

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 1992

*Ben Nottingham*

Acting Refuge Manager

*6-3-93*

Date

*Paul A. Grubel*

Associate Manager Review

*6/10/93*

Date

*Wesley W. Benson*

Regional Office Approval

*6/16/93*

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. Currituck Sound area 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. In 1989, the refuge entered a lease with The Conservation Fund and The Knapp Foundation to manage 760.18 acres. These leased lands are to be donated to the Service at a future date. The donation will also include a hunting lodge which now serves as an office/visitor contact station. In 1992, a 72 acre parcel (which is part of the boundary expansion plan) was acquired from The Conservation Fund. To date, the refuge land size is 7,928 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 I shows the acreage of each habitat type/land use.

HABITAT TYPE	APPROXIMATE ACRES	PERCENTAGE
Wetland-Estuarine	5,725	72.2
Woodland	1,507	19.0
Buildings, Roads, Etc.	289	3.6
Cropland	220	2.8
Brush	187	2.4
TOTAL	7,928	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 1-8%. Submerged aquatic vegetation (SAV) had been abundant in these waters but this is no longer true. The declines in SAV (*Miriophyllum*, *Potamogeton*, *Vallisneria*, *Ruppia*, etc.) are not fully explained but speculative causes range from salinity to agricultural and urban effluent.

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## A. HIGHLIGHTS

The East Pool, a 350 acre freshwater impoundment, was the site for the second annual kids fishing day event sponsored by Currituck Chapter Ducks Unlimited/Greenwing Club.

Over 4,000 hours of volunteer work were provided to Mackay Island and Currituck Refuges.

The North American Wetlands Conservation Council selects Mackay Island Boundary Expansion Project to be considered for funding by the Migratory Bird Conservation Commission.

## B. CLIMATIC CONDITIONS

Temperatures were again above normal during winter months (ie. December, January, and February) as with only 14 freezing days occurring in January and February; some highs of near 70 degrees were recorded during these winter months. Precipitation was average with 43.5 inches of rain falling on the refuge.

MONTH	PRECIPITATION	TEMPERATURE		FREEZE DAYS
		AVG. HIGH	AVG. LOW	
January	3.43	48	34	9
February	1.60	52	36	5
March	2.81	51	40	6
April	1.34	63	47	0
May	2.94	65	51	0
June	2.75	79	64	0
July	2.86	86	73	0
August	9.33	82	68	0
September	6.98	72	62	0
October	2.78	67	51	0
November	4.41	60	47	2
December	3.24	50	34	2

## C. LAND ACQUISITION

### 1. Fee Title

In December, the refuge accepted fee title ownership of a 72 acre parcel, consisting primarily of marshland from The Conservation Fund (TCF). Funds for this purchase were made through a special request by the Realty Division of the Regional Office to use private inholding funds. The Service made a commitment to purchase this parcel from TCF in 1992.

### 3. Other

For a second straight year, the refuge submitted a second North American Wetland Conservation Act (NAWCA) proposal for consideration in FY-93. In late December, the proposal was selected by the NAWC Council to be considered for funding by the Migratory Bird Conservation Commission. If the project is approved by the Commission, \$350,000 will be awarded 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. The Knapp Foundation intends to donate over 636 acres of marsh, to the Service. These lands are presently managed by the refuge under a lease agreement.

In August, Andy Eller, RO appraiser, visited the refuge to conduct an appraisal on the proposed Knapp Foundation land donation. This appraisal value was needed to meet the requirements of the NAWCA proposal submitted in August.

A Phase I level Contaminant Survey was completed by refuge staff on the Boundary Expansion Lands. No contaminant areas were found and further surveys are not warranted.

A boundary dispute of approximately 1.5 acres continues with adjoining landowner Lloyd Mr. White. Mr. White has claimed refuge property near the shop entrance driveway since before 1975. All legal deed and survey documents clearly identify the United States government as rightful owners of the disputed lands. Recently, Mr. White enlarged his claim of refuge property and the Regional Office was notified. Bill Rasberry (surveyor) from the RO Realty made a visit to unofficially assess the situation. Associate Manager Grabill decided that the appropriate action at this time would be to document this incident and hold off posting the refuge boundary. We would claim the refuge property after Mr. White's death.

## D. PLANNING

### 2. Management Plan

A station aviation plan was drafted this year for our management activities involving aircraft use. This plan also provides direction in the event of any aviation emergencies on the refuge.

A handicapped accessibility evaluation of refuge programs was completed for the first time.

#### 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 the COE due to unfavorable consistency 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. Since the permit denial, in-house meetings and preconsultations with concerned state and federal entities have been completed. A second application with a new project design has been formulated and will be submitted in 1993. MARSH funding for the project has been available since Fiscal Year 1990. With continued patience and a little luck the formerly functional dike system and interior marsh will be enhanced to provide an open water habitat valuable to waterfowl, wading birds, endangered species and fish populations.

The Regional Historic Preservation Officer provided archeological survey clearance on a maintenance project to rehabilitate a one mile section of the Long Dike at the East Pool Impoundment. Construction work will begin in March 1993.

#### 5. Research and Investigations

Diane Beeman, a Doctorate student from North Carolina State University used the refuge to gather preliminary data for research work entitled "Mixed Function Oxygenase Models For Assessing Contaminant Exposure In Avian Embryos: Applications For Field Bioassessment." The study was initiated in Spring 1992 to determine whether monooxygenase induction in wood ducks is a suitable biomarker for assessing wildlife exposure to dioxins. Wood ducks were of interest because they can be readily attracted to nest boxes for study. They frequently occur along waterways below numerous pulp paper mills in the Southeast. Pulp paper mills have frequently been associated with dioxin contamination as a result of the chlorine bleaching process. The first component of this work was to determine ideal assay conditions and characterize monooxygenase responses by injecting either eggs or adult birds with one of two classic inducers, 3-methylcholanthrene or phenobarbital. The second component of the project focused on a field assessment of dioxin exposure using techniques as detailed above. Two reference sites (Mackay Island and Pocosin Lakes refuges) and two dioxin-contaminated sites (Roanoke River, NC, Sampit River, SC) were examined.





Photo of Dave Fisher collecting wood duck eggs. 5/92 BN

Dave Fisher, research assistant, conducted field work on Mackay Island refuge. Approximately 62 wood duck nest boxes were monitored weekly and ten clutches of eggs were collected.

Number of eggs per nest, hatching success, weight at hatch, 10 day survival rates and weight at ten days were determined. The hatching success of five clutches that were allowed to hatch ranged from 24 percent to 71 percent. The average hatching success was 54 percent. The results from all the field collections sites are as follows: There were no gross abnormalities among birds that successfully hatched. Livers from two pipping embryos, two 10 day old ducklings and two 18 week old birds per nest were excised and frozen for monooxygenase analysis. Microsomes were prepared from the pipping embryos and the BROD, EROD and MROD analysis run. The data from these are presently being analyzed. Carcasses were retained and frozen for analytical chemistry analysis. Livers from the 10 day and 18 week old birds will be assayed in the in the winter of 1992 to 1993.

Mackay Island refuge will not be used again in 1993 as a control site. A site closer to the other field sampling areas will be used.

E. ADMINISTRATION

## 1. Personnel

- |                                      |   |           |
|--------------------------------------|---|-----------|
| 1. Elizabeth A. Souheaver            | Refuge Manager<br>EOD 05/20/91          | GS-11 PFT |
| 2. Ben G. Nottingham                 | Ass't Refuge Manager<br>EOD 08/11/91    | GS-09 PFT |
| 3. Peggy VanZant                     | Office Assistant<br>EOD 01/13/92        | GS-05 PFT |
| 4. Timothy G. Williams               | Maintenance Worker<br>EOD 04/21/85      | WG-08 PFT |
| 5. Michael R. Panz                   | Law Enforcement Officer<br>EOD 09/28/86 | GS-07 PFT |
| 6. Robert Futrell                    | Maintenance Mechanic<br>EOD 07/01/90    | WG-10 PFT |
| 7. Wayne Cason                       | Forestry Technician<br>EOD 01/30/92     | GS-04 TFT |
| 8. David W. Halsey<br>(Not Pictured) | Forestry Technician<br>EOD 12/10/91     | GS-04 TFT |



Right to Left: 1, 2, 3, 4, 5, 6, 7,

2/93 JD

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

TABLE 3

	PFT	PT	TEMP	VACANT (PFT)	TOTAL FTE's
1992	6.0	-0-	.85	-0-	6.85
1991	4.9	-0-	.5	1.1	6.50
1990	5.8	-0-	1.4	.20	7.40
1989	6.0	-0-	-0-	-0-	6.00
1988	5.1	-0-	.90	.90	6.00

In January, the final complement to our staff was made when Peggy VanZant came onboard as the new administrative assistant. Peggy transferred from the Department of Defense (Virginia Beach, Virginia).

On a darker side, problems continue to plague our recruitment efforts for seasonal firefighters. The low pay for a GS-4 Forestry Technician attracts very few applicants. To add to our poor recruitment interest, delays have occurred with three of our four selections due to drug testing. The results from the drug test have taken as much as six weeks with the shortest turn around time of three weeks. We lost three months of seasonal work for two firefighters due to the problems associated with recruitment and obtaining drug test clearance.

### 3. Other Manpower Programs

The refuge participated in the YCC program for the first time in six years. Three enrollees from the local area were hired for eight weeks to complete tasks such as general facilities/ground maintenance, Partner's project assistance, wood duck nest box repairs, boundary line clearing and wood duck trapping and baiting activities.



Three YCC enrollees erected silt fence at a Partner's project site. We had a good cohesive crew. 7/92 DW

The refuge was fortunate to have a crew leader for the YCC camp. Mr. David Wales volunteered his services as leader for the first month of the program. As funding became available, Mr. Wales was hired for the remainder of the program as a temporary laborer. Mr. Wales efforts were extremely valuable as his assistance spared refuge staff of this supervisory responsibility. No serious accidents were recorded during the camp which always means a successful year. The enrollees gained valuable work experience and many labor intensive work projects were accomplished.



David Wales first volunteered and then was paid to lead the YCCs. After the YCCs finished, he led surveying elevations at the Kitchin marsh dike restoration project. 8/92 WG

#### 4. Volunteer Program

This was a banner year for the volunteer program. ARM Nottingham devoted considerable time and effort to promote/organize the refuge volunteer program. Over 4,000 hours of volunteer work was recorded for Mackay Island and Currituck Refuges. The highlights of the 1993 program included the second annual kids fishing day sponsored by Ducks Unlimited, assistance with the YCC program, numerous Boy Scout Projects, seven individuals participating on piping plovers surveys on Currituck Refuge and photography work of bird species on Mackay Island.

A total of 3,100 hours of services were accrued from the Currituck Chapter of Ducks Unlimited Volunteers in organizing and conducting the second annual Kids Fishing Day event at the East Pool Impoundment.

RM Souheaver and OA VanZant worked with 37 Boy Scouts and Girl Scout Brownies in February on refuge orientation and nature study to meet some of their requirements. They cleaned the refuge HQ and grounds in return.

In March, ARM Nottingham and Firefighter David Halsey helped 15 members of Boy Scout Troop 179 pick up tires along the shoreline at Refuge HQs.



Boy Scouts removed eight truckloads of tires from the shoreline. 3/93 BN

ARM Nottingham helped several Eagle Scout candidates with their projects in the spring. One scout coordinated the planting of 300 bald cypress trees, another scout coordinated the construction and installing of wood duck boxes; and a third Eagle scout coordinated restoration and maintenance work on the Great Marsh Trail on 3 different weekends.



One Eagle Scout project involved restoring and repairing the Great Marsh Trail.  
5/92 BN

Over 400 hours of labor were provided by all of the scouts and their leaders.

Eight volunteers from Alligator River NWR assisted with conducting nesting surveys for piping plovers and least terns on Currituck Refuge and adjoining lands on the Currituck Outer Banks. This effort combined with that of seven volunteers from Mackay Island NWR led to the most complete dataset yet compiled on piping plovers nesting activity on the Currituck Outer Banks.

Mr. Larry Wales, a talented photographer from Virginia Beach volunteered his services to photograph bird species on the refuge's bird list. Being a knowledgeable birder, Mr. Wales recorded new nesting activity on the refuge. Mr. Wales's work will continue into 1993. He is very talented and the refuge is now privileged to use his work during interpretive programs.

Other volunteers assisted refuge staff with collection of bi-weekly sampling of water quality testing, operation of the refuge deer check station, and refuge tours during the annual Peach Festival. In November, the refuge staff hosted a volunteer banquet at the Refuge Headquarters and honored all our volunteers for their most generous gift to us, their time.

Two nominations for the Take Pride In America Award (TPIA) were submitted by the refuge this year. A group award recognizing the Currituck Chapter of Ducks Unlimited and an individual award for the DU Greenwing Chairman, Mr. Jackie Simmons, were submitted.

## 5. Funding

Funding levels were essentially maintained from the 1991 level with Ducks Unlimited (DU) contribution still unspent due to Corps of Engineer permitting obstacles for one "MARSH" project. Since 1990, fire funding (9120) has been sufficient to maintain the refuge burning program. Improvements to the office/visitor contact station were required this year with 1260 funds. The front of the office was landscaped with ornamental plants and a colorful, sandblasted sign was installed recognizing Joseph P. Knapp. A private lands project was funded to complete dike restoration work on a 100 acre marsh impoundment. A breakdown of funding for the past four years is as follows:

	<u>FY-92</u>	<u>FY-91</u>	<u>FY-90</u>	<u>FY-89</u>
Base Funding (1261 & 1262)	\$245,900	\$239,900	\$236,600	\$223,100
DU Reimbursable Account (1971)	\$143,800	\$145,000	\$167,000	
Fire Funding (9120)	\$28,100	\$27,300	\$74,000	
Private Lands (1120)	\$9,600			
Small Maintenance Funding (1262)		\$11,300		
RO Matching Funding (1261)			\$33,000	

## 6. Safety

Mechanic Bob Futrell served as Station Safety Officer during 1992. Monthly safety meetings were held which included discussions on defensive driving, safety with hand cutting tools, heavy equipment operation safety, boating safety, public safety for rabid animals, and fire fighting safety. ARM Nottingham provided the annual CPR refresher training and emergency first aide training. No reportable accidents occurred during the year.

In late 1991, Knotts Island Volunteer Fire Department requested that the refuge allow the department to install a dry fire hydrant at the Great Marsh Trail pond which would provide permanent water access during the winter months when other water supplies might be frozen. The refuge obtained the necessary state/federal nationwide permits in 1992. The hydrant was not installed this year.

## 8. Other

RM Souheaver presented revenue share checks to Currituck County (\$42,797.00) and City of Virginia Beach (\$1272.00) in July.

Associate Manager Bill Grabill made one supervisory visit during the year.

During July, a Procurement Management Review was conducted by Johnnie Poole, Contracting and General Services from the Regional Office.



### Training:

#### RM Souheaver:

- Fire Training for Line Officers, 40 hours, Tallhassee, FL.
- LE refresher, 40 hours, Tallhassee, FL.
- Supervisory Aviation Training, 8 hours, Atlanta, GA.
- Semi-annual pistol requalifications, Windsor, NC.
- Coaching Skills for Managers, 8 hours, Virginia Beach, VA.

#### ARM Nottingham:

- LE refresher, 40 hours, Tallahassee, FL.
- Semi-annual pistol requalifications, Windsor, NC.
- Introduction to Supervisory Training, 40 hours, OPM in Norfolk, VA.
- Wetlands Reserve Program Workshop, 12 hours, Greenville, NC.
- Automated Time and Attendance Training, 32 hours, Atlanta, GA.
- Sustainable Agriculture for Wildlife Training, 16 hours, Kinston, NC.
- Coaching Skills for Manager, 8 hours, Virginia Beach, VA.

#### RO Panz:

- LE refresher, 40 hours, Tallahassee, FL.
- Semi-annual pistol requalifications in Windsor, NC.
- Handicap Accessibility Training, 32 hours, Tallahassee, FL.

#### OA VanZant:

- Small Purchases/Schedule Contracts, 40 hours, Norfolk, VA.
- S-130 & S-190 Introduction to Fire Training, 24 hours, Manteo, NC.
- Automated Time and Attendance Training, 32 hours, Atlanta, GA.

Mechanic Futrell and Maintenance Worker Williams each obtained their North Carolina commercial drivers license.

## F. HABITAT MANAGEMENT

### 1. General

Habitat management at Mackay Island NWR has been accomplished by a variety of techniques. Management practices have primarily consisted of: (1) water level manipulation in four impoundments, (2) prescribed burning in emergent marsh, 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). There is a cooperative farming program that enables the refuge to provide supplemental green browse/cereal grains for wintering Snow and Canada Geese.

Habitat monitoring has been accomplished with vegetative transects to evaluate management practices. In 1989, transects were surveyed in the West Pool, Middle Pool, and East Pool impoundments. The results confirmed visual estimates that submergent and emergent vegetation had improved in refuge impoundments likely due to improved water delivery systems to all impoundments. Until 1988, water control within the three impoundments was influenced primarily by precipitation, wind direction and velocity and augmented by the use of portable pumps. The construction and installation of a permanent pumping station and connecting water control structures in 1988 overcame the deficiencies in water management. Additionally, two weirs were replaced at ponds in the Middle Marsh, thereby enabling us to stabilize water levels and encourage the growth of SAV in a selected area of open marsh.

Water elevations in the open marshes are influenced by wind direction and velocity, and to a lesser extent by precipitation. Due to the changing salinity of Currituck Sound waters over the last decade, the refuge commenced a monitoring program 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. A corresponding map identifies the location of each sampling station. 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 or playing the siphon of wind tides. With a stop-log riser, the water level in this impoundment is controlled with a great deal of flexibility. Typically, the water level in this pool is drawn down by playing wind tides in the Sound and/or by pumping to below 1.00 feet msl in May or June. One third of the impoundment bottom is disked on a rotational basis to allow moist soil species to regenerate. This year *Eleocharis* spp., *Juncus* spp. and *Polygonum* spp. responded well to moist soil conditions. Part of the impoundment that slopes into the Live Oak Point cropland was seeded in October with winter wheat to augment the coop farmer's share of wheat planted for migratory geese. The moderate abundance of alligatorweed in this impoundment remained about the same this year.

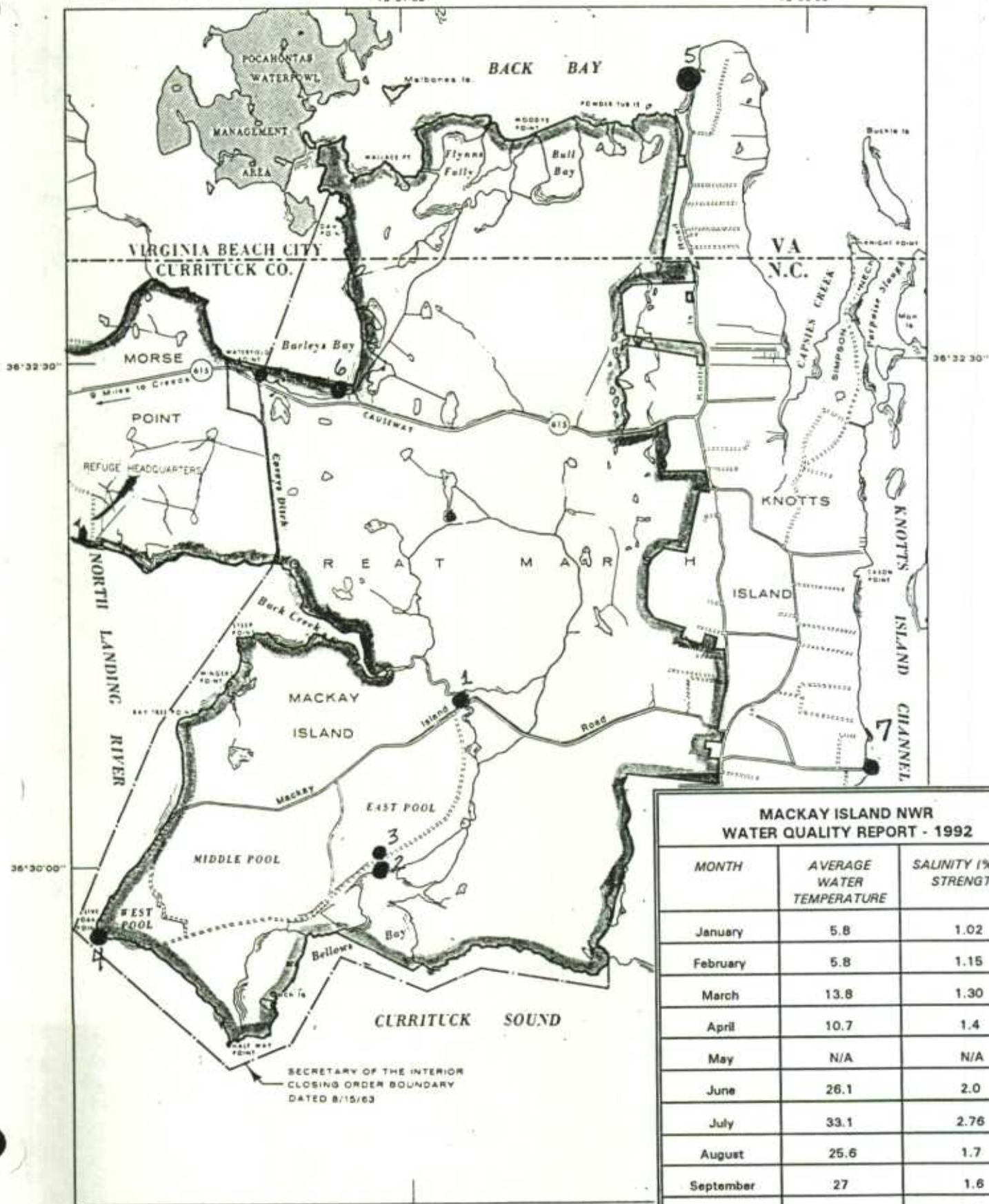
WATER QUALITY MONITORING STATIONS  
**MACKAY ISLAND NATIONAL WILDLIFE REFUGE**

UNITED STATES  
DEPARTMENT OF THE INTERIOR

UNITED STATES  
FISH AND WILDLIFE SERVICE

75°57'30"

75°55'00"



MACKAY ISLAND NWR WATER QUALITY REPORT - 1992		
MONTH	AVERAGE WATER TEMPERATURE	SALINITY (% SEA STRENGTH)
January	5.8	1.02
February	5.8	1.15
March	13.8	1.30
April	10.7	1.4
May	N/A	N/A
June	26.1	2.0
July	33.1	2.76
August	25.6	1.7
September	27	1.6
October	20.2	1.38
November	23.87	1.37
December	9.75	1.28

COMPILED IN THE DIVISION OF REALTY  
FROM SURVEYS BY U.S.G.S. AND U.S.F.A.W.S.

75°57'30"

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NEWTON CORNER, MASSACHUSETTS FEBRUARY 1985  
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### Middle Pool

The Middle Pool was created by the construction of the 0.7 mile long cross dike in 1983-84. The Pool is approximately 550 acres in size and 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.

The dual limitations affecting management and waterfowl potential of this Pool had been adequate water delivery and habitat type. Starting in 1988, the installation of a pump station in the East Pool and water control structures to the sound and between the East Pool combined with clearing approximately 180 acres of trees alleviated these problems. Vegetation transects in the Middle Pool clearings indicated a significant increase of waterfowl foods in the first couple of growing seasons. *Juncus* spp., *Scirpus* spp., and *Eleocharis* spp. were common as were *Polygonum* spp. and *Sagittaria* species.

No contract work was done this year to clear timber for increasing the ratio of open canopy areas to closed canopy areas; this work had been performed as a DU MARSH project for the last few years. This year we evaluated the response of previous openings to evaluate prospects for future clearing. During the 1992 growing season, moist soil species generated well as patches of wild rice, sedges, and pondweeds were observed in cleared area during a September reconnaissance by RM Souheaver and Management Biologist Otto Florschutz. Several brush and woodpiles remained to be burned to expose more habitat for waterfowl plant species.

### East Pool

This impoundment was formed by the construction of the cross dike and is approximately 350 acres in size. The south, southeast and east quadrants of this Pool are mainly open and were previously composed of high freshwater marsh. The northern section of the Pool was forested with loblolly pine, sweetgum, blackgum and red maple. Water levels have been maintained at high level over the last 4 years to encourage SAV. Most timber in this Pool has died as a result of impounded water but a fair number of black gums have desirably remained resilient to this higher water regime. Dominant SAV is composed of eurasian water milfoil (*Myriophyllum spicatum*), bladderwort (*Utricularia* spp.), naiad (*Najas* spp.), coontail (*Ceratophyllum* spp.), and muskgrass (*Chara* spp.). Cattail (*Typha* spp.) and reedgrass (*Phragmites* spp.) continued to be dominant emergents, however, cattail density continues to decline due to persistent high water levels and muskrat activity.



Green-wing teal found the East Pool edges most accomodating. 11/92 LW

Waterfowl concentrations of 3,500-4,000 birds were notable in the East Pool again during the 1991-92 winter. Dominant species observed were black ducks, mallards, and green-winged teal. However, the overall species was very diverse.

#### Kitchin Upland Impoundment

This 26-acre impoundment which was first flooded in Fall 1991 was kept only about 25% flooded during the middle of the 1991-92 winter due to a breakdown on the Couch pump power unit (late Dec. 1991). Once the pump was repaired in late January it was run only about 25 more hours till the end of winter. The impoundment was not filled during this first season and it was noticed that this impoundment did not hold water well during this period.

In June, some millet volunteered on low moist soil areas (3 acres) of the impoundment. In July, the refuge had the coop farmer apply fertilizer and minerals across 5-acres of the impoundment which had been excavated during construction to level the bottom. At the same time the refuge staff planted brown-top millet on 12 acres of low bottom to complement the volunteer millet. We also planted 6 acres of partridge pea on impoundment high bottoms in July. Stranger things have happen before but this section responded by growing millet. All millet matured rapidly, and as last year, fair amounts of the seed were consumed by cowbirds, blackbirds, and grackles before fall arrived.

Before fall flooding, a section of the dike was plugged to alleviate the water holding problem (see Section I.2.). However, the water retention problem was still evident when the impoundment was flooded for the second time in early November. The millet was immediately used by migrating green-wing teal, mallards, and black ducks.

### 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 low-water level in two very small ponds (Fish Ponds) in this large marsh. 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 1980s severely decimated these aquatic food beds, especially those on the Virginia end of the refuge. The beds of milfoil and wild celery continued to grow in Bellows Bay and on the southside of Knotts Island.

### 3. Forests

There are approximately 1,500 acres of forest on the refuge, of which an estimated 350 acres have commercial value. In late August, a small southern pine beetle infestation was discovered in a loblolly pine stand on the old Corbell Tract across from the Knotts Island store. Found somewhat late after its' initial outbreak, the infestation had spread over about 20 acres through a relatively pure stand of loblolly pine estimated to be 40-45 years old. An immediate consultation was made with Mr. Tom Morgan and Dan McCarthy of N.C. Division of Forestry. It was decided that a clear cut would serve in controlling the spread to adjacent pine timber.

Upon clearance from the regional office, bids were taken from three loggers to sell the infested pine in a salvage cut where a small portion of green timber would be cut in a buffer area and used as partial incentive to gain an improved price on the "stained" or infested timber. J.W. Jones Lumber Co. provided the highest bid on four pine products- pulpwood, chip-n-saw, plylogs, and sawlogs. A Special Use Permit was issued to Jones Lumber setting the provisions of cutting. Cutting began in mid-September and lasted about one month. Field inspection through the end of the year showed the cut was successful in controlling the beetles.



We disliked the clearcut but the practice paid off in controlling the pine beetle spread to other pines on the fringe of the Great Marsh. 10/92 BN

Michael Sawyer & Son were the actual cutters for J.W. Jones Lumber. Because most of the pine was already dead once cut, it was mostly marketed as pulpwood. Revenues generated from this sale totalled \$20,393.51. In settlement for this amount, Jones Lumber paid for crush and run gravel to be placed over the access road to the cut site and prepaid approximately \$2100 in reforestation costs (seedlings & planting labor) to a contract forestry firm. The balance was submitted to the U.S. Fish and Wildlife Service.

#### 4. Croplands

In 1989, the refuge farmland increased from 170 to 250 acres with the addition of the Kitchin Tract. After completion of the Kitchin Upland Impoundment in 1990, the farm acreage dropped to 220 acres which are farmed under a cooperative farming agreement with a single farmer and the only one who operates on Knotts Island.

Two cooperative agreements were signed in February one for the Kitchin Tract (2-year term) and the other for the Knotts Island-Mackay Island acreage. The farmer provides all equipment, seed, fertilizer, pesticides, and labor to farm the 220 acres. The refuge receives 50 acres of wildlife planting (22.7% of the total acreage) in lieu of farmland rent. This year we took the 50 acres as 20 acres of corn and 30 acres of winter wheat on the Live Oak Point (LOP) farmfield.

The corn was planted in early May and a tropical variety seed was planted. In early June and following label prescription, the farmer sprayed a mixture of 2,4-D and Beacon herbicides for broadleaf weed and Johnsongrass control, respectively. This application caused the the 12" high corn to wilt and stunted its' growth for roughly two weeks. The explanation for this occurrence was not easily determined. The farmer was surprised as



The tropical corn here faired well but most was unable to compete with the Johnsongrass that dominated a sizable area in and outside of the field. 8 /92 DW

as we were. He had determined that this Pioneer seed variety was not one of those that is susceptible to Beacon and he had closely monitored the number of granule packets used in the formulation since the packets are so expensive. Even the Ciba-Geigy Chemical Representative made a site visit and he seemed somewhat perplexed though he felt the corn would recover. The corn did slowly recover but the timing of this application combined with the lost growing time did not help the corn compete well with the Johnsongrass that emerged later in mid-summer. The end result was only about a 40-50% yield of corn. To add salt to the wound, unfortunately only a small portion of this corn was used by migratory waterfowl after deer feeding and most of this use was by snow geese who were not the intended recipients (i.e., Canada geese) of the corn. At least the wheat crop at LOP served the thousands of snow geese that regularly frequent the LOP section of the refuge.

The coop farmer received a mixed return on his crops. Winter wheat produced well on 120 acres; soybeans yield was very low on roughly 70 acres; and corn on the 50-acre Kitchin Tract produced only about 70 bushels/acre. A small change was made this year on the crop rotation at the 48-acre field the check station. Milo was planted here instead of soybeans to



see if deer depredation could be minimized and see how much of a market price could be gained. The milo produced a fair yield but the farmer did not make his money back.

#### 9. Fire Management

Mackay Island NWR has an active fire management program and approximately 2,000 of 6,000 acres under prescription are attempted to be burned 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.

Continued funding for fire management allowed the hiring of two Forestry Technicians who assisted with prescribed burning and maintenance projects. Five burns were conducted this year resulting in 989.5 acres of marsh being burned. One of these burns was on private land and was allowed with a "Partners" agreement. Road shoulders and brush piles were also burned in accordance with the annual plan.



This photograph shows one of the cleaner burns of the 1992 season. 3/92 BN

## 10. Pest Control

Pest control is largely accomplished through the cooperative farming and trapping programs. A cooperative farmer selectively eliminates pest plants in croplands listed in the cooperative farming plan. Because the coop farmer employs a no-till farming strategy there is a dependency on several pesticide applications each year. The refuge is working with this farmer to reduce the number of pesticides used in the future to support the Region's Integrated Pest Management goals. To this end, only five (Table 4) of ten pesticides approved for use were applied in 1992 by the coop farmer.

TABLE 4

<u>Pesticide</u>	<u>Used To Control</u>
Basagran	Nutgrass & cocklebur in milo & soybeans
Weedar 64 (2,4-D)	Broadleaf weeds in wheat, corn
Blazer (Actifluorfen)	Broadleaf weeds in soybeans
Beacon	Johnsongrass in corn
Duel 8E (Metochlor)	Grasses, broadleaf weeds in corn, soybeans
Rodeo	Phragmites in refuge impoundments

The refuge enlisted Jim Beasley, Alligator River NWR to supervise and assist staff in applying Rodeo on new patches of phragmites that had invaded recently cleared sections of the Middle Pool. Having a commercial applicator's license for aquatics, Jim supervised and assisted refuge staff in September by spraying about 3 acres of phragmites, which if left unchecked, would have defeated the purpose of having created the open areas for moist soils vegetation in the Middle Pool.



Jim Beasley applies Rodeo to a patch of phragmites in the Middle Pool. 9/92 BN

Nutria, raccoon and muskrat were selectively controlled during the winter of 1991-92 through a slightly revitalized trapping program (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, two mature eagles were seen frequenting the East and Middle Pool impoundments. No other late winter or spring sightings were made. 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. In comparison to last year none of the adults showed any pair bonding.

Peregrine falcons are typically seen during the fall migration. Several peregrines were seen in October and November and at least one bird was regularly seen in December hunting over the East Pool impoundment. The frequency with which these birds are seen is a function of time spent watching for this species.

### 3. Waterfowl

Description of the wintering waterfowl use at Mackay Island in recent years is, as in most areas along the mid-Atlantic Region, very dependent on the winter severity and habitat condition. November through February are typically the highest use months. During this timeframe, habitat management programs including water management and fire management (Section 9.) are in full swing to provide enhanced feeding habitat for ducks and snow geese. Monthly aerial surveys were conducted in conjunction with weekly ground surveys to assess use. During the 1991-92 winter, the overall waterfowl use was down again from the previous year (Table 5) and was the lowest since the 1984-85 winter. This decline was probably due to another mild winter, because habitat conditions were in good condition.

#### A. Snow Geese

This winter snow goose use increased substantially and accounted for two-thirds of the overall waterfowl use. Snow geese use peaked in both early December (1991) and mid-January when 19,000 birds were estimated on the refuge. Flocks of seven to eight thousand geese consistently used burn areas in the Great Marsh from mid-December into February. While the wheat field on Live Oak Point received consistent use early in the season, most of this winter's use by snow geese was probably due to an early arson burn on the south side on the Knotts Island Causeway which drew the geese to the Great Marsh area. This use pattern provided many geese viewing opportunities on the Causeway and translated into favorable public relations.



At times, Snow geese fed at the road's edge along the Causeway. 2/92 JL

ARM Nottingham conducted two age ratio surveys of snow geese for Biologist Florschütz.

#### B. Tundra Swan

Swan use was up noticeably from the previous year (Table 5) and this corresponded to a statewide increase as revealed by the mid-winter survey. The peak of swan use occurred in November.

#### C. Canada Geese

Migrant Canada geese use remained well below historical levels. Several small flocks totalling 65-80 geese used the refuge regularly through the winter.

#### D. Ducks and Coots

The overall duck use in 1991-92 was down (Table 5), falling to the lowest of the past ten years. Duck habitat was in good condition with impoundments being fully watered. The decrease in the combined duck use was mostly attributed to the mild weather. Duck surveys may also have been influenced by a change in surveyors where ARM Nottingham may have underestimated duck use not being thoroughly familiar with all of the habitat.

Most duck use is by dabblers feeding in SAV or moist soil waters. This winter, green-wing teal was the most abundant duck species followed by mallards (Table 6). Widgeon numbers increased mostly due to an early season wave of migrants. Pintail and blue-wing teal use increased appreciably. A small flock of fulvous whistling ducks uncommonly appeared good early in the season and departed not long after temperatures cooled in the fall.



Pintails were seen over the East Pool from December-February. 12 /92 LW

Diving duck use was scant and was characterized by small numbers of ruddy ducks, ring-necked ducks, bufflehead, hooded and red-breasted mergansers.



The ruddy duck was present in our pools and common in Currituck Sound. 12/92 LW

**TABLE 5**  
**WINTERING WATERFOWL OCCURRENCE ON**  
**MACKAY ISLAND NWR**  
**1991-1992**

<i>GROUP</i>	<i>PERCENT</i>	<i>NUMBER OF USE-DAYS</i>	<i>PERCENT DIFFERENCE FROM 1988-89</i>	<i>PEAK NUMBER</i>	<i>PEAK PERIOD</i>
Tundra Swans	2.4	38,605	+66.9	650	Nov 10 - 16
Canada Geese	0.6	9,814	-45.6	170	Jan 10 - 16
Snow (& Blue) Geese	67.4	1,091,125	+40.9	19,000	Dec 1-6/Jan 10-16
Ducks	25.3	410,452	-61.2	6,050	Dec 14 - 20
Coots	4.3	69,720	+47.6	800	Dec 21 - 26
All Waterfowl	100.0	1,619,716	-14.9	23,500	Jan 10 - 16

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

<i>SPECIES</i>	<i>PERCENT</i>	<i>NUMBER OF USE-DAYS</i>	<i>% DIFFERENCE FROM 1990-1991</i>	<i>PEAK NUMBER</i>	<i>PEAK PERIOD</i>
G. W. Teal	24.8	101,990	-72.8	1,250	Dec 21 - Jan 9
Gadwall	9.0	36,960	-86.0	750	Dec 1 - 6
Mallard	21.2	87,080	-47.5	1,000	Jan 10 - 16
Black Duck	10.7	43,750	-52.0	500	Dec 14 - 20
Wood Duck	6.4	26,446	-70.6	750	Sept 21 - 27
B. W. Teal	2.7	10,885	+32.5	150	Sept 2 8 - Oct 4
Shoveler	1.9	7,994	-41.0	85	Feb 21 - 27
Wigeon	13.7	56,210	+321.5	1,100	Nov 3 - 9
Pintail	2.7	11,095	+42.4	200	Jan 24 - 30
Ruddy Duck	0.5	1,995	-31.3	25	Oct 20 - Nov 9
Bufflehead	0.3	1,330	-45.6	20	Nov 3-9/Dec 7-13
Merganser	0.3	1,400	-32.2	20	Dec 7 - 13
Scaupe	0.3	1,155	+100.0	40	Jan 3 - 16
Ring-necked Duck	0.4	1,505	+100.0	40	Dec 7 - 13
Fulvous Tree Duck	0.1	371	+100.0	15	Oct 20 - Nov 9
All Ducks	100.0	1,026,718	+26.9	11,200	Feb 7- 13

### Wood Duck Production

The wood duck nesting box program has had a colorful and successful history at Mackay Island NWR because of a sustained management effort. In 1970, thirty-seven pairs of wood ducks from Patuxent Wildlife Research Center were acclimated and released at the refuge. Simultaneously, thirty-four nest boxes installed across the refuge. Since then, the program has been expanded to 139 nesting boxes (three new boxes installed in 1992).

Wood duck production crashed the year. Only 72 of 138 functional boxes were utilized by wood ducks yielding a 58% use rate. This measure was appreciably lower than last year's rate of 79% and a 10-year average of 77%. Successful nests per number of available boxes was only 23% which was drastically lower than the 10-year average of 61% during the 1980s and last year's measure (62%). Similarly, the rate of nesting success (ratio of number of successful nests/number of boxes used by wood ducks) was very low at 44% and noticeably down from the 1980-89 average of 81%.

While the drop in box use could not be readily explained, we believe that the intensive checking of nest boxes from the contaminants study had a negative impact on wood duck nesting success. From April till mid-June, researchers checked 62 boxes (45% of the total number boxes) weekly to assess nesting chronology for the purpose of collecting 10 clutches as control samples for the study. During the fieldwork the technician discovered a number of predation incidents (n=24) at the boxes being checked; this included crushed, pecked, and missing eggs. At and around these boxes, the technician observed mostly crows along with occasional red-headed woodpeckers. In several instances, crows and woodpeckers were seen emerging from nests where losses were found. We suspect that a few crows and woodpeckers keyed on the researcher's activity and contributed to this nesting loss.

A quantitative evaluation supported our contention. A predation rate of 48% was determined from the sample of boxes being checked in the study (calculation excluded researcher removal of clutches). This predation rate was significantly higher than a normal loss rate of < 10%. When one considers that 24 of 81 boxes used by woodies were predated upon, it does not take long to figure out why this year's production was probably the lowest in years. We urge other refuges to be cautious in permitting or conducting intensive (weekly) checks of nest boxes throughout the nesting season.

Also of interest, one of the boxes checked in the study revealed an apparent hooded merganser clutch; this clutch, however, was not incubated to term.

**ANNUAL NARRATIVE REPORT FORM  
WOOD DUCK BOX PROGRAM INFORMATION**

REFUGE: MACKAY ISLAND

NESTING YEAR: 1992

	<u>NUMBER</u>	<u>PERCENT</u>
Total usable boxes	138	
Estimated boxes used by wood ducks	81	58
Estimated boxes used by other ducks	1 (hooded merganser)	
Estimated boxes used by other wildlife	13 (9 starling nests after wood duck hatch)	
Estimated wood duck broods produced	32	
Estimated wood ducks hatched	320	
Estimated WD's surviving to flight stage	160	

Plans for next year (Indicate number):

xx 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. The status of these birds are shown in Table 7.

TABLE 7

MARSH AND WATER BIRDS							
SPECIES	COMMON	UNCOMMON	SEASON				NESTING
			W	SP	SU	FA	
Pied-billed Grebe	X		X			X	
Double-crested Cormorant	X		X			X	
Great Blue Heron	X		X	X	X	X	X
Green-backed Heron	X			X	X		X
Little Blue Heron	X			X	X		
Cattle Egret	X			X	X		
Great Egret	X		X	X	X	X	
Snowy Egret	X		X	X	X	X	
Tri-colored Heron		X	X			X	
Black-crowned Night Heron		X		X	X		
Yellow-crowned Night Heron		X		X	X		
Least Bittern	X		X	X	X	X	X
American Bittern	X		X	X	X	X	X
White Ibis		X			X		
Glossy Ibis		X		X	X		
King Rail		X	X	X	X	X	X
Clapper Rail	X		X	X		X	X
Virginia Rail	X		X	X	X	X	X
Sora		X	X	X	X	X	
Common Moorhen	X		X	X	X	X	X
American Coot	X		X	X	X	X	

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 other species of water birds are nesting on or near the refuge. In 1989, three great blue heron nests were observed in the East Pool for the first time. No documentation of nesting activity by great blue herons was made this year.

During early December, both MINWR and Eastern Shore of VA NWR staff spotted a single adult wood stork on Mackay Island. This bird was seen for about four days and it was recorded as a new species record for 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 soils units. Killdeer, snipe, woodcock, spotted sandpipers and greater yellowlegs are common at the refuge. Lesser yellowlegs, semipalmated plovers, solitary, semipalmated, and least sandpipers are uncommon across the refuge. During nor'easters and other ocean storms in the spring and fall, whimbrel, sanderling, and ruddy turnstone are observed seeking protective shelter and feeding on 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.

Our volunteer photographer discovered and documented with photographs the first known nesting activity of black-necked stilts on the refuge. Unfortunately, this nest attempt was not successful as the nest was later predated upon. Though Larry got excellent photos of this nest, he maintained a good distance and let his 600mm lens with a 2x converter make up the distance.



Black-necked stilt nested in the shallows of the East Pool. 5/92 LW

## 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 nearly 100 vultures roosting in the pines at several locations on the refuge.

Ten osprey platforms have been erected on the refuge. In 1992, six platforms were active nest sites of ospreys. In addition, an osprey pair nested on a snag tree in the East Pool. By July, young birds had successfully fledged at four sites.



The osprey is an early harbinger of Spring; they arrive in mid-March. 4/92 LW

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 fledge before duck nesting begins. In 1992, only two boxes were used by screech owls.

#### 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.1.). Refuge personnel observed 60-80 deer during pre-hunt season evenings in croplands adjacent to the office and the shop on Knotts Island. Necropsies were conducted on five refuge deer harvested by representatives of the Southeastern Cooperative Wildlife Disease Study (SCWDS) in 1988. The results of those tests indicated the Mackay Island deer herd was near its' nutritional carrying capacity. We have attempted to increase the harvest to decrease population and maintain it within its' carrying capacity. A sampling session by the SCWDS had been scheduled for 1992 to assess the current population condition but this session was delayed till 1993 to attend to higher priority refuges.

Beginning in July, a small number of raccoons were seen during the day and showed a lack of fear of humans. A fair number of these subjects appeared to show symptoms of possible "dumb" rabies or distemper with some frothing at the mouth, encrusted eye mucus, and reduced body weight. During this same time, our sightings corresponded with several confirmed diagnoses of rabies in raccoons in south Virginia Beach and other sightings of abnormal raccoons on Knotts Island.

Sightings of abnormally behaving raccoons ebbed and flowed in August and September. Several refuge deer hunters reported similar observations as the deer season progressed. In late October, LEO Panz shot one raccoon that definitely appeared sick and this specimen was taken to the N.C. Department of Agriculture Veterinary Diagnostic Lab in Edenton, NC. This animal tested negative for rabies and the cause of death was suspected to be parasitic. No distemper testing was conducted on this animal. The diagnostic lab felt that with the positive evidence coming out of Virginia Beach and Gates County, NC that no further testing was needed and conceded that a regional rabies outbreak was occurring. Several public health advisories were issued for northeast NC and southeast Virginia. Though the Mackay Island raccoon density is thought to be moderately dense, no large die-off of raccoons was detected by year's end.

#### 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. In the early to mid-1980s, high salinity devastated freshwater SAV populations in Back Bay and Currituck Sound. More recently, salinity measures have declined due to discontinued pumping of saltwater into Back Bay and no storm overwashes from the Atlantic. 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.

Because little information was available, the refuge staff had desired to assess the condition of the sport fish population in the East Pool prior to or early in the new fishing season. Fisheries Biologist Pete Kornegay of the North Carolina Wildlife Resource Commission

(NCWRC) had been approached during the last two years to conduct electroshock sampling but without a NCWRC assistant he was unable to do anything. In May, Pete electroshocked the East Pool with the assistance of RM Souheaver and ARM Nottingham. Length and weight measures and with scales from bass were taken. This sampling revealed an abundant population of forage fish but the number of keeper largemouth bass (14" total length) was scant. There were a fair number of 12-13" size class bass sampled and released. By comparison, some hook and line sampling by fisherman over the summer did reveal a few keeper bass still existed within the impoundment. The number of fish species collected in the East Pool was fifteen; estuarine species (e.g. mullet, bay anchovie, menhaden) were lacking although freshwater eels were found.

During the same day, Pete was also able to electroshock the Kitchin Marsh Impoundment with ARM Nottingham assisting. Twenty-two species were identified; 16 were freshwater species and six were estuarine species. The occurrence of estuarine species was not surprising considering that the dike system is now slightly breached and connected to the Sound. The most common species collected were pumpkinseed, bluegill, and croaker.

#### 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, however, 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 a free spirit. 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 early July. Trapping through use of a swim-in trap was begun in mid-July with the assistance of the YCCs and their work leader.

This effort continued till the end of September. Captures started out productively but waned as the summer progressed. Nutria caused problems in feeding on corn and displacing it outside of the trap where ducks fed avoiding capture. A total of 66 woodies were banded, missing our target goal of 100.

In February, Mackay Island NWR staff collaborated with Back Bay NWR staff to attempt to rocket net migrant Canada geese on the ag field at Refuge Office. This effort proved futile because the few geese that used this field could not be consistently drawn to corn because of mild weather.

## 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 habitat management. This closure successfully reduces wildlife/human conflicts but restricts our ability to show the public how prescribed burning, water management, food production and other programs are used at the refuge for migratory bird management.

### 2. Outdoor Classrooms - Students

The geographic location of Mackay Island NWR is somewhat limiting for outdoor classroom use. There is one elementary school on the island, however, other North Carolina school groups must travel by ferry for one hour to reach the island. Most Virginia schools are not very eager to cross the state line when Back Bay NWR is about 20 miles closer as an environmental study area.

In mid-May, ARM Nottingham spoke to 65 kids from Lake Taylor Elementary School, Norfolk, VA about endangered species and provided a tour of the refuge emphasizing how the refuge offered wintering habitat to Bald Eagles.



Most kids from Lake Taylor Elementary School wanted to see a snake in the East Pool. Do you think they saw one here?

5/92

#### 4. Interpretive Foot Trails

The refuge maintains one trail and seven miles of dikes. The Great Marsh Trail, located along the Knotts Island Causeway, winds 1/3 mile around a horsehoe shaped pond and is open all year; this trail a self-guided trail without any written interpretation.

The Mackay Island Trail follows the East Pool for 3.8 miles and the Live Oak Point Trail follows for 6.5 miles of dikes around all three impoundments. They are open to the public from March 15 through October 15. The first mile of Mackay Island Road is open to pedestrians only from October 16--March 14.

#### 5. Interpretive Tour Routes - Motorized

Two sections of road on the refuge are used by visitors for wildlife observation. The first mile of Mackay Island Road is open to vehicles March 15--October 15 and receives use of 5,000 vehicles per season. A 3.5-mile stretch of Route 615 traverses the refuge marshes and provides travelers an excellent opportunity to observe wildlife, especially wintering waterfowl. Visitors may stop anywhere along the shoulder, at the entrance sign, Corey's Ditch bridge or the Marsh Trail to view wildlife year-round. Over 100,000 vehicles use the causeway each year; we estimate that 30% of this use is Refuge oriented.

The annual "Open Road Day" was held on December 12. Due to extremely poor weather, only 150 cars were counted using the refuge dike system. Visitors were not as rewarded as last year since birds were clustered in the center of the impoundment and did not show themselves.

#### 6. Interpretive Exhibits/Demonstrations

The refuge maintains an informational display at the office. A new kiosk was constructed at the entrance to Mackay Island Road this year. It displays a color coded map and a panel dedicated to Joseph Knapp and provides a leaflet dispensing box for refuge literature. 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 positively to a variety of groups requesting presentations and tours. This was a busy and fruitful year in making positive public contacts. The following programs and tours were given:

RM Souheaver and OA VanZant worked with 37 Boy Scouts and Girl Scout Brownies in February on refuge orientation and nature study to meet some of their requirements. They cleaned the refuge HQ and grounds in return.

Staff members Souheaver, Nottingham and VanZant operated a refuge display at the Virginia Beach Wildfowl Festival on 2/1/92. Over 800 contacts were made at this event while a number of duct stamps were sold.

ARM Nottingham spoke to 15 kids (DU Green-wings participants) about wood duck conservation. Later in the month, RO Panz conducted an auto tour with 8 members of the Outer Banks Audubon Society.

On May 2, ARM Nottingham and OA VanZant manned a refuge and endangered species exhibit in conjunction with Back Bay NWR at the Virginia Beach Earth Day Festival. This event drew between 8000-10,000 persons and many fruitful contacts were made and numerous sources of literature were dispensed.

RM Souheaver presented a Duck Stamp exhibit at the Waterfowl and Nature Crafts Festival at Northwest River Park (Chesapeake City Park) on May 9. Though attendance was sparse due to several other public events, contacts were positive.

On June 23, eighteen kids were given a "CATCH" fishing clinic by NC Wildlife Resources Commission (NCWRC) Wildlife Officers and a NCWRC fishery biologist, and RO Panz. This clinic took place at the East Pool.



Eighteen kids received instruction in the "CATCH" fishing clinic. 6/92 MP

The Knotts Island Ruritans held their annual Peach Festival in July and the refuge staff manned a refuge exhibit during both days. With volunteer assistance from Steve Federinko (bus driver), the refuge managers provided several refuge tours during Saturday of this event weekend.



In July, ARM Nottingham held tours for four Old Dominion University summer camp teachers and a Weeblos Den from Chesapeake, VA.

The Currituck Wildfowl Festival was held at Currituck High School in September. RM Souheaver and OA VanZant hosted an exhibit to 1800 visitors.

Fourteen Virginia Beach Audubon members and fourteen Junior High age folks from Great Bridge Presbyterian Church toured the refuge in November.

The Virginia Science Museum brought 12 people to the refuge for a wildlife observation trip in December.

### 8. Hunting

White-tailed deer hunting is permitted each fall to provide recreational use of a renewable resource and to attempt to manage a deer population for minimizing habitat degradation. Interested hunters may apply for the reserved hunts by mailing in the postcard from the hunt brochure. A lottery was held to fill 50 slots on each of the first two weekends. The other six days were open to public hunting and no reservation was required. The gun hunt dates were October 16-17, 23-24 and 26-31.

The management of bow hunting was changed slightly this year where bow hunters were not required to report to the check station for stand/area assignments. Bow hunters were permitted to enter and roam freely throughout the entire hunt area. Deer were checked in at the local store.

Eighty-nine deer were taken during 333 gun hunter visits. Only one was taken all week during 15 bow hunter visits. Three others were found dead. A total of 93 deer were taken during 348 hunter visits over 16 days. The sex ratio was 51 bucks and 39 does of those deer brought in to the check station.

DEER AGE COMPOSITION BY SEX						
	½ YR	1 ½ YR	2 ½ YR	3 ½ YR	4 ½ YR	TOTALS
BUCKS	17	13	17	3	1	51
DOES	17	3	10	4	5	39
TOTALS	36	16	27	7	6	90

AVERAGE LIVE WEIGHTS BY AGE AND SEX					
	½ YR	1 ½ YR	2 ½ YR	3 ½ YR	4 ½ YR
BUCKS	50	106	122	145	0
DOES	46	67	84	102	0
# POINTS	--	2.4	6.7	8.5	--

## 9. Fishing

A large part of refuge visitation is derived from fishing. More than 20,000 visits are estimated annually for this activity. The East Pool was open for the second year to fishing on March 15. By the end of April, over 350 anglers had been checked using the 300 acre pool. A good number of 2 to 4 pound largemouth bass were caught by happy fishermen. Also, crappie, bluegill, pumpkinseed, and catfish were taken. Fishing is permitted on the dikes from March 15--October 15. 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.

For National Fishing Week, the Currituck County Chapter of Ducks Unlimited cosponsored a kid's fishing day with the refuge on June 13. Approximately three hundred fifty kids participated in the event which was held at the East Pool impoundment. Participants paid \$15 and received a Abu Garcia rod/reel, a catch & release certificate, tee shirt, hat, goodie bag, and lunch. About 300 adults, refuge staff, NC Wildlife Officers, and the Knotts Island Volunteer Rescue provided parking, security, transportation via "hay rides", hot dogs and drinks, hook baiting, and first aid. The slogan for this year was "Get Hooked on Kids and Conservation".



The DU sponsored Fishing Day was again our big public use event of the year. 6/92 ES



Only part of the DU volunteers and FWS staff that pulled the Kids Fishing Day off. 6/92

#### 10. Trapping

A high density of nutria, muskrat, and raccoons has built up on the refuge recently and mild winters over the last three years has especially favored a nutria increase. Nutria and muskrats have been responsible for damage to roads and dikes and this has provided strong rationale to control these populations. Between 1979 and 1989, trappers had placed bids on various marsh units to trap these furbearers, including raccoons. However, no trappers had expressed any interest over the previous two winters due to low pelt prices.

In 1992, several trappers were motivated to contact the refuge about trapping opportunities. Because of the continued depressed fur prices and the need to attempt to control nutria and muskrats, management decided to not to require any bids and even encouraged trappers by offering to pay for their trapping licenses. Three trappers were permitted to trap various marsh units and a reasonably good distribution of trapping effort resulted. Of the three, one obliged with the offer to have his license bought.

Trapping harvest over the last twelve years appears in the table below. This removal effort should be viewed as only marginally effective at best in controlling nutria and muskrat populations. Because trapping is concentrated along dike areas, it is hoped this removal will partially slow burrowing activity by rodent species. Trapping statistics for the last two years of record support the trappers' recognition that nutria appear to be displacing muskrats in marshes around Knotts and Mackay Islands.

Trapping Harvest 1980 - 1992											
	80	81	82	83	84	85	86	87	88	89	92
N	57	116	34	95	102	99	352	431	464	527	646
R	15	40	22	67	17	17	56	46	109	17	49
M	768	1065	1385	629	551	1461	665	509	1029	90	323

### 11. Wildlife Observation

Bird watching and general wildlife observation is an important recreational opportunity for refuge visitors. State Highway 615, which runs through the middle of the refuge to Knotts Island, is open all year and treats winter motorists to the sight of tens of thousands of snow geese foraging in the marsh. Parking areas are provided at the Refuge entrance sign, the bridge over Corey's Ditch and the Great Marsh Trail, but visitors may stop anywhere along the shoulder.

As noted earlier, burn areas along the Knotts Island Causeway drew in thousands of snow geese during January and February; this had a positive impact in providing viewing opportunities to the public that do not ordinarily leave their automobiles to watch wildlife.

Mackay Island and Live Oak Point Trails are open to hiking and bicycling from March 15 through October 15. The first one and one half segment of Mackay Island Road is open during the same period to motor vehicles but is limited to pedestrians and bicyclists from October 16 to March 14.

#### 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 350 visits for this activity were recorded in 1992. 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. All three positions were occupied throughout 1992.

Mackay Island officers work independently with little or no readily available back-up assistance. Although Currituck County Sheriff's Department has two deputies for Knotts Island, they cover all of the north end of the county, and may not be close by. Currituck deputies cover a 25 mile section of the Outer Banks, which includes all three Currituck Refuge tracts. Their 4-wheel drive trucks provide emergency access to most of the refuge. NC Wildlife and NC Highway Patrol Officers live on the mainland are a minimum of one hour away.

#### **NOTABLE INCIDENTS**

RO Mike Panz was called to assist Back Bay refuge in early January on a baited area on the west shore of the bay, just off the refuge. He apprehended two duck hunters on the 2nd within 200 feet of a pile of corn. They were charged, found guilty and fined \$100 each.

On April 12, a fisherman returned to his truck on Mackay Island Road to find the camper shell had been pried open. There was approximately \$300 damage done to the vehicle and about \$500 worth of equipment was reportedly taken from the truck. Currituck Deputies investigated the incident but could not determine any suspects and the owner had no receipts or identification numbers of the equipment.

RM Elizabeth Souheaver noticed someone spotlighting deer outside her residence on the refuge on the night of June 24. She enlisted the aid of Currituck Deputy Waterfield in stopping the violator, who was identified and charged with trespassing after dark. The use of a spotlight was not prosecuted and no firearms were found in the vehicle.

Currituck Deputies flew a marijuana eradication mission on September 11 and discovered a plot on the refuge. They removed five plants. The refuge was not notified until a week later when Knotts Island Deputy Waterfield found out about it through the gossip line. He and Officer Panz found the area, which contained 13 plant sites. One live plant was seized by them. Since the water buckets, plant pots and other evidence had been outside so long, prints could not be lifted off of them. Any footprints left by the grower(s) were obliterated by the deputies when they seized the plants on the 11th. No suspects have been identified although some other Knotts Island growers were arrested in cases off of the Refuge.

There were nine motor vehicle accidents reported this year. Three involved deer; two could be attributed to reckless driving; and one serious pedestrian accident occurred on the causeway bridge. On September 20, at 9:10 am, a thirteen year old Virginia Beach youth darted into the path of a westbound vehicle while crossing from one catwalk to the other. The youth was propelled about 50' through the air and landed on the roadway. The vehicle then crashed into the bridge railing, narrowly missing fishermen on the catwalk. The driver was not hurt but the youth was transported to the hospital. Miraculously, no life threatening injuries were sustained. The youth was back fishing at the bridge two weeks later.

When our office assistant came to work on November 17, she found a gunshot victim parked at the front gate. He was transported to the hospital and suffered a disabling injury to the spine. Investigation by Currituck Deputy Waterfield revealed the victim, a Canadian citizen temporarily residing in Virginia Beach, had attempted suicide by shooting himself in the abdomen. He had written a note and purchased the gun only a few days earlier. His parents took him home to recuperate several weeks later.

On the last day of the year, Officer Panz caught three men hunting over a baited pond in Gibbs Woods, adjacent to the refuge. The elder hunter freely admitted to placing the corn and milo in front of the blind to attract waterfowl. The man and his son were charged with hunting with the aid of bait. The grandson, a juvenile, was not charged. The case is pending.

## STATISTICS

The total numbers for 1992 were as follows:

Incident Reports filed	102
Violation Notices issued	25
Written Warnings given	35
Verbal Warnings	110
Visitor Assists	320
Cases made by state officers	6

### A breakdown of incidents by category:

Type of incident	# reported	# violation notices
Aircraft Incidents	1	
Accident:Motor Vehicle	9	
Arson: Marsh	1	
Assist Citizen	4	
Assist Other Agency	13	
Boundary dispute	1	
Collecting w/o permit	1	
Dogs at large	8	1
Firearms	2	1
Fishing w/o license	15	7
Hunting:MBTA-Take w/aid of bait	2	4
-Unplugged shotgun	1	1
MBH&CSA-Duck Stamp	2	2
Refuge	4	
Larceny	1	
Littering	2	
Narcotics:Marijuana Cultivation	1	
Property Found	1	
Suicide Attempt	1	
Traffic	2	
Trespass:Camping	2	
Closed Area	4	3
Motor Vehicle	13	6
Cattle	5	
Vandalism	3	
Wildlife Incidents	3	
<b>TOTALS</b>	<b>102</b>	<b>25</b>

## I. EQUIPMENT AND FACILITIES

### I. New Construction

The computer file room of the office was enlarged and remodeled. Additional space was needed for file storage and a new computer workplace.

A kiosk (public information display) structure was constructed along the primary refuge entrance road. Two interpretative panels and brochure rack were installed in the kiosk. The office/visitor contact station was landscaped by a local nursery. The ornamental plants enhanced the building's appearance.



A contractor landscaped the front of the Refuge HQs/Office. 9/92 ES

A new office sign was also installed recognizing Joseph P. Knapp.





With a new sign and landscaping the Refuge HQs/Office took on a much improved appearance. 12/92 LW

A 1 1/2 acre moist-soil impoundment was constructed as a wildlife management study site. The site was located along the entrance road to the Refuge HQs/Office in a former farmfield. Conceived by Management Biologist Otto Florschutz, the study will primarily evaluate the compatibility of the site for crawfish production area and as a resting/feeding area for wintering waterfowl. Other objectives include evaluating ideal plant species for both crawfish and waterfowl and promoting wildlife diversity by modifying standard crawfish production methods. Deviations from standard crawfish methods include a longer summer drawdown to produce more seed from moist-soil species or crop plants and constructing irregular interior depths for habitat diversity. To evaluate compatibility between these resources, crawfish production and bird use will be quantitatively measured for two years. If study results demonstrate reasonable compatibility, then this information will be made available to crawfish producers should they want to modify their crawfish operations to enhance waterfowl, wading birds, and shorebirds.

The pond was designed and laid out through consultation with Dwayne Hinson and Mike Doxey of the local SCS Office. Construction was performed in April with contract assistance from former Maintenance Mechanic James Pittman. MW Tim Williams and MM Bob Futrell did the finish grading. After liming the pond, it was filled in early May and a batch of adult crawfish were stocked during the third week of May.



Maintenance Worker Tim Williams puts a finish grade on the bottom of the new crawfish study impoundment.

4/92 BN

Crawfish were allowed to acclimate for two weeks before a drawdown in early June. During drawdown, the only available cover for crawfish was hay bales that had been put out for a food source. Most crawfish that did not use the hay bales for cover either were predated on by boat-tailed grackles or wading birds or they emigrated out of the pond. The crawfish that remained were allowed several weeks to burrow down before 25 pounds of milo was planted and fertilized. Milo was augmented with a planting of 30 pounds of brown-top millet. Both of these crops were planted instead of relying on moist soil propagation because the subsoil bottom did not have any natural seed.

Both crops matured reasonably well, however both suffered depredation by non-target wildlife before the impoundment was flooded. Cowbirds and grackles consumed the millet and deer scarfed up the milo. The impoundment was flooded in early December but virtually no waterfowl use was documented by year's end due to the food sources having been consumed. While the impoundment was drawn down in June, small numbers of spotted and least sandpipers, semi-palmated plovers, killdeer, and yellowlegs were seen on moist bottoms.

A heating ventilating-air conditioning system was installed in Government Quarters #30 with funding from the Quarters Account. Princess Anne Plumbing and Electrical Suppliers were awarded the contract for the system installation.

## 2. Rehabilitation

Minor road repairs were made throughout the year with the addition of crush and run gravel. The age of the dike roads and muskrat and nutria burrowing contributed to significant maintenance problems. The Middle Pool Impoundment received the most gravel replenishment, especially along low parts of Mackay Island Road or the north face of this impoundment.

The 26-acre Kitchin upland impoundment was rehabed by adding a clay plug across a former drainage ditch that originated within the unit. During the 1991-92 winter when this impoundment was first filled, it was noticed that the impoundment was losing water. It was speculated that the dike section over the former ditch was not packed and sealed thoroughly during construction of the impoundment. Therefore, Maintenance Worker Williams dug out the inside toe of the dike where the ditch had been covered. Two truckloads of clay were dozed into this hole and the clay was packed into the hole and ditch line. After refilling the impoundment in the fall, it was noticed again that water was still being lost. It appears that seepage is occurring through the bottom of the impoundment. For the time being, refuge staff will keep this impoundment partially full during the 1992-93 waterfowl wintering season.

## 3. Major Maintenance

A new radiator was installed on the John Deere 2640 Tractor which has long suffered an overheating problem when a moderate load placed on this unit.

A new gate was installed on the outboard side of the West Pool water control structure. The previous structure was damaged by waves during a prolonged southwest wind blow in July.

Three custom made windows were installed in the refuge office to replace the existing crank type. All of the office windows need replacement but the expense is too great to handle in one year.

The D-4 dozer had the right rear idler bearing replaced and the air conditioner received a shop servicing. A plexiglass shield was also replaced on the D-4.

## 4. Equipment Utilization and Replacement

In July, a list of 20 plus items was sent to Property Management (CGS) in the Regional Office to be processed as excess property. Items consisted of old farming implements and various other shop equipment that was no longer needed.

A new 70 horsepower Evinrude outboard was acquired.

The diesel engine on the couch pump was repaired by replacing a piston, the rings on the remaining pistons, and the power head.

The lower unit on the 40 HP outboard engine was replaced with a new unit.

A new "Go-Devil" outboard motor was acquired to replace the old mud king outboard.

Using 9120 funds, an automated fire weather station was acquired and installed at the edge of the marsh adjacent to Refuge Office.

A 17' Souwester boat was transferred to the refuge from the Division of Law Enforcement.

#### 5. Communications

The new communication software for the Service "CCMail" was installed and operational by early October.

A second software program, Procomm, was acquired for accessing the Fire Management Information System (FMIS).

#### 6. Computer Systems

A new 486 Swan personal computer was acquired with fire monies (seasonal firefighter salary savings) for handling our fire management communication needs including being able to access the new automated fire weather system and FMIS.

### J. OTHER ITEMS

#### 1. Cooperative Programs

RM Souheaver initiated A Partners for Wildlife agreement with Stuart Yarbrough who owns a substantial farm on Knotts Island. This agreement encompassed several habitat enhancement treatments. The first was a cooperative burn of a 225-acre emergent marsh. The refuge staff attempted to ignite this marsh on January 27 but conditions were not favorable to carry the fire. In February, Maintenance Mechanic Futrell assisted by several NC Division of Forestry personnel burned the marsh along with 10 acres of upland pine forest.

The second enhancement was a more intensive endeavor and included replacing three water control structures along a man-made dike system. Before work began, RM Souheaver submitted an application for a Coastal Area Management Act minor permit on behalf of

Mr. Yarbrough. After permit approval, our maintenance staff began installing the water control structures in June. To facilitate this installation, our staff laid down a number of old military mats and filled low spots (nutria holes) to allow backhoe access. Rip-rap was placed around the pipe and riser ends. In completing this work, the refuge had helped this landowner restore water management capability to an estimated 100-acre low dike system where a good plot of SAV and emergent grasses grows. These structures will ensure that water will be retained during the SAV growing season and during the winter waterfowl use period.



One of three flashboard riser-pipes installed on the Yarbrough Partners Project.

6/92 ES

The third enhancement consisted of installing five wood duck nest boxes and two osprey nest platforms across the Yarbrough farm. Additionally, the perimeter of the dike system was posted with Partners signs.

In April, RM Souheaver met with Jim Kelley of Patuxent Wildlife Research Center to discuss prospects of using Mackay Island as a study site to evaluate the use of wood duck hen call counts. Coordinating the Wood Duck Study Initiative, Jim Kelley toured the refuge and enlisted our help in starting a hen call count during the peak of nesting. ARM Nottingham conducted a single count in early May (this year was a late peak) and forwarded these data to Jim.

In June, ARM Nottingham began preparation for working on the Wetland Reserve Program (WRP) with SCS and landowners by attending a training workshop. Later in June, ARM Nottingham, Management Biologist Otto Florschutz, and SCS officials Dwayne Hinson, and

Mike Doxey met with two Currituck County landowners that had signed up to offer their land for bid as wetland reserve easements. Both landowners' lands were inspected for eligibility at this time. In July, ARM Nottingham worked with these SCS officials in drafting Wetland Reserve Plans of Operations. Both landowners ended up submitting high bids and neither of their bids were accepted later in the year.

In November, LEO Mike Panz provided instruction to a Hunter Safety Class at Knotts Island School; he later assisted this class with a field exercise on the refuge.

Throughout the year, RM Souheaver participated on the Joint Venture Committee for the Back Bay-North Landing River-Blackwater River Focal Area by attending their quarterly meetings. During the later part of the year, RM Souheaver began a special project within this committee to develop an information brochure on existing conservation areas within this Focal Area.

### 3. Items of Interest

In February, Kent Cochran and Ron Parker of the Region 4 Engineering Division visited the refuge to evaluate the use of a geothermal heat pump system for the refuge quarters.

On March 16, an informal review of the fire management program at Mackay Island was presented to several FWS fire management officials. Visiting official included Roger Erb, FWS Fire Coordinator, Skippy Reeves, Region 4 Forestry and Fire Management Chief, Shaw Davis, Division of Refuges-WASO, and FMOs Steve Fowler and Chris Farinetti.

In June, Dr. Lee Foote of the National Wetlands Research Center visited the refuge to evaluate and discuss strategy on developing a feasible proposal for the Kitchin marsh dike restoration project. Drawing from his previous experience with developing marsh restoration projects in Louisiana, Lee was very helpful in steering the staff's development and consultation of drafting a new project proposal.

### 4. Credits

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

#### Photo Credits

ES - Ellizabeth Souheaver	BN - Ben Nottingham
JL - Joe Leo	DW - David Wales
JD - Jason Davenport	LW - Larry Wales
MP - Mike Panz	WG - Wayne Gilbert