	c	c	c
RAILS, CRANES, GALLINULES, AND COOTS				
___American Coot*	c	r	c	c
___Common Moorhen*	c	c	c	u
___King Rail*	c	c	c	c
___Purple Gallinule	r	r		
___Sora*	o	o	o	o
___Virginia Rail*	u	u	u	u

SHOREBIRDS	SP	S	F	W
___American Woodcock	o	r	o	r
___Killdeer	u	u	u	o
___Common Snipe	u		u	u
___Greater Yellowlegs	o		o	
___Least Sandpiper	o		o	o
___Lesser Yellowlegs	o		o	r
___Semipalmated Sandpiper	u		u	o
___Solitary Sandpiper	r			
___Spotted Sandpiper	u	o	u	o

JAEGERS, GULLS AND TERNS				
___Black Tern		u		
___Bonaparte's Gull			o	o
___Caspian Tern	o	o	o	
___Common Tern	u	c	u	
___Forster's Tern		r	o	o
___Great Black-backed Gull	u		u	u
___Herring Gull	u	u	u	u
___Laughing Gull	u	u	c	c
___Least Tern		o	o	
___Ring-billed Gull	u		u	u
___Royal Tern	r	r		
___Sooty Tern			r	

PIGEONS AND DOVES				
___Mourning Dove*	c	c	c	c
___Rock Dove	o	o	o	o

CUCKOOS				
___Black-billed Cuckoo		r	r	
___Yellow-billed Cuckoo*	c	c	c	

OWLS				
___Barred Owl			r	r
___Common Barn-Owl	r	r	r	r
___Eastern Screech-Owl	c	c	c	c
___Great Horned Owl*	u	u	u	u
___Short-eared Owl*	r	r	r	r
___Snowy Owl			r	r

GOATSUCKERS				
___Chuck-will's widow*	u	u		
___Common Nighthawk	r	r		

SWIFTS, HUMMINGBIRDS, KINGFISHERS	SP	S	F	W
___Belted Kingfisher*	c	c	c	c
___Chimney Swift	o			
___Ruby-throated Hummingbird*	u	u		

WOODPECKERS				
___Common Flicker*	c	c	a	c
___Downy Woodpecker	u	u	u	u
___Hairy Woodpecker	u	r	r	r
___Pileated Woodpecker*	u	u	u	u
___Red-bellied Woodpecker	u	u	u	o
___Red-cockaded Woodpecker*	r	r		
___Red-headed Woodpecker	r	r	r	r
___Yellow-bellied Sapsucker	o	o	o	o

FLYCATCHERS				
___Eastern Kingbird*	u	c	u	
___Eastern Phoebe			c	
___Eastern Wood-Pewee*	c	o		
___Great Crested Flycatcher*	c	u		

MARTINS AND SWALLOWS				
___Barn Swallow	c	c	c	
___Northern Rough-winged Swallow	r	r	r	
___Purple Martin*	u	c		
___Tree Swallow	c	c	a	o

JAYS AND CROWS				
___Blue Jay*	u	u	c	u
___Common Crow*	c	c	c	c
___Fish Crow	u	u	u	

CHICKADEES AND TITMICE				
___Carolina Chickadee*	c	c	c	c
___Tufted Titmouse*	u	c	c	

NUTHATCHES AND CREEPERS				
___Brown Creeper	o			o
___White-breasted Nuthatch		u	u	

	SP	S	F	W
WRENS				
___Carolina Wren*	c	c	c	c
___House Wren*	u	u	o	
___Marsh Wren*	u	u	u	u
KINGLETS AND GNATCATCHERS				
___Blue-gray Gnatcatcher	r	r		
___Ruby-crowned Kinglet	o	o	o	
THRUSHES, ROBINS AND BLUEBIRDS				
___American Robin*	o	u	u	o
___Eastern Bluebird	o	o	o	
___Hermit Thrush				u
THRASHERS, MOCKINGBIRDS AND CATBIRD				
___Catbird*	u	u	u	u
___Brown Thrasher*	c	c	c	c
___Mockingbird*	c	c	c	c
WAXWINGS, SHRIKES AND STARLINGS				
___Cedar Waxwing	o		o	o
___European Starling*	c	c	c	u
VIREOS				
___Red-eyed Vireo*	o	o		
___White-eyed Vireo*	u	c		
WARBLERS				
___American Redstart			u	
___Black-and-white Warbler			r	
___Blackpoll Warbler	o			
___Black-throated Green Warbler	o			
___Common Yellowthroat*	c	c	c	
___Hooded Warbler	o			
___Magnolia Warbler	o			
___Myrtle Warbler	u	o	u	u
___Northern Parula	r			
___Ovenbird	o			
___Palm Warbler			c	
___Pine Warbler	r			
___Prairie Warbler*	c	c		
___Prothonotary Warbler*	c	c	o	
___Yellow-rumped Warbler	o		a	a
___Yellow-throated Warbler	o	r		
___Yellow Warbler	o			
CARDINALS, GROSBEAKS AND BUNTING				
___Blue Grosbeak	u	u		
___Indigo Bunting	u	u		
___Northern Cardinal*	c	c	c	c
___Rose-breasted Grosbeak	o		o	o
SPARROWS				
___Chipping Sparrow	o		c	
___Dark-eyed Junco	u		u	u
___Field Sparrow	c			c
___Fox Sparrow				u
___Rufous-sided Towhee*	c			c
___Savannah Sparrow*	c	c	c	c
___Sharp-tailed Sparrow		r		
___Song Sparrow*	c		c	c
___Swamp Sparrow			c	c
___White-crowned Sparrow			o	
___White-throated Sparrow	c		c	c
BLACKBIRDS, MEADOWLARKS ORIOLES AND COWBIRD				
___Boat-tailed Grackle	c	c	c	c
___Bobolink	o			
___Brown-headed Cowbird*	c	c	c	c
___Common Grackle*	c	c	c	c
___Eastern Meadowlark*	c	c	c	c
___Northern Oriole	o			
___Orchard Oriole*	u	u		
___Red-winged Blackbird*	c	c	c	c
FINCHES				
___American Goldfinch	u	u		
___Purple Finch	o		o	o
WEAVER FINCHES				
___House Sparrow*	u	u	u	r

SIGHTING NOTES

Date: _____ Time: _____ to _____

Weather: _____

_____

No. of species: _____

Route or area: _____

Observers: _____

Remarks: _____

_____

_____

_____

_____

_____

For additional information, contact:
Refuge Manager
Mackay Island National Wildlife Refuge
P.O. Box 31
Knotts Island, North Carolina 27950
Telephone: (919) 429-3100