REVIEWS AND APPROVALS

Mattamuskeet National Wildlife Refuge

Swanquarter, North Carolina

ANNUAL NARRATIVE REPORT

Calendar Year 1991

Donald S. Temple — Refuge Manager — 7/29/92 — Date

Karen S. Cartledge — Refuge Supervisor — 8/3/92 — Date

Harold W Berson — Regional Office Approval — 8/13/92 — Date

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

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INTRODUCTION

Mattamuskeet National Wildlife Refuge encompasses 50,180 acres of coastal plain in Hyde County, North Carolina, and is dominated by a 40,000 acre lake. It is hypothesized that Lake Mattamuskeet was formed by a meteorite, or as Indian legends tell, by a peat bog fire that burned for 13 moons. The U.S. Geological Survey believes the lake was once a large juniper swamp.

Documents from the Hyde County Historical Society files say the lake bottom soils were once as fertile as those of the Nile River Valley, and many people believed the lake could be drained and farmed. The idea was considered as early as 1789, but it was the early 1900's before the idea became a reality. A pumping station was constructed with a volume of 1,250,000 gpm and over 2,000 miles of ditches and canals were dug to drain the lake. The enterprise had a short life span and by 1932 insect and drainage problems brought the project to a close. Thousands of bushels of rice, corn, potatoes, buckwheat, barley, and other crops were left in the fields. Expenditures of $17,000,000 were lost.

Prior to its drainage, Lake Mattamuskeet had been an important resting and feeding area for waterfowl and other migratory birds, so in 1934 the Federal Government bought the land for $318,607 and the Lake Mattamuskeet National Wildlife Refuge was established. Refuge wildlife habitat includes 40,000 acres of open water, 6,425 acres of freshwater marsh, 2,850 acres of commercial forestland, 605 acres of non-commercial forestland and 300 acres of farmland.

Lake Mattamuskeet is 18 miles long and 6 miles wide and varies in depth from 1.5' to 5'. Most of the north shore is privately owned while refuge lands border its other sides.

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A. HIGHLIGHTS

--Efforts to stabilize the Mattamuskeet Pump Station/Lodge continued to march forward in 1991 including extensive roof repairs (Sections D.4. and I.2.).

--A contract to remove our underground fuel storage tanks and install aboveground storage tanks was initiated but stalled late in the year (Section I.2.).

--Major repairs were made to the Link-Belt dragline (Section I.4.).

--Three hundred acres of lakeshore Phragmites were sprayed with Rodeo in September (Section F.2.).

--Canada goose use was the second lowest on record; duck use was the fourth highest since 1960-61 (Section G.3.).

B. CLIMATIC CONDITIONS

A year-long drought was ended in January this year when a higher than normal amount of rain was recorded. Heavy rainfall in June, July, and August resulted in unusually high water levels in Lake Mattamuskeet during the later part of the year. October's levels were 6 - 8 inches above "normal" October levels.

Table 1. Weather Data - 1991.

	TEMPERATURE (F)					
			AVERAGE		RAINFALL	SNOWFALL
MONTH	MAX	MIN	HI	LO	(inches)	(inches)
Jan	70.0	23.0	56.3	38.7	8.29	
Feb	75.0	19.0	60.1	35.3	0.49	
Mar	81.0	34.0	66.1	46.0	5.26	
Apr	86.0	38.0	76.8	55.0	1.62	
May	95.0	55.0	82.0	63.0	1.06	
Jun	95.0	57.0	83.0	65.0	6.03	
Jul	97.0	70.0	91.1	74.1	8.52	
Aug	96.0	66.0	89.0	69.5	6.88	
Sep	91.0	53.0	84.3	64.2	2.05	
Oct	82.5	42.0	74.0	55.0	3.44	
Nov	81.0	34.0	65.3	46.0	1.75	
Dec	78.5	26.0	61.1	41.2	5.37	
					50.76	

C. LAND ACQUISITION

2. Easements

Refuge staff inspected and posted an Onslow County easement in April, magnetic markers were set at each boundary post. The status of conservation easements assigned to Mattamuskeet NWR is listed in Table 2.

Table 2. Status of FmHA Conservation Easements, December 1991.

County	Owner (Former Owner)	Adequate Survey?	Posted?
Beaufort	FmHA (Elks)	Yes	Yes
Duplin	Knoles (Smith)	No	missing markers
Duplin	FmHA (Torrans)	No	No
Jones	Riggs (FmHA)	No	missing markers
Lenoir	FmHA (Cox)	Yes	Yes
Onslow	Sweeting (Smith)	Yes	Yes
Pender	FmHA (Woodcock)	Yes	Yes
Pitt	Cherry (FmHA)	No	No
Pitt	FmHA (Elks)	Yes	Yes

One FmHA easement (391.63 acres) in Hyde County was conveyed in fee title to the Service in June. Due to the tract's proximity to Pocosin Lakes NWR, its administration was moved to that station.

3. Other

Project Development Biologist Dennis Creamer visited Mattamuskeet and Swanquarter NWRs in March to gather information for the preparation of documents justifying expansion of both refuges.

East Coast Management Biologist Florschutz visited in May to discuss acquisition planning needs.

D. PLANNING

2. Management Plan

Management plans completed during the year included annual water management plans for all refuge impoundments and Lake Mattamuskeet, the final Hurricane Action Plan (approved by RO in June), and a draft Safety Plan (under in-house review as of the end of the year). In addition, several burn prescriptions were prepared.

Following the 1989 Waterfowl Review Team recommendation that a larger acreage of corn be incorporated into waterfowl management

at Mattamuskeet NWR, several moist soil units were appraised for conversion to corn and soybean production. After considering such factors such as current production of beneficial moist soil plants, location, historic waterfowl usage, and status under current wetland regulations, a decision was made to put MI-5 and 6 back into crop production (these units had been farmed in the 1980s). RB Davis met with SCS County Agent Bill Blackwell in March to discuss reverting these units to cropland and prepare the necessary paperwork to ensure compliance with wetland regulations. At year's end, the status of MI-5 and 6 had not been officially established pending a site-visit by SCS. However, we expect the units will be ruled as prior converted cropland in "conservation use" status.

4. Compliance with Environmental and Cultural Resource Mandates

ARM Buckingham attended a recycling fair at Mattamuskeet High School early in the year. In April three 50-gallon barrels were placed around the refuge on an experimental basis to collect aluminum cans for recycling. The initial public response was good. Although we had hoped to begin a recycling program at the refuge this year, the project was on still on hold at the end of 1991 due to other operational priorities.

A Clean Water Act Section 404 Permit for the Sandy Dike banding site was received.

Efforts to stabilize the Mattamuskeet Pump Station/Lodge building, a refuge facility on the National Register of Historic Places, continued this year. See I. 2. for a description of work performed on the building itself. The following paragraphs describe the planning and other administrative tasks performed.

RM Temple met with representatives of Hyde County and the East Carolina Regional Development Institute in January to develop a cost/benefit analysis to justify the restoration of the Lodge. In March, representatives from the North Carolina Department of Cultural Resources visited the refuge to discuss ongoing and planned stabilization activities and later sent a follow-up letter with recommendations.

Temple traveled to East Carolina University (ECU) in January with Mr. Roy Clarke, Chairman of the Friends of the Mattamuskeet Lodge (a Hyde County Chamber of Commerce committee) to meet with staff members of ECU's Department of Construction Management. The purpose of the meeting was to determine if that Department was capable and interested in participating in an engineering evaluation of the Lodge (FWS engineers recommended last year that a structural analysis of the building be made after discovering corrosion in the steel support columns). Several professors and staff members from ECU visited the refuge twice in February to assess various structural concerns and later submitted a report

on their findings. In September, RM Temple and ARM Phillips met with ECU and Hyde County officials at ECU to discuss the funding status of the proposed structural analysis study.

In February, the Friends of the Mattamuskeet Lodge committee agreed to sponsor a series of work days on the Lodge in response to a Service Challenge Grant of $10,000. On May 31, 119 volunteers participated in a"Lodge Clean Up Day". Three additional clean up days were also held in June, July, and August. The services provided by volunteers were estimated at over $6,500. Money from the Service's part of the Challenge Grant was used to make repairs to the roof and furnish supplies for the volunteers.

Temple met with Hyde County Planner Angie Tooley and other county officials in February to discuss the refuge office and visitor center needs that could be met if the Lodge was restored. County officials needed the information to develop a funding proposal for the renovation of the building.

In December, Temple attended a meeting of the Friends of the Mattamuskeet Lodge committee and reported on Service activities pertaining to the building.

5. Research and Investigations

Mattamuskeet NR 91 - "Population dynamics of resident and migrant Canada Geese in the Atlantic Flyway" (42530-1)

Dr. Jay Hestbeck, University of Massachusetts Cooperative Fish and Wildlife Research Unit, is the project leader on this multi-year study involving banding, neck collaring, and observation of migrant and resident Canada geese in fifteen states and provinces. Banding and neck collaring continued at Mattamuskeet NWR in 1991 (see G.16).
Objectives:

1. To compare distribution, abundance, migration patterns, and survival rates of migrant and resident Canada geese.

2. To examine the relationship between harvest regulations, recovery rates, and survival over the harvest period for migrant and resident geese.

3. To estimate interstate movements of resident and migrant geese during the harvest period.

Mattamuskeet NR 91 - "A Preliminary Investigation into Methods for Management of Phragmites" (42530-2)

In 1991, an experiment was begun to compare the effectiveness of wiped-on Rodeo (glyphosate) vs. Arsenal (imazapyr) herbicide in

common reed (Phragmites australis) control. The experiment was conducted in the target-rich MI-2 impoundment by NCSU Weed Science Specialist Dr. Stratford Kay and assistant Steve Hoyle. A research proposal was received and approved in May and the work began in June. A preliminary evaluation of the degree of phragmites control in each study plot was made in October. Arsenal, at either 25 or 50 percent strength of the commercial formulation, was found to provide better suppression of reeds than glyphosate at similar dilutions and 50% Arsenal was more effective than 25% Arsenal. Final evaluations are scheduled to be made next spring near the beginning of the growing season.

Phragmites control plots were established by Dr. Stratford Kay in MI-2E. KD-91

E. ADMINISTRATION

1. Personnel

Back: 8, 7, 1, 10, 9
Front: 11, 3, 5, 4, 2

1. Donald E. Temple, Refuge Manager, GS-12, PFT
2. Howard Phillips, Refuge Manager, GS-11, PFT
3. Kelly Davis, Wildlife Biologist, GS-09, PFT
4. Dianna J. Daniels, Office Assistant, GS-06, PFT
5. Bernice D. Kitts, Clerk-Typist, GS-04, PPT
6. Roy Swindell, Heavy Mobile Equip. Mech., WG-10, PFT
7. Walter Cooper, Crane Operator, WG-09, PFT
8. Jesse Williams, Crane Operator, WG-09, PFT
9 Larry Boomer, Maintenance Worker, WG-08, PFT
10. Robert Schmitt, Maintenance Worker, WG-08, PFT
11. Glenn Price, Biological Aid, GS-03, Temporary-NTE 180 days, completed assignment 04/17/92

Table 3. Mattamuskeet NWR Staffing.

	Permanent			
FY	Full Time	Part Time	Temporary	FTE
87	10	.6	.5	11.1
88	10	.6	.5	11.1
89	11	.6	.5	12.1
90	12	.6	.5	13.1
91	11	.6	1	12.6

Stuart Marcus, Key Deer NWR's Assistant Refuge Manager, was detailed to Mattamuskeet NWR for two weeks (June 3 - 14) as part of the Mid Level Executive training program.

RM Temple was interviewed by a Service investigator on August 20 regarding an age discrimination complaint filed by an applicant for a 1989 vacant position.

Crane Operator Williams was detailed to ACE Basin NWR for a total of nine weeks to assist with emergency dike repairs.

2. Youth Programs

Applications for the summer Youth Conservation Corps (YCC) were received in April and two youths, Andy Mann and April Latham, were selected. They began their 8 week appointments on June 17 and finished on August 2.

6. Safety

Safety meetings were held monthly throughout the year with individual employees providing presentations on various safety topics. In May, a safety audit was conducted by RO staff and CPR training was provided to refuge staff. In July, a Ford Ranger pickup truck caught fire and was completely destroyed. Apparently, dried grass on a recently mowed dike caught underneath the vehicle and was ignited by engine heat. No injuries were sustained. In November, all fire extinguishers were inspected and maintained as necessary. Annual auditory tests were provided to applicable staff in December.

7. Technical Assistance

The Partners Pond Program, the refuge's major contribution to the Partners for Wildlife Tomorrow, continued in 1991 with the construction of 9 ponds bringing the total construction to 29

completed and one incomplete pond. The refuge funded equipment maintenance, fuels costs and the majority of the operator's salary for six of the 1991 ponds. The Hyde County Waterfowl Association paid a portion of the operator's salary on one pond and contracted the construction of the remaining two ponds.

The one to three acre shallow ponds were periodically inspected; several were used by wintering waterfowl, shorebirds and wading birds; at least six hosted resident Canada geese, and at least two were used by nesting black ducks.

In April, a local Army Corps of Engineers and Division of Coastal Management field biologists met with refuge staff to discuss an apparent dredge and fill activity associated with a Partner's site. On his own accord, the landowner had used a shovel to clean out an existing 1'x1'x20' ditch that connected his incomplete pond with a creek to lower the water level in the pond and facilitate completion. Although the old ditch was faintly obvious on recent aerial photos the landowner was required to replace the material. No charges were filed.

A second Partner's project was conducted in cooperation with Management Biologist Florschutz and a small waterfowl club near Mt. Olive, North Carolina. In September and October the refuge fabricated and installed a 30" culvert and 48" riser to improve water management on an 80 acre millpond.

Partners funds were used to construct and install a culvert and riser to improve water management in an 80-acre millpond near Faison, North Carolina. OF-91

The PFWT Regional Review Committee, consisting of Jim Tisdale and Charles Baxter, conducted an inspection of the Partner's pond and the millpond project with refuge staff November 19-20. Refuge staff assisted the Hyde County ASCS office with development of the County Conservation Reserve Program (CRP) plan. Staff also helped the SCS District Conservationist and a local landowner develop a CP-4 plan for a 150 acres tract.

8. Other

A Special Use Permit was issued to the Hyde County Fire Marshal for installation of a dry hydrant on a refuge canal near MI-4. The hydrant would be used in an emergency to obtain water from the canal for fire fighting purposes.

A preliminary museum property inventory was completed in October.

F. HABITAT MANAGEMENT

1. General

One of the purposes for establishing Mattamuskeet NWR was to manage for optimum habitat for migratory birds, especially wintering waterfowl. Lake Mattamuskeet is a natural and excellent waterfowl area in its own right. To complement the values on the lake, the refuge carries out an intensive management program involving native moist soil plants, woody and brushy wetlands and agricultural crops.

2. Wetlands

a. Salinity

Lake Mattamuskeet is connected to Pamlico Sound via four major outlet canals. Water control structures are located in the canals near the refuge boundary to inhibit saltwater intrusion from the sound into the lake. Salinity levels have been monitored at the water control structures since the mid 1940s; 1991 readings are listed in Table 4.

New gates for these water control structures were installed in 1987 and 1988 and function well. Although occasional leaks or jammed gates allow some saltwater to enter the system, most readings at the structures show significantly lower salinity in the lake vs. the sound. The new gates replaced an old system of gates that leaked much greater volumes of saltwater.

Although it has not been proven, recreational crabbers believe that blue crab immigration was also decreased by the new gates. In an effort to increase the number of blue crabs in the lake and canals, one gate in each of three major structures was replaced with one "crab entry gate". The crab gates have three 2"x6" holes to facilitate crab immigration from the sound side to the lake side of the structures. Crabs can enter the lake when either the lake or the sound head is greater. Salinities were measured while the crab gates were in place; when lakeside readings 1/2 mile inland of the structures exceeded 5 ppt the holes were plugged or the original gates were installed. All original gates were replaced by July 1.

b. Lake Mattamuskeet

The 40,000 acre Lake Mattamuskeet, the dominant feature of the refuge, is a major waterfowl staging and wintering location. The lake margin produces desirable emergent plants and the lake proper is underlain by vast beds of desirable submergents. In dry years the emergents flourish, in wet years the submergents spread, and through it all is the ever increasing growth of phragmites along the lakeshore.

As in all years since the refuge establishment, the lake level fluctuated depending on rainfall, wind tides, and evapotranspiration. The level was also effected by refuge and private impoundments pumping out of the lake and agricultural drainage into the lake, however, the degree of influence these factors have on lake water levels is as yet unknown measures.

The lake level recovered from the fall 1990 drought by December 1990 and remained at normal levels through spring. Rainfall was scant during the spring months and the lake level slowly decreased to 3.3. Following heavy rains in late July and early August the level increased to 4.1 which was more or less maintained by northeast to southeast winds and rainfall through December.

The high levels of late summer and fall eliminated approximately 3000 acres of emergent flats along the northern, southern, and western shores. The high elevation margins along the eastern shore were only shallowly flooded and survived the inundation.

Although total waterfowl use days in the 1991-92 season were greater than the 10 year average, use of the lake proper was markedly less than the two previous seasons. Its heaviest use occurred in December when it hosted 93,000 dabblers, 10,000 divers, 35,000 tundra swans, 6,000 Canada geese and 4,000 snow geese. Shorebird use of the lake proper was also less, probably because of the lack of extensive mud flats and other shallow shoreline areas.

The 1991 full lake vegetation survey, part of the Water Quality and Habitat Monitoring Plan, was conducted from July 24 to August 10. Using a LORAN and SAV (submerged aquatic vegetation) tongs, vegetation was examined at 303 sample points. The dominant SAV (in rank order) were wildcelery, southern naiad, redheadgrass, and muskgrasses; SAV was found at 80% of the points and in depths of six to fifty-five inches. Dominant emergent vegetation (in rank order) was threesquare, saltmarsh bulrush, foursquare, Phragmites, water hyssop, and dwarf spikerush; emergents were found at 10% of the points and in depths of zero to six inches. Scytonema, a nitrogen fixing blue-green algae was found at 47% of the points and at all depths either growing on the bottom, on plant stems or floating on the water surface. Scytonema was observed during the 1989 survey but only in the shallow southwestern bays.

Due to the sizable increase in blue-green algae production, refuge staff contacted biologists at NCSU, ECU, Texas Tech University, and the National Wetlands Research Center. Three field investigations were conducted during which the researchers identified the algae and its associated bacteria and examined its widespread occurrence in the SAV and emergent zones. Two of the researchers (Bill Rizzo - NWRC and Bob Christian - ECU) are currently studying refuge water quality data and hope to conduct more detailed examinations during the 1992 growing season.

Phillips and Christian examine the blue-green algae along the northeastern shore of Lake Mattamuskeet. KND

The cause of the bloom is unknown. Neither Vince Bellis, an expert phytologist at ECU, Christian or Rizzo attributed the bloom to a nutrient overload, though they all agreed that if the lake's nutrient budget was better understood the diagnosis would be easier. Bellis postulated that following the heavy waterfowl use of last winter, the lake water was actually nitrogen deficient due to (fecal) carbon loading. Thus, the warm, turbid, nitrogen deficient lake would have presented ideal growing conditions for Scytonema. The next full lake survey is scheduled for 1993.

In late September, approximately 300 acres of Phragmites were sprayed by helicopter with Rodeo and surfactant. The treated areas were: the bay north of FA-3, the bay north and east of MI-8 and MI-9, the bay north of Waupoppin Canal, and the southeastern corner of MI-2 East. The kill rate will be estimated during the 1992 growing season by comparing 1991 and 1992 aerial photographs and stem densities.

Table 4. Lake Mattamuskeet Salinity Readings (ppt).

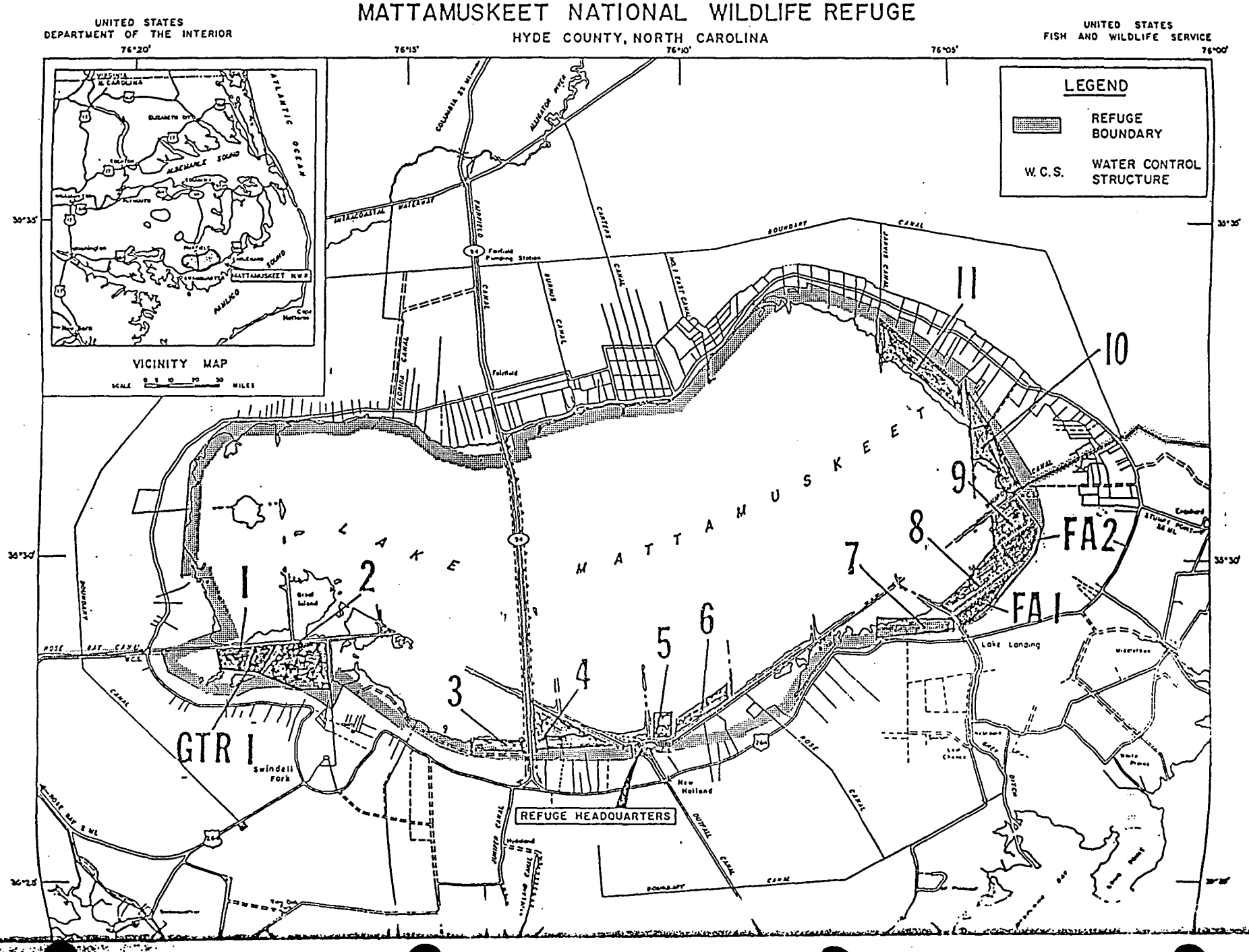
Month	Outfall WCS	Lake Landing WCS	Waupoppin WCS	Rose Bay WCS	Hwy 94	Rainfall Inches	Lake Level
Jan	0-2	1-2	0-3	0-2	0-2	7.84	3.6
Feb	0	1-2	1	1	0-2	0.49	3.6
Mar	0-1	0-2	0-2	0-1	0	4.54	3.85
Apr	1-4	0-3	1-2	0-2	0-1	1.62	3.6
May	2-6	2	2-6	0-1	0-2	1.06	3.6
Jun	2-10	2-7	4-13	0-5	0-1	6.13	3.35
Jul	2-5	3-7	2-3	0-2	0-1	1.15	3.4
Aug	0	0	0	0	0	6.70	3.95
Sep	1-2	1-2	0	0	0	2.05	3.8
Oct	0-2	0-1	0	0-1	0	3.41	3.8
Nov	0-2	0	0	0	0	1.70	4.0
Dec	0	0-2	0	0	0	5.33	3.9

c. Impoundment System

The eleven refuge marsh impoundments and one greentree reservoir (Map 2) were managed in accordance with an approved Annual Water Management Plan. Most units were managed within prescription and the resulting waterfowl food production was excellent overall. Management actions focused on improving habitat for migratory waterfowl, shorebirds and wading birds, and controlling Phragmites.

Weekly waterfowl ground counts in all impoundments began in 1986. Overall waterfowl use of the impoundments in 1991 was less than in the 1989-90 season but greater than in the other 4 seasons.

MAP 2
Marsh Impoundment Locations



Biweekly shore and wading bird counts were also conducted. Vegetation surveys were conducted in all units using a University of Missouri grid technique. Moist Soil Advisor program (to be received in 1992) will be used to evaluate data from these surveys.

Impoundment management was as follows (1.0 gauge reading equals ditch top):

MI-1 (77 acres)

The unit remained flooded from 1.7 to 2.0 for waterfowl and shorebird benefits until mid April. A gradual mid spring drawdown was allowed until late May when the flapgate was opened for gravity outflow. Beginning in late June, the unit was pumped down to 0.0 in preparation for partial disking or rollerchopping. Heavy rains in late June, late July, and early August countered the pumping and the disking plans were cancelled. The rain was allowed to impound the unit to 1.7 by mid August for the benefit of migratory shorebirds and blue-winged teal. The level fluctuated with rainfall through December with an average fall depth of 1.4.

Vegetation transect analysis indicated that good foods (notably redroot, Centella, and Scirpus) increased 30% from 1990. The western third of the unit was dominated by redroot and Centella, while the eastern two-thirds contained these and lush stands of Scirpus, spikerushes, beakrushes, and roundrushes. Overall food production (good and fair foods totalled) was a desirable 90%. The one problem with MI-1 is the increasing growth of loblolly pine and wax myrtle in the southern third of the entire unit.

Waterfowl use was greatest in MI-1 from early January to mid February and peaked around January 10 when 1,500 dabbling ducks (mainly pintails, mallards and green-winged teal), 250 Canada geese and 300 tundra swans were observed. Shorebird use peaked in late May when 600 plovers and sandpipers were counted.

MI-2 (475 acres)

The two subunits (MI-2 East and MI-2 West) were managed separately in 1991; MI-2 East was kept in a deep flooded state to facilitate phragmites control and MI-2 West was managed as a moist soil unit.

The 1991 management plan called for a slight decrease in the 2 East level in late winter to make submergents more available for waterfowl, however, the water was held high to avoid excessive and/or difficult pumping if the lake level did not fully recover during the winter. In late September 1991, approximately 50 acres of Phragmites was sprayed with Rodeo using the airboat spray rig; an additional 20 acres was sprayed with Rodeo from a

helicopter. High water was maintained throughout the growing season and fall to continue stressing Phragmites.

The new spray rig was used to treat 50 acres of Phragmites with Rodeo in MI-2E. KD-91

In mid June, Dr. Stratford Kay, NCSU weed scientist, began a series of experiments to compare the Phragmites killing effectiveness of wipe-on Rodeo with wipe-on Arsenal in a small section of MI-2 East. Preliminary analysis indicated that the most effective control was in deep flooded plots that were cut with a submersible weed-eater. The second most effective measure was 50% Arsenal solution wiped-on during the summer. The research will be continued in 1992.

An informal vegetation survey conducted in MI-2 East in September revealed the presence of a variety of submergent, emergent, and floating leaved vegetation including bladderwort, southern naiad, water hyssop, water primrose, Centella, Pennsylvania smartweed, and foursquare. The blue-green algae Scytonema was also present, though in relatively small amounts. Approximately half of the live Phragmites was so dense that no emergent and little submergent vegetation was found under it. Stem densities in the other half were low enough that foursquare, cutgrass, water primrose, and bladderwort were growing amongst or under the stems.

During the 1991-92 waterfowl season, waterfowl use in MI-2 East was only fair probably because of the deep water that was maintained through the fall and winter. Flocks of 10-100 mallards, green-winged teal were observed throughout the season in the open water areas and thin Phragmites stands. Wood duck, black duck, and mallard flocks were regularly flushed from the flooded woods along the southern edge. One hundred to 200 tundra swans were frequently seen, and on three occasions, 150 Canada geese were counted roosting on the open water.

MI-2 West was drawndown in mid May and held dry into June in preparation for rollerchopping and disking to control woody growth and stimulate production of desirable annuals. Rains in late June, late July and early August postponed soil disturbance until September. The Rome and John Deere harrows were used to double disk all of the subunit except the Phragmites patches along the northern and eastern margins. The unit was held dry throughout October to hasten some green browse regrowth.

Summer rains delayed double disking in MI-2W until September. KD-91

November and December rains were allowed to impound MI-2W and with the addition of gravity flow water from MI-2 East, the unit was gradually reflooded from November 15 to December 25. Waterfowl response was immediate and impressive; refuge staff counted 1,000 - 3,500 ducks, 100 - 300 Canada geese, and 200 -

450 tundra swans in the unit in December 1991 and January 1992. Shorebird use was also excellent; several hundred to 2,000 black bellied plovers, semi-palmated sandpipers, and greater yellowlegs were repeatedly observed.

The freshly disked and shallowly flooded conditions in MI-2W drew large numbers of waterfowl from mid-December through February. KD-91

MI-3 (84 acres)

The 1991 Management Plan called for MI-3 to be maintained for submergent vegetation growth until late July when it would be drawndown for the installation of a culvert and riser. Due to budgetary constraints and pump shortages the plan was postponed. Instead, the water level was allowed to fluctuate naturally during with the mid spring drought and sporadic growing season rains (1.7 - 2.9).

Vegetation transects revealed that the unit produced a substantial amount of good and fair waterfowl foods (55% and 45% respectively). The northern half of MI-3 was dominated by Chara (muskgrass) and bladderwort. The southern half had a mixture of submergent, emergent, and floating leaved species including algal bulrush, bladderwort, slender-leaved pondweed, spikerushes, marsh smartweed, and white water lily. Buttonbush and baldcypress were

also prevalent throughout the southern half. Unlike other impoundments that had been held in deep conditions, there was no Scytonema found in MI-3. This was probably because the other units' high levels were maintained by pumping in with lake water in which the algae was present. The MI-3 level was maintained by rainfall only.

Waterfowl use was fair to good in MI-3 during the 1991-92 season. Three hundred to 1,500 ducks and 85 Canada geese were observed in the unit from November through January. The unit was also used by ten pairs of nesting wood ducks, several wood duck broods, and two pairs of resident Canada geese.

MI-4 (486 acres)

The MI-4 water level was held higher than normal (1.8 - 2.4) through most of the growing season in order to stress Phragmites, add variation to the standard prescription for early season moist soil drawdowns, and to facilitate control of alligatorweed.

In early May an alligatorweed invasion was evident in many of the pools and along the Entrance Road canal; the weed had spread across three quarters of the marsh by mid June, chocking out desirable submergents and emergents. Alligatorweed control experts at the University of Florida, the N.C. Division of Water Resources, and NCSU were contacted. Following their advice, the high levels were maintained and approximately 100 infested acres were sprayed with Rodeo by airboat in late June and early September. Meanwhile, the Phragmites continued its spread with no apparent hindrance by the high water. Fifty acres of it were sprayed with Rodeo during the alligatorweed control activity in September.

Following herbicide application, the unit was drawndown to 0.5 in preparation for an early winter prescribed burn that would eliminate dead Phragmites stems in advance of 1992 herbicide application. The burn was postponed due to the unavailability of a fire crew and rescheduled for March 1992. Rainwater was allowed to flood the unit to 1.5 in late December.

Despite the extensive pest plant problem, the marsh portion of MI-4 contained an abundance of good and fair waterfowl foods (75%) including Centella, foursquare, threesquare, dwarf spikerush, and water hyssop. Where the herbicide was effective, spikerushes, bladderwort, pickerelweed, foursquare and water hyssop replaced the alligatorweed.

The open water or "lake" portion of MI-4 was dominated by good and fair foods (97% total) including wildcelery, southern naiad, and muskgrasses. The only non-food found was Scytonema which was growing with desirable submergents at one third of the survey stops. This was the first documentation of its presence in this

unit and was likely brought in when lake water was used to maintain high levels during the growing season.

Waterfowl and shorebird use was excellent in MI-4 during the 1991-92 season, particularly during the late fall and early winter when 100 - 450 tundra swans and 500 - 2,000 mallards, green-winged teal, and pintails fed in the shallow "lake" portion. Several hundred dowitchers, semi-palmated sandpipers, and yellowlegs also fed in the shallow areas and adjacent mudflats.

MI-5 (50 acres)

Plans called for conversion of MI-5 from moist soil to cropland in order to increase the amount of refuge hot foods. The unit was drained in mid February and held dry until mid July so that lateral ditches could be cleaned before planting a late maturing variety of corn. Unfortunately, the heavy maintenance workload precluded ditch work and the conversion plans were cancelled for 1991. Early August rains returned the unit to a moist soil state. Pumping was required to flood the unit for the Youth and regular waterfowl hunts.

Despite the long drying period, MI-5 produced a satisfactory amount (79%) of good and fair waterfowl foods including smartweeds, wild millet, fall panicum, and threesquare, Less than twenty Sesbania plants were found. Phragmites stands increased in size, especially in the northern and western sections and covered approximately 5% of the unit.

Waterfowl use was generally poor during the 1991-92 season. Twenty-five tundra swans and 10 - 50 pintails were frequently observed in December and January.

MI-6 (44 acres)

Plans called for conversion of MI-6 from moist soil to cropland in order to increase the amount of refuge hot foods. The unit was drained in mid February and held dry until mid July so that lateral ditches could be cleaned before planting a late maturing variety of corn. Unfortunately, the heavy maintenance workload precluded ditch work and the conversion plans were cancelled for 1991. Early August rains returned the unit to a moist soil state. Pumping (MI-5 & 6 combined) was required to flood the unit for the Youth and regular waterfowl hunts.

Despite the long drying period, MI-6 produced a substantial amount of good and fair waterfowl foods (75%). The northern third was dominated by fall panicum, wild millet and smartweeds. The center third was a mixture of wild millet, marsh fleabane, marsh coreopsis, saltmarsh bulrush, and flat sedges. The southern third was densely vegetated by dog fennel, fireweed,

roundrushes, foxtails, ragweed and common paspalum, indicative of the dry soil condition. Two small patches of Phragmites were found and sprayed with Rodeo as was an alligatorweed infestation in the eastern interior canal.

Waterfowl use was poor in MI-6 prior to and during the refuge waterfowl hunt and poor to fair after the hunt. No more than eighty puddle ducks were ever seen at one time in contrast to last year when 500 - 1,500 ducks used the unit regularly before and after the hunt. Vegetation composition was similar in both years; the difference in duck use was possibly because of the August 1990 mowing of Sesbania that scattered other moist soil plant seeds.

MI-8 (249 acres)

MI-8 East:

A delayed drawdown was conducted from early April to June 1 for the benefit of late season waterfowl and migrating shorebirds. The unit was held within five inches of ditchtop for the remainder of the growing season to stimulate the growth of desirable annuals. The water level was slightly increased in October to accommodate early fall shorebirds and waterfowl. The slightly flooded level (1.1 - 1.3) was held through mid December to facilitate prescribed burning of the Phragmites and cordgrass. Unavailability of a fire crew postponed the burn until March 1992 and rains were allowed to complete the inundation in late December.

Several small patches of alligatorweed growing along the southern edge towards the center of the unit were sprayed three times with Rodeo during the flowering stage. Approximately 90% of the stems were killed and replaced by water hyssop, spikerushes and wild millet.

Vegetation transect analysis revealed that the unit was dominated by good and fair waterfowl food plants (79%), however, non-food abundance (21%) increased 5% since 1990 and doubled since 1988. This was partly due to an increase in cordgrass which is considered a fair food in thin stands or a browse stage and a non-food when it grows in dense, unburned stands. The non-food category was also boosted by the spread of Phragmites in the eastern section and the remnant alligatorweed along the southern edge. The major good foods included water hyssop, threesquare, fall panicum, wild millet, foursquare, and Centella.

Waterfowl use was good to excellent during the 1991-92 season. The unit received regular use by 1,500 green-winged teal, 1,500 mallards, 1,000 pintails, 150 Canada geese, 2,000-4,000 snow geese, and 800 tundra swans. Shorebird use was also good with 500 - 2,500 sandpipers and plovers foraging in late spring and

early fall.

MI-8 West:

As with MI-8 East, a delayed drawdown was conducted from early April to June 1 for the benefit of late season waterfowl and migrating shorebirds. The unit was held within five inches of ditchtop for the remainder of the growing season to stimulate the growth of desirable annuals. The water level was slightly increased in October to accommodate early fall shorebirds and waterfowl. The slightly flooded level (1.1 - 1.3) was held through mid December to facilitate prescribed burning of the Phragmites and cordgrass. Unavailability of a fire crew postponed the burn until March 1992 and rains were allowed to complete the inundation in late December.

A large patch of alligatorweed along the southern edge was sprayed three times during the growing season with Rodeo. Stem kill was approximately 95%. Water hyssop and spikerushes replaced the weed.

Vegetation transect analysis indicated that good and fair foods totalled 73%, down 2% from 1991 and were dominated by wild millet, water hyssop and dwarf spikerush. Nonfoods totalled 27%, up 20% from 1991 because of the increase in Phragmites, cordgrass and cattail.

Waterfowl use was good to excellent in MI-8 West during the 1991-92 season. Early to mid season use averaged 350 - 800 puddle ducks, 80 Canada geese, and 400 tundra swans. Use doubled during the swan baiting period (January 10 - February 11). Shore and wading birds responded to the spring drawdown and fall flooding; 200 - 1,500 sandpipers and plovers and 50 - 200 herons, egrets and glossy ibises were regularly observed.

MI-9 (272 acres)

High water levels were maintained through July 1 to stress Phragmites. The unit was drawndown to ditchtop level in mid July and held around 1.0 through early November to stimulate wild millet and spikerush production. Rainfall was allowed to gradually flood the unit to 1.6 by late December.

Approximately sixty acres of Phragmites were sprayed with Rodeo from the bombardier in October. Because the unit had not been burned since the fall of 1990, the Phragmites stands were extremely dense and precluded optimal herbicide coverage.

Transect analysis revealed that, as expected, the late drawdown resulted in excellent production of dwarf spikerush, wild millet, flat sedges and threesquare. These good and fair foods accounted for 79% of the unit vegetation; non-foods were dominated by

cattail, Phragmites, frogfruit, and cocklebur.

The central bowl was nearly covered by dwarf spikerush with scattered cattail, threesquare, millet, and water hyssop patches. The western third of the unit produced approximately 100 acres of wild millet; in fact except for the numerous tenth-acre patches of Phragmites, it was a millet field. The majority of the Phragmites was concentrated along the lateral ditches and windrows in the eastern and southern sections.

Waterfowl use was fair to good in December and excellent in January when 3,000 - 6,000 puddle ducks, 350 Canada geese, 2,400 snow geese, and 700 - 2,400 tundra swans were regularly observed. MI-9 was well used by shorebirds in spring, summer and fall. Four immature and two adult bald eagles and three peregrine falcons were frequent users throughout the waterfowl season.

MI-10 (432 acres)

MI-10 North:

The Annual Water Plan called for a late March to early April drawdown, however, the shortage of portable pumps postponed the drawdown to early May. The unit was held in a moist soil state through early August when heavy rains increased the level to 1.5. The unit was allowed to fluctuate between 1.5 and 1.8 through mid December.

Transect analysis revealed that MI-10 North was dominated by good and fair waterfowl foods (59% and 23% respectively). The northern third consisted of 30% open water (4-8 inches deep) and 70% moist to shallowly flooded soil during the early September survey. The open water pools were vegetated by water hyssop, bladderwort, and spikerushes. The moist to shallowly flooded areas were dominated by water hyssop, Centella, cattail, foursquare, threesquare, beakrushes, flat sedges and wild millet.

The middle third consisted of 50% open water area vegetated by water hyssop, bladderwort, algal bulrush, and watergrass, and 50% moist to shallowly flooded soils vegetated by water hyssop, foursquare, saltmarsh cordgrass, knotgrass, threesquare, cattail and other emergents.

The southern third consisted of 15% open water area and 85% moist to shallowly flooded areas vegetated similarly to the northern and middle sections.

Saltmarsh cordgrass growth was dense along the eastern and western edge of most of the unit. It was not present in the area along the eastern dike that was double disked in 1989. Fifteen Phragmites patches were scattered around the unit and averaged less than one quarter acre in size.

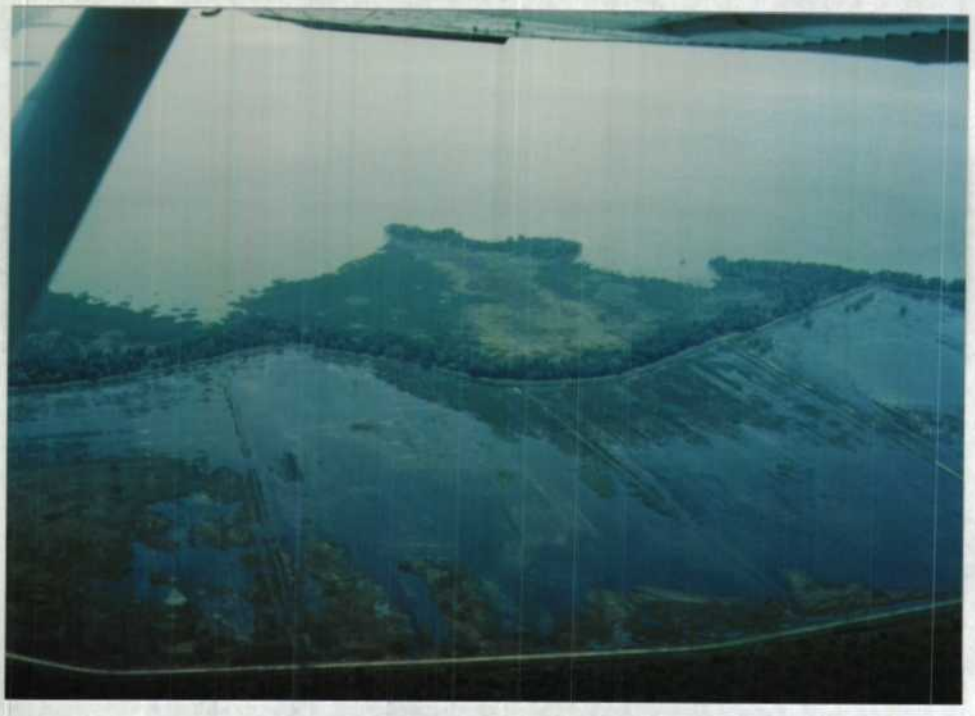
Waterfowl, shorebird and wading bird use was excellent during the 1991-92 season. Staff regularly counted 1,500 - 5,000 puddle ducks, 150 Canada geese, 500 - 4,500 tundra swans, and 150 - 1,500 shore and wading birds. The only user group to noticeably decline over the past three years was snow geese; 2,000 snows used MI-10 North infrequently during October and November but were rarely seen there during the rest of the season.

Tundra swan use of MI-10 North peaked in January.
KD-91

MI-10 South:

Water levels were lowered from 3.5 in late January to 2.0 in mid February to make submerged aquatic vegetation available for waterfowl. Response was minimal so the high level was restored in early March.

Deep water levels (2.8 - 3.5) were maintained throughout the growing season to inhibit Phragmites growth. In late September, the remaining 25 acres of Phragmites were sprayed with Rodeo from the airboat. A follow-up treatment was conducted in early October. All stems, including those on the adjacent dike, were sprayed and most appeared to be dead by early November.



MI-10 South before Phragmites treatment (1989) (green area inside dike is Phragmites) KD-89

MI-10 South after Phragmites treatment (1991). KD-91

An informal vegetation survey conducted in early September revealed that a variety of SAV was present in MI-10 South including algal bulrush, watergrass, and bladderwort. Water hyssop and water primrose were also well established.

Waterfowl use in MI-10 South was minimal from October through December and increased slightly in January when 25 - 50 puddle ducks and 25 tundra swans were seen repeatedly. Other water bird use was good, especially during the spring and summer when 100 - 150 wading birds were regular users. The unit was also home to three pairs of pied-billed grebes and several common moorhens. Seven white pelicans used MI-10 South exclusively from December through early February.

MI-11 (429 acres)

In accordance with the Annual Water Management Plan, MI-11 was returned to a deep flooded condition during the 1991 growing season. The level gradually increased from 2.3 in early April to 3.1 in mid August. Rainfall was used to keep fall and early winter levels high. The unit was pumped down to 2.0 in early February 1992 to increase SAV availability for waterfowl.

A mid September vegetation survey showed that SAV and floating leaved vegetation had become reestablished in 1991 (the unit was drawndown for ninety days in 1990 to aerate the substrate and recycle nutrients). The open water pools contained dense beds of Chara (a muskgrass), water milfoil, and southern naiad with surface growths of white water lily and spadderdock. The southern cattail areas were interspersed with foursquare, dwarf spikerush, other spikerushes, threesquare and bladderwort. The northern edge contained a near 100% coverage of a variety of SAV and emergent vegetation including water hyssop, foursquare, water primrose, water milfoil, duckweed, and Azolla (water fern). The blue-green algae Scytonema was also present.

Waterfowl use was good in MI-11 throughout the 1991-92 season. Use peaked in late December when 1,500 gadwall, 800 wigeon, and 1,000 other puddle ducks were counted.

GTR-1 (65 acres)

This forest unit, located between MI-1 and MI-2 West, is dominated by sweetgum, red maple, American elm and baldcypress, and is usually flooded in late fall and dewatered in late winter. It traditionally attracts mid to late season mallards, black ducks and wood ducks.

Following the 1990-91 waterfowl season the GTR was gravity drained to 0.0 by June 1. The unit remained dry until mid July when water pumped into it from MI-1 moistened the soil. Heavy rains in early August caused water to pool in some of the low

areas; most of the unit was not inundated. The moist state was maintained by infrequent rains until the unit was pumped in to 2.0 in early December. Waterfowl response was immediate with at least 200 wood ducks, black ducks, and mallards observed along the unit's edge. Undoubtedly many more ducks were using the unit's interior.

4. Croplands

The farm units (FA-1, FA-2, and FA-3) were managed through cooperative farming agreements. Two local farmers had a total of 387 acres under cultivation.

Both co-op farmers began their farming operations in mid March. Corn was planted in April and soybeans were planted during May and June. Corn was harvested in late August and beans were harvested in late October. On September 24, winter wheat was aerially seeded in 127 acres of soybeans in FA-2 and 3. Crimson clover seed was mixed with wheat and seeded in an eight acre field in FA-2.

Generally, FA-1 was kept shallowly flooded from late December through early March. FA-2 and 3 were held dry to promote wheat growth for Canada goose browse except during heavy rains in late December and early January. Refuge staff met with cooperative farmers and the Hyde County Agricultural Extension Agent to discuss cropping practices and integrated pest management.

FA-1 (176 Acres)

Eighty-seven acres of corn and 89 acres of soybeans were planted; the refuge received 56.5 acres of standing corn as its share. Corn yields averaged 75 bushels per acre and soybeans averaged 39 bushels per acre. No winter wheat was sown in FA-1.

During December, water was pumped into FA-1 to flood the standing corn. Because the pipes had flapgates on the canal side only, locking mechanisms were fabricated to prevent the water from running back out of the impoundment when the pump was stopped. Later, as the water pressure increased, several leaks thought to have been caused by nutria activity in the dike between FA-1 and FA-2 were discovered. A cofferdam south of the dike was constructed in early January to facilitate water management until the pipe could be replaced.

Fall waterfowl use of FA-1 began in late October when 850 snow geese fed heavily in the harvested soybean fields. By early December, 500 Canadas and 3,200 snows were seen regularly in the soybean fields. Late December rains and pumped water flooded the northern half of FA-1 and use increased immediately; approximately 7,500 puddle ducks (mainly pintails, green-winged teal and wigeon), 3,000 snow geese, 150 Canadas, and 1,000

dowitchers and yellowlegs filled the flooded bean fields. The water was held high for continued use through early March. Three to seven hundred tundra swans, 750 shovelers and 1,000 wigeon were the major users in February. The flooded corn attracted 500-2,000 puddle ducks (pintails, wigeon and mallards) from late January through early March. Total waterfowl use (309,000 use days) was more than twice that of 1990-91 and three times the previous five year average.

Flooded soybean fields in FA-1 attracted large numbers of puddle ducks from late December to early March. KD-91

FA-2 (161 acres)

The cooperative farmer planted 84 acres of corn and 77 acres of soybeans; the refuge received 40 acres of standing corn as its share. Corn yields averaged 100 bushels per acre and soybeans averaged 32 bushels per acre. Winter wheat was aerially seeded in 77 acres of standing soybeans. Wheat germination and growth was above average for the refuge. Crimson clover was aerially seeded with the wheat in one field and germinated well, however, the heavy rains in early January killed most of it.

Fall waterfowl use of FA-2 began in mid November when 100 Canada geese and 1,500 snow geese discovered the young wheat browse. Geese continued to feed in the wheat throughout the season with peak use by 4,000 snows and 200 Canada in mid January. Late

December rains shallowly flooded 90% of the wheat and standing corn and resulted in immediate use of the flooded fields by 2,000 geese, 2,500 pintails, 2,200 wigeon and 250 mallards. The unit was pumped down by January 8 to salvage the wheat for late winterbrowse. The standing corn was knocked down following the Canada goose season on February 3; 500 - 1,000 dabbling ducks (mainly mallard and wigeon), 100 - 150 Canadas and 1,500 snows fed in the fallen corn until early March. Total waterfowl use (2,053,085 use days) was nearly double the 1990-91 use and previous five year average.

FA-3 (49.5 acres)

The cooperative farmer planted the entire unit in soybeans; the yield averaged 29 bushels per acre. Ten percent of the beans were salt and/or water damaged. Winter wheat was aerially seeded in the beans and generally germinated well.

Fall waterfowl use of FA-3 began in early November when fifty Canada geese were observed feeding on the wheat. Moderate goose use occurred throughout the season with a peak of 450 Canadas in late January and early February. The unit was shallowly flooded for one week in early January; during this period 150 pintails were observed feeding in the flooded fields. The unit was pumped down by January 8 to salvage the wheat.

6. Other Habitats

Ten acres of winter wheat were planted in the Central Canal spoil deposition areas to provide food for migratory birds and resident wildlife, improve wildlife observation opportunities in the Wildlife Drive vicinity and decrease Phragmites acreage.

9. Fire Management

Continued emphasis was placed on using prescribed fire as a management tool in 1991. Unfortunately, the lack of a fire crew at Mattamuskeet and with the unavailability of fire personnel and equipment from adjacent refuges at the times we needed them complicated our planned arrangements for several of the scheduled fall and early winter burns. Burn prescriptions and an ESA Section 7 review were approved prior to burn initiation.

Although burns were scheduled for MI-4, 8, 9 and 500 acres of lakeshore marsh, only a thirty acre burn of the woods south of MI-5 was accomplished in 1991. The remaining burn units were rescheduled for March 1992.

10. Pest Control

Phragmites control measures continued in MI-2 East, MI-4, MI-9 and MI-10 North and were begun in three bays on the east side of Lake Mattamuskeet (Section F.2). Generally the most successful control method in the impoundments appeared to be thorough mowing in the late spring or early summer followed immediately by a deep flooding. Because of unpredictable winds, rainfall and lake levels, immediate flooding is difficult and the control process usually extends through three growing seasons and includes a combination of mowing or rollerchopping, burning, deep flooding and Rodeo application. Unpredictable weather and wet conditions preclude reliable use of mechanical control in the lake marshes thus a combination of burning dead stems and Rodeo application is used.

Alligatorweed control measures (i.e. multiple Rodeo applications) were necessary in MI-4, MI-8 East, MI-8 West and along several of the headquarters area canals.

A 50 gallon custom fit spray rig was procured for Rodeo application from the airboat. Prior to its arrival, a similar spray rig was borrowed from the North Carolina Division of Water Resources. The new spray unit was also used with a 300 gallon tank on the bombardier.

11. Water Rights

Three requests for drainage ditch maintenance were received in March. One Special Use Permit was issued.

In April, refuge staff met with fifteen landowners to discuss water level management of Lake Mattamuskeet. The attendees were mainly farmers interested in maintaining their drainage rights (Section F.2).

12. Wilderness and Special Areas

Salyer's Ridge Research Natural Area was treated in 1987 for an infestation of southern pine beetle. This area was inspected again this year for new outbreaks with no signs of pine beetle activity.

G. WILDLIFE

2. Endangered Species

Mattamuskeet NWR provides habitat for two federally listed and one State listed endangered species. Bald eagles are sighted year-round and one pair nests nearby. Peregrine falcons are fall and winter migrants and American alligators (State listed) are rare summer residents.

Although no red wolves have been sighted on Mattamuskeet NWR, a few wandered into the Engelhard vicinity in 1991.

Bald Eagle

Eight bald eagle pairs either successfully nested or went through the motions in North Carolina in 1991. Although none nested on the refuge, two of the nests are near Swan Quarter and Cedar Island NWRs so we monitor their status during aerial waterfowl surveys. This year the nearest nest, located on the Gull Rock Game Land, produced three young and the other nest, located near Aurora, produced one young. A former Gull Rock Game Lands nest, one-quarter mile northeast of Swan Quarter NWR, was abandoned early in 1988 and has been unused since.

Staff will continue to monitor the movements of adult bald eagles with the hope that some of the birds hacked at Mattamuskeet NWR between 1983 and 1988 will return to nest.

Bald eagles were observed on the refuge in spring and summer of 1991, however, the peak use (6-10 birds) occurred from late October 1991 through February (1992) when waterfowl concentrations were greatest.

The annual National Wildlife Federation Mid-Winter Bald Eagle Census was conducted January 5-18. Numerous aerial and ground sightings were reported. The refuge population was estimated at 8 (6 immatures and 2 adults).

Peregrine Falcon

Peregrine falcon sightings were reported frequently during the 1991-92 fall and winter period. Falcon activity was greatest in the shallowly flooded eastern impoundments and peaked in mid December. An immature falcon was found dead off the refuge by a local hunter who turned it over to refuge staff. Special Agent Curtis was notified.

American Alligator

As in 1989 and 1990, one alligator estimated to be ten feet long, stayed in the Outfall Canal "pool" from mid May to late June. On August 1, refuge staff found a dead three feet long alligator on Highway 94 near the refuge entrance road intersection.

Red Wolf

Since 1987, Alligator River NWR has conducted a red wolf reintroduction program. During 1991 20 to 27 wolves were free roaming and several had home ranges within a few miles of Lake Mattamuskeet. The wolves locations were monitored daily by the

Alligator River wolf crew. In June, two wolves were repeatedly observed in yards and fields along S.R. 1311, a road that follows the Lake Mattamuskeet ridge connecting Engelhard with Fairfield. Needless to say, the refuge received numerous inquiries and complaints, which were forwarded to the wolf crew who were aware of the wolves' locations. The Alligator River wolf crew was able to capture one of the wolves and return her to her usual location. The other wolf, a young male, was struck by a car, lost a leg and will probably become part of the captive stock. Following the excitement, the Alligator River staff held an information session for Hyde County residents, but only four attended.

In December, a third wolf was in the Nebraska vicinity, four miles west of Engelhard. This was nothing new to the Nebraska residents for a wolf had also wandered there in 1990. Both Nebraska wolves seemed to prefer the gum swamp to yards and caused no alarm. On the night of December 14 the wolf was on or near S.R. 1110 in Nebraska and was killed by a vehicle. Residents contacted Mattamuskeet NWR staff who picked up the wolf on December 15. It was later transported to Alligator River NWR.

3. Waterfowl

Note: Wintering waterfowl populations are reported on a seasonal basis. Population estimates are made by refuge and NCWRC during biweekly and mi-winter aerial censuses and weekly ground counts.

Tundra Swans

During the past thirty years the Atlantic Flyway tundra swan population has increased 68% from 62,500 to 92,000 (Table 5).

During the same period, that portion of the population that wintered in North Carolina increased from about 27% to over 79%, and the portion that wintered at Mattamuskeet NWR increased from 1.5% to 50% due to a major wintering area shift from Chesapeake Bay to the Lake Mattamuskeet vicinity.

Although the 1991-92 North Carolina tundra swan population was about 3,700 less than the record high set in 1989-90, it is the second highest on record. The refuge peak of 37,700 was the third highest behind 45,000 in 1990-91 and 38,500 in 1986-87 and 5,200 above the 10 year average. Total use days in 1991-92 (2.0 million) was the fifth highest recorded and equal to the average and refuge objective level. The comparatively low use day total was due to a greater number of swans feeding in winter wheat fields away from Lake Mattamuskeet and roosting on Pungo Lake, Lake Phelps and the Pungo River. The majority of the swans arrived in early November and departed in early March.

Table 5. Historical Tundra Swan Populations and Production Data 1961-91

Year*	Flyway Population**	North Carolina Population** (% of Flyway)	Mattamuskeet Population*** (% of Flyway)	% of YOY in Flyway
1961	62,500	16,800 (26.9)	930(1.5)	15.0
1962	39,400	9,200 (23.4)	1,000 (2.5)	16.7
1963	61,400	13,000 (21.2)	1,950 (3.2)	14.8
1964	61,000	24,700 (40.4)	1,220 (2)	12.1
1965	54,000	7,900 (14.6)	530 (1)	12.1
1966	57,800	10,900 (18.8)	1,500 (2.6)	11.2
1967	72,300	18,800 (26)	3,200 (4.4)	9.0
1968	45,600	17,200 (37.7)	3,000 (6.6)	10.1
1969	62,000	25,600 (41.3)	5,650 (9.1)	4.8
1970	55,000	15,000 (27.3)	11,000 (20)	14.9
1971	58,200	16,000 (27.5)	9,000 (15.5)	14.6
1972	62,800	17,000 (27.1)	11,000 (17.5)	4.4
1973	57,100	19,000 (33.3)	11,700 (20.5)	14.6
1974	64,200	25,000 (38.9)	18,000 (28)	17.4
1975	66,900	26,900 (40.2)	20,200 (31)	18.5
1976	78,650	41,700 (53.0)	22,900 (29.1)	9.3
1977	76,200	43,300 (56.8)	22,400 (29.4)	19.7
1978	70,200	23,800 (33.9)	9,000 (12.8)	5.3
1979	78,600	30,500 (38.8)	26,200 (33.3)	39.9
1980	63,500	19,700 (31)	14,000 (22)	10.5
1981	92,800	46,600 (50.2)	19,000 (20.5)	30.2
1982	76,300	42,200 (55.3)	25,000 (32.8)	11.4
1983	86,500	52,200 (60.3)	22,500 (26)	25.9
1984	81,100	50,000 (61.6)	36,800 (45.4)	not avail.
1985	93,900	52,500 (56)	34,000 (36.2)	24
1986	91,000	53,000 (58.2)	38,000	9
1987	94,000	46,400 (49.4)	29,800 (31.7)	10
1988	90,100	69,600 (77.2)	23,000 (25.5)	14.8
1989	90,000	76,700 (85.2)	30,000 (33.3)	11.4
1990	90,000	65,000 (72.2)	45,000 (50.0)	6.9
1991	92,000	73,000 (79.3)	37,700 (41)	not avail.

*Year represents waterfowl season, e.g. 1988 = 1988-89 season
**From USFWS/NCWRC winter censuses
***Wintering peak
1991 % YOY at Mattamuskeet: 3.2
1991 Avg. YOY per family at Mattamuskeet: 2.0

In early December refuge staff and Management Biologist Florschutz conducted the annual tundra swan productivity survey and found that birds identifiable as pairs had an average of 2.0 young and that 3.2% of the flock was young of the year birds.

This was the eighth year of the North Carolina "permit only" tundra swan hunt and the sixth year that permits were honored on the refuge hunt (Section H.8).

Canada Geese

Canada goose use (900,000 use days) was the second lowest on record and only slightly greater than the all time low season of 1990-91 (850,000 use days). The 6,000 or so birds remaining in the southern cohort population arrived as usual between mid September and early December. A mid January cold snap (a snap is significantly shorter than a spell) pushed down an additional 3,400 from the Delmarva peninsula. A second snap in February boosted the population to 11,550, the season peak. The majority of the birds arrived in late October and departed in late February. The peak and use day total were both below the ten year average (13,500 and 1.2 million) and refuge objective (20,000 and 2.0 million).

Canada geese fed regularly in soybean stubble, winter wheat, sprouted corn, and standing corn on private and refuge property. Use of standing or knocked down corn was less than in normal, colder winters. The birds were particularly attracted to the privately owned state waterfowl sanctuaries in Nebraska and Lake Comfort. These areas, totalling 1,500 acres, were part of a 6,000 acre project initiated in 1988 by the NCWRC to provide feeding sanctuary for Canada geese. In return for a fee, the landowners planted corn and winter wheat for the birds and prohibited all activities, including hunting, except for those required by normal agricultural practices.

Canada goose use peaked at 144,400 birds at Mattamuskeet NWR during the 1959-60 season. Since then, the refuge goose peak has decreased as the majority of the Atlantic Flyway birds have wintered north of North Carolina. Between 1981 and 1985 the NCWRC released over 1,300 geese in Hyde and adjacent counties with the intent of establishing a resident flock. The refuge did not encourage this project, and although none were released on the refuge after 1981, the lake and impoundments have received year-round use by about 200 of those birds for the past three years. Several broods were seen on the refuge in May, June and July. State biologists estimate that 250 goslings were raised in Hyde County in 1991.

Snow Geese

The refuge snow goose population includes both the lesser and greater race. The flocks arrive and depart separately but frequently feed and roost together. The refuge population peaked at 4,000 (400,000 use days) in the 1991-92 season. The peak was 1,000 less than the 1990-91 count and 800 below the ten year average. Use days were 100,000 below last year but 40,000 above the average. The decline in population was likely the result of mild winter temperatures in Delaware and Maryland.

The first snow geese arrived in late September and by early November 2,500 were on the refuge. The peak occurred in December when 3,000 lessers and 1,000 greaters were counted in FA-2 and MI-8 East. Both flocks departed by mid February.

Ducks

The duck population peak of 102,950 was the fourth highest since the 1960-61 peak of 192,800 (Tables 6 & 7) and for the fourth consecutive year the use day total (8.6 million) exceeded the refuge objective (7.0 million). The 1991-92 peak and use day totals were significantly less than those of the previous three seasons, accented by a 32% and 39% decrease from the 1990-91 figures. Whether the decline was due to overall flyway conditions or unusually high lake levels that knocked out the vast emergent marshes of 1990-91 is unknown, however, the decrease in use was quite evident to refuge staff and waterfowl enthusiasts.

The 1991-92 peak included 28,700 pintails, 26,300 green-winged teal, 20,800 mallards, 6,100 black ducks and 5,500 scaup. The refuge duck count steadily increased from 30,000 in mid October to 70,000 in mid November to the peak of 102,950 in late December. By mid January the duck count decreased to 90,000, in mid February it was 25,000 and by mid March most migratory ducks had departed.

The late December green-winged teal peak of 26,300 was a refuge record high and nearly three times the ten year average. The late December pintail peak of 28,700 was 4,500 less than in 1990-91 but the second highest count since 1980. The mid January mallard peak of 21,300 was less than the previous three seasons but 5,000 above the average. The mid October wigeon peak of 11,300 was a five year low and 1,300 below the average. The mid January black duck peak of 9,800 was 1,600 above last year the third highest since 1982. The late November canvasback peak of 6,100 was 9,400 less than last year the lowest peak recorded in ten years. The mid November scaup peak of 7,400 was 11,900 less than last year but only slightly below the average. The late January ring-necked peak of 3,800 was well below the previous two seasons and the average.

Canvasbacks peaked at 6100 birds in late November. KD-91

Table 6. Peak Waterfowl Populations and Use Days (Millions) (1982-83 - 1991-92)

Season	Tundra Swan Peak (Use Days)	Canada Goose Peak (Use Days)	Snow Goose Peak (Use Days)	Duck Peak (Use Days)
1980-81	14,000 (0.9)	20,000 (1.7)	6,000 (0.4)	40,500 (3.8)
1981-82	19,000 (1.3)	13,900 (1.3)	3,200 (0.1)	88,300 (6.3)
1982-83	25,100 (1.1)	13,500 (1.1)	3,500 (0.3)	36,500 (2.1)
1983-84	22,500 (1.0)	12,500 (1.1)	2,900 (0.2)	44,300 (2.7)
1984-85	36,800 (3.1)	16,800 (1.7)	6,000 (0.45)	53,200 (4.2)
1985-86	34,000 (2.3)	18,600 (1.1)	5,500 (0.3)	64,300 (4.2)
1986-87	38,500 (2.1)	11,700 (1.3)	4,100 (0.3)	47,600 (4.2)
1987-88	29,800 (1.9)	10,100 (1.0)	5,500 (0.3)	86,550 (7.4)
1988-89	23,000 (1.5)	17,300 (1.3)	5,000 (0.3)	122,400 (8.0)
1989-90	30,000 (2.1)	15,000 (1.4)	6,200 (0.6)	145,900 (9.9)
1990-91	45,000 (2.5)	8,000 (0.85)	5,000 (0.5)	151,850 (14.2)
1991-92	*37,700 (2.0)	11,550 (0.9)	4,000 (0.4)	102,950 (8.6)
10 Year Average	32,200 (2.0)	13,500 (1.2)	4,800 (0.36)	85,555 (6.6)
Refuge Objectives	20,000 (2.0)	20,000 (2.0)	No Objective	70,000 (7.0)

*Tundra swan peak includes 10,000 birds that fed in Kilkenny and New Lake area wheat fields during the day and roosted on Lake Mattamuskeet at night. Actual count of birds on lake and adjacent fields during aerial census time (10 AM - 3 PM) was 19,600.

Table 7. Mattamuskeet NWR - Duck Peak Populations 1982-83 to 1991-92.

Species	91-92	90-91	89-90	88-89	87-88	86-87	85-86	84-85	83-84	82-83	*FYI 59-60	10 Year Average
Mallard	21,300	36,800	30,500	30,700	11,400	8,400	6,600	9,300	3,900	5,300	6,000	16,400
Canvasback	6,100	15,500	27,200	20,500	24,200	15,000	14,700	20,000	17,800	16,500	1,000	17,750
Pintail	28,700	33,200	25,300	25,900	18,500	19,000	10,400	15,000	28,500	22,500	100,000	22,700
American Wigeon	11,300	26,800	24,300	19,200	21,000	4,100	4,100	10,100	2,900	2,500	45,000	12,600
Scaup	7,400	19,300	15,000	5,700	3,300	10,200	4,100	11,000	1,350	3,000	25,000	8,000
Black	9,800	8,200	14,800	9,100	6,400	5,700	8,300	11,850	3,500	2,600	8,000	8,005
Ring-Necked	3,800	16,800	14,700	1,800	7,800	2,600	5,000	<1,000	2,250	1,000	10,000	5,700
GW Teal	26,300	25,000	11,900	8,500	6,600	3,000	6,900	3,000	2,900	1,400	8,000	9,550
Ruddy	4,100	4,600	7,100	3,100	12,000	3,700	1,200	2,000	<1,000	<1,000	35,000	4,000
BW Teal	2,000	3,000	2,000	2,000	<1,000	<1,000	6,000	5,400	<1,000	<1,000	<1,000	2,400
Gadwall	2,800	3,400	1,800	2,700	1,500	1,000	4,000	1,100	<1,000	<1,000	3,000	2,000
Northern Shoveler	1,050	2,200	1,000	1,000	<1,000	<1,000	2,600	<1,000	<1,000	<1,000	<1,000	1,400
Duck Peak**	102,950	151,850	145,900	122,400	86,550	47,600	64,300	53,200	44,300	36,500	240,800	85,550

*For Your Information; not included in 10 year average
**Includes redhead, bufflehead, mergansers, wood duck

Table 8. Wintering Duck Peaks 1940-91

Period/Waterfowl Season	Peak
1940-41 - 1949-50 (10 yr. avg.: 22,440)	40,500 1947-48 season
1950-51 - 1959-60 (10 yr. avg.: 129,900)	240,800 1959-60 season
1960-61 - 1969-70 (10 yr. avg.: 63,200)	192,800 1960-61 season
1970-71 - 1979-80 (10 yr. avg.: 77,400)	119,750 1973-74 season
1980-81 - 1989-90 (10 yr. avg.: 73,000)	145,900 1989-90 season
1980-81	40,500
1981-82	88,300
1982-83	36,500
1983-84	44,300
1984-85	53,200
1985-86	64,300
1986-87	47,600
1987-88	86,660
1988-89	122,400
1989-90	145,900
1990-91	151,850
1991-92	102,950

Table 9. Wintering Mallard Populations 1940-91

Period/Waterfowl Season	Peak
1940-41 - 1949-50 (10 yr. avg.:2,100)	4,000 1946-47 season
1950-51 - 1959-60 (10 yr. avg.:9,900)	15,000 1954-55 season
1960-61 - 1969-70 (10 yr. avg.:7,500)	8,000 1960-61 season
1970-71 - 1979-80 (10 yr. avg.:8,000)	13,950 1978-79 season
1980-81 - 1989-90 (10 yr. avg.:14,200)	11,200
1981-82	25,300
1982-83	5,300
1983-84	3,900
1984-85	9,300
1985-86	6,600
1986-87	8,100
1987-88	11,400
1988-89	30,700
1989-90	30,500
1990-91	36,800
1991-92	21,300

Overall dabbling duck counts were above the ten year averages, but diving duck counts were below. As in 1990, canvasbacks staged on the Chesapeake about 30 days longer than normal. This was probably the reason for the relatively low canvasback count (6,100) on Lake Mattamuskeet; when the other 20,000 or so birds did reach North Carolina in January, they bypassed the lake and went directly to Pamlico Sound.

All refuge wood duck boxes were checked and repaired in August 1991 and January and February 1992 (Table 10). Twenty-five of the 98 boxes had wood duck nests; 23 were successful. Nine boxes were used by other species (screech owls and tree swallows). Twelve boxes were moved from along dikes to over water locations and twenty old boxes were replaced with new boxes donated by the Hyde County Waterfowl Association

A gadwall brood (hen and 4 young) were observed in MI-4 July 4.

4. Marsh and Water Birds

Marsh and water birds were censused biweekly from March 1 to November 15. Their use of the refuge increased during the planned slow spring impoundment drawdowns and during the late summer and fall reflooding. Units that received the greatest use were MI-2 West, MI-8 East and West and MI-9. The most abundant species were common and snowy egrets, great blue herons and glossy ibis. A sandhill crane was observed near the refuge during the December 29 Christmas Bird Count. Seven white pelicans were observed throughout December, January and February in MI-10 South.

This was the fifth year that a systematic census was conducted in the impoundments. The peak migration periods were May 10-30 and August 20 - September 20 when up to 1,500 waders were counted on separate census dates. Approximately 500-1,000 waders were observed during non-migration periods and many over-wintered in the impoundments/lake vicinity.

In late June staff discovered four active great-blue heron nests in live cypress trees along the remains of #1 East Canal.

Table 10
1991
Wood Duck Production

Refuge: Mattamuskeet NWR

Nesting Year: 1991

	Number	Percent
Total Usable Boxes	98	
Estimated Boxes Used By Wood Ducks	25	26
Estimated Boxes Used By Other Ducks	0	0
Estimated Boxes Used By Other Wildlife	29	30
Estimated Wood Duck Broods Produced	25	
Estimated Wood Ducks Surviving to Flight Stage*	88	
Total Wood Duck Production On Refuge**	352 **	

Plans for next year (indicated number):

0 more boxes

0 fewer boxes

_____ no change

Remarks: _____

*= number of broods multiplied by 3.5

** Estimated wood duck to flight stage from nest boxes divided by .25 equals total wood duck production on refuge

Seven white pelicans made MI-10 South home during the 1991-92 winter. KD-91

5. Shorebirds, Gulls, Terns and Allied Species

These species were censused biweekly from March 1 through November 15 in the marsh impoundments. Several units (MI-2 West, MI-4, 8, 9 and 10 North) were managed specifically to benefit migratory shorebirds and to produce moist soil waterfowl foods (Section F). As with marsh and water birds, this was the fifth consecutive year that use was monitored in the refuge impoundments and farm areas. Overall use peaked from May 20 - June 20 and from September 15 - November 1. MI-4 attracted an unusually high number of shorebirds while it was held at 1.0-1.5 from September - December for prescribed burning. Observers regularly counted 200-600 dowitcher, 100-700 western and semi-palmated sandpipers, 100-200 yellowlegs and 50-250 dunlins during that period. The first ruff reported in North Carolina in the winter was observed in the FA-1 flooded soybean fields from late December - mid January.

Additional shorebird, gull, and tern use occurred along the shoreline of Lake Mattamuskeet. Some 5,000 birds were counted feeding in the shallowly flooded emergent zone during aerial surveys in October and November. The most abundant species were western sandpipers, semi-palmated sandpipers, long-billed dowitchers, yellowlegs, dunlins, ring-billed gulls, and Forster's terns. Total use was significantly less than in 1990-91 when

lake levels were much lower.

6. Raptors

Osprey

Since 1973 the refuge staff has surveyed osprey nests on Lake Mattamuskeet. Our records indicate the population has experienced increasing production and growth since the first nest was discovered in 1963. The 1982-91 average of 58 active nests has annually produced about 68 fledglings. Generally, clutch size, production per active nest, and new nest attempts have increased over the past ten years (Table 11).

In 1991 the occupied nest count (81) was the highest on record and 17 above the average. The active nest and breeding pair counts (77) was also the highest on record and 19 above the average. Average clutch size (2.44) was slightly greater than 1990 (2.41) and 10 year average (2.36). Production success (1.12) hit a four year low and was .18 below the 1982-91 ten year average. Total production (86) was fifth highest on record but 20 below the 1990 count and 48 below the 1988 high. The egg/nestling mortality rate (54% was 13% above 1990 and 8.5% above the ten year average. The new nest count (14) was 3 below 1990 but 2 above the average.

This year's high occupied and active nest count and average clutch size indicates that initial production effort was at an all time high. The June survey results show that above average nestling mortality occurred between late May and late June. Refuge staff observed three nests that were destroyed in mid June thunderstorms and the remains of 7 young entangled in those and other nests (two were sent to the FWE Raleigh Field Office for mercury analysis; results have not been received). One nest (#36) was blown out of its tree and found intact and occupied by two healthy nestlings.

To decrease disturbance of nesting birds by fishermen, informational signs were erected at each boat ramp. Additionally, nest #80 was individually signed to protect it from the Highway 94 boat ramp activity. Refuge staff monitored compliance for nest #80 and reported that very few boaters and no waders entered the 50 yard radius closed area. The adults did not abandon the nest as they did in 1990 and one young fledged.

7. Other Migratory Birds

The National Audubon Society annual Christmas Bird Count was conducted December 29. The ten observers counted 134 species, a refuge record high.

The following is a list of this year's unusual or uncommon avian sightings (migratory and nonmigratory):

Date	Species	Location
May 15	Wild Turkey (2)	Salyer's Ridge
June 1	Black Skimmer (20)	MI-8 East
July 28	Wild Turkey (hen & 3 polts)	Rose Bay Canal
Nov. 15	Eurasian Wigeon (1)	Lake; east of Rt. 94
Nov. 17	Hudsonian Godwit (1)	MI-4
Dec. 15	Eurasian Wigeon (1)	Sandy Dike Banding Site
Dec. 29	Ruff (1)	FA-1
Dec. 29	Atlantic Brant (3)	FA-1
Dec.-Jan.	White Pelican (3-7)	MI-10 South

8. Game Mammals

A helicopter pilot reported observing three black bear along the eastern shore of Lake Mattamuskeet in late September.

10. Other Resident Wildlife

The first recent record of wild turkey production on the refuge occurred in late July when a hen and three young polts were seen near MI-1. In 1980 the North Carolina Wildlife Resources released several wild turkeys about fifteen miles west of refuge headquarters. Subsequent sightings on the refuge have been scant; the first in 1985, several in 1986, two in 1987, none in 1988, one in 1989, three in 1990 and five total in 1991.

11. Fisheries Resources

In 1990, refuge staff met with FAO Project Leader Bill Cole and state fisheries biologists to discuss the development of a fisheries management plan for Mattamuskeet NWR. State biologists began preliminary sampling in October 1990 but time and budget constraints precluded further sampling in 1991. The plan will be prepared after adequate sampling is completed and analyzed.

One hundred largemouth bass were collected for mercury analysis in May (see Section F.2).

12. Wildlife Propagation and Stocking

North Carolina Wildlife Resources Commission personnel were granted permission to trap otters from Mattamuskeet NWR for a restocking effort in western North Carolina. In January, nine refuge otters were trapped and successfully relocated.

14. Scientific Collections

In August, Dr. Vernon Proctor, Texas Tech University was permitted to collect algae and wildcelery samples for laboratory propagation.

UNC-Chapel Hill researchers Marlene Braun and Bill Ussler were permitted to collect gas and water samples for preliminary analysis of methane and nitrogren content from October 15 - December 31.

NCSU weed scientist Dr. Stratford Kay was permitted to collect Scirpus plants for laboratory culture in June and July.

In early February, Edward Thompson and Dana Stanford were permitted to collect specimens for the Fernbank Museum of Natural History. The team collected one tundra swan, one black duck, one wigeon and one mallard and received numerous donations from the refuge freezer. The team returned in December and were permitted to collect one black duck, one mallard, one green-winged teal and two swans.

In October, Ted Kahn of Ecothermal Scientific, was permitted to collect five milksnakes for biochemical research at the National Museum of Natural History.

16. Marking and Banding

Canada Geese

1991 was the second year of a special Atlantic Flyway Canada goose collaring program (Section D.5). Rocket nets were set at Sandy Dike, Waupoppin, MI-8 West and on private land near Engelhard. Refuge staff banded and collared 216 geese during the 1991-92 winter including 104 at Waupoppin, 94 at Sandy Dike and 18 at MI-8 West. Collar observations of geese marked during this and previous studies were submitted as usual.

Biological Aid Glenn Price displays the flexible plastic neck collar. KD-91

Tundra Swans

Annual tundra swan banding operations were conducted February 11. Refuge staff rocket-netted 50 swans of which 43 were banded and collared by Swan Research Program staff and refuge volunteers.

Wood Ducks

Preseason wood duck banding began in late May. The 200 bird quota was met by June 20 and by September 15, 373 had been banded.

Osprey

Five nestlings were banded in 1991 (Section G.6).

17. Disease Prevention and Control

Eight dead tundra swans were collected and preserved in December, most appeared to be lead poisoned. Necropsies conducted by staff (3) and the National Wildlife Health Research Center (3) confirmed the diagnosis.

Table 11. Mattamuskeet NWR - History of Osprey Nest Results.

YEAR	*CLUTCH SIZE 0	1	2	3	4	TOTAL TO FLEDGE	OCCUPIED NESTS	ACTIVE NESTS	PRODUCTION PER ACTIVE NESTS	NEW NEST
1982	18	11	18	4	-	59	51	48	1.23	12
1983	8	6	12	26	2	58	52	46	1.26	5
1984	1	4	30	27	3	75	65	64	1.17	20
1985	15	10	13	20	-	37	62	46	0.80	11
1986	3	10	13	15	-	39	41	38	1.03	3
1987	6	4	24	34	-	96	68	62	1.54	21
1988	4	8	26	35	2	134	75	71	1.89	9
1989	3	7	16	30	1	82	57	54	1.51	9
1990	6	6	31	37	0	106	80	74	1.43	17
1991	4	9	25	43	0	86	81	77	1.12	14
TOTAL	68	75	208	271	8	682	632	580	12.98	121
1981-1990 Ten Year Avg.	9.4	7.6	18.8	22.9	0.8	71.1	59.8	52.4	1.30	11.6
1982-1991 Ten Year Avg.	6.8	7.5	20.8	27.1	0.8	68.2	63.2	58.0	1.3	12.1

*Clutch size figures taken from May survey. Some 1- and 2- bird nests become 3- bird nests before the June survey.

H. PUBLIC USE

1. General

Refuge visits totalled 65,065 in 1991 (Table 12). The largest use category included fishing, crabbing and hunting visits (31,585) followed by wildlife observation (24,100) and interpretation/education (9,380). Fishing was still the number one activity although above average late summer lake levels did not result in increased use. Significant increases occurred in the wildlife observation and interpretation/education categories, probably a result of numerous newspaper articles extolling the refuge's wildlife viewing opportunities. Visits in all use categories were the highest recorded since 1985.

Table 12. Public Use Visits 1987-91.

Year	Interpretation and Education	Wildlife Observation	Fishing, Crabbing & Hunting	Total Visits
1987	5,800	15,000	31,100	51,900
1988	6,200	16,000	28,000	50,200
1989	6,200	17,000	30,000	53,200
1990	6,960	17,000	30,450	52,540
1991	9,380	24,100	31,585	65,065
5-year Average				

Development and testing of a new public use sampling plan was begun during December.

Members of the following groups were given tours and/or refuge overviews: NC Aquarium Senior Citizens Group, River Park North Bird Club, International Wild Waterfowl Association, NCSU Leopold Wildlife Club, Ocracoke Elementary School 4th grade, S.C. Governor's School for Science and Math, Outer Banks Audubon, Boy Scot Troop #345-Raleigh, Museum of the Albemarle, UNC-CH ornithology class, Cape Fear Bird Club and Cypress Group Sierra Club. Off-refuge programs are listed in Section I.3.

The Mattamuskeet/Swan Quarter NWRs Wildlife Checklist was updated in October.

2. Outdoor Classrooms - Students

On October 24, Hyde County's fourth graders attended the annual Environmental Field Day held at Mattamuskeet Refuge and sponsored by the Pamlico Soil and Water Conservation District. Biological Aid Price and representatives from five other resource agencies gave the students short programs on resource management.

5. Interpretive Tour Routes

The entrance road, wildlife drive and causeway provided visitors with twelve miles of outstanding wildlife viewing, especially during the winter months when waterfowl were plentiful.

6. Interpretive Exhibits/Demonstrations

Refuge staff designed and manned a "Test Your Nongame I.Q." display at Hyde County Farm Days, October 4-5. Approximately 400 people viewed the exhibit and about 150 took the challenging test. Refuge staff also displayed a refuge exhibit at the Belhaven May Fest in May.

7. Other Interpretive Programs

The eighth annual Open House was held December 7 and attended by 172 people, 20% of whom were county residents. Refuge staff and volunteers led guided tours through the lake's east end management area enabling visitors to experience first-hand the how's and why's of refuge management.

Nature Week '91, an outdoor education camp for local elementary students sponsored by the Hyde County 4-H was held at Mattamuskeet NWR on June 10-14. Forty campers and fifteen volunteer leaders participated in a variety of activities.

N.C. Wildlife Officers taught Nature Week campers a variety of outdoors skills. GP-91

In recognition of Earth Day and National Wildlife Week, refuge staff gave special programs to local senior citizen groups and elementary school classes in April and May.

Endangered species programs were given to three local elementary classes in November and December.

Refuge staff assisted N.C. Ducks Unlimited with the annual Great Greenwing Adventure on February 9 by providing a tour, waterfowl identification program and swan banding demonstration to the 12 attendees.

The Coastal Carolina Girl Scout Council hosted "Summer Scene 91", an introductory scouting program for local girls on July 17.

8. Hunting

The refuge hosted a waterfowl hunt (ducks, coots & swans) for the thirteenth consecutive year during the 1991-92 season. A total of 1,011 applications for the annual waterfowl hunts were received this year. Of these, 960 were for the regular hunts, 43 for the youth hunt, and 8 for the handicapped blind.

Maintenance and repairs to all 16 hunt blinds was completed in November. Camouflage netting, obtained from military surplus, was placed on each blind in lieu of cutting and installing brush. The netting was an easy and quick way of camouflaging the blinds and is expected to last 4 or 5 years.

The season began with the Youth Hunt on November 29 and 30. Fourteen youths and their adult supervisors participated in a hunt orientation, hunter safety refresher course, waterfowl identification program and refuge tour. The youths hunted two half days and bagged 11 ducks and 2 coots.

The regular hunt was held on twelve days in December and January during which 245 hunters (498 hunter days) bagged 254 ducks, 1 coot and 6 swans for an average of 0.55 birds bagged per hunter day. Total kill and per hunter kill were the lowest since the hunt's establishment, probably because of the low number of waterfowl that used the hunt area during the hunting season (Table 13). The top bagged species were: wigeon, black duck, pintail and mallard.

The reservation fee for the Youth and Regular Hunt was changed from $15 per blind to $10 per hunter, in accordance with new USFWS policy. A 25-shell limit per hunter was again imposed in an effort to reduce sky-busting.

Body condition data (weight, tarsus, wing-cord, culmen and bill width measurements) and wings were collected from approximately 250 of the ducks for a NC-CFWRU study. The study is designed to determine the effects of low-flying military aircraft on waterfowl by comparing body conditions of ducks inhabiting areas of regular low-level activity with those inhabiting areas of little or no low-level activity. This was the second consecutive year these measurements were recorded.

Table 13
Mattamuskeet Hunt
General Comparison 1979-91

	79-80	80-81	81-82	82-83	83-84 (1)	84-85	85-86	86-87	87-88	88-89 (2)	89-90 (2,3)	90-91 (4,5)	91-92 (4,5)
# of Hunters	856	638	662	546	530	555	502	629	679	544	504	541	498
# of Birds Killed	462	662	619	528	252	595	462	631	691	459	592	507	271
Birds Killed/ Hunter	0.8	1.0	0.9	0.9	0.4	1.1	0.9	1.0	1.1	0.8	1.2	0.9	0.5
# Shots Fired/ Birds Killed	5.0	5.8	5.7	5.5	8.8	7.5	6.8	6.8	7.2	7.8	6.1	8.3	8.8
# Hours Hunted/ Birds Killed	5.1	4.5	4.9	4.9	9.3	4.2	5.4	4.2	4.1	4.7	3.1	4.8	7.6
# Birds Cippled	123	153	157	115	96	137	104	165	180	84	86	131	80
Cost ($)	?	6900	5900	5300	(1) 8200	5700	4285	4239	4158	4725	6015	7874	5825

(1) Replaced all blinds
(2) Hunted 16 days (previous 18 days)
(3) Shooting time: Sunrise (previous ½ hr. before sunrise)
(4) Shooting time: ½ hr. before sunrise
(5) Hunted 14 days

Price and Phillips measure ducks at the hunt check-out as part of the NC-CFWRU noise study.
KD-91

9. Fishing

Lake Mattamuskeet was open to fishing and boats from March 1 through November 1. Unseasonably warm temperatures in late winter and early spring warmed the lake water and bream and bass fishing took off. Fishing activity peaked in May when approximately 5000 fishing visits were recorded. Activity died down in mid June and by July few boats were on the lake. Despite high lake levels from late July through late October, boat fishing remained minimal. New signs were erected at all refuge boat ramps to inform fishermen of the March 1 - November 1 open period. Most late summer and fall fishing activity occurred at the five Hwy 94 culverts where catfish were hitting natural bait (needlefish and shrimp) from July through November.

Herring dipping was permitted at the major outlet canal water control structures from March 1 - May 15. Herring dippers had moderate success from March 15 - April 15 but little before or after.

Crabbing remained popular, especially from the water control structures and culverts. Special crab gates were installed in one bay at three of the outlet canals to increase juvenile crab immigration during high sound or lake wind tides. Whether the gates actually increased the number of crabs in the lake is yet to be determined, but they sure improved crabby attitudes. Crabbing success peaked in September.

The first Fairfield Heritage Bass Tournament, sponsored by the Mattamuskeet Jaycees and Fairfield VFD, was conducted on Lake Mattamuskeet May 4 and 5. Twenty-two teams entered the contest. The largest fish brought in weighed 5 pounds while the largest 2-day team catch was 22 pounds.

The winning tournament team from Tārboro, North Carolina caught the biggest and the most bass.
KD-91

11. Wildlife Observation

Thirty two canoeists accompanied refuge staff on an osprey observation outing June 22.

Several vistas along N.C. Highway 94 were mowed in October to facilitate waterfowl observation in Lake Mattamuskeet.

16. Other Non-Wildlife Oriented Recreation

Members and families of the Mattamuskeet and Bell Island Civilian Conservation Corps (CCC) held their annual reunion in the Lodge on June 1.

Nearly 100 people enjoyed food and fellowship at the Mattamuskeet Lodge during the 1991 CCC Reunion. DET-91

17. Law Enforcement

On May 20, Buckingham and Price discovered two men preparing to plant marijuana on the refuge. They contacted the Hyde County Sheriff's Department, gave them the license plate number and a description of the car, and identified the perpetrators when they were arrested later that same day. Information on this incident was provided to Special Agents Curtis and Baker.

Thirteen hunting dogs were picked up on the refuge during 1991. No citations were issued but five verbal warnings were given and $100.00 in kennel fees collected.

Barry Jordan, the selectee for the Mattamuskeet NWR 1802 position, was detailed to the refuge from Tensas NWR from December 15 to December 23. Jordan assisted with enforcement efforts during this segment of the waterfowl hunting season and familiarized himself with refuge boundaries and operations.

N.C. Wildlife Officers issued approximately 100 Notice of Violations on Mattamuskeet NWR in 1991; most of these were for boating violations. No citations were issued by refuge staff.

I. Equipment and Facilities

1. New Construction

Service Engineers Sid Lokasundarn and Ralph Rider visited Mattamuskeet NWR in August to take measurements for the new West Main Canal bridge. The new bridge will be built adjacent to the existing bridge. The existing bridge will be closed to traffic but left in place for use as a fishing platform. In September, an engineering firm from Norfolk, VA collected soil samples at the site of the new bridge to determine the soil's suitability for pilings.

Refuge staff built and installed three crab entry gates in three major outlet canals in May (see Section H.9).

A rocket net box with launches was built to facilitate Canada goose banding.

2. Rehabilitation

Work continued on the stabilization of the Mattamuskeet Pump Station/Lodge building (Section D.4.). Force account work included cleaning exterior walls; scraping and painting eaves; and minor repairs to windows, the water system, the entrance stoop, and bathrooms. Much of this work was done the last Friday of each month from January through August. Maintenance staff spent approximately 4 weeks repairing the roof valley and skylight areas on the north side of the main section of the building during portions of May, June, August, and September.

Refuge maintenance staff spent four weeks repairing the lodge roof. KD-91

In February, the Friends of the Mattamuskeet Lodge committee agreed to sponsor a series of work days on the Lodge in response to a Service Challenge Grant of $10,000. On May 31, 119 volunteers participated in "Lodge Clean Up Day". Three additional clean up days were held in June, July, and August. A contract for the rehabilitation of the lower sections of the roof (those parts over water) was awarded late in the year. The contract work began in November and was still in progress at year's end.

A contract to excavate and remove the underground fuel storage tanks in the maintenance yard and replace them with above-ground tanks was awarded to Legacy Environmental Services, Inc. (Greensboro, N.C.). Work began in November and by the end of the month appeared to be nearing completion. The two 1,000-gallon underground tanks were removed and two 1,000-gallon, 18,000 pound, concrete encased, above-ground tanks were delivered. In-house forces backfilled the excavated areas and had the site ready for installation of the above-ground tanks when we found out that two of the several soil samples showed a petroleum hydrocarbon level in excess of State limits (the contractor believes it may have been from accidental spillage over the years when vehicles were fueled; there were no detectable leaks in the tanks). Work on the project stopped when the State asked for a

groundwater sample to be taken (which would of course require a temporary well permit). At year's end, we were waiting on the State to send us information on how they wanted us to handle the "contaminated" soil and act on the contractor's application for a temporary well permit.

3. Major Maintenance

As is the case every year, facility maintenance accounted for a major portion of the maintenance staff's time. Maintenance of the ten marsh impoundments, three farmed impoundments, one green tree reservoir, and their associated canals, dikes, permanent pump stations, and water control structures kept the staff busy, particularly during the warmer months. In addition, routine maintenance and repairs on three residences, one administrative office, the old Headquarters building, three shop buildings, three "bone yards" (storage areas), and miles of dirt and graveled roads also took their toll.

In March a cement ramp was poured at the Rose Bay Canal boat launch to make the launch safer and easier to use. In addition, several fallen trees were removed from Rose Bay and No. 5 West Canals to improve boat access.

Quarters 41 was overhauled in July and Quarters 42 in December to prepare for the arrivals of the ARM and RLEO (in 1992) respectively. Sheetrock was repaired, interiors were painted, and extensive cleaning was done.

New aboveground liquid propane tanks were installed at all of the residences and the office during the year. A community service worker poured the concrete pads and the county trenched the service lines. One of the shop buildings also received some attention when the heating elements and thermostat in the hot water heater were replaced.

A sewer ring and cover were replaced in November after being broken by a bush hog during the summer (the event also resulted in mower repairs).

Fifty feet of three phase current was installed in the tin-shop to service several new and surplus machines.

Approximately six miles of dikes along the lakeside of MI-8 and 9, the east side of MI-10, and Sandy Dike Road along MI-3 were graded and shaped. In addition, deep holes in the road to the Waupoppin banding site and the west side of MI-10 were filled.

Locking mechanisms for the flapgates on the Lake Landing Canal side of the FA-1 pump outlet pipes were fabricated in August (Section F.2). Because there are no flapgates on the impoundment side of the pipes, the locking devices were needed to prevent

water flow out of the FA-1 impoundment. This allowed the standing and cut corn and cut soybeans in the unit to be flooded during the fall and winter.

4. Equipment Utilization and Replacement

Much of the equipment used on Mattamuskeet NWR is old and/or military excess property, and therefore requires a lot of maintenance and repairs. Maintenance, repair, and fabrication of equipment, along with facilities maintenance and repair, consumed the lion's share of the maintenance staff's time in 1991.

Military surplus equipment is invaluable for a station that has the need and talent to fabricate custom designs and repair old and nearly dead equipment and facilities. Refuge staff made five trips to pick up military surplus items at nearby bases in 1991. This year's booty included numerous rolls of roofing felt, several portable heaters and canvas cots, an air compressor, a jointer, a belt-disc combination sander, a cutting torch, an assortment of metric wrenches, 16,000 pounds of blasting sand, 78 gallons of zinc chromate steel primer, and bunches of camouflage netting.

Some of the equipment fabricated in 1991 includes the following. Two 525 gallon fuel tanks with electric pumps on tandem axle fuel trailers were fabricated by refuge staff to facilitate pumping activities in the farm areas and marsh impoundments (Maintenance Worker Boomer received a Special Achievement Award for his efforts in constructing these trailers). A third trailer was built to carry a 471 diesel engine to power a portable pump. A 500-gallon surplus fuel tank (trailer-mounted) was modified to store aviation fuel. A "banding trailer" was fabricated to hold and transport waterfowl captured for banding purposes (Maintenance Worker Schmitt received an On-the-Spot Award for the design and fabrication of this trailer). Surplus steel was used to build a corn sweep and sprayer skid for the bombardier and a new fuel tank for the Glassmaster boat. A 50 gallon spray rig with a 500 psi diaphragm pump was custom built and installed on the airboat. The rig was designed for interchangeable use on the bombardier with a surplus 300 gallon tank obtained from the NC Division of Water Resources.

Schmitt and Boomer show off award winning fuel tanks with trailers for Temple. KD-91

Some of the repairs made in 1991 include the following. The Link-Belt dragline received extensive repairs including structural repairs to the boom, rust control measures, installation of new pins and a stainless steel cab roof, replacement of the fairleaders, boom hoist cylinder, and some hydraulic lines, and a complete paint job that matched the original colors. Fairly intensive repairs were made to the International 186 farm tractor including replacement of the water pump, the rear window, one wheel hub, and 2 sets of wheel U-bolts. The main shaft and bearings in the old 16" Gator portable pump were replaced and a walkway was fabricated and attached. The drive shaft bearings were replaced in the Deutz power unit but an oil leak and other problems persisted into 1992. The exhaust system on the Chevrolet Blazer was replaced. The John Deere front-end loader bucket was repaired, the teeth and engine seal were replaced and the body was repainted. The bombardier transfer case was rebuilt and in October; the gear box, fuel pump, fuel lines, and steering assembly, all of which broke

during the month, were repaired. A drive shaft on the John Deere 1508 was repaired and the hitch on the John Deere 1008 mower was replaced. The boom-axe winch was repaired and a tilt cylinder and several cables were replaced. The front PTO of the Ford tractor (the boom-axe tractor) was repaired. A new exhaust system was installed in the D-7D crawler. Panther airboat repairs included work on the regulator, alternator and tachometer. The deck of the low boy trailer was patched at least once during the year. The White 4-210 tractor was taken to a local dealer for transmission repairs. Later, a nut came off the power shaft between the transmission and the engine and refuge staff had to remove the engine and complete the repair.

A 1991 Chevrolet 4 x 4 diesel pick-up truck was received during the year while the Jeep Cherokee, listed as excess in 1989 but temporarily resurrected in 1990, was transferred to NPS, Cape Hatteras National Seashore for use by researchers on the beach (extensive repairs to the exhaust and electrical system were needed at the time of transfer). A broken main shaft on the cutter head of a 1942 SK Planer was irreparable so it was replaced with a Foley Bellsaw. A surplus Huber motor grader was transferred to Lake Ophelia NWR while a surplus motor and transmission for a Huber motor grader was transferred to Eufala NWR. A new 16" portable Gator Pump was received in September and equipped to operate with the trailer-mounted 471 power unit.

Although the JD 4230 tractor was reportedly fixed after two trips to Lee Tractor Co. in Washington, NC, the tractor was up to its old tricks again in September making sudden (and unexpected) right turns. After a disappointing discussion with the (new) Service Manager at Lee Tractor, RM Temple decided to drop back and punt. A solicitation package for the tear down, diagnosis, and repair of all deficiencies was scheduled for FY 92 but as of the end of CY 91 had not been prepared - to be continued...

5. Communication Systems

Repairs were made to refuge radios in February and November. A FAX machine was installed in September along with a third telephone line dedicated to that machine (this equipment eliminated the 20+ mile round trip to Swan Quarter, NC to send and receive facsimile transmissions). Several vehicle-mounted and hand-held radios were acquisitioned in 1991 but approval was not received.

6. Computer Systems

A new microcomputer system with a 386SX processor, color monitor, and modem was purchased and set up for the office assistant. She primarily uses the system for running the new budget and time and attendance programs. A new color monitor was obtained for use with the Commodore PC 20 microcomputer to replace its original

monitor which had become unserviceable.

8. Other

In January Associate Manager Bill Grabill conducted an operations inspection of the refuge.

In July the White 4-210, John Deere 4230 and Gator pump were hauled to Pocosin Lakes NWR to help control a wildfire.

In August the FA-1 pumphouse was broken into and a solenoid was stolen from one of the pumps. The Sheriff's Department was notified. In September an exterior window on the metal shop building was found broken out and the screen bent and partially pulled out. The Sheriff's Department was also notified of this incident and classified it vandalism.

J. OTHER ITEMS

1. Cooperative Programs

An official weather station was maintained for the National Weather Service.

Three gypsy moth traps were placed at strategic locations in cooperation with the U.S. Forest Service. No moths were captured.

In cooperation with the U.S. Marine Corps and the N.C. CFWRU, staff conducted biweekly aerial waterfowl censuses of nearby military bombing ranges.

2. Other Economic Uses

A $250 (high bid) Special Use Permit was issued to an individual for the commercial collection of American eels from Lake Mattamuskeet and refuge canals. A $50 Special Use Permit was issued to another person for commercial guide (fishing) services. A SUP ($50.00) was also issued to an individual for the collection of immature eels during the spring months at the lake's water control structures.

A $165 (5% of entry fees) Special Use Permit was issued to the Fairfield Volunteer Fire Department (Bass Tournament Committee) to authorize the Fairfield Heritage Bass Tournament on May 4 and 5.

3. Items of Interest

Staff attended North Carolina refuge coordination meetings in January, April, and September.

Davis and Buckingham attended the Piping Plover Census Workshop in Morehead City on January 9 in preparation for the piping plover census of Cedar Island NWR.

Temple provided a tour of Mattamuskeet NWR to Congressmen Tim Valentine and N.C. Secretary of Eduction Bob Etheridge on January 20. Temple also provided a brief presentation on the pump station and other refuge management issues to several state legislators and their spouses on January 21 as part of a tour provided by the Hyde County Chamber of Commerce.

Fowler attended the quarterly manager's meeting in Windsor, N.C. on January 8 to update attendees on the Fire Management Program. On January 9 he met with N.C. Forest Service's District Forester Dan Smith to discuss the planned prescription fire operations at Pocosin Lakes NWR.

Fowler also met with Jim Savery at Pocosin Lakes NWR on January 25 and with the Alligator River staff on January 29 to discuss fire management and equipment purchases for FY 91.

Davis gave a Partners for Waterfowl Tomorrow program to the Engelhard Rotary Club on February 14.

On February 12 Davis met with DU MARSH coordinator Ralph Bitely to discuss potential MARSH projects on Mattamuskeet NWR. Also attending were DU representative Steve Thomas and NCWRC biologist Tom Monschien.

Davis gave a program on bird banding to the Belhaven Lioness Club on February 5 and a general refuge slide show to the Sweet Pea Garden Club in Belhaven on February 11. She also gave a program on Backyard Wildlife Landscaping to the Macha Pungo Garden Club in Belhaven on February 15 and to the Swan Quarter Flower Patch Garden Club on February 28.

National Geographic photographer Jim Brandenburg visited the refuge on February 14-16 to take wildlife shots to be used in a future issue of the magazine.

Temple, Merritt and Buckingham attended the Project Leader's Meeting in Nashville, Tennessee February 10-15.

Fowler met with ARD Benson and RFMC Reeves on March 6-9 in Atlanta and briefed them on concerns regarding the cooperative fire agreement between the state of North Carolina and the FWS. On the 12th he attended a negotiating session between FWS and the

state in Manteo.

Fowler met with a representative of Forest Technology Systems in West Virginia March 20-22 to discuss remote automated weather stations for FMD 1.

Williams taught a heavy equipment training course at Okefenokee NWR in March.

Davis gave a waterbird program to the Demille Book Club in Washington, North Carolina on March 7.

On March 11-15, Temple and Davis attended workshops on Biological Farming and wood duck management at Wheeler NWR.

Davis attended a follow-up Piping Plover Workshop in Morehead City on April 2.

Davis attended the NC-CFWRU annual meeting in Raleigh on April 10. On the following day, Temple, Davis and Buckingham attended the NCSU Barkelow Lecture, featuring University of Missouri's waterfowl specialist Dr. Leigh Fredrickson.

On April 25, Davis met with Monsanto representative Roxiana Lee to discuss Rodeo application rates on lakeshore phragmites.

Davis, Temple, and Buckingham travelled to Raleigh to attend the Refuges 2003 public scoping meeting on April 29.

Temple and Daniels attended a Basic Word Processing course at Beaufort Community College (January - May).

Davis attended the N.C. Weather Observers Centennial Celebration in Raleigh on May 9.

Davis attended Basic Prescribed Fire Training at Wekiva Springs State Park near Orlando, Florida May 13-17.

Davis attended the 2nd Annual FWS Geographic Information System Workshop in Ft. Collins, Colorado June 10-13.

Boomer and Fowler attended a two day explosives workshop at Okefenokee NWR in July.

Jay Hestbeck (University of Massachusetts - CFWRU) conducted a Canada goose collar observation workshop for refuge employees at the Mattamuskeet Lodge on August 1.

Temple attended Aviation Training for Supervisors in Manteo on August 6.

Temple attended a red wolf meeting in Manteo on August 7.

Phillips attended Aviation Safety Training at Mackay Island NWR on September 19.

Phillips attended the Wildlife Management in Agricultural Wetlands Workshop at Manteo on September 27.

On September 30, Temple and Management Biologist Florschutz met with DU representatives to discuss MARSH projects.

Davis attended the Coastal Nongame Workshop in Gainsville, Florida on September 9-12.

Phillips and Davis attended an OAS ditching course in Manteo on October 23.

On October 4, Davis gave a refuge presentation to thirty members of the Federal Retired Employees Association in Washington, North Carolina.

Davis was appointed to the Hyde County Economic Development Task Force in November.

Phillips attended training on the new time and attendance computer program in Raleigh, North Carolina November 5-8.

On December 3, Davis gave a refuge and lodge history program to the Society of American Foresters - Croatan Chapter at their annual Christmas Banquet in New Bern, N.C.

Daniels and Kitts attended training on the new time and attendance computer program in Atlanta, Georgia December 9-13.

FWS Director John Turner, his wife and three children were treated to a tour of the refuge and the Lodge by Davis on December 21.

Director Turner and his family visited
our wet wonderland on December 21. KD-91

Refuge employees voluntarily cleaned up a 2-mile section of NC Highway 94 (which bisects Lake Mattamuskeet) on a quarterly basis as part of the State's Adopt-a-Highway program.

4. Credits

Donald E. Temple - Section K
Howard Phillips - Sections A, B, C, D, E and I
Kelly Davis - Section F, G, H, I, and J
Bernice Kitts - Assembly and Typing

K. FEEDBACK

UNDER STAFFED...UNDER FUNDED...OVER COMMITTED...OVER REGULATED...OVER "POLICIED" - This sums up the way things are in the field these days, at least from this manager's perspective.

The year 1991 was a busy and challenging year at Mattamuskeet. The assistant manager position was vacant for eight months. We had to advertise the vacancy twice before being able to fill the position. The Cedar Island wildlife technician was absent for the entire year due to an injury. The complex continued to be short two maintenance positions that were not replaced when previous employees retired or resigned in the last few years. The second assistant (trainee position) was vacated again in June and not refilled. Our clerk typist worked two days per week, on loan to Pocosin Lakes NWR three days per week for most of the year until they could recruit an office assistant.

In spite of all the personnel shortages and the workload, the staff maintained a positive attitude and accomplished many things during the year. My thanks go to the entire staff for their devotion to their job, their enthusiasm, and their support.

REVIEWS AND APPROVALS

CEDAR ISLAND NATIONAL WILDLIFE REFUGE

Cedar Island, North Carolina

ANNUAL NARRATIVE REPORT

Calendar Year 1991

Donald E. Temple — Refuge Manager — 7/29/92 Date

Karen S. Cartledge — Refuge Supervisor — 8/3/92 Date

Harold W. Bevan — Regional Office Approval — 8/13/92 Date

CEDAR ISLAND NATIONAL WILDLIFE REFUGE

Cedar Island, North Carolina

ANNUAL NARRATIVE REPORT

Calendar Year 1991

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

REVIEWS AND APPROVALS

CEDAR ISLAND NATIONAL WILDLIFE REFUGE

Cedar Island, North Carolina

ANNUAL NARRATIVE REPORT

Calendar Year 1991

Refuge Manager — Date: 7/29/92

Refuge Supervisor — Date

Regional Office Approval — Date

INTRODUCTION

Cedar Island National Wildlife Refuge is located in Carteret County, North Carolina on the end of a peninsula marking the southern end of Pamlico Sound. The refuge lies 5 miles northeast of Atlantic and about 40 miles northeast of Beaufort, North Carolina. The island can be reached by ferry from Swan Quarter via Ocracoke, North Carolina or by traveling east on State Route 70 through Morehead City to State Route 12 which ends near refuge property.

Cedar Island once provided wintering habitat for thousands of migratory waterfowl. To ensure the perpetuation and enhancement of that resource, the U.S. Fish and Wildlife Service acquired a portion of the island (7,830 acres) in 1964. In 1970 an abandoned U.S. Navy radar station was transferred to the Service and converted into the refuge headquarters.

Today the 14,480 acre refuge consists of approximately 11,500 acres of irregularly flooded brackish marsh and 2,200 acres of pocosin and woodland habitat. The dominant marsh plants include black needlerush, saltmarsh cordgrass, saltmeadow hay, and salt-grass. The woodland areas are dominated by loblolly, longleaf, and pond pine. Live oak is also abundant on some upland sites.

Cedar Island Refuge is administered from Mattamuskeet National Wildlife Refuge.

INTRODUCTION

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F. HABITAT MANAGEMENT (Cont.)

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H. PUBLIC USE (Continued)

I. EQUIPMENT AND FACILITIES

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A. HIGHLIGHTS

--An application for a 404 permit to implement Integrated Marsh Management on Cedar Island NWR was submitted to the COE in June. The 401 Water Quality Certification for this project was denied in August (D.1).

--The USMC funded study on the effects of military aircraft noise on waterfowl continued during the year by the NC-CFWRU (D.5).

--Cedar Island NWR continued to be an unmanned station with Biological Technician Brohawn's absence due to an injury received in 1989.

B. CLIMATIC CONDITIONS

Table 1. Weather Data for 1991.

Month	Snowfall (inches)	Rainfall (inches)	Temperature	
			Max.	Min.
January	0	8.78	56	23
February	1	1.59	76	26
March	0	5.36	80	35
April	0	4.59	87	40
May	0	1.64	98	54
June	0	3.59	96	53
July	0	7.36	100	69
August	0	8.51	95	66
September	0	3.67	95	56
October	0	6.62	81	50
November	0	1.01	80	33
December	0	8.28	77	26

The most significant weather event of the year was Hurricane Bob passing by the area but no damage was incurred except shoreline erosion. Total rainfall for the year was 61.00 inches, slightly above the 10-year average of 55.08 inches.

C. LAND ACQUISITION

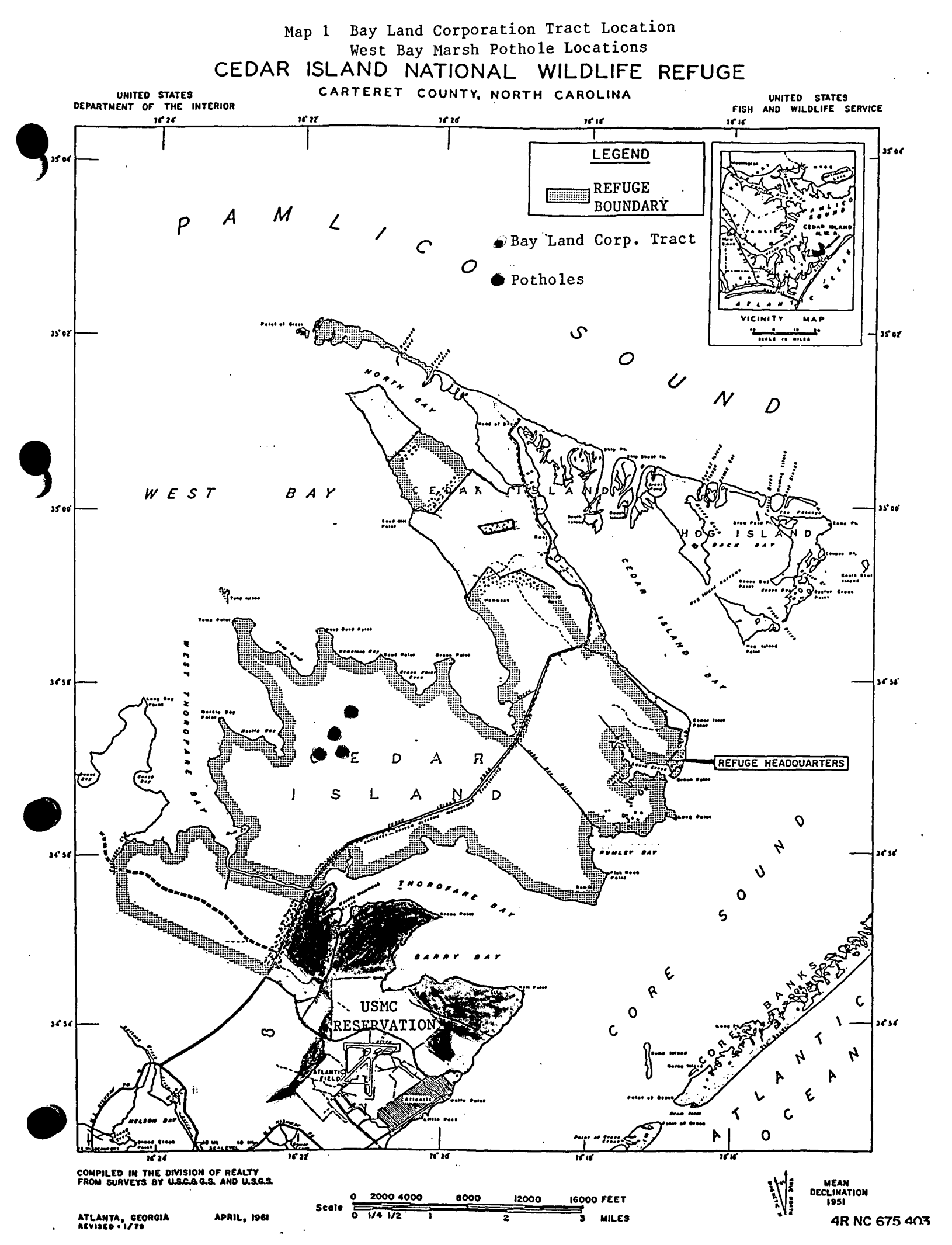
1. Fee Title

Through contacts with the Nature Conservancy, Bay Land Corporation, a development company from Fayetteville, North Carolina, donated 1,955.67 acres of land to the refuge (Map 1) in December 1990. The official ceremony honoring the donation was held on March 2 in Fayetteville, NC. Manager Temple and Regional Director Pulliam joined June Whalen of the Office of the Secretary of the Interior in formally accepting the property from representatives of the Bayland Corporation. The boundary has not been posted as of the end of 1991 due to the lack of a boundary survey and manpower. A

Map 1 Bay Land Corporation Tract Location
West Bay Marsh Pothole Locations

CEDAR ISLAND NATIONAL WILDLIFE REFUGE

CARTERET COUNTY, NORTH CAROLINA



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FROM SURVEYS BY U.S.C.& G.S. AND U.S.G.S.

ATLANTA, GEORGIA APRIL, 1961
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certificate of inspection has not been completed to date due to the uncertainty of boundary lines.

D. PLANNING

2. Management Plan

A Hurricane Action Plan for Cedar Island NWR was completed and approved in June.

A draft report of a Waterfowl Management Evaluation conducted in November, 1991 by a team of Service representatives and a waterfowl biologist from the N.C. Wildlife Resources Commission was reviewed and comments provided to the East Coast Management Biologist in Washington, N.C. The final report was not available at the end of the year.

4. Compliance with Environmental and Cultural Resources Mandates

The Environmental Assessment prepared in 1991 proposing Integrated Marsh Management for Waterfowl and Other Wildlife (IMM) at Cedar Island NWR and Gull Rock Game Lands was finalized in March of this year and copies distributed to interested parties. The IMM proposal consists of 54 shallow one-tenth acre ponds at Cedar Island and 60 similar ponds at Gull Rock. The Service and the North Carolina Wildlife Resources Commission (NCWRC) then began the process of applying for 404 and N.C. Coastal-Management Act (CAMA) permits. After considerable effort and consultation with the regulatory agencies the Service's application for a 404 permit was submitted to the Corps of Engineers. NCWRC applied for their CAMA permit in July. The 404 permit was not obtained because the N.C. Department of Environment, Health and Natural Resources, Division of Environment (DEM) denied a 401 water quality certification for the Cedar Island application. During two years of interagency meetings, project proposal review, and review of the draft EA, DEM had not expressed any previous concern about water quality. The Service appealed DEM's denial and the issue is in litigation as of the end of the year.

The NCWRC application for the Gull Rock portion of the project was returned to them twice by the N.C. Division of Coastal Management for revision and additional information. As of the end of the year NCWRC had not resubmitted their application.

A Section 7 Consultation on N.C. Department of Transportation proposed bridge replacement over the Thorofare Bay Channel was completed in April.

5. Research and Investigations

Cedar Island NR 90 - "Response of Marsh Inhabitation of Migrating and Resident Waterfowl to High Noise Environments Associated with Military Aircraft at the Proposed Mid-Atlantic Electronic Warfare Range, Piney Island, NC." (42531-2)

Dr. Jaime Collazo of the NC-CFWRU and graduate student John Conomy are studying the effects of low-level military aircraft on waterfowl. The objectives of the study are:

1. To determine if the ecology of migrating wintering waterfowl is affected by the high sound impact environments at Piney Island and Cedar Island.

2. To determine if pair formation and breeding of resident black ducks and other waterfowl species present at Piney Island and Cedar Island are affected by these high sound impact environments.

3. To determine if black ducks accommodate high levels of aircraft sound and if so, how rapidly?

Field data collection continued during 1991. John Conomy and other graduate students working on this research project and closely related research projects on nearby Piney Island used the Cedar Island Field Office for lodging and as an operational base for their research.

NC-CFWRU researchers monitored waterfowl behavior from marsh blinds during the military aircraft noise study.
JD-91

Cedar Island NR 91 - "The Impact of Sea-level Rise on the Coastal Wetlands in Albemarle and Pamlico Sounds, North Carolina: A Study of Wetlands Dynamics"

Dr. Orrin Pilky, Professor of Geology, Duke University and a graduate student will research the impacts of sea level rise and windblown sand accumulations at various points along the North Carolina coast with Cedar Island being one of those points. The objectives of the study are:

1. To determine the biological and sedimentological characteristics of the transgressing edges of coastal wetlands. To identify the variants of conversion from upland environment to coastal wetland.

2. To examine and date the slope of the inundated upland surface underneath recently formed (last 25-1000 years) salt marsh, in order to determine the rate and nature of new marsh formation. To determine the slope of marsh fringing upland topographies as compared to the surface already inundated by marsh, identifying those areas that are likely to become wetland assuming various EPA sea-level rise scenarios.

3. To construct a series of maps outlining areas of new wetland formation and floral succession during the next 50, 100, 250, and 1,000 years, assuming minimum, moderate, and maximum sea-level rise scenarios. To construct a similar series of maps indicating areas where human development will prevent the formation of new wetland.

The only work completed on Cedar Island during the year was to locate and stake the proposed research site.

6. Other

Permission was granted to the North Carolina Natural Heritage Program to conduct vegetation sampling on the upland portions of Cedar Island, however, no sampling was done because of travel restrictions for budgetary reasons.

E. ADMINISTRATION

1. Personnel

One permanent full-time position was assigned to Cedar Island NWR. Administrative personnel are assigned to the Mattamuskeet NWR staff.

Biological Technician Hubert Brohawn underwent surgery in February, 1990 expecting to be out on a work-related disability for six weeks. Unfortunately, complications resulted from the surgery and he is still out on Workmans Compensation with no expected date for a return to duty. For most of 1990 and all of 1991 there was no one present at Cedar Island NWR on a daily basis. Basic maintenance such as mowing and trash pickup was performed by Mattamuskeet staff during bi-monthly trips.

Table 2. Cedar Island NWR Staffing.

	Permanent		Total	
FY	Full-Time	Part-Time	Temporary	FTE
91	1	0	0	1
90	1	0	0	1
89	1	0	0	1
88	1	0	0	1
87	2	0	0	2
86	2	0	0	2
85	2	0	0	2

5. Funding

Funding was allocated through the Mattamuskeet NWR Budget.

6. Safety

All fires extinguishers from Cedar Island were inspected and recharged in November.

8. Other

On December 3, RM Temple met with Phillip Morris of Loral Aerospace services, a contractor with Cherry Point NAS, concerning boat docking privileges on Cedar Island NWR.

On December 4, Temple met with Mike Kazmenski of the U.S. Customs Service concerning that agency's request to install a high frequency communications antenna facility at Lola Point on Cedar Island NWR. The request was forwarded to the Regional Office for their guidance.

F. HABITAT MANAGEMENT

2. Wetlands

Cedar Island NWR wetlands are dominated by estuarine emergent species such as black needlerush and saltmeadow hay . In the early 1960's 21 potholes were created in the West Bay Marsh by explosive blasting (Map 1). These potholes contain wigeongrass which attracts black ducks, gadwall, pintails, mallards, blue-winged teal, green-winged teal and ring-necked ducks. Except for fire management, no habitat management was performed this year.

Black ducks, mallards and gadwall are regular users of the four West Bay Marsh potholes. KD-91

G. WILDLIFE

3. Waterfowl

Note: Waterfowl use is reported on a seasonal basis. The 1991 narrative covers the 1991 nesting season and the 1991-92 wintering period.

Biweekly aerial censuses were conducted to determine wintering populations and two surveys were conducted in the spring to determine nesting populations. The spring censuses revealed that 20-30 black ducks and 20 gadwall were present during the nesting season, however, only two gadwall broods were observed. NC-Coop Unit researchers conducted nest searches by foot in April and May and found two black duck and two gadwall nests/broods.

Peak use for the 1991-92 winter occurred in mid February when observers counted 9,837 ducks including 1,856 puddle ducks and 7,981 diving ducks. The peak count included 7,900 redheads in Merkel Bay, the highest redhead count in at least ten years. The redheads appeared in mid January, peaked in mid February and departed in late February.

The puddle duck peak occurred in late February when observers counted 2,368 ducks including 1,000 wigeon, 721 gadwall, 613 black ducks, and 33 mallards. The wigeon peak of 1,244 birds in early March was the highest wigeon count recorded since the aerial censuses began in 1986. The late December black duck peak of 925 birds was the second highest peak since 1986 and about 150 over the 5 year average. The late February gadwall peak of 721 was 550 greater than the previous season and 2 1/2 times the 5 year average. Other ducks observed in order of season peaks were: bufflehead (320), pintail (275), common merganser (260), green-winged teal (75), mallard (33), hooded merganser (29) and common goldeneye (2).

In 1991-92 the major waterfowl use areas on Cedar Island NWR were Pamlico Sound (north of Point of Grass), Deep Bend, North Bay, East Marsh potholes, Merkel Bay and West Bay Marsh (WBM) potholes. The four .05 acre potholes in WBM Zone III accounted for 6%-75% (average 18%) of total puddle duck use during the season.

4. Marsh and Water Birds

Nesting waterbird colonies are surveyed on refuge islands and nearby state and National Audubon Society-owned islands. The 1991 survey was conducted by Dr. James Parnell (University of North Carolina - Wilmington). No nesters were observed on Point of Grass Island. Results from Tump Island were:

Table 3. Colonial nesting birds on Tump Island, May 29, 1991.

	No. of Nests		
Nesting Species	1989	1990	1991
Black Skimmer	3	20	2
Forester's Tern	55	62	2
Glossy Ibis	167	170	23
Great Egret	1	0	0
Gull-billed Tern	0	2	0
Herring Gull	0	1	0
Laughing Gull	1564	1600	3490
Little Blue Heron	2	1	1
Snowy Egret	2	1	0
Tricolored Heron	138	140	4
TOTALS	1933	1997	3522

5. Shorebirds, Gulls, Terns and Allied Species

Refuge staff participated in the 1991 International Piping Plover Census on February 1. All refuge shorelines and backwash areas were surveyed but no plovers were observed.

See Section G.4 for the results of the annual Colonial Nesting Waterbird Survey.

6. Raptors

Three swallowtail kites were observed over West Bay Marsh by Co-Op Unit personnel in late September.

H. PUBLIC USE

1. General

As in previous years, Cedar Island to Ocracoke ferry traffic was the principle source of visitors. Annual visitation was estimated at 50,000.

8. Hunting

Approximately 400 acres of marsh along the West Bay Marsh shoreline were open to waterfowl hunting during all state seasons. Because of the absence of manpower, no regular bag checks and hunter interviews were conducted.

9. Fishing

Fishing for spotted seatrout and Atlantic flounder in the John Day Ditch and Thorofare Creek was popular during the fall. Occasionally, refuge visitors fished for trout and spot around Tump Island and Green Point.

A few thick-skinned visitors braved the mosquitos and fished from the refuge saltmarsh banks. KD-91

17. Law Enforcement

Because the station has been essentially unmanned since February, 1990 no citations were issued in 1991.

I. EQUIPMENT AND FACILITIES

3. Major Maintenance

Due to the Biological Technician's extended absence very little maintenance was completed during the year. Various members of the Mattamuskeet staff made bi-weekly trips during the growing season to mow and trim the grounds and perform minor maintenance projects.

A new pump and supply line were installed in the domestic water supply system and a new pump/well cover constructed by the Mattamuskeet maintenance staff.

In November, two rooms in the field office were rewired to facilitate the use of window-type heat pumps installed by the N.C. Fish and Wildlife Cooperative Unit at N.C. State University.

J. OTHER ITEMS

1. Cooperative Programs

The refuge field office was used as a housing facility by the research staff of the NC-CFWRU during the study of the effects of low level military aircraft on waterfowl.

4. Credits

This narrative was written by Donald Temple and Kelly Davis, edited by Temple and typed and assembled by Bernice Kitts.

REVIEWS AND APPROVALS

SWANQUARTER NATIONAL WILDLIFE REFUGE

Swanquarter, North Carolina

ANNUAL NARRATIVE REPORT

Calendar Year 1991

Refuge Manager — Date 7/29/92

Refuge Supervisor — Date 8/3/92

Regional Office Approval — Date 8/13/92

SWANQUARTER NATIONAL WILDLIFE REFUGE

Swan Quarter, North Carolina

ANNUAL NARRATIVE REPORT

Calendar Year 1991

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

REVIEWS AND APPROVALS

SWANQUARTER NATIONAL WILDLIFE REFUGE

Swanquarter, North Carolina

ANNUAL NARRATIVE REPORT

Calendar Year 1991

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INTRODUCTION

Swanquarter National Wildlife Refuge, located on Pamlico Sound in Hyde County, North Carolina, was established on June 23, 1932. It was named after the nearby village of Swan Quarter.

The refuge is 15,643 acres of saltmarsh islands and forested wetland interspersed with potholes, creeks, and drains. An additional 27,082 acres of adjacent, non-refuge open water are closed by Presidential Proclamation to the taking of migratory and nonmigratory birds. Marsh vegetation is dominated by black needlerush and sawgrass while the mainland is forested by loblolly pine, pond pine and baldcypress. Approximately 8,800 acres are included in the National Wilderness Preservation System.

Swanquarter NWR is an important estuarine and wilderness resource, it and the surrounding proclamation waters provide winter sanctuary for up to 1,500 black ducks and many thousands of canvasbacks, redheads and scaup. Additionally, it provides habitat for nesting osprey and colonial waterbirds and supports one of the northernmost populations of the American alligator.

INTRODUCTION

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F. HABITAT MANAGEMENT (Cont.)

G. WILDLIFE

H. PUBLIC USE

H. PUBLIC USE (Continued)

I. EQUIPMENT AND FACILITIES

J. OTHER ITEMS

K. FEEDBACK "Nothing to Report"

L. INFORMATION PACKET - - - (inside back cover)

A. HIGHLIGHTS

-- Bell Island was one of two research sites for the NC Cooperative Fish and Wildlife Research Unit study of the effects of low level aircraft noise on waterfowl (Section D.5)

-- Nearly two-thirds (800 acres) of Burn Unit F-1a was prescribe burned December 11 (Section F.9)

-- An environmental assessment for the acquisition of 768 acres was prepared and reviewed (Section C.1)

B. CLIMATIC CONDITIONS

No official weather data is collected for Swanquarter NWR.

C. LAND ACQUISITION

1. Fee Title

Administrative processes were continued for the transferral of a 768 acre tract from The Nature Conservancey with the preparation and review of an environmental assessment. Transamerica Insurance Services, the original donor, offered to sell the property to the Service in 1989. The tract is located west of Juniper Bay and connects the disjointed Nebraska Tract with the main body of Swanquarter NWR. It is divided nearly equally into irregularly flooded brackish marsh and forested wetlands. Its acquisition would enhance Service fire management capabilities and create a greater buffer between residential and agricultural operations located to the north.

D. PLANNING

5. Research and Investigations

Swanquarter NR 91 - "Effects of low level military aircraft on reproduction in black ducks (Anas rubripes)

NCSU Master's candidate Edmund Temple, is the primary investigator for this one year study of the effects of low level military aircraft noise on black duck body condition and reproductive success. Temple is comparing captive wild strain black ducks at Swanquarter NWR (no military aircraft activity) with black ducks at Piney Island (USMC Bombing Target 11 - regular military aircraft activity).

Objectives:

1. Compare the courtship behavior and pair formation of black ducks in a high noise level environment to black ducks in a low noise level environment.

2. Compare nesting chronology, productivity, and brood survival of the two black duck groups.

Research assistant Pete Credle proudly displays a captive wild strain black duck. ET-91

F. HABITAT MANAGEMENT

1. General

Since its establishment, minimal habitat management has occurred on Swanquarter NWR because of inadequate access and legal mandates prohibiting the alteration of needlerush marshes. Designated wilderness (8800 acres) makes up two thirds of refuge holdings and is dominated by black needlerush, sawgrass and giant cordgrass. Remaining tracts consist of small stands of loblolly pine, pond pine, and baldcypress with typical brackish tolerant understories.

Swan Quarter and Juniper Bays, both within the Presidential Proclamation Boundary, are designated by the State of North Carolina as Outstanding Resource Waters. The intent of this classification is to maintain excellent water quality in these and other coastal water bodies with existing outstanding fisheries, aquatic organism nurseries, and/or special ecological significance.

9. Fire Management

Prior to 1991, there were no records of any prescribe burns. On Swanquarter NWR, however, several wildfires were allowed to burn out.

In 1991, increased emphasis was placed on using prescribed fire as a management tool to remove hazardous fuel accumulations, to create open water areas for migratory birds, and to perpetuate the existence of pyrophytic communities.

Eight wildfires have occurred on the refuge since 1970 with burn areas of one acre to 840 acres in size. Four of these fires were within the designated Bell Island burn units F-1a and F-1b. Known fire causes included: lightning (3), uncontrolled signal fire (1), Navy plane crash (1), and smoldering snag (1).

In light of its wildfire history, burn unit F-1a (1200 acres) was selected as the first prescription to be implemented. The unit is located between Rose Bay Creek, Rose Bay and the Bell Island entrance road (Map 1). On December 11, a nine person crew from Mattamuskeet and Pocosin Lakes NWR successfully burned approximately 700 acres of F-1a, including 450 acres of sawgrass and needlerush and 250 acres of pine woods. The remaining acreage is scheduled for burning by helicopter ignition in 1992.

MAP 1

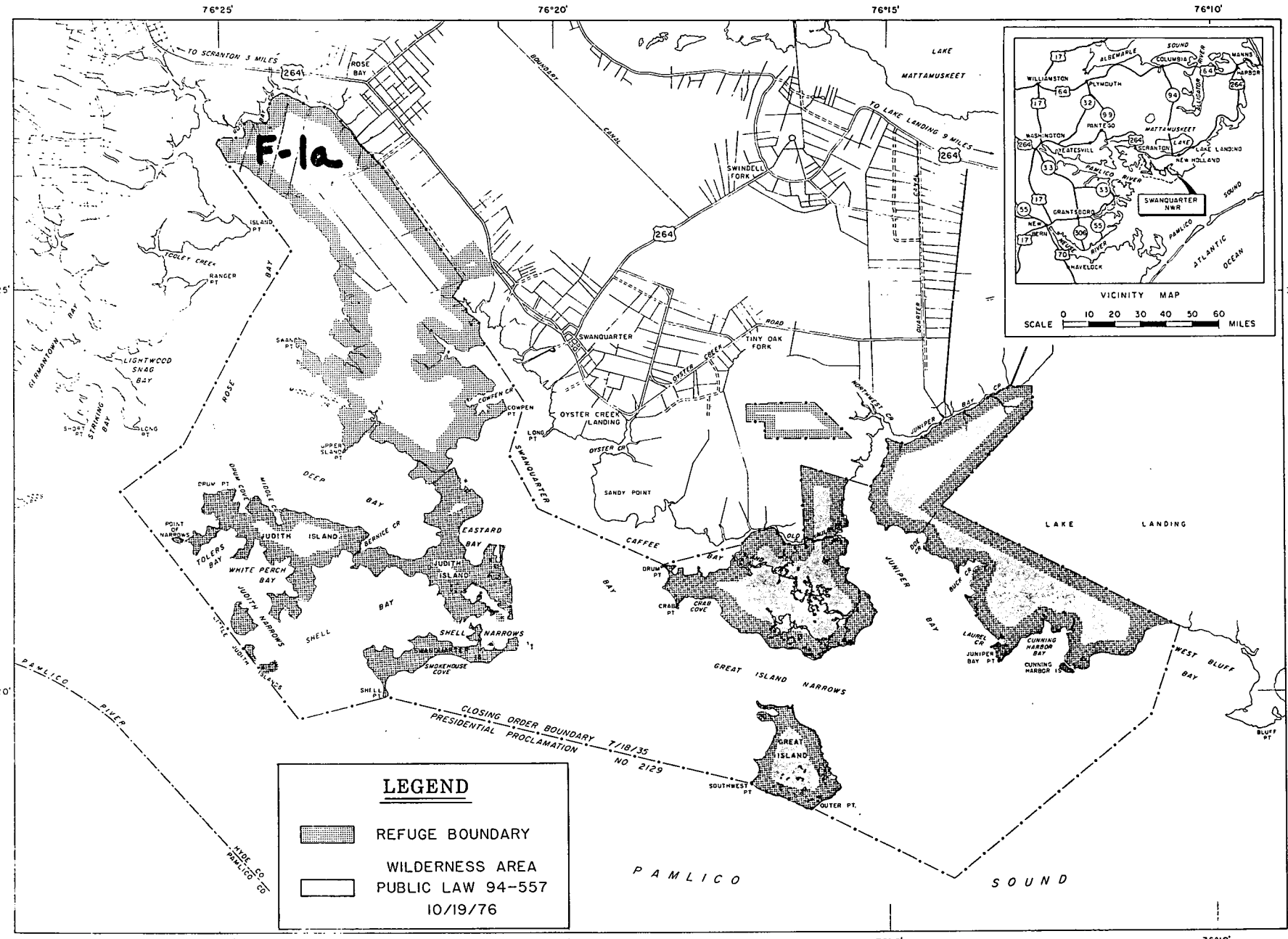
Prescribe Burn Location

SWANQUARTER NATIONAL WILDLIFE REFUGE

HYDE COUNTY, NORTH CAROLINA

UNITED STATES
DEPARTMENT OF THE INTERIOR

UNITED STATES
FISH AND WILDLIFE SERVICE



LEGEND

REFUGE BOUNDARY

WILDERNESS AREA
PUBLIC LAW 94-557
10/19/76

COMPILED IN THE DIVISION OF REALTY FROM SURVEYS BY U.S.G.S

0 2640 5280 10560 15840 21120 FEET

0 1/2 1 2 3 4 MILES

7°10' TRUE NORTH MAGNETIC N.

MEAN DECLINATION 1976

ATL[illegible] GEORGIA
REV[illegible]/81

MARCH, 1976

4R N[illegible]6 404

The F-1a prescribed burn consumed heavy fuel loads in the needlerush marsh and pond pine woods. TC-91

G. WILDLIFE

2. Endangered and/or Threatened Species

American Alligator (listed as threatened by the State of North Carolina and federally listed as threatened due to similarity of appearance)

Swanquarter NWR is near the northern range limit of the American alligator. Refuge staff conducted night counts in the Juniper Bay area on May 22 and 29; four alligators were sighted during the first count ranging from four feet to ten feet, and two alligators were sighted during the May 29 count. Several other sightings in this area were reported by fishermen and state wildlife officers. In addition,, N.C. Co-op Unit researchers reported sighting a large alligator in the Bell Island area. The alligator inventory procedure was begun in 1984; 0-5 alligators have been sighted on the ten surveys, with an average count of 1.8 (Table 1). The population appears to be holding steady.

Bald Eagle

The first successful bald eagle nest in North Carolina since 1970 was discovered on private land within 1/4 mile of the refuge in January 1984. The nest was aerially monitored during the refuge bi-weekly waterfowl counts. The pair raised two young in 1984 and three in 1985. In September 1985 Hurricane Gloria destroyed the nest tree. In December 1985, the pair returned and raised one eaglet in a nearby abandoned osprey nest on the State owned Gull Rock Game Land. Since the new nest was also located very near the refuge, we continued to aerially monitor the eagles' status. During the 1987 counts we observed only one eagle and one egg which did not hatch. In February 1988 two adults were present, however, no eggs were observed. By mid spring the nest was vacant. One adult was perched near the nest in late December 1989, but no eggs were laid. In May 1990, an active nest was discovered on the Game Land with three large eaglets. The same nest was active in 1991 and produced 3 young. At the time of this report (March, 1992), an adult was observed on the same nest. We will continue to monitor the nest and search for others during aerial waterfowl and shorebird counts.

Refuge staff investigated reports of a manatee near the commercial fishing landing in Swan Quarter on July 8. The area was well searched but no manatees were seen.

Table 1. American Alligator Survey Results 1979-1991.

Year	SURVEY DATA/NO. SIGHTINGS		SURVEY AREA
1991	05/29/91	2	Juniper Bay Creek
1991	05/22/91	4	
1990	05/23/90	5	
1989	05/24/89	2	
	05/27/89	1	
1988	05/28/88	2	
	06/22/88	1	
1987	05/28/87	4	
	05/30/87	1	
1986	05/21/86	2	
	05/29/86	2	
1985	07/30/85	0	
1984	07/17/84	1	
1979	07/11/79	2	Juniper Bay Creek
	07/18/79	0	Rose Bay Creek
1978	07/24/78	0	Mattamuskeet NWR

3. Waterfowl

Note: Wintering waterfowl populations are reported on a seasonal basis and include all waterfowl observed on refuge property and within the Presidential Proclamation boundary.

Refuge objective levels are: 2 million use days (ducks) and 800 produced (ducks).

Use days for the 1991-92 season totalled 1.12 million, the fifth highest in the past ten years and slightly above the ten year average (Table 2). Production was estimated at 350 wood ducks, 75 mallards and 75 black ducks.

The 1991-92 total waterfowl population peaked at 28,000 in late February (Table 2). The count was less than one-half the ten year high recorded in the 1989-90 season, and 22% below the 1990-91 peak due to the relatively low diver peak (26,800).

The puddle duck population climbed from 150 in late October to 1,020 by mid December for the third highest peak since the 1982-83 season. The total decreased in mid December, peaked again in late January and gradually decreased in late February and early March.

The most abundant species in rank order were black duck, gadwall, mallard, green-winged teal and wigeon. Puddle duck use was greatest in Judith Island and Marsh Island followed by Bell Island, Great Island, Swan Quarter Island and the Juniper Marsh.

Diving duck numbers increased from 700 in mid November to 12,500 in late December to 26,800 in late February. The peak was the fifth highest during the past ten years and 3,600 above the ten year average. The most abundant diving ducks were canvasback, scaup, ring-necked, bufflehead, hooded merganser, and common goldeneye. Diving duck use was concentrated in the western bays before, during, and after the waterfowl hunt season with Rose Bay, Shell Bay and Deep Bay receiving the greatest use followed by Swanquarter Bay, Juniper Bay and Caffee Bay.

Sea ducks are infrequent users of the Proclamation waters; most were observed south of the boundary in Pamlico Sound proper. Approximately 500 black scoters, 150 old-squaw and 1,000 common mergansers were seen south of Great Island and Swan Quarter Island during mid to late February.

Thousands of scaup and canvasback rafted in Rose Bay during February. KD-91

Minimal tundra swan and Canada goose use occur on Swan Quarter NWR and adjacent waters. During the 1991-92 season 10-115 tundra swans were observed in the western bays; no Canada geese were seen.

Table 2. Peak Waterfowl Populations, 1982-83 through 1991-92.

Season	Dabblers	Sea Ducks & Divers	(Canvasbacks)	Swan & Geese	Total	Duck Use Days (Mill.
1982-83	500	1,550	(1,200)	250	2,300	0.3
1983-84	600	42,500	(30,000)	0	43,100	1.5
1984-85	400	37,100	(30,000)	0	37,500	1.4
1985-86	600	9,200	(8,300)	900	10,700	0.3
1986-87	450	550	(0)	115	1,122	0.1
1987-88	1,900	9,800	(7,500)	500	12,700	0.8
1988-89	500*	1,000	(800)	100	1,200	0.2
1989-90	2,400**	67,350	(29,300)	450	68,900	2.1
1990-91	600	35,800	(12,300)	125	37,200	2.3
1991-92	1,000	26,800	(17,700)	115***	28,000	1.1
10-Year Average	895	23,200	(13,700)	255	24,275	1.0

*This figure represents mid-January dabbler peak (505); total waterfow peaked in mid-December when 155 dabblers were present.
**Late December freeze; included 1,500 black ducks; total waterfowl peake on February 21 (1400 dabblers and 67,350 divers) at 68,900.
*** 0 geese

4. Marsh and Water Birds

The annual Colonial Breeding Bird Population and Production Survey was conducted May 22 for green-backed herons and May 2 for great blue herons. The Juniper Bay Creek green-backed heron colony had six active nests that could be reached by boat. It is likely that there were several more in the impassable section of the creek tributaries. Great blue heron nests were found only on the Nebraska Tract; Bell Island had no active nests. Total nests (46) was the highest on record, and 7 greater than the 1990 count.

Numerous brown pelican sightings were reported in 1991; pelicans were most frequently sighted at Bell Island pier and near the Little Judith Islands.

5. Shorebirds, Gulls, Terns, and Allied Species

Several refuge islands have historically supported nesting tern colonies. In 1991, Great Island NW #2 and Little Judith Island had active colonies. The annual tern nest count was conducted May 22. One common tern colony and two Forster's tern colonies were located. Total common tern nests (11) were down 4 from 1990 and 100 below the 1982-91 average. Total Forster's tern nests (115) were about double the average but 30 less than in 1990.

Table 3 lists tern nest history. As the number of common tern nests have decreased, the Forster's terns have increased. This year a mixed colony of 11 common tern nests and 209 Forster's tern nests was located on Hog Island, about five miles east of the refuge; this colony also had significant common tern nesting in 1989 and 1990 and might account for the low refuge count.

Table 3. Tern Nest History.

Year	Nests			
	Common	Least	Forster's	TOTAL
1970	150	75	0	225
1975	153	0	"	153
1980	143	"	"	143
1981	210	"	"	210
1982	204	"	"	204
1983	216	"	"	216
1984	144	"	"	144
1985	150	"	40	190
1986	0	"	23	23
1987	181	"	7	188
1988	156	"	132	288
1989	29	"	127	156
1990	15	"	145	160
1991	11	"	115	126
1982-91 AVERAGE	111	-	59	170

6. Raptors

Seven occupied (five active) osprey nests were located during the June 2 Osprey Production Survey. For several years 3-8 pairs of osprey have nested in loblolly pine and baldcypress snags in the Juniper Bay and Bell Island vicinities. In 1991, five active nests were located on Bell Island, one in the Nebraska Tract and one in the Juniper Marsh.

H. PUBLIC USE

1. General

Swan Quarter NWR received approximately 26,700 visits in 1991; fishing was the major use (92%) followed by wildlife observation (7%) and waterfowl hunting (1%).

8. Hunting

Approximately 6,100 acres were open to waterfowl hunting during the 1991-92 season. This was the fifth season that permit holders could harvest tundra swans, however, we were not aware of any that were bagged (the few swans that wintered on the refuge were well away from the hunt area). Based on state wildlife officer's reports we estimate that 200 ducks were

bagged. The most frequently killed species were likely bufflehead, black duck and wigeon.

9. Fishing

Sportfishing continued to be the major public use of Swanquarter NWR. The 1,100 foot pier at Bell Island provided fishing access to Rose Bay where speckled trout, spot, croaker, and blue crab were typical catches. The pier's use peaked from July through October when puppy drum and blue crabs caught some attention.

Speckled trout fishing from refuge islands was popular from September through October.

The Bell Island pier was used by 20-30 fishermen per day during the October trout run. KD-91

17. Law Enforcement

Refuge staff patrolled the hunt area during the early October waterfowl season, however, no hunters were encountered.

No citations were written by refuge staff in 1991; State Wildlife Officers issued 25, most for boating violations.

I. Equipment and Facilities

1. New Construction

NCSU researcher Temple and assistants constructed a 180' x 35' wire pen to house captive wild strain black ducks (Section D.5) at the southeast terminus of the Bell Island boundary road. The pen was checked daily and maintained by research assistant Pete Credle.

NCSU researcher Temple (far right) supervised construction of black duck pen on Bell Island in July and August. KD-91

J. OTHER ITEMS

4. Credits

This report was written by Kelly Davis, edited by Donald Temple and typed by Bernice Kitts.