ANNUAL WATER MANAGEMENT PROGRAM - CY 1995

PRIME HOOK NATIONAL WILDLIFE REFUGE

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I. INTRODUCTION

This report describes the results of Prime Hook's 1994 Water Management Program and delineates plans for 1995. 1994 marked the third year that asynchronous drawdowns were performed between the refuge's three impoundments. Asynchronous drawdowns have become part of a concerted effort to avoid repetitive yearly manipulations including similar dates for flooding, dewatering and/or performing soil manipulations, that can result in a gradual decrease in the potential for greater food diversity and long term productivity as impoundments age. (See Table 1.) The staggering of water regimes between units also enhances our opportunity to practice a more integrated and intensive wetland management scheme.

TABLE 1. THE PRACTICE OF ASYNCHRONOUS DRAWDOWNS AT PRIME HOOK NATIONAL WILDLIFE REFUGE

YEAR	IMPOUNDMENT	DRAWDOWN INITIATION	COMPLETION
1992	Unit II	05/01/92	06/15/92
	Unit III	05/15/92	06/15/92
	Unit IV	04/15/92	05/06/92
1993	Unit II	03/15/93	05/15/93
	Unit III	04/15/93	06/15/93
	Unit IV	04/01/94	05/01/93
1994	Unit II	04/01/94	06/01/94
	Unit III	01/01/94 & 05/01/94	01/30/94 & 06/30/94
	Unit IV	03/01/94	05/10/94

We strive at Prime Hook NWR to develop and manage our 4200 acres of fresh water impoundments as assorted complexes or mosaics of a diversified

wetland landscape in order to maximize their attraction for our trust species as well as targeting the greatest diversity of other bird fauna and wildlife. We recognize that a varied spatial arrangement of different wetland types provides the greatest quality and availability of resources which become the critical factors determining the abundance and biodiversity of wetland wildlife. We agree with Fredrickson and Laubhan (1994) that intensive wetland management is the key to enhancing biodiversity in this day of continuing degradation and wetland lose.

The basic premise behind intensive wetland management is that more resources and subsequently a greater abundance of target species can be accomodated more consistently year after year on smaller managed areas. Intensive wetland management can improve wetland productivity and biodiversity if the correct combination of water level manipulations plus other habitat management techniques are applied at the appropriate times. Incorporating the management of the refuge's wetlands with the principles of landscape ecology and ecosystem management within the wider context of the Delmarva River/Delmarva Coastal Watershed must also be considered to prioritize management actions and better recognize Prime Hook's tremendous contribution to wildlife resources on such a small land-base.

Adopting a more comprehensive approach embraced through integrated wetland management, the most difficult component of such a scheme becomes the complex thought necessary to integrate an enormous amount of diverse information into a single comprehensive annual water level management program. With this in mind, we are constantly learning and developing adaptive management strategies to accomodate highly dynamic environmental parameters to target the greatest diversity of species within our impounded wetland complex. The general strategy of our multifaceted management approach is based on 1) the knowledge of life history requirements of waterfowl and shorebirds in particular, and 2.) the importance of continually fine-tuning monitoring endeavors that gauge the successes and failures of each annual program.

Each year we attempt to match the associated chronology and particular biological events such as molt, migration, or reproduction, with the specific water level manipulations within our impoundments. Then we monitor the vegetative response to the varying hydrological periods and subsequent wildlife response to each year's uniquely created conditions.

1) HISTORICAL DRAWDOWN REGIMES AND CURRENT PHILOSOPHIES

Prime Hook's current wetland complex was not created overnight, as it involved close to 12 years in its creation. Unit IV's 200 acre impounded area was the first to be completed in 1982. Then Unit III (2500 acres) came on line in 1984 and finally Unit II (1500 acres) was completed in 1987. This was a mega restoration endeavor that spanned over a decade in planning and implementing. Merged with the newly created water manipulating capabilities was the importance of an experimentally wide-scale aggressive Phragmites control program. The Phragmites control effort was paramount to the success of this large-scale habitat restoration project as large existing monocultures within these newly created impoundments were treated with herbicide. Subsequently a dramatic improvement was realized in wetland plant diversity.

For the first several years after water control capability was achieved, the general drawdown and reflooding schedule was essentially the same each year for each impoundment. This schedule consisted of a rapid drawdown in June with moist-soil conditions usually realized by July 1st. Then rapid reflooding occurred in October. Later, to improve the use of drawdowns as a management technique to create greater vegetation diversity, asynchronous drawdowns between impoundments were initiated in 1992. In addition to staggering the water regimes between units, we attempted to create different hydrological periods every growing season in each unit by never adhering to the same drawdown dates in consecutive years.

We also started to focus on incremental drawdowns as it became recognized that slow and gradual drawdowns (4 to 6 weeks with 4" logs at PMH) usually are more desirable for plant establishment and wildlife use. Fredrickson (1991) found that prolonged exposure periods associated with slower drawdowns created more favorable conditions for moist-soil plant germination and better root development compared to rapid drawdowns within impoundments subject to identical weather conditions. Slower drawdown schedules also translated into higher seed yields. In addition greater invertebrate availability to foraging birds is realized along the soil-water interface as water is incrementally discharged from the impoundment. Slow drawdowns also lengthen the period for optimum foraging by extending larger portions of food resources within the foraging range of a greater spectrum of species.

The practice of moist-soil management at Prime Hook NWR has changed and evolved through the years with the realization that a proactive approach can very often become more of an art than a science as each of our impoundments and subunits have very unique characteristics that determine the success of various management attempts. We are constantly learning from our experiences and this exemplifies adaptive resource management at its best as we experiment with both partial and complete drawdowns, stagger hydrological regimes between impoundments and vary the starting dates, duration, frequency, rate of drainage and reflooding, while simultaneously adjusting to climatic extremes when trying to meet management objectives.

The strategy of an integrated approach to managing our wetlands seeks to insure long-term productivity of our marshes while targeting the widest diversity of wildlife. The crux of our water management planning incorprates two key ideas: 1) not to manage our wetland systems too deeply and 2) the avoidance of any semblance of stabilized hydrologic regimes.

2) 1994 ACCOMPLISHMENTS

In 1994 we experimented for the first time with the idea of attempting multiple drawdowns during the same calender year within a single unit and alternating between the use of a partial drawdown and a complete drawdown. Some of the advantages recognized with partial drawdowns are 1) invertebrates will not be reduced to levels so low that fewer are available for inoculating adjacent wetland areas given the right conditions 2) the ratio of plants to open-water area is usually better with a partial drawdown as complete drawdowns conducted annually will result in profuse vegetative growth that can completely close out open-water areas or eliminate mudflats (important considerations if targeting spring & fall migrating shorebirds), and 3) muskrats can survive better.

The partial drawdown initiated this season from 1/1/94 to 1/30/94 in Unit III yielded excellent results. This drawdown was stopped at half pool level with a gradual reflooding during February and completed by the first week of March. To deal with extra rainfall that was above normal during the first 3 months of 1994, flap gates were left fully functional at low tide to rapidly release excess waters. The intent was to rejuvenate soil substrates and solidify the bottom plus stimulate seed banks via an ice-scouring effect. It

was also intended to help control Nutria present in the impoundment by freeze stressing them.

This technique proved very sucessful! To date no Nutria have been observed or trapped and seed yields for *Echinochloa walteri* (wild millet) increased by 30% over last year, ranging from 1332 lb/acre to 1454 lb/acre in 1994. Likewise large increases were also noted for chufa where this year's seed yields ranged from 254 to 443 lb/acre.

An on-going, aggressive Phragmites control program is also an important and integral component of the continued measured success of Prime Hook's Water Management Program. A total of 320 acres were treated in 1994 with the herbicide glyphosate (RODEO). On August 28 and 29, 120 acres in Units II, III, and IV, including a firebreak along the beach, was sprayed at the two quart rate by Allen Chorman Inc., using a fixed wing aircraft rather than a helicopter. Specific subunits treated comprised the following: PMH3B-20 acres, PMH3D-10 acres, PMH4A-15 acres, and PMH2C-75 acres. (See Figure 1 for Subunit Designations)

We were experiencing difficulties obtaining a contract helicopter to do our spraying at a reasonable cost (one bidder wanted $45/acre). We finally accomplished the work for a $9/acre rate with a fixed-wing and obtained excellent results. This was the first time we ever used a fixed-wing aircraft to aerially spray Phragmites and most likely will not be the last. An additional 200 acres were sprayed in Unit II on August 30, all in subunit PMH2C under a cost sharing program with the Delaware Division of Fish and Wildlife. One hundred acres were treated at a 2 quart/acre rate and 100 acres at a 1 quart per acre rate. The lower rate was applied to areas sprayed a second time as part of a two-year follow-up treatment schedule.

A severe Nor'easter ripped through the refuge on March 2 and 3 with gusting winds up to 60 mph causing extreme high tides and dumping 4.50 inches of rain. The storm destroyed much of the duneline along our eastern boundary and most of the undeveloped beach from Slaughter Beach to Prime Hook Beach was breached. This resulted in unrestricted flow of Delaware Bay into the Unit II impoundment for several days as Fowler Beach and Prime Hook Beach roads were under water for nearly one week. The loss of the dunes (all on privately-owned lands) resulted in the loss of integrity of our Unit II impoundment and virtually eliminated our "rice-dike" surrounding Field 212,

which was created 4 years ago. The overflow of salt water (Bay salinities ranged from 24-28 ppt) entering Unit II also continued southward into portions of Unit III creating further negative impacts within this impoundment also. The extensive dune loss also subjected these two impoundments to salt water intrusion for the rest of the year and continues to do so during high tide events.

As a result of the storm and flooding, extensive damage occurred to refuge roads, dikes and water control structures. The following repairs were made force account using base maintenance funding:

- Unit II Water Control Structure: 180CY select borrow to repair severe erosion around the structure

- Unit III Water Control Structure: 30CY select borrow to repair severe erosion around the structure

- West Dike in Unit III: 465 CY select borrow to repair the eroded top of the dike

- Stoplogs: Replaced 80 logs lost during severe storm flooding

In addition, as much as 3600 feet along the west dike needs an average of 4 inches of select burrow to restore the dike to its original elevation or further degradation of Unit III's integrity will occur.

II. CLIMATE AND WATERSHED CHARACTERISTICS

1. WEATHER. 1994 was generally a wet year with rainfall 14.61 inches above normal. Early spring was very wet with the month of March alone proving to be the wettest for the year (10.58"). This resulted in all our pool levels being much higher than planned during this period. Then below normal rainfall in August, October and December also thwarted our plans, creating pool levels much lower than we really wanted.

Two destructive natural events - a severe ice storm on February 11 plus the previously mentioned nor'easter of March caused considerable habitat

destruction. The ice storm was the worst such storm to hit the lower Delaware area in over 200 years, as hundreds of trees of all species were downed by the weight of extreme ice while hundreds more lost their crowns.

However, extreme cold weather in January coupled with the ice storm effects in February resulted in 39 days of ice in the marsh. On the bright side - this severity of weather coincided with our planned partial drawdown in Unit III and served to maximize the 'ice-scouring' effect we were seeking. Likewise, the above normal rainfall especially in March plus the consistent rains throughout the growing season helped to attenuate the negative impacts of continual salt-intrusions within the impoundments resulting from the March nor'easter.

2) TIDES. The normal tidal range of the Delaware Bay Water Basin surrounding refuge lands is between 12 and 26 inches but the level of individual tides will vary with moon phase, wind velocity and direction. The lowest tides occur during winter when northwesterly winds are prevalent, blowing bay waters away from impounded units.

Highest tides are associated with nor'easters when tide levels can be 2 to 8 feet above normal and bay waters are blown into the refuge's impoundments, particularly Units II and IV. Of growing concern are the breached dunes (destroyed in 1993 and 1994 nor'easters) along the eastern boundary of Unit II, which are resulting in the systematic introduction of saline waters (25-30 ppt) into this impoundment during peak tides.

3) WATER SALINITY. Water salinities vary from year to year within the lower Delaware Bay area surrounding Prime Hook's impoundments and are largely governed by storm surge flooding, significant rain events and discharge from Slaughter canal, Prime Hook Creek and the Broadkill River.

Originating in Unit I, Slaughter Canal runs through the entire unit and continues on to Unit II where this year salinities ranged from 4 to 18 ppt, somewhat lower than last year. In general the salinity levels are diluted as the canal filters through Unit II. Prime Hook Creek meanders for seven miles through Unit III and is strictly fresh water. It feeds into the main ditches contained within the Unit III impoundment. Finally, the Broadkill River runs adjacent to the southern portion of the Unit IV impoundment and in 1994 its salinity readings ranged from 6 to 20 ppt. Impoundments in Unit's II and IV still

require the most work in maintaining higher quality water (i.e., brackish to fresh water conditions) due to the periodic Delaware Bay spill-overs.

In general the average salinities for all the impoundments were lower than last year. This is mostly attributed to the 14.6 inches of above normal rainfall received in 1994, providing a constant supply of sheet water flushing through the impoundments. Unit II maintained a remarkably low average of 1.4 ppt, despite all the salt-water intrusion episodes, while Unit IV recorded a slightly higher average of 2.3 ppt but exhibited a wider range of fluctuation from 0 to 6 ppt. Unit III remained virtually fresh throughout the year.

In addition to water level manipulations, wildlife use of the impoundments is also dependent upon the year's climatic conditions that influence the number of ice free days and food availability based on appropriate water levels. The amount of rainfall drives the adjacent watershed hydrology which in turn influences the timing and duration of flood events, length of inundation and/or lack of water within the refuge's impoundments. For example, lack of rain in October (0.54") and December (1.22") this year significantly contributed to lower duck-use during these months compared to the same periods last year. The food was undoubtedly there, as attested by this year's recorded seed yield estimates, but the lack of water severely hampered food availability for the ducks. However, it should be noted that the snow geese did not care about the water levels. With or without the water, they were always there, and in record numbers this year; a constant crescendo in the background, ever increasing throughout the fall and winter, peaking at 128,200 birds in December.

III. EFFECTS OF 1994 WATER REGIME AND RESPONSE OF VEGETATION AND WILDLIFE

1. GENERAL. The same general patterns of avian use were noted in the form of numbers and diversity within all 3 impoundments in 1994 despite a very wet, early Spring. Above normal rainfall continuing throughout the summer months resulted in triple the effort in stoplog manipulations to maintain water-levels close to schedule. Despite the constant variations in pool levels bird usage was excellent throughout the summer, but dropped off in October due to mini-drought conditions, which depressed wading bird and duck usage.

Thick stands of wild millet, nutsedges, spikerushes, and wild rice were measured in Units II and III; but our greatest success story was to be realized in Unit IV. During the 1992 growing season the predominant vegetative species there was salt marsh fleabane (*Pluchea purpurascens*). Since fleabane does not provide a seed source used by waterfowl, monocultures of this plant in PMH4A were diminishing bird use. Therefore in 1993 we drew the Unit down a month earlier (4/1/93). Despite fleabane reductions, it still accounted for 30% of the unit's vegetative cover. In addition, the dead plants from 2 seasons of accumulated growth of thick stands were still very robust structurally, so they were serving to diminsh Unit IV's value as a targeted shorebird area.

Based on discussions with the South Zone Biologist we drew down even earlier during the 1994 growing season (March 1). The results were phenomenal!! The predominant vegetation this season was sprangletop (*Leptochola filiformis*) accounting for 41% cover of PMH4A, mixed in with wild millet, chufa, sea purslane, etc., (See Appendix A), while fleabane had been virtually eliminated!!! Additionally, these sprangeltop plants were the second most robust stands refuge-wide compared with measurements taken in other units. PMH4A *Leptochloa* plants yielded about 751 pounds of seed per acre compared to 619 lb/acre in PMH2A and 55 lb/acre in PMH2C.

Further germination studies (Laskowski 1995) have identified most of the environmental parameters that can preclude the establishment of fleabane within an impoundment's plant community. These include early drawdown dates to allow other desirable vegetation to get a good head start before late May and optimal fleabane soil temperatures of 90^{O} F are realized. Then good to excellent vegetative structure of other more desirable moist-soil plants are able to dwarf later germinating fleabane plants, thereby relegating it to a minor component of the wetland plant community's understory.

On the down side, our water level manipulations in PMH4A were cited by the state as having a negative effective on nearby OMWM-areas in Unit IV. In an effort to improve this situation we changed our initial 1994 plans to targeting only the Spring migrating shorebirds and forgo attempts to create habitat conditions for the Fall migrants in this subunit in July and August. We did this by achieving a gradual early-spring drawdown that was completed by 5/10/94. Then on June 1st, we put logs back into both structures and tried to maintain constant shallow water levels for the entire summer so that negative

impacts on mosquito-eating fish could not be attributed to our water regime. This goal was fully achieved especially given the substantial rainfall from June through September, with no dry periods occurring during this time frame. As a result this impoundment never exposed any bare soil areas from June 1st to the rest of the year.

Despite these efforts , Unit IV's small impoundment was sprayed a total of seven times within an eight week period from 06-17-94 to 8-19-94. On a positive note, the use of temephos (Abate) within Prime Hook's impoundments has been eliminated fron the State's mosquito control permit for 1995 in accordance with terms of the 1992 working agreement with the Service.

2. WILDLIFE RESPONSE . The asynchronous drawdowns performed in 1994 produced habitat conditions that attracted ducks, geese and raptors (notably several bald eagles and two golden eagles) during the winter, and ducks, geese, rails, bitterns, wading birds and shorebirds during the spring, summer and fall. Increased diversity but decreased numbers of shorebirds (See Table 2.) made use of Unit IV during the spring migration, whereas increased diversity and numbers of shorebirds made use of Unit II both during the spring and fall migrations. The appearance of a black-tailed godwit (*Limosa limosa*) on 6/11/94 created quite a stir within the Birding Community as birders from New Hampshire to South Carolina, Nebraska and even Alaska flocked to Route 16 to spy on this rare summer visitor from Europe. It frequented Prime Hook's mudflats and impounded marshes flip-flopping back and forth from PMH3D toPMH4A being seen for the last time on 06/17/94.

TABLE 2. Shorebirds seen during 1994 migrations using Prime Hook's National Wildlife Refuge Impoundments	
Black-bellied plover	Sanderling
Semipalmated plover	Semipalmated sandpiper
Killdeer	Western sandpiper
American Avocet	Least sandpiper
Black-necked stilt	White-rumped Sandpiper
Greater yellowlegs	Pectoral sandpiper
Lesser yellowlegs	Dunlin
Willet	Ruff
Spotted sandpiper	Stilt sandpiper
Black-tailed godwit	Short-billed dowitcher
Ruddy turnstone	Common Snipe
Red Knot	American woodcock

As explained earlier, we did not target PMH4A for Fall shorebird migrants. However, larger snow goose eat-outs in PMH2C, where substantial areas of mudflats were created, interspersed with shallow water and flourishing moist-soil plants, wound up attracting the majority of Fall migrants stopping over in August and September. This accounted for the only increase in shorebird use-days recorded in 1994.

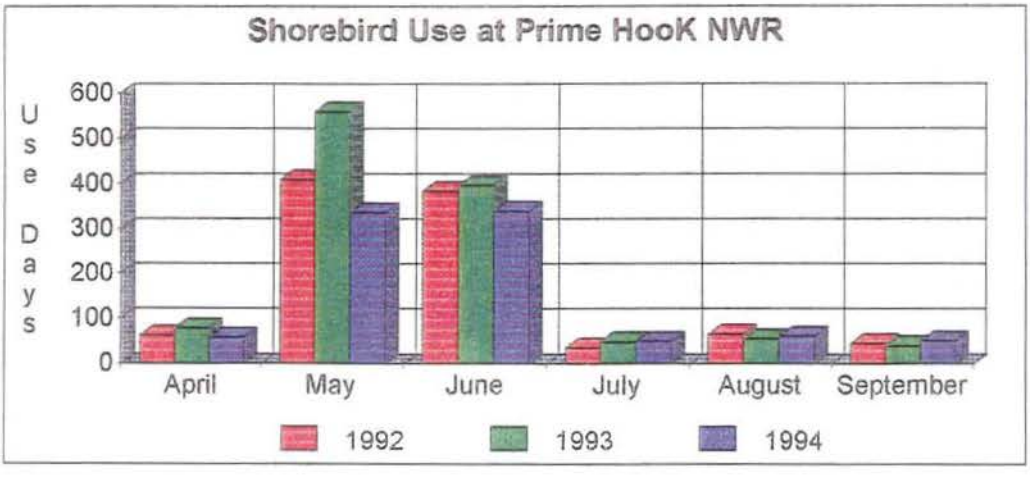
In general the wetter then normal spring and summer often times reduced the areas of available mudflats for shorebird use when excessive sheet water could not be removed quickly enough from affected impoundments. In addition, when the shorebirds did start utilizing PMH4A, the birds would abandon the site immediately after mosquito spraying and would not return for several days afterword. The continual weekly disturbance also helped to reduce shorebird use-days of the impoundment. Marsh and wading birds also

made excellent use of all impoundments in April and May, but then dropped off from June to August and finally peaked again in September. (See Summaries below of use-days of various marsh guilds)

MARSH AND WATERBIRDS (Use Days in Thousands)

Month	1992	1993	1994
April	18.3	24.2	25
May	21.9	23.8	24.8
June	22.8	20.7	9
July	39.5	40.8	39.9
August	40.2	46.2	39.8
September	37.6	39.6	52.6

	SHOREBIRDS (USE DAYS IN THOUSANDS)			
Month	1992	1993	1994	
April	61.8	77.1	58.1	
May	409.6	559.5	336.2	
June	384	396.2	339.4	
July	35.7	48.7	49.7	
August	65.4	55.4	60.8	
September	45.3	40	51.2	



Ring-necked ducks and snow geese were the most common wintering diving duck and goose species, while the most significant wintering dabblers (descending from greatest to least numbers) that utilized all 3 impoundments included green-winged teal, pintails, black ducks, mallards, gadwalls, shovelers and wigeon.

Overall peak wintering duck populations decreased in October compared to last year from 49,586 to 17,131; stayed about the same in November (59,019 vs 60,308) and then dropped off in December. These decreases in duck numbers this year were attributable to the lack of precipitation in October and December. We are strictly dependent upon rainfall as our only source for restoring pool levels. As a result, impounded marsh conditions were much drier than we planned for this particular time of the year. Subsequently this reduction in duck usage was associated to the complete lack of water in many areas within the impoundments.

PEAK DUCK POPULATIONS USING PRIME HOOK'S IMPOUNDMENTS

Month	1992	1993	1994
September	11150	12500	11800
October	39870	49586	17131
November	39236	60308	59019
December	38905	63024	49005

DUCK POPULATIONS (Use Days in Thousands)
Prime Hook National Wildlife Refuge

Month	1992	1993	1994
September	236	317.4	316.7
October	1175.5	1231.9	479.3
November	1107.9	1545.1	1583.2
December	1099.6	1516.4	1493.4

The first Canada goose arrived in early September and numbers peaked at 10,491 by December. Numbers were slightly up this year as they made extensive use of PMH3D, PMH4A, and ag fields in Units III and IV. The first snow goose arrived on September 5 and populations continued to build to record numbers throughout the fall. By October numbers reached 65,000; then soared to 127,300 by November and continued to escalate in December to 128,200.

PEAK CANADA GEESE POPULATIONS AT PRIME HOOK NWR

Month	1992	1993	1994
September	65	60	125
October	2425	2674	3030
November	5211	4520	5210
December	2000	9485	10491

PEAK SNOW GEESE POPULATIONS AT PRIME HOOK NWR

Month	1992	1993	1994
October	45570	48500	65000
November	45000	80000	127300
December	60000	90000	128200

Snow geese continue to be our major means of roto-tilling the soils within our large impoundments. Since they are associated with foraging modes that appear to produce effects similar to disking they have become a blessing in disguise, especially when they grub for tubers or new browse. Due to the generally unconsolidated soils in large areas of the impoundments and inaccessibility to any type of disking equipment, the snow geese provide us with our only means of physically manipulating our moist-soils.

Although we have only collected seed production estimates for the last 2 years, we intuitively feel that increased snow geese 'eat-out' activities in part have contributed to increases in seed yields especially in subunits PMH2A and PMH3B from 1993 to 1994. We have recorded a steady increase in snow goose 'eat-out' acreage totals since 1989. (See summary below) We surmise that if major declines in snow geese eat-out activites occur, that it may very well correlate directly with seed yield reductions in affected areas of our impoundments.

SNOW GOOSE EAT-OUT ACREAGE ESTIMATES AT PRIME HOOK

Year	Unit I	Unit II	Unit III	Unit IV	Total Acres
1989-1990	43	168	401	80	692
1990-1991	76	249	659	94	1078
1991-1992	108	291	631	97	1127
1992-1993	120	300	680	91	1191
1993-1994	103	450	733	109	1395

As our impoundments age, the seed production will naturally drop to lower levels especially if seed banks can not be mechanically stimulated, but the current physical disturbance of snow geese feeding modes are probably helping to shift plant response to earlier successional stages and maintaining and/or increasing seed and tuber production in impoundments that are seven years old or older. In addition, the physical manipulation of vegetation can be

one of the major costs of moist-soil management, but the snow geese make it extremely cost effective.

3. VEGETATION RESPONSE. 1994 has been the second year that we have been measuring the seed production of moist-soil plants. We began focusing on this particular monitoring endeavor for several reasons: 1) the increased recognition of the tremendous contribution of moist-soil plants to the biological requirements of migrating and wintering waterfowl; 2) the extremely high food quality provided by these seeds as they contribute the greatest biomass of food within moist-soil habitats; and 3) to maximize this food resource through our water level managing schemes and then more accurately monitor and document changes in seed production and plant community structure particularly as our impoundments age.

A practical methodology to achieve this was developed by Murray K. Laubhan. (See last year's Annual Water Management Program) It is a quick and cost-effective method. The time required to collect data for estimating seed production is minimized by restricting measurements to easily collected vegetation variables related to seed production plus limiting measurements to a single representative plant and inflorescence within a small sample frame. Because of the small sample area per plot used (0.0625 m2) and changes in the density of plants within an impoundment, it is recommended that as many samples as economically feasible be collected to obtain the most reliable seed production estimates. With this in mind, we tried to increase the sample size in all inspected subunits this year.

In the literature, data suggest that millet grasses, flat sedges, beakrushes, some smartweeds and sprangletop produce more seed than do other plant species for which estimates exist. (Laubhan and Fredrickson 1992) Reported seed yield estimates for the above mentioned moist-soil plants ranged from 45 lb/acre to 1450 lb/acre in intensively managed units. (Fredrickson & Taylor 1992; Reinecke et al 1989) Using collected field data during August and September of 1994 and a seed yield software program (See Appendix B), seed yield calculations were generated for each measured plant species. The table below summarizes the responses of the dominant moist-soil plants to 1994 water level managment actions.

TABLE 3. Response of Selected Moist-soil Plants on Prime Hook National Wildlife Refuge to 1994 Water Level Management Actions

PRIMARY MANAGEMENT GOALS

SPRING/SUMMER	FALL/WINTER
Habitat: Breeding Cover for Wood ducks, Black ducks, Gadwalls & BWT.	Habitat: Thermoregulation and resting for waterfowl.
Food: Migrating Shorebirds, Rails, Bitterns, Wading Birds and Breeding Ducks.	Food: Migrating and wintering waterfowl.

Unit	Drawdown	Veg Type	Lb/Acre
PMH2A	Mid-spring	Millet	1421
		Sprangletop	919
		Chufa	680
PMH2C	Mid-spring	Millet	1021
		Sprangletop	55
		Chufa	312
		Fox Tail	1170
PMH3A	Late-spring	Millet	1454
		Chufa	444
PMH3B	Late-spring	Millet	1332
		Sprangletop	85
		Chufa	254
PMH4A	Early-spring	Millet	330
		Sprangletop	751
		Chufa	26

Not every impounded subunit was sampled. This sampling bias is determined by unconsolidated bottoms and inaccessibility in certain areas of our impoundments. Subunits sampled in 1994 included PMH2A, PMH2C, PMH3A, PMH3B, and PMH4A, providing an array of estimates to represent all 3 impoundments. Average seed production for each subunit was calculated and compared between units and years. In general total seed production was usually greater in areas experiencing earlier drawdowns. (See table below) The exception was PMH2A where unit production doubled from 1393 to 3020 lb/acre. This is attributed to a significant increase in snow goose feeding activites. In 1994 increases were realized in all subunits except PMH2C. This subunit was our record high seed producer last year with dense stands of wild millet, foxtail, sprangletop and nut sedge. But in 1994 seed yields were reduced by 47% due to 2 factors: 1) consistent salt water intrusion through breached dunes during the early growing season and 2) a later drawdown date compared to 1993.

TOTAL SUBUNIT SEED PRODUCTION AVERAGES IN POUNDS PER ACRE DETERMINED IN 1993 AND 1994 AT PRIME HOOK NATIONAL WILDLIFE REFUGE

Drawdown	1993-lb/acr	Subunit	1994-lb/acr	Drawdown
Early Spring	1393	PMH2A	3020	Mid-Spring
Early Spring	5443	PMH2C	2571	Mid-Spring
N/A	N/A	PMH3A	1898	Late W/S
Late-Spring	1307	PMH3B	1671	Late W/S
Mid-Spring	619	PMH4A	1107	Early Spring

We consider these average seed production totals to be reasonable estimates for calculating the carrying capacity of each moist-soil subunit. In fact the seed yield program does just that by multiplying these calculated averages (based on the individual plant species actually measured) by the estimated acreage of the subunit. (See Appendix B for Seed Yield Unit Summary Print-Outs) For example, the total poundage estimated for PMH2A in 1994 was 673,424 versus 317,083 in 1993. This data can be used for assessing food production as an index of carrying capacity within each sampled area. The carrying capacity of seed resources translated into duck-use days for example, could be theoretically calculated based on the quantity of food necessary to feed 1 duck for 1 day with information on the amount of seed produced per unit.

It is also conjectured that these seed production averages are conservatively low estimates compared to the actual pounds per acre of seeds produced. This is so because only the dominant vegetation in each subunit is sampled to ensure that a significant sample size is obtained. Therfore there are many moist-soil plants contained within the subunit that go unmeasured. Additionally, for carrying capacity evaluations, seed production estimates provide reasonable food production approximations since seeds do supply the greatest biomass of food in moist-soil habitats. But these food production estimates are also low because tubers, roots, rhizomes, stems, leaves, invertebrates and herpetofauna, that provide a wide variety of foods for waterfowl, are not factored in.

Individual plant species response was also compared between units and showed great variations. These differences are partially attributed to draw-down schedules (early vs late) and soil salinity fluctuations. For example, *E. walteri* seed yields ranged from 330 to 1450 lb/acre. The lower yields were found in PMH4A and were attributed to higher soil salinities as plants here

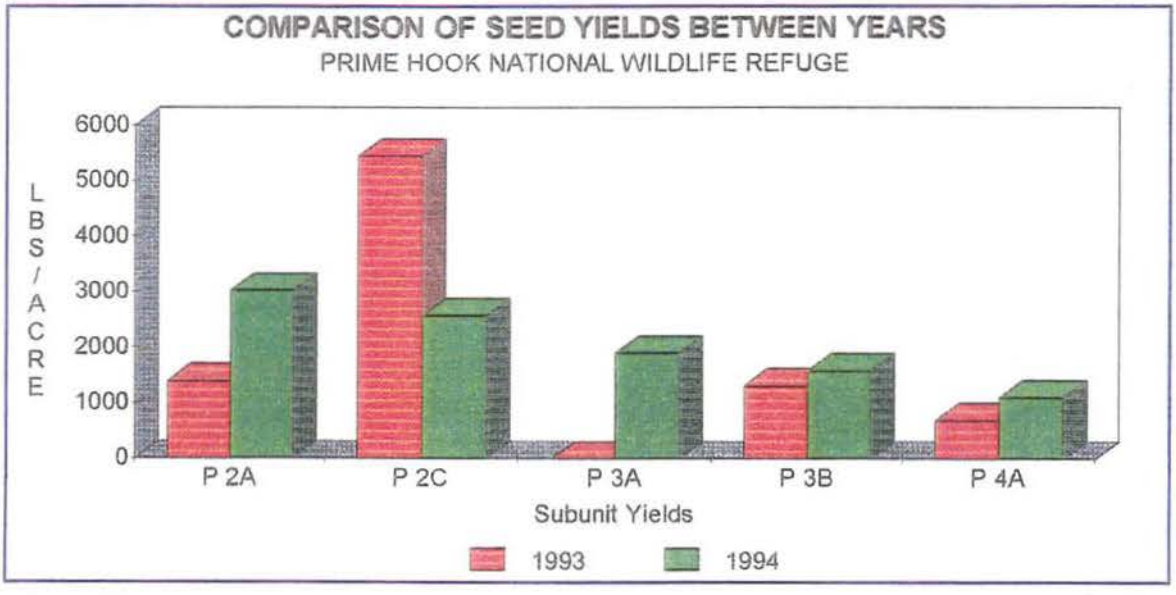
only achieved heights of around 0.5 M. Units II and III however, achieved the highest seed yields where thick stands grew plants that averaged about 1.5 M in height.

TABLE 4

COMPARISONS OF INDIVIDUAL MOIST-SOIL PLANT SPECIES RESPONSE TO 1993 AND 1994 WATER LEVEL MGT AT PRIME HOOK NATIONAL WILDLIFE REFUGE

PMH2A-93						
Millet	Leptochola	W Pepper	Chufa			Total lb/acr
491	325	67	510			1393
		PMH2A-94				
Millet	Leptochloa	W Pepper	Chufa			Total lb/acr
1421	919	0	680			3020
		PMH2C-93				
Millet	Leptochloa	W Pepper	Chufa	Setaria		Total lb/acr
1166	241	0	138	3989		5443
		PMH2C-94				
Millet	Chufa	W Pepper	Setaria	Leptochloa		Total lb/acr
1021	312	13	1170	55		2571
		PMH3A-94				
Millet	Leptochloa		Chufa			Total lb/acr
1454	0		444			1898
		PMH3B-93				
Millet		W Pepper	Chufa			Total lb/acr
930		100	277			1307
		PMH3B-94				
Millet		W Pepper	Chufa			Total lb/acr
1332		0	254			1586
		PMH4A-93				
Millet	Chufa	Leptochloa	W Pepper			Total lb/acr
448	0	125	46			619
		PMH4A-94				
Millet	Leptochloa	W Pepper				Total lb/acr
330	751	26				1107

Comparisons between years also showed that chufa yields were significantly higher than last year's, ranging from 254 lb/acre in Unit IV to 680 lb/acre in Unit II. This was mainly attributed to an even distribution of rainfall in 1994, in contrast to the year before where a robust crop of nutsedge germinated early in the season but later succumbed to a long 6-week dry spell in August. Very significant increases in the sprangletop crop were also noted in 1994. *Leptochloa* stands in PMH2A jumped from 325 lb/acre to 919 lb/acre. Soil salinities were similar for each year but the drought conditions of 1993 served to dessicate much of the sprangletop crop before it even went to seed, hence its lower yields that year. Unit IV also made dramatic increases in *Leptochloa* yields this year. This is attributed to the longer growing season established in the 1994 drawdown schedule plus the wettier spring and summer conditions. We were also impressed with *Leptochloa's* excellent tolerance of higher soil salinities as they ranged from 15 to 18 ppt in Unit IV.



4. INVERTEBRATE RESPONSE. Casual sampling of invertebrates in all moist-soil units turned up very slim pickings. A few Chironomids in Unit II, and virtually nothing in Units III and IV. According to the literature, optimal invertebrate densities for attracting shorebirds must be at least 100 individuals per square meter. This year we recorded fewer than 10 per square meter in Unit II, 1 per square meter in Unit III and no invertebrates at all in Unit IV.

We are trying to manage for the midge larva by providing a good diversity of plant biomass and making it available to these detritivores at opportune times. By exposing some vegetation to winter drawdown and then inundating slowly in the early spring, we hoped to cause the dead vegetation present to decompose more rapidly. Then by slowly reflooding and maintaining shallow water levels during warmer ambient temperatures we hoped to encourage good algal growth and nutrients to spike midge production. Despite these efforts to cultivate good production of Chironomids and inoculate them to adjacent wetland plant communities, numbers were even lower in 1994 than 1993.

5) DESCRIPTION OF PRIME HOOK'S INTEGRATED WETLAND COMPLEX

a) UNIT I. No current active water level management is practiced in Unit I. It contains approximately 1145 acres of which 250 acres is in switchgrass and scrub-brush habitat while the rest is salt marsh.

Shorebirds, especially dunlins, dowitchers, yellowlegs, and to a lesser extent red knots, turnstones and sandpipers made good use of mud-flats created by snow geese particularly during high tides. In addition wading birds, especially glossy ibis, made excellent use of Unit I during the spring and summer. In the winter this unit became an important secondary resting and feeding area for migrating geese and ducks when the fresh water impoundments froze up first.

Transect comparison data from 1991 and 1994 revealed that some earlier snow geese eat-out areas have revegetated nicely as the bare-ground components were reduced from 66% to 22% in (P-1) and from 79% to 21% in (P-2) while simultaneously experienceing increases in plant cover. These included increases from 30 to 45% cover in salt grass (*Distichlis spicata*) and 3 to 29% in *Spartina alterniflora* in P-1. {See Table 5} Likewise both salt grass and cord grass components rose from 19 to 29% and 3 to 44% cover in (P-2) respectively.

In 1988, the state of Delaware identified 934 acres of potential mosquito breeding habitat. Then a 6-year implementation of OMWM as a biological source reduction technique to control salt marsh mosquitoes (primarily *Aedes sollicitans & A. cantator*) was started in 1989

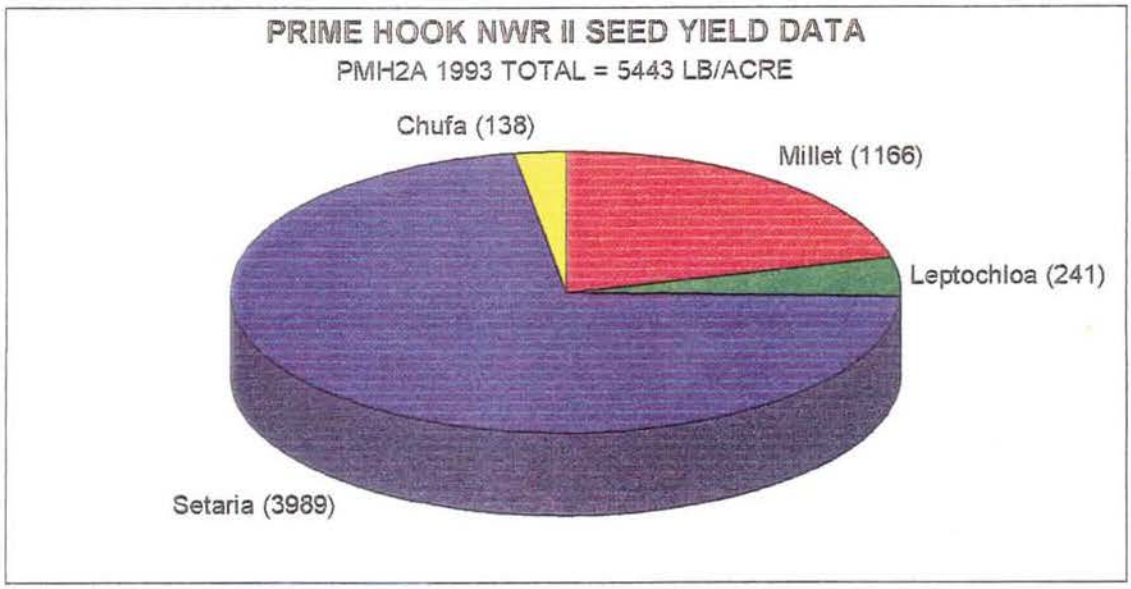
and completed this year. A total of 1260 acres of saltmarsh were treated with OMWM refuge-wide but most of the work was concentrated in Units I and IV. These OMWM areas included the creation or restoration of 234 non-tidal ponds providing 19 acres of open water habitat. Work started in Unit I in 1991 and was completed in 1994 where 857 acres of OMWM systems were created. This included a total of 195 ponds (average size of 0.07 acres) providing 13.2 acres of open, ponded water. The actual OMWM acres created in Unit I were reduced by 77 from the earlier identified number of potential habitat equal to 934 acres as defined in the 1988 EA. The state surmised that these 77 acres were converted to non-mosquito breeding areas through snow goose grazing activities.

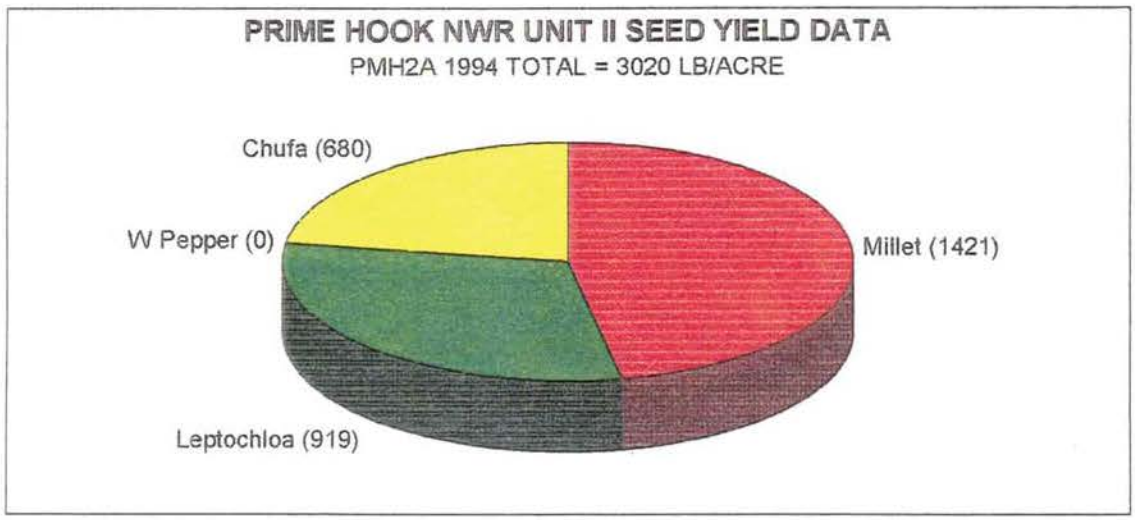
b) UNIT II.

i - PMH2A - (223 acres). Drawdown was initiated on April 1, 1994 and completed in 61 days. Average soil salinities were around 8.0 ppt with certain 'hot spots' exceeding 15.0 ppt in areas suffering the worst effects from this year's salt intruding episodes due to storm surges. No formal vegdata griding is done in Unit's II or III because of the large portions of inaccessible areas within these units. Instead a combination of boat and ground surveys are used to estimate the dominant vegetation covertypes. In this unit for 1994 these consisted of the following: *Echinochloa walteri 45%; Leptochloa filiformis 30%; Cyperus spp. 12%; Typha angustifolia 10% Hibiscus palustris 5%;* and a 4 % mix of *Polygonum, Eleocharis, Lemna, Phragmites, Scirpus validus & Pluchea purpurascens.*

This year seed production data was collected in PMH2A from the inflorescence measurements of the 3 most dominant moist-soil plants. The average seed yield of wild millet tripled compared to last year's production from 491 lb/acre to 1421 lb/acre. Likewise sprangletop *(Leptochloa filiformis)* seed yields doubled from 325 lb/acre in 1993 to 619 lb/acre. These seed production increases are attributable mostly to 2 factors: 1.) increased acreage affected by snow goose "disking effects' that resulted in a large portion of the subunit's seedbed experiencing a type of shallow-disking soil treatment,* and 2.) more abuntant rainfall patterns distributed evenly throughout the growing season. { *NOTE: WE HAVE DUBBED OUR WHITE-FEATHERED GEESE AFFECTIONATELY AS OUR WHITE-BELLIED ROTO-TILLERS}

The pie-charts below show the seed yield distributions of measured moist-soil plants for subunit PMH2A and compare 1993 results with 1994.





During the spring and summer of 1994, breeding ducks (mostly wood ducks,gadwalls, black ducks and some blue-winged teal) made excellent use of food and brood cover in PMH2A. Wading birds, particularly great and snowy egrets and great blue herons congregated in large flocks while the slow drawdown was progressing to feast on concentrated food sources. By October through December large numbers of green-winged teal, pintails, black ducks, mallards, gadwalls, shovelers,

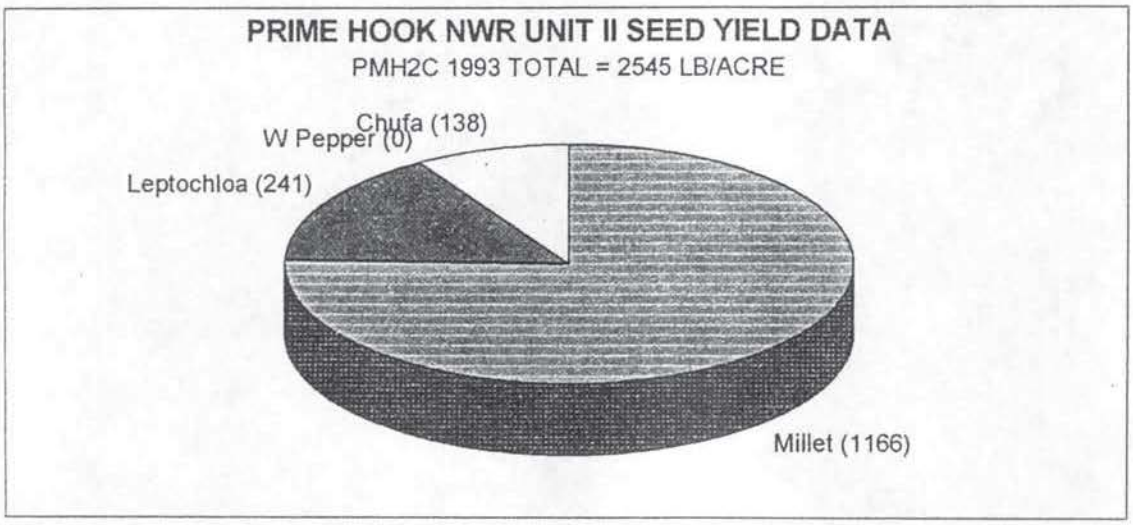
wigeon, Canadas, Snow geese and Tundra Swans made use of PMH2A as a major feeding, resting and loafing area.

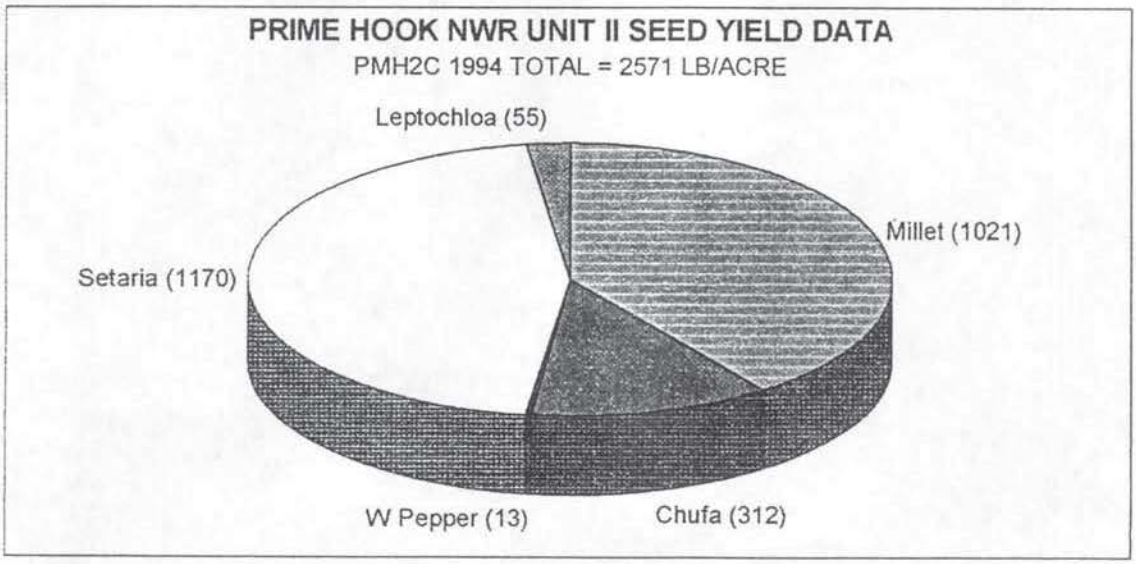
ii - PMH2B - (523 acres). Drawdown was initiated on 04/01/94 and completed on 06/10/94. The average soil salinity within the subunit was approximately 6.0 ppt with 'hot spots' exceeding 20 ppt. A greater diversity of plants occurred here as a mix of some salt tolerant vegetation co-exists with larger sections of fresh water moist-soil plants, based on the patchiness of soil salinity gradients. Phragmites encroachment has greatly expanded within this subunit from 10% to 20% this year. We shall target these growing areas with herbicidal treatment in 1995. Wild millet was the dominant vegetative type (30%) followed by Phragmites, spikerushes 15% and chufa 5%. Of noteworthy mention were the particularly robust stands of *Eleocharis* this year throughout PMH2B, compared to last year when 90% of the spikerush crop was lost by July due to the extended drought. The remaining 30% of the subunit was covered with a mix of fresh water plants including *Typha,Leptochloa,Setaria,Polygonum,Bidens, Galium, & Hibiscus spp.* and *Spartina patens, S. alterniflora, and S. cynosuroides.* No seed production data was collected for PMH2B as access is not always guaranteed during wet and drying periods. Great blue, green-backed, and tri-color herons, great, snowy and cattle egrets, eagles, and osprey made excellent use of the deeper pool areas in the spring and summer, while killdeer, terns, dunlin, dowitchers, yellowlegs, willets, glossy ibis, black skimmers, cormorants, gulls and nesting ducks partitioned use onto the mudflats and shallower sections of the subunit. There is no public access to PMH2B so it also makes it a popular refugia for all manner of wetland species throughout the year. This fall and winter snow and Canada geese, pintails, green-winged teal, shovelers, wigeons, hooded mergansers, scaup, coot, red heads, and some canvasbacks heavily used this subunit for feeding, resting, and seeking some relief from hunting pressures.

iii - PMHC - (530 acres). Drawdown was initiated on 04/10/94 and completed in 71 days. Average soil salinities were about 7.5 ppt. Characteristic vegetation included wild millet (30%), cattail (25%), sprangletop (15%), chufa (10%), and 10% represented by a mix of *Phragmites, Setaria,* and water pepper. The rest of the unit was cover-

ed in *Hibiscus, Eleocharis, Bidens,* with some small patches of *S. patens* and *alterniflora.*

Seed yield estimates for PMH2C included 5 species of moist-soil plants: wild millet 1021 lb/acre, nutsedge 312 lb/acre, water pepper 13 lb/acre, sprangletop 55 lb/acre and foxtail 1170 lb/acre accounting for a total average yield of 2571 pounds per acre for the entire subunit, a slight increase over last year's total yield with a somewhat more diversified mix of plants.





Differences in plant yields and distributions between years in PMH2C

are attributed to weather factors and varied soil disk-treatment patterns created each year by snow geese.
Variations in extended mudflats opened up by snow geese also increased the potential shorebird habitat this year in PMH2C and the birds took full advantage. Although shorebird numbers were generally down refuge-wide, double the number of shorebirds used this area, especially when PMH4A was not available for their use in July and August. Red knots, ruddy turnstones, least, western and semipalmated sandpipers, dowitchers, dunlins, semipalmated plovers, yellowlegs, common snipe and woodcock were the prevalent shorebirds. It was also a favorite spot for large flocks of glossy ibis and black skimmers. PMH2C is also extensively used by breeding ducks in the spring and summer especially woodies, and to a lesser extent by gadwalls and blue-winged teal. We experimented this year in using this subunit as a new site for duck banding efforts. Access problems required that a 2-mile round trip by canoe be made to reach the site. However these efforts paid off by the new and interesting discoveries that we made.

These trips were initiated in mid-June and ended in late July. They afforded us extra "observational opportunities" on a daily basis instead of weekly trips to witness the summer's good use by various water- and shorebirds. We also learned new facts about our breeding wood duck population. During the breeding season at Prime Hook we usually band about 50 to 100 adult hen woodies each year in nest boxes located in Unit III, but very rarely do we ever see any drakes around. We wondered where they spent their time and as it turned out this part of Unit II proved to be their favorite haunt. In the first 12 days of trapping we banded close to 125 adult woodie drakes, and by the end of June, including retraps, we caught close to 200 woodies - all drakes. We did not start to trap any female or local woodies until mid-July.

Our first nesting bald eagles in refuge history were also located in this subunit where they were observed feeding heavily on carp and other fish in the spring and summer, and on what else but snow geese in the fall and winter. Other birds using PMH2C throughout the year included ospreys, marsh hawks, herons, egrets, belt-king fishers, coots, mallards, black ducks, green-winged teal, shovelers, wigeon, gadwalls, Canada geese and tundra swans.

iv - PMH12 - (26 acres). Drawdown was initiated on 05/01/94 and completed in 31 days. Soil salinities averaged around 5.0 ppt. Three weeks later this paddy field was deep disked (i.e., > 4") by a co-operative farmer. This was an attempt to reduce the percentage of upland weeds and increase the coverage of more desirable moist-soil plants. Based on vegdata analysis we succeeded in eliminating high frequencies of milkweeds, crabgrasses and horsetails.

Vegdata grid sampling of PMH12 showed the dominant vegetation to be Olney three-square (25%), up from 7% cover last year, sprangletop (23%), up from 15% in 1993, and wild millet (11%) also an increase from last year. Other plants included saltmarsh aster, nutsedge, spike-rush, switchgrass and curly dock. The sad part was that in the fall, much of this food was not readily available to waterfowl due to the lack of water in part because of lack of rain and in part due to the completely eroded dike, destroyed in the March Nor'easter. Whenever water did manage to stay on the field for any length of time immediate waterfowl use and some wading bird use occurred.

C. UNIT III.

i. PMH3A (290 acres). This subunit experienced a double drawdown in 1994. The first, a partial drawdown initiated on 01/01/94, was completed in 29 days. Reflooding occurred faster than we had planned due to heavy spring rains, and then a complete, late spring drawdown was initiated on 5/01/94 and moist-soil conditions achieved in 60 days.

This subunit consists of about 20% open water. Cattail is the dominant vegetation (25%). The millet component increased this year from 10 to 20%, *Rumex* 15%, chufa 10%, marsh mallow 5%, bulrush and other plants 5%. Dense vegetative stands and deeper pool levels preclude shorebird use in PMH3A but it is a favorite area for wading birds, least and American bitterns, common and Forster's terns and rails in the spring and summer, while ducks and geese made excellent use of it in the fall and winter months.

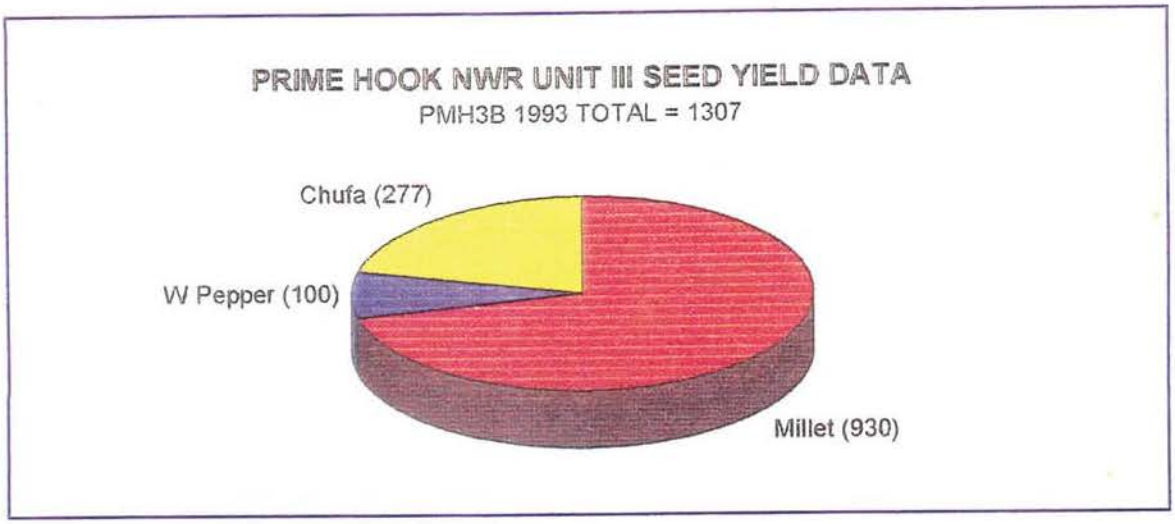
We collected seed yield data this year for 2 of the major moist-soil plants found in this subunit; wild millet, which averaged 1454 lb/acre,

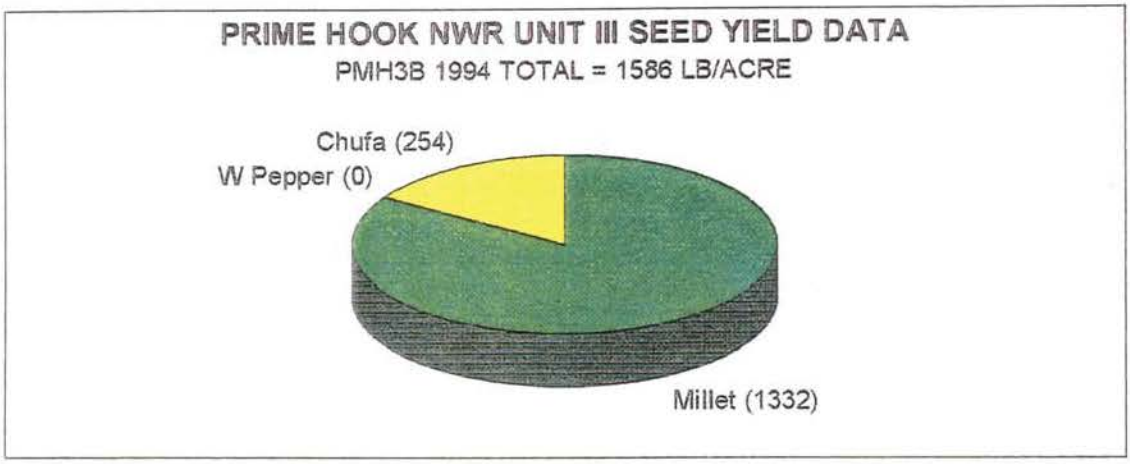
and chufa, producing about 444 lb/acre. Nutsedge yield values fell about mid-range of all sampled areas, but the millet stands were the most lush and tallest (> 1.5 M), generating the highest yield (1454 lb/acre) of all sampled areas. This tremendous millet crop can probably be ascribed to 4 effects that worked synergistically: 1) drainage patterns in Unit III, 2) excellent soil disturbance by ice-scouring effects created in January's drawdown and snow geese, 3) good rainfall, and 4) added nutrient loading compliments of "white-bellied fertilizers."

PMH3A drains down towards the Petersfield Ditch water control structure (near Rt. 16). Located at the top of Unit III its soils were exposed first {See Figure 1}. This in turn probably created a longer duration of ice-scouring effects during the January drawdown producing a more intensified soil-treatment effect. Additionally, since its soils were exposed first during the spring drawdown, this also served to maximize sunlight exposure compared to the other areas within the unit.

ii. PMH3B (479 acres). This subunit also experienced the effects of a double drawdown, a partial initiated on 01/01/94 and a complete drawdown on 05/01/94 taking 60 days. Average soil salinities were around 6.0 ppt. Visual inspection revealed the following dominant vegetative types: cattail 30%, wild millet 25%, open water 20%, chufa 10%, water willow and marsh mallow 5%, Phragmites 5%, spikerushes , duckweed and other plants 5%. Very little sprangletop or water pepper were evident this year as opposed to large patches of these plants in 1993.

Seed yield data collected in PMH3B included only 2 moist-soil plants in 1994 compared to 3 last year. Millet yielded 1332 lb/acre up from 930 lb/acre in 1993. The estimated total seed yield for the entire subunit increased by 22% (1586 lb/acre). This overall seed production increase is partly credited to the extreme weather oscillations in 1993 from wet to very dry to very, very wet compared to excellent moist-soil conditions throught the growing season in 1994.





Large portions of this subunit plus some smaller adjacent areas in PMH3C and PMH3D are managed for rails and bitterns. A management scheme for this group of birds is very different than for shorebirds because the former select dense, rank vegetation. Migrant sora, Virginia and clapper rails readily use this area in the spring as a large component of cattails provide them with the dense vegetative structure they require immediately upon their arrival. Good use by soras and rails had also been observed in Unit IV's impoundment in the fall. Use by this group of PMH4A is limited to late summer and fall because decomposition, ice, snow and heavy grazing by waterfowl completely destroys the vertical structure of annual plants come spring. PMH3B however, has the rank vegetation in the form of cattails in place and readily available for early spring arrivals.

We try to provide optimum breeding habitat for Rallidae members. Since they display a continuum of preferred water depths at nest sites, (Rundle and Fredrickson 1983), we recognize that stabilized water regimes would be catastrophic to a diverse breeding rail community. Therefore slow and staggered drawdowns provide the greatest array of optimal conditions.

We also endeavor to target Ardeidae family members in this subunit. Once again good numbers of least and American bittern used PMH3B in the spring and early fall and excellent use by great and snowy egrets, great blue, green-backed, and black-crowned night herons was noted.
Our wetland management scheme provides diversified mosaics of wetlands supplying foraging sites to meet the breeding-season food requirements for a large great blue heron rookery located adjacent to the refuge which we survey every year.

Once again slow drawdowns must be endorsed as they concentrate prey within the heron species' foraging range, whereas rapid drawdowns fail to emulate the natural recession of waters that makes fish and crayfish more susceptible to predation. Rapid oxygen depletion will also result from fast drawdowns when temperatures reach 30^{o} C or more, enhancing opportunites to create fish-kills.

Therefore our major management objective in the spring and summer for PMH3B was the protection of nesting habitat for rails, bitterns, and other wading birds and to provide a continual availability of wetland foods throughout the breeding and post-breeding season to maximize the breeding success of these birds.

Bald eagles, ospreys and marsh hawks also took advantage of these available food resources and used PMH3B extensively during the spring and summer. In addition glossy ibis, willets, yellowlegs, killdeer, and flocks of dunlin and dowitchers used the drawndown patchy areas in early spring just before vegetation started to germinate, especially during high tide. Finally, very heavy use was made in the fall and winter by migrating waterfowl for procuring food and cover.

iii. PMH3C (500 acres). This subunit was also influenced by the double drawdown previously described for Unit III. Soil salinities averaged around 5.0 ppt. Dominant vegetation included wild millet, cattail, sprangletop and a very noticeable expansion of our wild rice *(Zizania aquatica)* area to the right of the headquarters dike (about 40 acres).

PMH3C is connected to a 7 mile long meadering creek (Prime Hook Creek) which feeds a vast network of ponds and ditches creating another extensive mosaic of vegetated zones with open water zones. The areas of PMH3C influenced by this creek are characterized by thick and heavy growth of *Peltandra, Pontedaria, Polygonum* and button-bush that provide excellent wood duck brood cover, along with diverse mixes of *Carex, Cyperus, and Lemna* plant species. Forested wetlands in this area also provide excellent wildlife habitat.

Other dominant plant types interspersed within PMH3C's interior include *Decodon, Hibiscus, Rumex, Eleocharis, Scirpus, Bidens, Kostelezkya, Ludwigia,* and some patches with Phragmites and fleabane. A pattern of extremely heavy use by waterfowl was attested to by high numbers of ducks and record numbers of Snow geese. Large flocks of 50,000+ snow geese converged in this area and PMH3D almost methodically every evening in November and December.

iv. PMH3D (620 acres). The double drawdown routine was also experienced by this subunit. Soil salinities averaged about 4.0 ppt with hot spots located near and around Route 16. Mudflats created by consecutive year snow goose eat-outs were revegetated by predominantly sprangletop, spikerushes, some fleabane and stunted millet. Further up into the middle of PMH3D the dominant vegetation becomes cattails, water willow, and marsh mallow with patches of sprangletop, taller millet and nutsedges. Persistent Phragmites stands continue to expand along Prime Hook Creek adjacent to our eastern boundary.

PMH3D is still sustaining the largest snow goose eat-outs which keep expanding every year and 1994 was no exception. Shorebirds made limited use of these mudflats in early spring but denser vegetative

stands by fall proscribed their utilization. Another first for the refuge was the confirmation on July 25 of nesting black-necked stilts when 4 young and 2 adults were discovered and the whereabouts of their nest located. Black-necked stilt nesting has been suspected for the past 5 years based on observations, but this was the first confirmation.

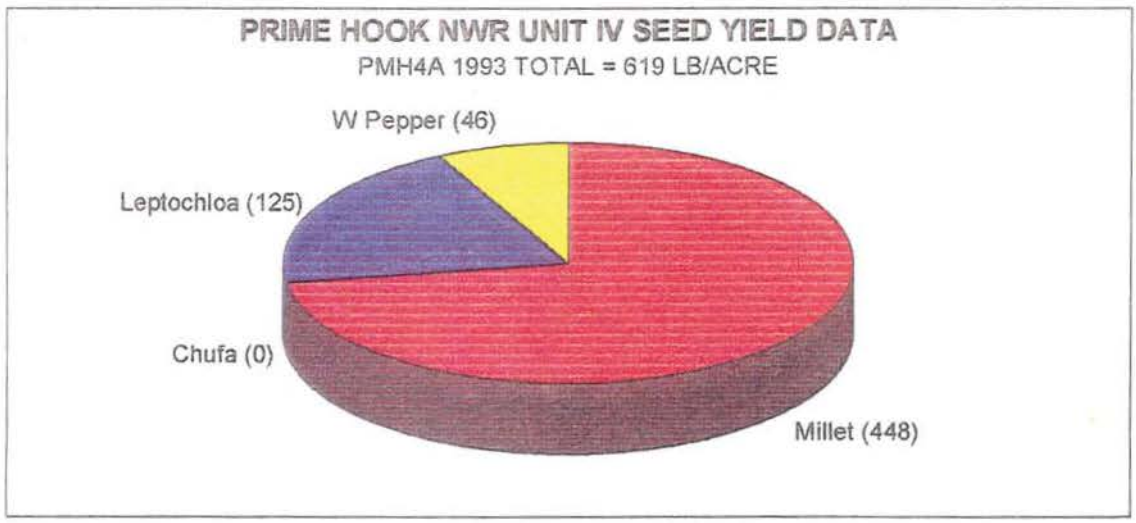
Excellent brood use by woodies, gadwalls and black ducks were noted all summer long, especially with the good water availability. Wading birds also used the area well. Excellent use by waterfowl continued in the fall and winter as large numbers of snow geese, green-winged teal, pintails, gadwalls, shovelers, black ducks, mallards and coots were everywhere.

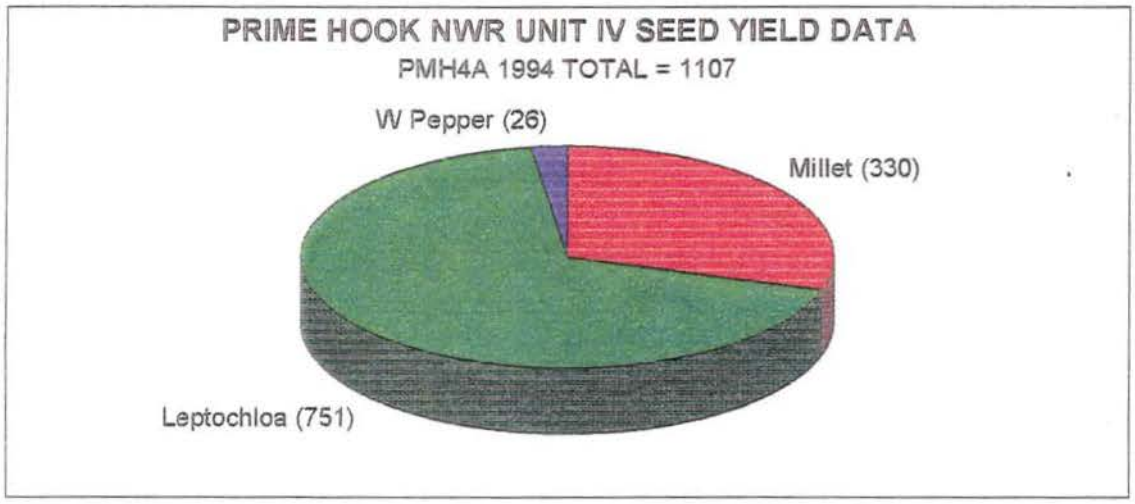
D. UNIT IV.

i. PMH4A (168 acres). Unit IV was drawn down earlier this year than in 1993 (3/01/94) and was completed in 70 days. As described in Part III's section one's general discussion a condition of semipermanent water was maintained beginning three weeks after drawdown completion (5/10/94). Logs were put back in both structures by early June and rainfall was then captured subsequently. Water levels were then retained anywhere from 4" to 12". Even during the mini-drought experienced in October, sheet water was always present on Virgie's Pond.

Soil salinities here were still the highest of all the units but slightly lower than last year's average of about 15 ppt. Vegdata analysis indicated sprangletop as the dominant cover-type (41%), followed by bareground (or open water in this case) 13%, wild millet 8%, chufa 4%, cattail 2%, sea purslane 1%, water hemp 1% and Phragmites 1%.

Seed yield estimates included 3 moist-soil plants, wild millet 330 lb/acre, sprangletop 751 lb/acre and water pepper 26 lb/acre. The total average seed yield from PMH4A nearly doubled compared to last year's figures. This is ascribed to two influences: 1) the unit's seed bed being exposed to an attenuated interval of sunlight, the direct result of dewatering 30 days earlier in 1994, and 2) constant availability of water during the growing season. Despite this year's increases, PMH4A's seed yields still remained much lower than all the other subunits because of its high soil salinities.





Shorebird use was not very good in 1994 compared to last year. We witnessed a major decline of 66% in the month of May, usually our peak month. Since PMH4A is managed primarily for shorebirds, especially for the spring migrants , we failed in this major management objective for this unit. The physical amenities were there to attract them, i.e., by late April mudflats were created with shallow water (2-6") interspersed with sparse vegetation and/or bare ground.But one fact remains undeniable as to why we could not keep them around: the lack of invertebrate densities needed to sustain shorebird interest. Minimally, 100 individuals per square meter are required to make it worth their while. Recommendations to remedy this will be made in

Part IV of this report.

On the bright side, wading bird use greatly increased due to the semi-permanent water conditions in PMH4A throughout the summer. In addition, the first nesting Ospreys since 1972, successfully raised 2 young which we banded in July. The fledglings and adults were seen fishing all summer long in PMH4A. King rails and black rails were also observed using the drier sites of fresh marsh and salt marsh interface along the border of PMH4A.

IV. PLANS AND OBJECTIVES FOR PRIME HOOK'S 1995 WATER MANAGEMENT PLAN

We plan to continue asynchronous drawdowns in 1995 and the avoidance of repetitive yearly manipulations in the form of similar dates for flooding, dewatering or the performance of specific soil treatments in each impoundment. We shall also continue to experiment with double drawdowns in Unit III and implement them for the first time in Unit II.

We will conduct a winter drawdown in Unit II from 1/30/95 to 3/21/95. Pool levels will start around 2.60 and then we will dewater to within a range of 0.60 to 1.00. In this way Unit II's wetlands can remain dry through some of the winter with the intent that vegetation will decompose more rapidly if it is exposed than if it is inundated. We will then return water slowly to the unit in April raising pool levels from 2.20 to 2.60. Hopefully the newly flooded unit will have sustained a flush of nutrients and the overwintering midge larvae will grow rapidly. Secondly, we will initiate a slow spring drawdown on 5/1/95 and extend it to 7/15/95.

In Unit III, we shall continue for a second year to practice another double drawdown. The first, a partial dewatering will start somewhat later this year, on 2/10/95 with the pool level range receding from 2.60 to 1.60. Then a slow reflooding will occur during the last 3 weeks of February to raise pool levels back to 2.20 - 2.40. Subsequently, a slow spring drawdown will be initiated a month earlier than 1994, starting on 3/1/95 and targeted for completion on 5/15/95. With greatly expanded snow goose-created mudflats in Unit III, we hope to at least target the spring shorebird migrants before dense annual vegetation stands take over these 'eat-out' areas by late July and August.

We concede that there were potential breeding hot spots in PMH3D in 1994 created by our drawdown schedules especially in two problem areas. The first is the old run of Back-Bay Ditch. When Unit III is drawn down it becomes a breeding hot spot but co/ownership of this ditch may present problems as to how to affect a solution. It is most unlikely that the owner would consider OMWM work on his property but perhaps it is an avenue that the state could explore. Secondly, a large section of PMH3D, east of Petersfield Ditch on the western side of Broadkill Beach, is a remnant patch of mosquito ditches dug in the 30's, and it too generates hot spot breeding areas during drawdowns. But it should be noted that at no time during 1994 was there any significant breeding within the PMH4A impoundment itself (also referred to as Virgie's Pond) especially since semi-permanent water levels were maintained all summer long. Some mosquito breeding was detected along the ponds' edges and fringes of the salt marsh behind the pool, but the fact that the state sprayed Unit IV seven times within an eight-week interval leads us to the conclusion that the 395 acres of OMWM system within this unit failed.

Since Unit IV is the smallest impoundment it therefore allows the greatest control in water level management capabilities. This coupled with its good location adjacent to Delaware Bay's coastline, makes it the most amenable unit for shorebird management with potential to target both the spring and fall migrants. Considering we dedicate PMH4A for shorebird management primarily in the spring and summer plus its small size, we would not practice winter drawdowns here. This is because after late reflooding in the fall, water levels must be maintained before the first heavy freeze. Further maintenance of flooded conditions are necessary to enable chironomids and other invertebrates to re-populate, as well as to ensure survival of larvae over winter.

In Unit IV for 1995 we plan to initiate a slow spring drawdown on 3/21/95 and target completion around 5/15/95 with the primary objective of attracting spring shorebird migrants. After this initial peak pulse of shorebirds, we will replace logs and attempt to hold no more than 2" to 6" of water on the mudflats from 6/10/95 to around 6/30/95. This will serve a two-fold purpose: 1) to stress any fleabane plants that will start to germinate from mid-May and 2) to aid in the re-inoculation of drawndown areas with chironomids for the fall migrants. Then will we eliminate this sheet water slowly from 6/30/95 to 7/15/95 in an attempt to optimize conditions for the Fall Migration in late summer.

In 1995 we will also begin to monitor invertebrates more closely to better understand their methods of dispersal and densities given certain water regimes and habitat conditions. Our water management design will have as its primary goal the increase of Chironomidae numbers in particular. Not Chironomidae diversity but rather increased midge biomass is what is required for maximum shorebird use.

The group of midges that are most important for migrating shorebirds are the Chironominae (bloodworm) species, in the genus (*Chironomus*). The larva are bright red (due to high hemoglobin conc.) and they grow to be as large as 24 mm in length. They are usually the earliest colonizers in newly available habitat we are planning to create this spring and summer. We are currently developing an experimental design and monitoring regime to adopt a more systematic method for recording invertebrate response in 1995 versus the casual invertebrate sampling of the past few years.

Our drawdown design will tentatively create areas of shallow open water where emergent vegetation will not shade the bottom in the most central areas of PMH4A, thus allowing increased algal growth on the submerged portions of vegetative stands. The chironomids should then form tubes of detritus along this vegetation and feed on the algae from these tubes. Since they flourish in warm, shallow water and are bright red they become prime targets for foraging shorebirds and should be easy to detect during monitoring.

However, to successfully perform any meaningful monitoring of chironomid and shorebird numbers, we would have to eliminate mosquito spraying activities on the 168 acres of PMH4A in 1995. Cessation of spraying activities would accomplish 2 major goals: 1) reduce the negative impacts on the chironomid community and 2) provide a significant reduction of disturbance to shorebirds. Disturbance is a critical factor to consider when trying to manage for shorebirds using coastal habitats. Managed wetland units like PMH4A are heavily used at night and during periods of high tides when other coastal feeding areas are unavailable. PMH4A can also become an important roosting area, necessary for rest and feather maintenance if disturbance is minimized particularly at dusk. Therefore to maximize the temporal and spatial availability of PMH4A's habitats for foraging and roosting shorebirds disturbance should be reduced or optimally eliminated.

Phragmites monitoring and control will continue in 1995. We will concentrate on spot treatments in Units III and IV and depending on how many dollars we are funded for we shall also fully utilize our cooperative agreement with the state to stretch our dollars-worth.

The Service's cookie cutter was used in 1994 for two days in Unit III. We have scheduled the cookie cutter for the entire month of March in 1995 and hopefully will be successful in getting it. We will then be cleaning ditches in Units II and III which will enable us to move about the inpoundments better to conduct wildlife surveys and vegetation sampling.

Storm damages accrued from the 1994 Nor'easter will also need to be addressed even though no funding is available. First, our rice dike in Field 212 needs to be rebuilt and select areas within this paddy field will also require sand panning. Next, additional flapgates (2 at the Petersfield Ditch WCS, 2 at the Prime Hook Creek WCS, & 1 in the Slaughter Canal WCS) are needed to enhance water management capabilities especially during storm events to more rapidly draw off excessive water and reduce our chances for flooding private lands. And thirdly, the entire toe of the Unit III dike has been heavily eroded. The superficial repairs made this spring will not suffice to maintain its integrity. Further repairs are required. This work will necessitate Army Corps and state wetland permits to accomplish.

In addition, we can not emphasize enough the importance of trying to renew and intensify our efforts to acquire the undeveloped portions of the beach between Fowler Beach and Prime Hook Beach in order to be able to maintain the integrity of both Unit II and III impoundments. If this storm damaged area continues to be ignored while continued rates of Bay water intrusions go unabated, it will probably take less than 5 years to revert Unit II back to predominantly salt marsh vegetation. Once this occurs, all waters continuing on south from Oak Island would eventually run-off into Unit III and also ruin its integrity. This would be extremely short-sighted after considering all the time, money and effort it took to create these impoundments. It could nullify the incredible success story of Prime Hook's restored wetlands that has translated into phenomenal waterfowl and other wildlife use. Service ownership of this beach area would provide a double benefit: 1) it would allow us to maintain the dunes in order to protect the greatly enhanced wetlands contained within our two major impoundments, and 2) it would

provide important habitat for migrating and nesting shorebirds including potential piping plover habitat.

Finally, to conclude this annual water management program we would like to emphasize the existence of some uniquely created fresh water communities. These were a direct result of the extensive habitat restoration and enhancement activities of the past 10 years which included actions in the form of Phragmites spraying and varying water level regimes. These various pockets of singular fresh-water wetland communities are adjacent to impounded areas and are influenced by our imposed hydrological management schemes. Upon noticing these patches two years ago, we invited several botanists from the Delaware Natural Heritage Program to visit them and comment on their importance. On three separate days (August 18, 19 and 27 in 1993) two small plots were inventoried and a significant number of state rare plants were found. These same botanists were disappointed that we were unable to obtain proposed funding for a mini-inventory last year, but revisited the areas with counterparts from the Virginia Heritage group and made further discoveries of more rare plants in the summer of 1994.

In light of the large numbers of rare plants and unique communities identified, we really need to acquire some minimal inventory data to evaluate what is on hand so that special managment concerns can be intelligently incorporated into current water level management and Phragmites control programs to avoid the needless destruction or extirpation of any existing threatened or endangered species that we do not know about. Furthermore, we do not have the expertise to do this. Therefore these unique communities are deserving of our attention in the form of some concerted effort to inventory, identify, and then monitor them.

The relevance of obtaining this information and studying the ecology of these newly created wetland plant communities would be extremely important to our vegetation management efforts and water level manipulating applications. Knowledge about these communities would provide us with a framework to better understand how these communities are put together by determining the species composition, structure and location. Then we could re-evaluate what combinations of water level manipulations and/or other factors helped produce these vegetative changes so as to exploit these techniques to further induce similar vegetative changes in more areas.

A bare-bones inventory by the Heritage folks would cost about $7,500 to $10,000. This would include multiple visits throughout the growing season (about 14 days afield) plus an additional 10 days for paperwork. This paperwork would include a final report describing a comprehensive biological inventory of rare plants, animals and biological communities with descriptions of rare and/or special plant forms, population sizes, and habitat parameters. Although ranked as a high priority we failed to obtain any funding for 1995 and 1996 for this extremely important project. Therefore we are now soliciting assistance from other offices for different ideas on how to tap and channel into any creative funding alternatives to accomplish this inventory.

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Figure 1. General Map with Management Unit and Subunit Divisions
PRIME HOOK NATIONAL WILDLIFE REFUGE
Sussex County, Delaware

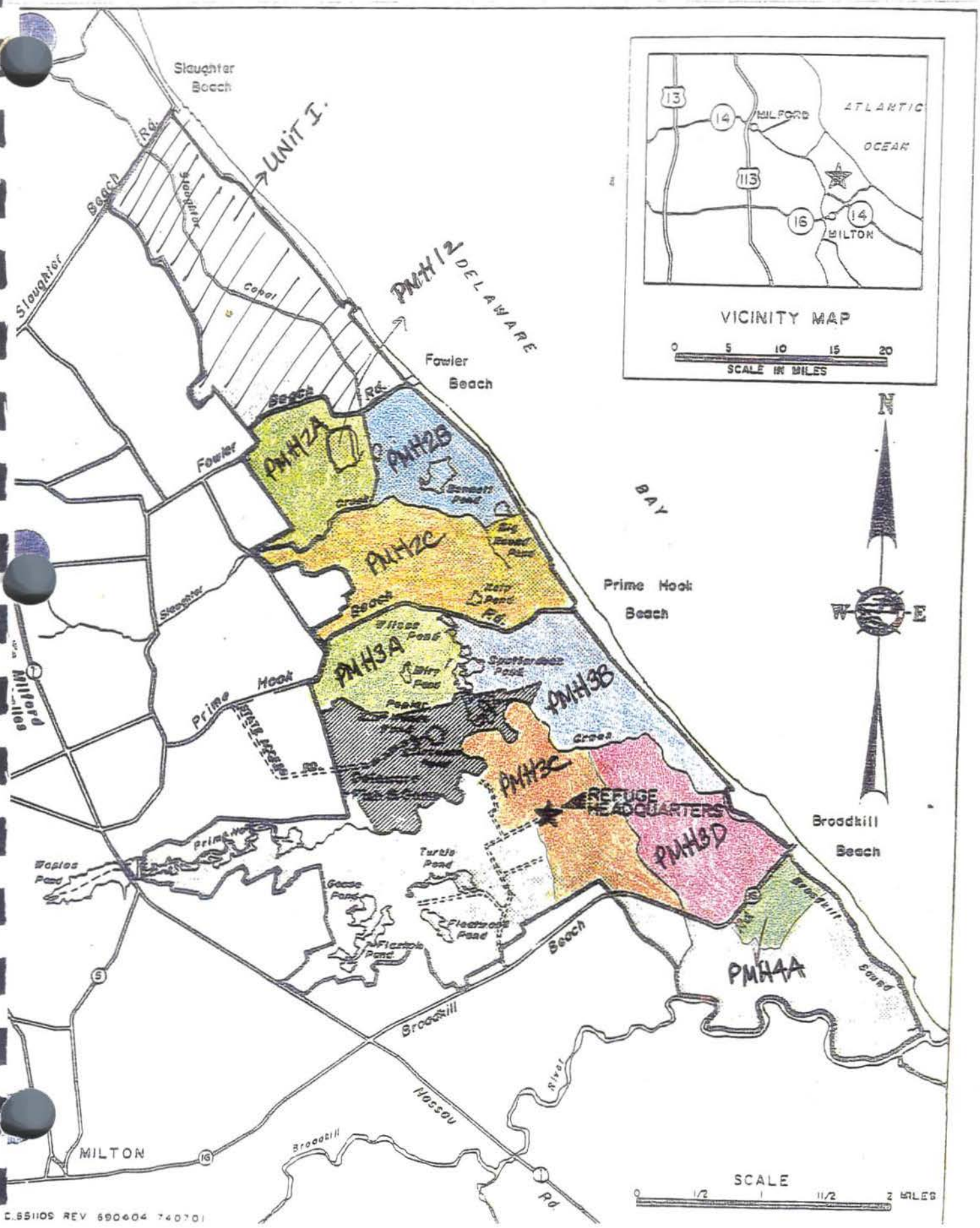
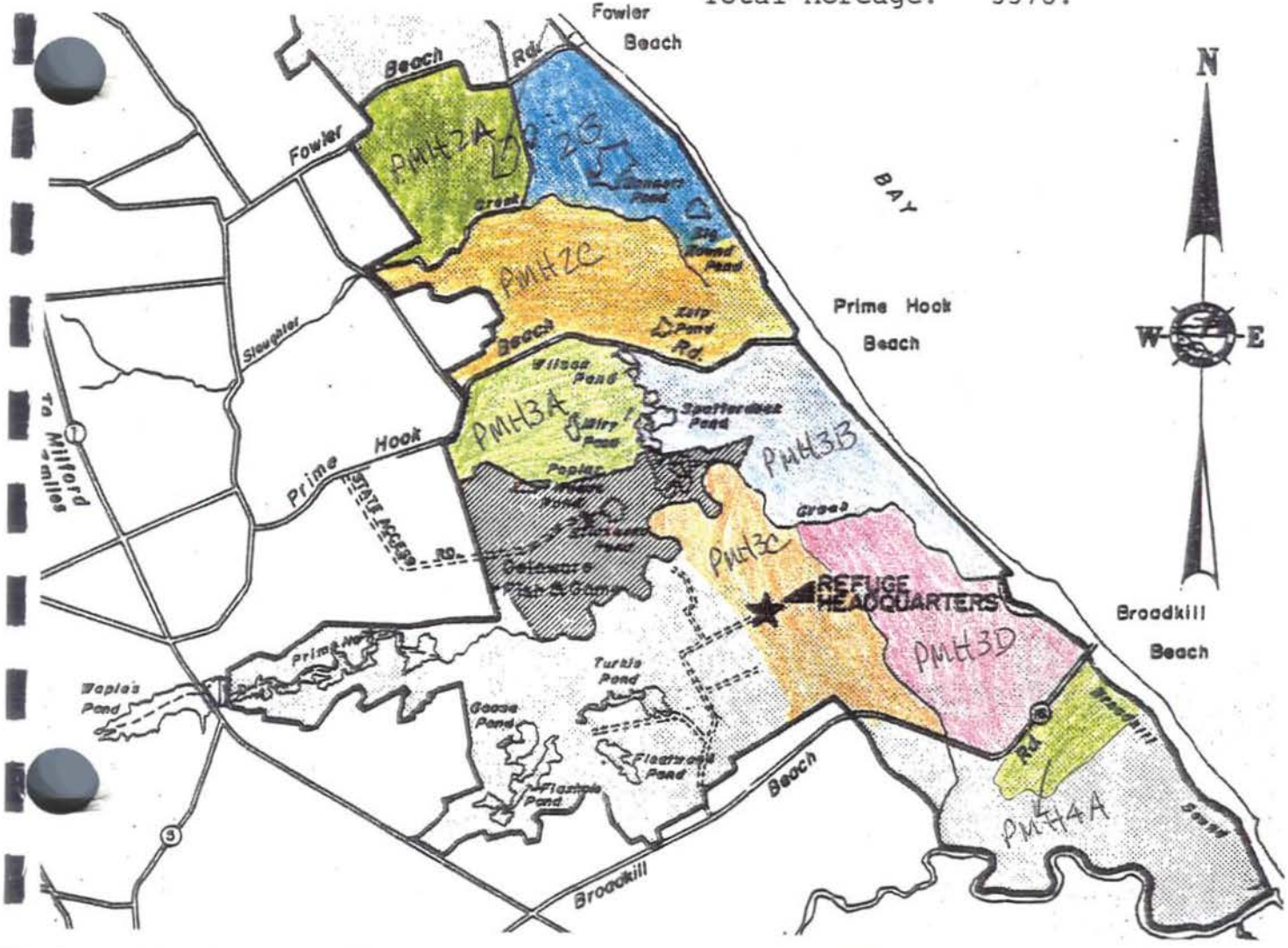


Figure 2. Prime Hook National Wildlife Refuge Moist-Soil Management Subunit Designations and Descriptions

Refuge Impoundments

Org. Number : 51560
Refuge Name : Prime Hook NWR

Unit #	Impoundment Name	Acres
PMH2A	subunit A of Unit II	223.
PMH12	Paddy Field 212 in A	26.
PMH2B	subunit B of Unit II	523.
PMH2C	subunit C of Unit II	530.
PMH3A	subunit A-Unit III	291.
PMH40	Paddy Field 340 in A	14.
PMH3B	subunit B-Unit III	479.
PMH3C	subunit C-Unit III	500.
PMH31	Rabbit Pond in III	0.25
PMH32	Frog Pond in III	0.3
PMH33	GBH Pond in III	0.75
PMH34	Raccoon Pond in III	0.25
PMH35	Deer Pond in III	0.25
PMH3D	subunit D-Unit III	620.
PMH4A	subunit A in Unit IV	168.
PMH41	Rectangle Pond / IV	0.75
PMH42	Duck-trap Pond / IV	0.5
PMH43	Yellow Sneak Pond-IV	0.5
	Total Acreage:	3378.



Appendix A.

Impoundment Vegetation Frequency & Cover Report

Org. Number : 51560 Report Date : 01/09/95
Refuge Name : Prime Hook NWR

Unit #: pmh12 Paddy Field 212 in Growing Year : 1994

Begin DrawDown : 05/01/94 Soil Type : 2 = Mineral Soil
Finish DrawDown: 06/01/94 Soil Salinity (ppt) : 5.

Seed Bed Treatment : 6 = DeepDisk - Dry

Veg. Number	Common Name	% Cover	Frequency
121	Dock	0	5
106	Common Reed	0	5
25	Water-Starworts	0	5
132	Sesbania	0	5
102	Switchgrass	0	5
110	Smartweeds	0	5
51	Large spikerush	0	10
107	Salt Marsh fleabane	1	30
124	Pickleweed	3	5
148	Cyperus	3	55
0	Bare Ground	4	75
15	Saltmarsh Aster	5	40
46	Walter millet	11	75
83	Sprangletop	23	80
131	Olney Three square	25	100
1003	Desirable Veg.	-0-	85
1001	Moderate Salt Veg.	-0-	100
1000	Salt Tolerant Veg.	-0-	35
	TOTAL COVER	169	

Number of Sample Plots = 20.

Note About SeedBed Treatment During the Growing Year
Date of Treatment: 06/23/94

This paddy field was deep disked (> 4") with a 25' wide by 18" blade pulled by 150 4x4 tractor on 6/23/94. Then PMH12 was kept dry until after the senescence of some undesirable plants (like milk- weeds and horse nettle) was realized. This was an attempt in increase the precentage of more desirable moist-soil vegetation within this paddy field.

Appendix A.

Impoundment Vegetation Frequency & Cover Report

Org. Number : 51560
Refuge Name : Prime Hook NWR

Report Date : 01/09/95

Unit #: PMH4A Subunit A in Unit

Growing Year : 1994

Begin DrawDown : 03/01/94
Finish DrawDown: 05/10/94

Soil Type : 1 = Organic Soil
Soil Salinity (ppt) : 15.

Seed Bed Treatment : 13 = Semiperm

Veg. Number	Common Name	% Cover	Frequency
21	Beggarticks	0	2
110	Smartweeds	0	2
81	Saltmarsh Mallow	0	4
133	Foxtail	0	4
129	Three-square bulrush	0	4
124	Pickleweed	0	6
102	Switchgrass	0	6
136	Cordgrass	0	6
150	Duckweed	0	12
107	Salt Marsh fleabane	0	6
15	Saltmarsh Aster	0	18
106	Common Reed	1	18
149	Water Hemp	1	20
163	Sea Purslane	2	22
142	Cattail	2	26
38	Chufa	4	30
46	Walter millet	8	48
0	Bare Ground	13	60
83	Sprangletop	41	98
1003	Desirable Veg.	-0-	98
1001	Moderate Salt Veg.	-0-	44
1000	Salt Tolerant Veg.	-0-	12

TOTAL COVER 166

Number of Sample Plots = 50.

Note About SeedBed Treatment During the Growing Year
Date of Treatment: 08/27/94

On 8/27/94 Allen Chorman with a fixed wing sprayed about 15 acres of Phragmites with the aquatic herbicide RODEO at a 2 qt/acre rate.This is part of an ongoing program to keep in check any Phragmites expansion within PMH's impoundments.

Appendix A.

Impoundment Drawdown Dates 1994

Org. Number : 51560
Refuge Name : Prime Hook NWR

Rpt. Date : 01/09/95

Unit #	Impoundment Name	DrawDown Iniatiated	Drawdown Complete	Drawdown Days
PMH3A	Subunit A-unit III	01/01/94	01/30/94	29
PMH3A	Subunit A-unit III	05/01/94	06/30/94	60
PMH3B	subunit B-Unit III	01/01/94	01/30/94	29
PMH3B	subunit B-Unit III	05/01/94	06/30/94	60
PMH3C	Subunit C-Unit III	01/01/94	01/30/94	29
PMH3C	Subunit C-Unit III	05/01/94	06/30/94	60
PMH3D	Subunit D-Unit III	01/01/94	01/30/94	29
PMH3D	Subunit D-Unit III	05/01/94	06/30/94	60
PMH2A	Subunit A of Unit II	04/01/94	06/01/94	61
PMH2B	Sunubit B of Unit II	04/01/94	06/01/94	61
PMH2C	subunit C of Unit II	04/01/94	06/01/94	61
PMH12	Paddy Field 212 in2A	05/01/94	06/01/94	31
PMH4A	Subunit A in Unit IV	03/01/94	05/10/94	70

Impoundment Soil Information 1994

Org. Number : 51560
Refuge Name : Prime Hook NWR

Rpt. Date : 01/09/95

Unit #	Impoundment Name	Soil Type	Soil Salinity	Soil Treatment
PMH3A	Subunit A-unit III	1	5.	1
PMH3A	Subunit A-unit III	1	5.	1
PMH3B	subunit B-Unit III	1	6.	7
PMH3B	subunit B-Unit III	1	6.	7
PMH3C	Subunit C-Unit III	1	5.	1
PMH3C	Subunit C-Unit III	1	5.	1
PMH3D	Subunit D-Unit III	1	4.	7
PMH3D	Subunit D-Unit III	1	4.	7
PMH2A	Subunit A of Unit II	1	8.	1
PMH2B	Sunubit B of Unit II	1	6.	7
PMH2C	subunit C of Unit II	1	7.5	7
PMH12	Paddy Field 212 in2A	2	5.	6
PMH4A	Subunit A in Unit IV	1	15.	13

Soil Type : 1 = Organic Soil
2 = Mineral Soil
3 = Nothing but Sand

Soil Treatment : See list of Codes Within Manual.

Soil Salinity = ppt.

Appendix A. Vegdata Program Summary

Refuge Impoundments

Org. Number : 51560
Refuge Name : Prime Hook NWR

Rpt. Date: 01/09

Unit #	Impoundment Name	Acres
PMH2C	subunit C of Unit II	530.
PMH3B	subunit B-Unit III	479.
PMH31	Rabbit Pond in III	0.25
PMH32	Frog Pond in III	0.3
PMH33	GBH Pond in III	0.75
PMH34	Raccoon Pond in III	0.25
PMH35	Deer Pond in III	0.25
PMH2A	Subunit A of Unit II	223.
PMH2B	Sunubit B of Unit II	523.
PMH12	Paddy Field 212 in2A	26.
PMH3A	Subunit A-unit III	291.
PMH3C	Subunit C-Unit III	500.
PMH3D	Subunit D-Unit III	620.
PMH40	Paddy Field 340 in3A	14.
PMH4A	Subunit A in Unit IV	168.
PMH41	Rectangle Pond / IV	0.75
PMH42	Duck-Trap Pond / IV	0.5
PMH43	Yellow Sneak Pond-IV	0.5
	Total Acreage:	3378.

TABLE 5.

UNIT I. TRANSECT COMPARISON DATA

Prime Hook National Wildlife Refuge
1991 - TRANSECT DATA - UNIT I.
(% Cover)/(Frequency of Occurrence)
vs
1994 - TRANSECT DATA - UNIT I

SPECIES	TRANSECT (P-1) (8/28/91)	NUMBERS (P-1) (9/20/94)
Distichlis spicata	29.8/13	44.8/21
Spartina alterniflora	2.8/9	28.9/13
S. patens	.25/3	.25/3
Bareground	66.3/26	22.1/30

	(P-2) (8/28/91)	(P-2) (9/20/94)
Distichlis spicata	19.3/19	29.0/13
S. alterniflora	3.0/6	44.7/20
S. patens	3.8/8	-
Bareground	79.0/29	21.0/28
Pluchea purpurascens	2.5	-
Salicornia	-	2.5

Table 6. Unit III Water Regime for 1994 & Proposed 1995 Plan

ANNUAL WATER MANAGEMENT PROGRAM - Year 1995

Refuge Prime Hook NWR Water Unit Name or Number III

Maximum w.s. elevation permissible 2.8' msl *

Flowline elevation of lowest drain structure -2' NGVD

Average elevation of pool bottom (not borrow pit bottom). Unknown

1994 - Double Drawdown Dates@	I.A. Water Surface Elevations and Salinity for Past Year		II.A. Planned Elevation and Salinity for Program Year	
Date	Water Surface Elevations	Salinity (%of Sea Water)	1994 Water Surface Elevation	1995 Proposed Water Level
Jan. 1	2.45	2	2.60@	2.80
15	2.50	0	2.30	2.60
Feb. 1	3.30	3	2.00	2.00
15	2.75	0	2.00	1.80
Mar. 1	3.20	0	2.00	2.20
15	2.85	0	2.30	2.10
Apr. 1	2.80	0	2.30	2.00
15	2.50	0	2.30@	1.80
May 1	2.70	2	2.60	1.60
15	2.60	0	2.50	[illegible]
June 1	2.60	0	2.00	1.50
15	2.50	2	1.75	1.50
July 1	2.44	2	1.60	1.50
15	2.00	2	1.50	1.60
Aug. 1	1.90	0	1.50	1.60
15	1.60	0	1.50	1.60
Sept. 1	1.70	0	1.50	1.80
15	2.20	2	2.00	2.00
Oct. 1	2.60	0	2.00	2.00
15	2.20	0	2.30	2.20
Nov. 1	2.52	0	2.30	2.40
15	2.78	0	2.30	2.50
Dec. 1	2.58	0	2.60	2.60
15	2.98	0	2.60	2.60
31	2.80	0	2.60	2.60

* To be used for pools approved for brackish water management

Table 7. Unit II Water Regime for 1994 & Proposed 1995 Plan

ANNUAL WATER MANAGEMENT PROGRAM - Year 1995

Refuge Prime Hook NWR Water Unit Name or Number II

Maximum w.s. elevation permissible 4.0 NGVD *

Flowline elevation of lowest drain structure -2' NGVD

Average elevation of pool bottom (not borrow pit bottom). Unknown

1994 Drawdown date was 4/1/94 completed on 6/1/94

	I.A. Water Surface Elevations and Salinity for Past Year		II.A. Planned Elevation an Salinity for Program Yea	
Date	Water Surface Elevations	Salinity (% of Sea Water)	1994 Water Surface Elevation	1995 Proposed Water Level
Jan 1	2.05	0	2.30	2.60
15	2.15	2	2.30	2.60
Feb 1	2.40	0	2.20	2.00
15	2.45	0	2.10	1.50
Mar.1	2.40	0	2.20	1.00
15	2.00	2	2.10	1.40
Apr.1	2.08	2	1.70	1.60
15	2.32	2	1.50	2.00
May 1	1.20	0	1.30	2.30
15	1.24	0	1.10	2.10
June 1	1.80	2	1.00	1.80
15	1.52	2	1.00	1.60
July 1	1.66	2	1.00	1.30
15	1.60	2	1.00	1.00
Aug. 1	1.50	4	1.20	1.00
15	1.40	2	1.20	1.00
Sept.1	1.15	2	1.40	1.20
15	0.80	0	1.40	1.40
Oct. 1	1.65	0	1.60	1.60
15	1.05	0	1.60	1.80
Nov. 1	1.70	2	1.80	2.00
15	1.90	4	2.00	2.00
Dec. 1	2.28	2	2.10	2.10
15	2.40	2	2.20	2.20
31	2.10	0	2.30	2.30

* Unit II is revised NGVD -
Revised datum is 0.5 ft. lower than Unit III.

5RF-8/8/68

Table 8. Unit IV Water Regime for 1994 & Proposed 1995 Plan

ANNUAL WATER MANAGEMENT PROGRAM - Year 1995

Refuge Prime Hook NWR Water Unit Name or Number IV

Maximum w.s. elevation permissible 4.0'msl

Flowline elevation of lowest drain structure 0' msl

Average elevation of pool bottom (not borrow pit bottom). Unknown

Date	I.A. Water Surface Elevations and Salinity for Past Year: Water Surface Elevations	Salinity (% of Sea Water)	II.A. Planned Elevation an Salinity for Program Year: 1994 Water Surface Elevation	1995 Proposed Water Levels
Jan. 1	1.70	3	2.20	2.80
15	1.80	5	2.20	2.60
Feb. 1	2.90	4	2.20	2.60
15	2.40	4	2.20	2.60
Mar. 1	2.30	3	2.20	2.60
15	2.60	2	1.70	2.40
Apr. 1	2.70	0	1.20	2.20
15	1.60	2	1.20	2.00
May 1	1.10	2	1.40	1.80
15	1.80	2	1.60	1.60
June 1	1.00	2	1.60	1
15	1.10	2	1.60	1.20
July 1	1.00	2	1.60	1.00
15	1.10	2	1.60	1.20#
Aug. 1	1.10	3	1.60	1.20
15	1.20	3	1.20	1.30
Sept.1	1.10	3	1.20	1.40
15	1.00	2	1.20	1.40
Oct. 1	1.30	1	1.20	1.50
15	1.40	2	1.40	1.60
Nov. 1	1.60	6	1.60	1.70
15	1.75	2	1.80	1.80
Dec. 1	1.70	0	2.00	2.00
15	2.75	1	2.20	2.20
31	2.80	0	2.40	2.20

Place logs back in both WCSs to hold water.

Appendix A.

Species Percent Cover and Frequency Report

Org. Number : 51560 Prime Hook NWR

Veg. Number : 1003
Genus : -0-
Species: -0-
Com. Name: Desirable Veg.

Growing Year : 1994

Unit Number	Drawdown Date Begin	End	Soil Salt	Soil Type	Soil Treat.	Percent Cover	Freq.
PMH12	05/01/94	06/01/94	5.	2	6	-0-	85
PMH4A	03/01/94	05/10/94	15.	1	13	-0-	98

Soil Salt in ppt.
Soil Treatment : See manual for list of codes.

Soil Type : 1 = Organic
2 = Mineral
3 = All Sand

Species Percent Cover and Frequency Report

Org. Number : 51560 Prime Hook NWR

Veg. Number : 1003
Genus : -0-
Species: -0-
Com. Name: Desirable Veg.

Growing Year : 1993

Unit Number	Drawdown Date Begin	End	Soil Salt	Soil Type	Soil Treat.	Percent Cover	Freq.
PMH12	03/15/93	04/30/93	7.5	2	1	-0-	70
PMH4A	04/01/93	05/01/93	18.	1	7	-0-	70

Soil Salt in ppt.
Soil Treatment : See manual for list of codes.

Soil Type : 1 = Organic
2 = Mineral
3 = All Sand

Date: 09/01/94 Org. Number : 51560
Initial: AL Prime Hook NWR
Impoundment Number : PMH4A
Subject: T

Veg. Response	= V	Water Elev.	= E	Future Ideas	= I
Waterfowl Use	= W	Veg. Germination	= G	Crop Planting	= C
Shorebird Use	= P	Fish Notes	= F	Drawdown	= D
Adm. Note	= A	Soil Conditions	= S	Soil Treatment	= T
				Other	= 99

Note: This unit was drawndown a month earlier than last year (3/1/94) andupon drawdown completion (5/10/94),we planned to hold stablized lowwater levels throughout the growing season after this date.As a result at no time from May 15th on did this unit revert to bare-soil conditions. This was an attempt to prove to Mosquito Control that our drawdown regimes were not adversely impacting adjacent OMWM areas, or enhancing mosquito production w/in PMH4A.

Date: 09/02/94 Org. Number : 51560
Initial: AL Prime Hook NWR
Impoundment Number : PMH4A
Subject: T

Veg. Response	= V	Water Elev.	= E	Future Ideas	= I
Waterfowl Use	= W	Veg. Germination	= G	Crop Planting	= C
Shorebird Use	= P	Fish Notes	= F	Drawdown	= D
Adm. Note	= A	Soil Conditions	= S	Soil Treatment	= T
				Other	= 99

Note: Despite our efforts (see impoundment note dated 09/01/94) Mosquito Control bombarbed this same area with 7 treatments (4 of these withABATE-4E) concentrated within a 10 wk period from June to Aug 15th.We have been attempting to manage PMH4A for shorebirds but invertebrate monitoring showed the complete absence of chronomids and hencezero shorebird use after Mosquito Control spraying versus the presence of chronomids and high shorebird use during the

Date: 09/03/94 Org. Number : 51560
Initial: AL Prime Hook NWR
Impoundment Number : PMH4A
Subject: T

Veg. Response	= V	Water Elev.	= E	Future Ideas	= I
Waterfowl Use	= W	Veg. Germination	= G	Crop Planting	= C
Shorebird Use	= P	Fish Notes	= F	Drawdown	= D
Adm. Note	= A	Soil Conditions	= S	Soil Treatment	= T
				Other	= 99

Note: continued from impoundment note dated 9/2/94, pre-sprayed intervals. The contrast of record peak numbers of shorebirds from one week to zero shorebirds immediately after mosquito spraying applications proved to be very dramamtic. Two points to be made: 1)It seems OMWM isn't working and 2) Mosquito control spraying, esp. of products like ABATE is dimetrically opposed to PMH's management objectives for this impoundment.

Appendix A.

Species Percent Cover and Frequency Report

Org. Number : 51560 Prime Hook NWR

Veg. Number : 1001
Genus : -0-
Species: -0-
Com. Name: Moderate Salt Veg.

Growing Year : 1994

Unit Number	Drawdown Date Begin	Drawdown Date End	Soil Salt	Soil Type	Soil Treat.	Percent Cover	Freq.
PMH12	05/01/94	06/01/94	5.	2	6	-0-	100
PMH4A	03/01/94	05/10/94	15.	1	13	-0-	44

Soil Salt in ppt.
Soil Treatment : See manual for list of codes.

Soil Type : 1 = Organic
2 = Mineral
3 = All Sand

Species Percent Cover and Frequency Report

Org. Number : 51560 Prime Hook NWR

Veg. Number : 1001
Genus : -0-
Species: -0-
Com. Name: Moderate Salt Veg.

Growing Year : 1993

Unit Number	Drawdown Date Begin	Drawdown Date End	Soil Salt	Soil Type	Soil Treat.	Percent Cover	Freq.
PMH12	03/15/93	04/30/93	7.5	2	1	-0-	50
PMH4A	04/01/93	05/01/93	18.	1	7	-0-	61

Soil Salt in ppt.
Soil Treatment : See manual for list of codes.

Soil Type : 1 = Organic
2 = Mineral
3 = All Sand

Appendix A.

Species Percent Cover and Frequency Report

Org. Number : 51560 Prime Hook NWR

Veg. Number : 1000
Genus : -0-
Species: -0-
Com. Name: Salt Tolerant Veg.

Growing Year : 1994

Unit Number	Drawdown Date Begin	End	Soil Salt	Soil Type	Soil Treat.	Percent Cover	Freq.
PMH12	05/01/94	06/01/94	5.	2	6	-0-	35
PMH4A	03/01/94	05/10/94	15.	1	13	-0-	12

Soil Salt in ppt.
Soil Treatment : See manual for list of codes.

Soil Type : 1 = Organic
2 = Mineral
3 = All Sand

Species Percent Cover and Frequency Report

Org. Number : 51560 Prime Hook NWR

Veg. Number : 1000
Genus : -0-
Species: -0-
Com. Name: Salt Tolerant Veg.

Growing Year : 1993

Unit Number	Drawdown Date Begin	End	Soil Salt	Soil Type	Soil Treat.	Percent Cover	Freq.
PMH12	03/15/93	04/30/93	7.5	2	1	-0-	20
PMH4A	04/01/93	05/01/93	18.	1	7	-0-	88

Soil Salt in ppt.
Soil Treatment : See manual for list of codes.

Soil Type : 1 = Organic
2 = Mineral
3 = All Sand

Appendix D. Subunit PMH2A - Sea Grass Summary

File Plot Quit

PMH2A/94 (223 acres)

Plot	Species	#Heads	Height	Head:Dia.	Head:Ht.	lb/acre

Unit Summary

Plant	Ave. Est. Weight lb/ac	lb/Unit	% Freq	SD (lb/ac)
BarnG	1420.8	316829.5	86.0	838.5855
CrabG	0.0	0.0	0.0	
FoxTl	0.0	0.0	0.0	
Panic	0.0	0.0	0.0	
RiceC	0.0	0.0	0.0	
Sprgl	918.8	204892.4	46.0	1367.8736
Sedge	0.0	0.0	0.0	
Chufa	680.3	151702.4	36.0	1104.0609
RRSed	0.0	0.0	0.0	
WSmrt	0.0	0.0	0.0	
WPepr	0.0	0.0	0.0	
Total	3019.8	673424.3		

Ok

File:F2 Save F3 New F4 Open Alt-F3 Close Plot:F5 New F6 Edit F7 Sumry

File Plot Quit

PMH2A/94 (223 acres)

Plot	Species	#Heads	Height	Head:Dia.	Head:Ht.	lb/acre
1	BarnG	6	1.50	14	18	1338
1	Sprgl	80	0.40	12	14	1710
2	BarnG	8	1.50	16	22	1959
2	Chufa	4	0.60	19	10	2127
3	BarnG	3	1.40	11	16	886
3	Sprgl	100	0.60	15	11	2621
4	BarnG	4	1.20	14	18	997
4	Sprgl	80	0.50	13	13	1876
5	BarnG	3	1.40	15	21	1104
5	Chufa	4	0.30	13	7	681
6	BarnG	7	1.40	13	18	1289
6	Chufa	4	0.40	22	13	3302
7	BarnG	4	1.10	14	17	924
7	Chufa	2	0.50	16	8	635
8	Chufa	3	0.50	14	8	638
8	BarnG	5	1.50	15	20	1373
9	BarnG	4	1.30	17	22	1344
9	Sprgl	50	0.60	10	10	628
10	Sprgl	60	0.50	8	10	490

File:F2 Save F3 New F4 Open Alt-F3 Close Plot:F5 New F6 Edit F7 Sumry

Appendix B: Field Measurements - PMH2A

Appendix B: Field Measurements - PMH2A

File Plot Quit

PMH2A/94 (223 acres)

Plot	Species	#Heads	Height	Head:Dia.	Head:Ht.	lb/acre
10	Sprgl	60	0.50	8	10	490
10	BarnG	3	1.10	15	20	929
11	BarnG	4	1.30	17	21	1314
11	Sprgl	80	0.60	9	10	777
12	Sprgl	100	0.60	11	12	1589
12	BarnG	5	1.20	15	23	1303
13	BarnG	2	0.90	16	19	726
13	Sprgl	60	0.80	17	17	3139
14	Sprgl	80	0.60	17	16	3856
15	Sprgl	60	0.70	14	14	1805
15	BarnG	3	1.40	16	17	1075
15	Chufa	3	0.60	15	10	785
16	Chufa	3	0.60	15	8	785
16	Sprgl	50	0.70	14	13	1430
16	BarnG	6	1.40	14	19	1316
17	Sprgl	80	0.75	14	13	2211
17	Chufa	2	0.60	16	9	635
18	Chufa	2	0.50	26	15	2725
19	Chufa	3	0.60	22	13	2477

File:F2 Save F3 New F4 Open Alt-F3 Close Plot:F5 New F6 Edit F7 Sumry

File Plot Quit

PMH2A/94 (223 acres)

Plot	Species	#Heads	Height	Head:Dia.	Head:Ht.	lb/acre
19	Chufa	3	0.60	22	13	2477
19	Sprgl	50	0.50	9	12	593
20	Sprgl	50	0.50	16	13	1782
20	Chufa	4	0.60	22	12	3302
21	Chufa	4	0.50	14	8	851
21	BarnG	6	1.30	16	20	1482
22	BarnG	6	1.50	19	22	2027
23	BarnG	12	1.50	18	20	2810
24	BarnG	10	1.50	20	22	3076
25	BarnG	9	1.60	19	20	2530
26	BarnG	6	1.50	16	20	1587
26	Sprgl	60	0.70	12	19	1801
26	Chufa	3	0.50	19	10	1595
27	BarnG	8	1.40	14	17	1428
27	Sprgl	50	0.65	23	18	4938
28	Sprgl	50	0.70	14	17	1825
29	Sprgl	50	0.60	25	18	5799
29	Chufa	3	0.70	21	13	2154
30	Chufa	3	0.60	23	14	2830

File:F2 Save F3 New F4 Open Alt-F3 Close Plot:F5 New F6 Edit F7 Sumry

Appendix B: Field Measurements - PMH2A

Appendix D. Field Measurements - PMH2A

File Plot Quit

PMH2A/94 (223 acres)

Plot	Species	#Heads	Height	Head:Dia.	Head:Ht.	lb/acre
30	Chufa	3	0.60	23	14	2830
30	BarnG	4	1.30	15	23	1221
31	BarnG	7	1.50	16	22	1813
31	Sprgl	40	0.60	15	19	1849
32	BarnG	14	1.50	18	21	3265
33	BarnG	8	1.40	18	19	2016
34	BarnG	14	1.50	17	19	2787
34	Chufa	2	0.50	26	14	2725
35	BarnG	6	1.60	15	19	1507
35	Sprgl	50	0.60	15	19	2280
36	BarnG	7	1.30	15	16	1338
37	BarnG	11	1.30	19	21	2852
37	Sprgl	9	0.50	12	13	273
38	BarnG	12	1.40	15	20	2140
39	BarnG	5	1.40	16	20	1401
40	BarnG	4	0.90	11	15	661
41	BarnG	8	1.00	15	18	1368
42	BarnG	10	1.10	13	15	1237
43	BarnG	6	1.20	17	20	1532

File:F2 Save F3 New F4 Open Alt-F3 Close Plot:F5 New F6 Edit F7 Sumry

File Plot Quit

PMH2A/94 (223 acres)

Plot	Species	#Heads	Height	Head:Dia.	Head:Ht.	lb/acre
43	BarnG	6	1.20	17	20	1532
44	BarnG	14	1.30	16	23	2827
45	BarnG	10	1.40	16	22	2200
46	BarnG	8	1.30	17	21	1945
46	Chufa	7	0.60	17	11	2666
47	BarnG	7	1.40	15	21	1595
47	Sprgl	30	0.60	10	11	457
48	BarnG	7	1.30	15	17	1379
48	Sprgl	50	0.70	16	16	2211
48	Chufa	5	0.50	20	16	3101
49	BarnG	5	1.40	16	20	1401
50	BarnG	10	1.30	15	18	1736

File:F2 Save F3 New F4 Open Alt-F3 Close Plot:F5 New F6 Edit F7 Sumry

Appendix B: Field Measurements

Appendix D: Subunit Timber Stock Yield

File Plot Quit

2C/94 (500 acres)

Plot Species #Heads Height Head:Dia. Head:Ht. lb/acre

2 Unit Summary

	Ave. Est. Weight			
Plant	lb/ac	lb/Unit	% Freq	SD (lb/ac)
BarnG	1021.2	510625.0	85.0	627.5105
CrabG	0.0	0.0	0.0	
FoxTl	1170.4	585200.0	25.0	2199.7987
Panic	0.0	0.0	0.0	
RiceC	0.0	0.0	0.0	
Sprgl	55.0	27525.0	15.0	134.8978
Sedge	0.0	0.0	0.0	
Chufa	312.0	155975.0	50.0	461.0385
RRSed	0.0	0.0	0.0	
WSmrt	0.0	0.0	0.0	
WPepr	13.4	6700.0	15.0	32.7533
Total	2572.1	1286025.0		

Ok É

File:F2 Save F3 New F4 Open Alt-F3 Close Plot:F5 New F6 Edit F7 Sumry

File Plot Quit

2C/94 (500 acres)

Plot	Species	#Heads	Height	Head:Dia.	Head:Ht.	lb/acre
1	BarnG	5	0.90	15	20	1058
1	Chufa	3	0.60	15	9	785
2	BarnG	5	0.80	13	18	816
2	FoxTl	3	2.00	3	28	2788
3	Chufa	7	0.50	15	9	1832
3	BarnG	5	1.00	14	18	984
4	BarnG	6	0.90	16	20	1272
4	Chufa	4	0.50	14	9	851
5	BarnG	5	0.90	18	22	1400
6	Sprgl	40	0.60	10	7	406
6	Chufa	2	0.50	14	8	426
7	Chufa	2	0.50	10	8	155
7	BarnG	6	0.90	16	22	1351
7	Sprgl	35	0.50	10	7	350
8	BarnG	14	1.30	15	27	2895
8	WPepr	20	0.70	1	5	85
9	FoxTl	4	2.20	3	36	4779
10	FoxTl	2	2.50	4	51	6018
11	BarnG	5	0.90	15	20	1058

File:F2 Save F3 New F4 Open Alt-F3 Close Plot:F5 New F6 Edit F7 Sumry

Appendix B.

Appendix D: Field Measurements - Printout

File Plot Quit

2C/94 (500 acres)

Plot	Species	#Heads	Height	Head:Dia.	Head:Ht.	lb/acre
11	BarnG	5	0.90	15	20	1058
11	Chufa	8	0.60	10	6	620
12	BarnG	6	1.20	15	20	1332
13	BarnG	5	1.00	14	20	1035
13	Chufa	6	0.20	7	3	160
14	Chufa	7	0.30	10	5	543
14	BarnG	6	0.90	13	18	947
15	BarnG	6	1.20	15	21	1367
15	WPepr	20	0.70	1	6	93
15	FoxTl	4	2.40	4	27	6372
16	BarnG	5	1.30	14	20	1192
16	Chufa	6	0.40	10	6	465
17	BarnG	7	0.90	14	20	1186
17	FoxTl	4	2.50	3	26	3451
18	BarnG	5	1.00	14	20	1035
18	WPepr	19	0.80	1	5	90
19	BarnG	5	0.90	13	20	912
19	Sprgl	30	0.50	10	8	345
20	BarnG	5	0.90	12	6	585

File:F2 Save F3 New F4 Open Alt-F3 Close Plot:F5 New F6 Edit F7 Sumry

File Plot Quit
2C/94 (500 acres)
Plot Species #Heads Height Head:Dia. Head:Ht. lb/acre
20 BarnG 5 0.90 12 6 585
20 Chufa 3 0.30 12 6 402
File:F2 Save F3 New F4 Open Alt-F3 Close Plot:F5 New F6 Edit F7 Sumry

Appendix - B.

Appendix B: Subunit TRNT3A - Seed yield summa

File Plot Quit

3A/94 (291 acres)

Unit Summary

Plant	Ave. Est. Weight lb/ac	lb/Unit	% Freq	SD (lb/ac)
BarnG	1454.1	423137.3	100.0	233.5287
CrabG	0.0	0.0	0.0	
FoxTl	0.0	0.0	0.0	
Panic	0.0	0.0	0.0	
RiceC	0.0	0.0	0.0	
Sprgl	0.0	0.0	0.0	
Sedge	0.0	0.0	0.0	
Chufa	443.5	129064.3	76.0	317.5719
RRSed	0.0	0.0	0.0	
WSmrt	0.0	0.0	0.0	
WPepr	0.0	0.0	0.0	
Total	1897.6	552201.6		

Ok

File:F2 Save F3 New F4 Open Alt-F3 Close Plot:F5 New F6 Edit F7 Sumry

PMt

File Plot Quit

3A/94 (291 acres)

Plot	Species	#Heads	Height	Head:Dia.	Head:Ht.	lb/acre
1	BarnG	4	1.40	14	22	1184
2	BarnG	6	1.30	15	21	1420
2	Chufa	5	0.40	12	8	670
3	Chufa	6	0.45	12	8	804
3	BarnG	7	1.30	14	20	1396
4	BarnG	5	1.20	13	18	1026
4	Chufa	3	0.30	10	6	233
5	Chufa	4	0.30	12	6	536
5	BarnG	6	1.10	14	20	1189
6	BarnG	5	1.40	15	22	1379
6	Chufa	6	0.40	12	7	804
7	Chufa	3	0.30	10	6	233
7	BarnG	5	1.40	19	25	1909
8	BarnG	6	1.40	18	24	1949
9	BarnG	5	1.30	17	23	1547
10	BarnG	5	1.40	19	25	1909
10	Chufa	5	0.40	11	6	516
11	Chufa	6	0.40	12	8	804
11	BarnG	5	1.20	14	20	1140

File:F2 Save F3 New F4 Open Alt-F3 Close Plot:F5 New F6 Edit F7 Sumry

Appendix B

Appendix D: Field Measurements - PM#3A

File Plot Quit

3A/94 (291 acres)

Plot	Species	#Heads	Height	Head:Dia.	Head:Ht.	lb/acre
11	BarnG	5	1.20	14	20	1140
12	BarnG	5	1.30	15	22	1326
13	BarnG	6	1.20	15	20	1332
13	Chufa	6	0.40	12	8	804
14	Chufa	6	0.30	10	6	465
14	BarnG	6	0.50	16	22	1141
15	BarnG	6	1.40	15	22	1508
15	Chufa	5	0.50	12	6	670
16	Chufa	4	0.45	10	6	310
16	BarnG	5	1.50	16	23	1553
17	BarnG	7	1.40	15	21	1595
17	Chufa	6	0.50	12	6	804
18	BarnG	5	1.50	15	23	1461
19	BarnG	6	1.50	15	22	1560
19	Chufa	4	0.50	12	6	536
20	BarnG	5	1.50	15	21	1402
20	Chufa	5	0.40	12	6	670
21	Chufa	5	0.40	10	6	388
21	BarnG	6	1.40	15	23	1543

File:F2 Save F3 New F4 Open Alt-F3 Close Plot:F5 New F6 Edit F7 Sumry

File Plot Quit

3A/94 (291 acres)

Plot	Species	#Heads	Height	Head:Dia.	Head:Ht.	lb/acre
21	BarnG	6	1.40	15	23	1543
22	BarnG	6	1.40	15	22	1508
22	Chufa	3	0.40	10	6	233
23	Chufa	6	0.40	12	7	804
23	BarnG	7	1.50	14	21	1537
24	BarnG	6	1.30	15	23	1490
25	BarnG	5	1.50	14	22	1348
25	Chufa	6	0.35	12	6	804

File:F2 Save F3 New F4 Open Alt-F3 Close Plot:F5 New F6 Edit F7 Sumry

Appendix B. - Field Measurements (continued)

Appendix D. Submitted PMH3B

File Plot Quit

PMH3B/94 (479 acres)

Unit Summary

Plant	Ave. Est. Weight lb/ac	lb/Unit	% Freq	SD (lb/ac)
BarnG	1332.0	638028.0	100.0	177.7094
CrabG	0.0	0.0	0.0	
FoxTl	0.0	0.0	0.0	
Panic	0.0	0.0	0.0	
RiceC	0.0	0.0	0.0	
Sprgl	84.9	40643.1	15.0	211.4997
Sedge	0.0	0.0	0.0	
Chufa	254.4	121857.6	70.0	219.1962
RRSed	0.0	0.0	0.0	
WSmrt	0.0	0.0	0.0	
WPepr	0.0	0.0	0.0	
Total	1671.2	800528.7		

Ok

File:F2 Save F3 New F4 Open Alt-F3 Close Plot:F5 New F6 Edit F7 Sumry

File Plot Quit

PMH3B/94 (479 acres)

Plot	Species	#Heads	Height	Head:Dia.	Head:Ht.	lb/acre
1	BarnG	5	1.50	15	23	1461
1	Chufa	5	0.45	6	10	84
2	Chufa	4	0.50	8	10	159
2	BarnG	6	1.40	15	22	1508
3	BarnG	5	1.40	16	22	1468
3	Chufa	4	0.40	12	6	536
4	Chufa	3	0.40	10	6	233
4	BarnG	4	1.40	16	23	1348
5	BarnG	5	1.40	15	22	1379
5	Sprgl	40	0.50	10	8	426
6	BarnG	4	1.40	15	22	1250
7	BarnG	5	1.30	16	22	1415
7	Chufa	4	0.45	12	6	536
8	Chufa	4	0.30	10	6	310
8	BarnG	5	1.30	14	22	1243
9	BarnG	4	1.20	13	20	982
9	Sprgl	50	0.50	12	8	684
10	BarnG	5	1.30	13	21	1144
10	Chufa	4	0.50	10	8	310

File:F2 Save F3 New F4 Open Alt-F3 Close Plot:F5 New F6 Edit F7 Sumry

Appendix B.

Appendix D: Field Measurements: PMH3D.

File Plot Quit

PMH3B/94 (479 acres)

Plot	Species	#Heads	Height	Head:Dia.	Head:Ht.	lb/acre
10	Chufa	4	0.50	10	8	310
11	BarnG	5	1.20	14	22	1191
11	Chufa	3	0.40	10	6	233
12	Chufa	4	0.50	12	8	536
12	BarnG	5	1.30	13	22	1166
13	BarnG	6	1.50	17	23	1825
13	Chufa	3	0.45	10	6	233
14	Chufa	4	0.50	12	6	536
14	BarnG	5	1.40	15	22	1379
15	BarnG	5	1.40	15	22	1379
15	Chufa	4	0.30	12	6	536
16	Chufa	4	0.40	10	6	310
16	BarnG	5	1.40	14	22	1296
17	BarnG	5	1.20	16	22	1363
17	Sprgl	60	0.50	10	8	587
18	BarnG	4	1.40	17	23	1427
19	BarnG	4	1.30	16	23	1295
20	BarnG	3	1.40	15	22	1121
20	Chufa	4	0.50	12	6	536

File:F2 Save F3 New F4 Open Alt-F3 Close Plot:F5 New F6 Edit F7 Sumry

File Plot Quit

PMH4A (168 acres)

Unit Summary

Plant	Ave. Est. Weight lb/ac	lb/Unit	% Freq	SD (lb/ac)
BarnG	329.6	55372.8	30.0	560.1086
CrabG	0.0	0.0	0.0	
FoxTl	0.0	0.0	0.0	
Panic	0.0	0.0	0.0	
RiceC	0.0	0.0	0.0	
Sprgl	751.1	126184.8	83.3	513.1259
Sedge	0.0	0.0	0.0	
Chufa	26.3	4418.4	10.0	81.2205
RRSed	0.0	0.0	0.0	
WSmrt	0.0	0.0	0.0	
WPepr	0.0	0.0	0.0	
Total	1107.0	185976.0		

Ok

File:F2 Save F3 New F4 Open Alt-F3 Close Plot:F5 New F6 Edit F7 Sumry

Appendix B: Subunit PMH4A - Seed Yield Summary

Appendix B: Field Measurements. PMH4A.

File Plot Quit

PMH4A (168 acres)

Plot	Species	#Heads	Height	Head:Dia.	Head:Ht.	lb/acre
1	BarnG	10	1.60	13	17	1587
2	Sprgl	80	0.50	13	7	1058
2	Chufa	3	0.40	10	6	233
3	Sprgl	80	0.50	8	12	723
4	Sprgl	40	0.50	9	13	528
5	BarnG	6	1.50	13	18	1262
6	BarnG	5	1.50	13	19	1205
6	Sprgl	70	0.50	8	13	691
7	Sprgl	80	0.40	11	13	1352
7	BarnG	4	0.90	12	18	742
8	BarnG	4	0.90	13	18	789
8	Sprgl	70	0.50	10	12	951
9	Sprgl	60	0.50	8	12	568
10	Sprgl	60	0.50	8	13	607
11	Sprgl	70	0.40	8	12	625
12	Sprgl	60	0.50	9	13	740
12	BarnG	4	0.90	15	18	894
13	BarnG	3	0.80	15	19	754
13	Sprgl	70	0.50	10	15	1162

File:F2 Save F3 New F4 Open Alt-F3 Close Plot:F5 New F6 Edit F7 Sumry

File Plot Quit

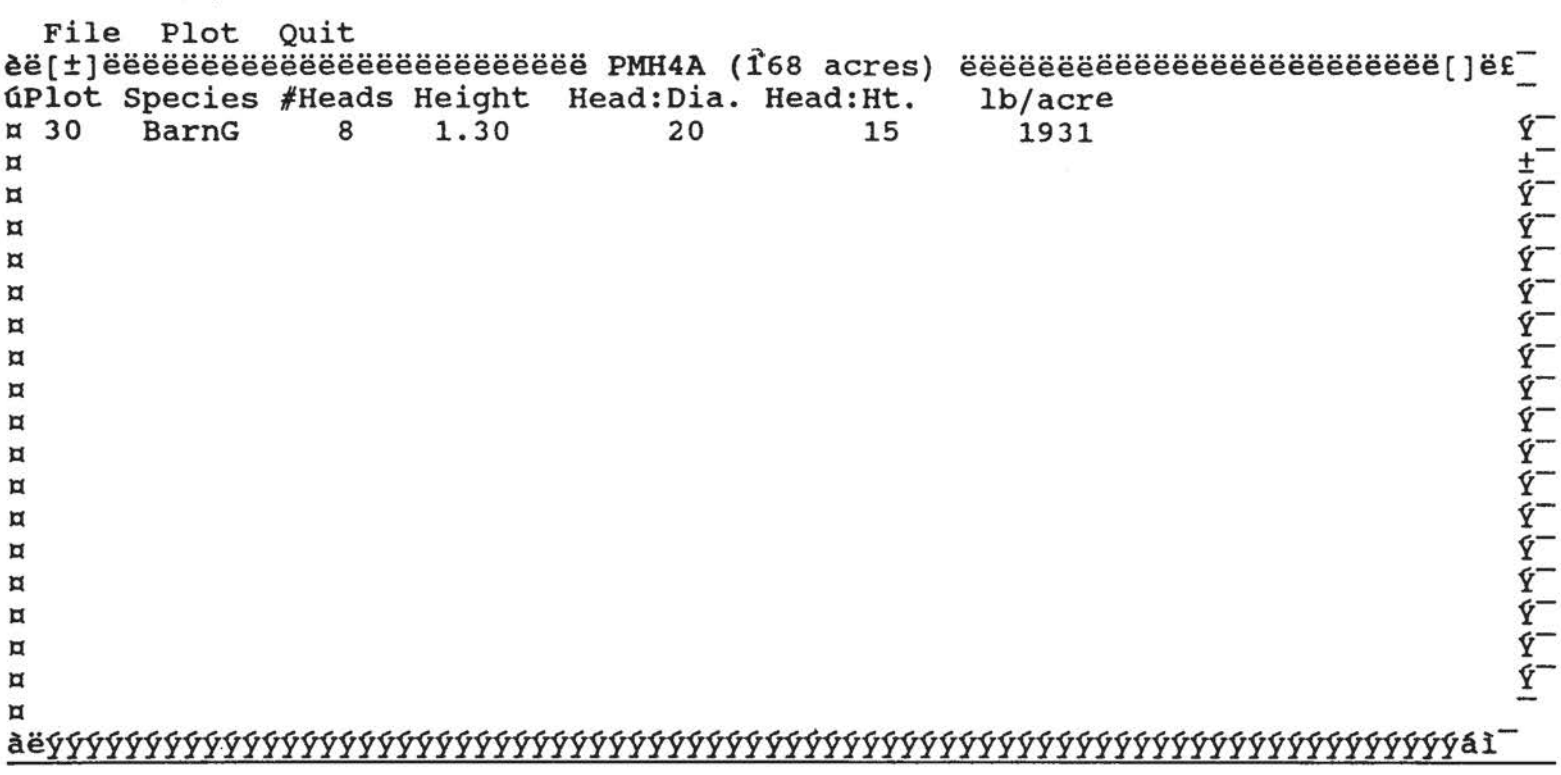
PMH4A (168 acres)

Plot	Species	#Heads	Height	Head:Dia.	Head:Ht.	lb/acre
13	Sprgl	70	0.50	10	15	1162
14	Sprgl	70	0.50	10	15	1162
15	Sprgl	80	0.40	10	12	1051
16	Sprgl	80	0.50	10	12	1072
17	Sprgl	60	0.50	8	13	607
18	Sprgl	70	0.50	8	12	645
19	Sprgl	80	0.40	9	12	867
20	Sprgl	60	0.50	9	14	790
21	Sprgl	70	0.50	9	12	790
22	Sprgl	60	0.40	8	13	586
23	Sprgl	70	0.50	8	13	691
24	Sprgl	80	0.50	9	13	953
25	Sprgl	55	0.50	11	13	976
25	Chufa	8	0.41	8	13	318
26	Chufa	6	0.40	8	10	238
27	Sprgl	70	0.50	18	11	2620
28	BarnG	5	0.90	11	16	724
29	Sprgl	50	0.30	10	13	718
30	BarnG	8	1.30	20	15	1931

File:F2 Save F3 New F4 Open Alt-F3 Close Plot:F5 New F6 Edit F7 Sumry

Appendix B.

Appendix D.


File Plot Quit
PMH4A (168 acres)
Plot Species #Heads Height Head:Dia. Head:Ht. lb/acre
30 BarnG 8 1.30 20 15 1931
File:F2 Save F3 New F4 Open Alt-F3 Close Plot:F5 New F6 Edit F7 Sumry

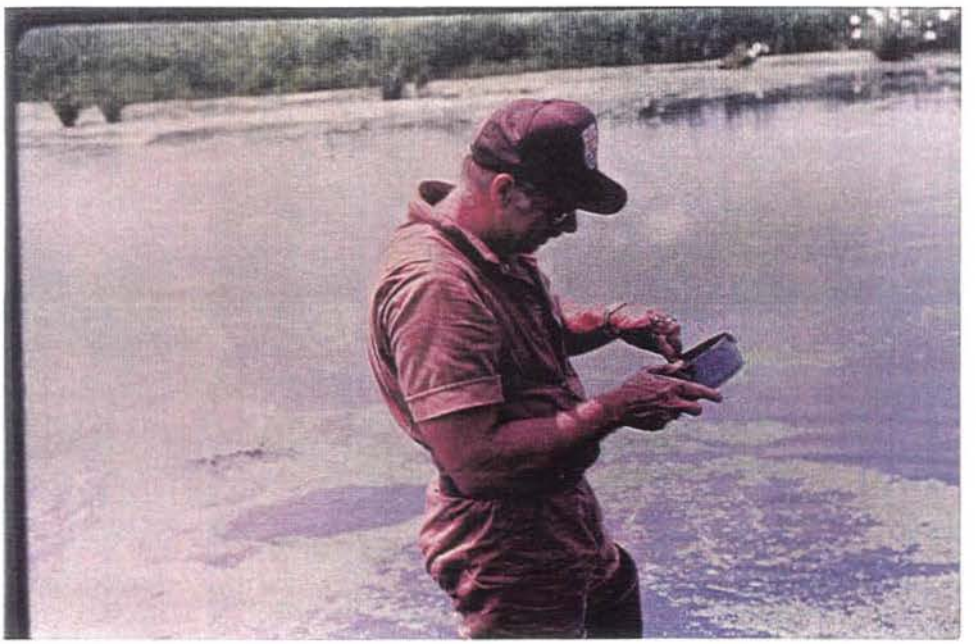
APPENDIX C. PHOTOS OF 1994 WATER MGT PROGRAM AT PRIME HOOK NATIONAL WILDLIFE REFUGE

DESPERATELY SEEKING INVERTEBRATES

Chironomid pickings were very slim in 1994

Some ES Folks giving a helping hand, grubbing for chironomids

DESPERATELY SEEKING INVERTEBRATES



More help from our friends. South Zone Biologist grubbing for red worms.

EUREKA!! RED GOLD!! Some chironomid numbers were found in Unit III, but nothing in Unit IV, our prime target area for shorebirds.

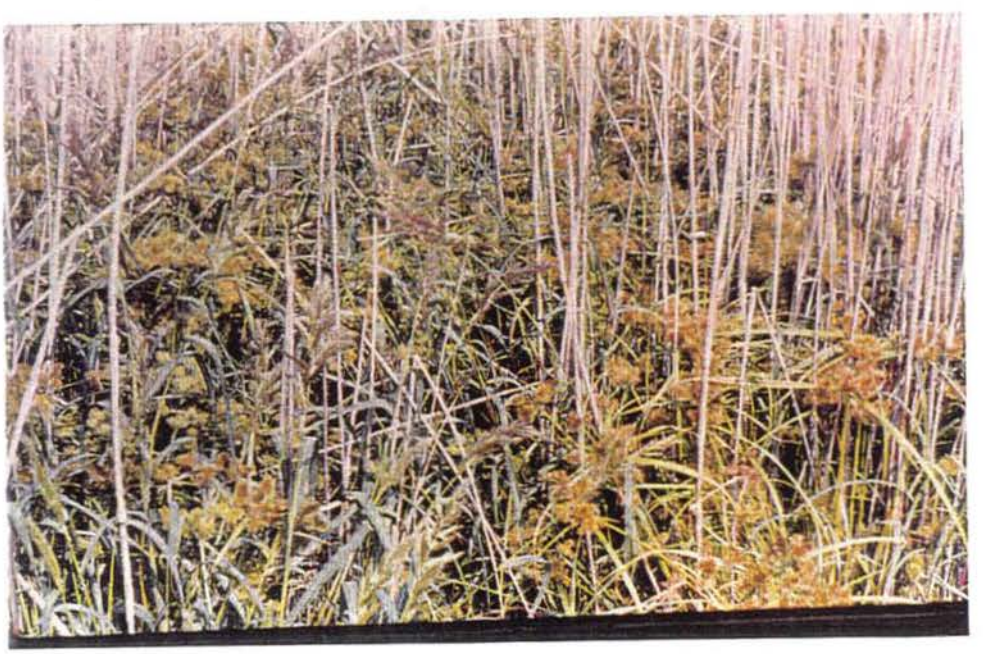
PMH3A: These photos depict thick, robust stands of wild millet (*Echinochloa walteri)* in this subunit. Refuge-wide the most vigorous millet growth was found in PMH3A where the average height of plants was about 1.5 meters. Seed yields were the grandest here for a refuge record of 1454 pounds per acre.

PMH3C: *Zizania* fields forever. Posh, thick stands of wild rice expanded to about 40 acres this year in Unit III with average plant heights above the 2.0 meter mark on the profile board.

PMH3D: This is a large snow goose eat-out area in Unit III. Created in the winter of 1993 it revegetated to predominantly fleabane. This year drawdown dates were carefully selected to preclude large stands of fleabane resulting in the majority of the mud-flat greening-up in spikerush *(Eleocharis)* with stands of wild millet along higher elevations. These were created by snow geese foraging activities which clumped balls of soil along certain spots.

PMH2A: This picture shows a small bareground spot which was surrounded by millet and sprangletop plants. Taken in late September it dramatically demonstrates the ample amount of seeds that are available in robust plants as seed-heads are dispersed. The highest sprangeltop seed yields refuge-wide were realized in this subunit at 919 pounds per acre. Millet yields were also quite excellent at 1421 pounds per acre.

PMH2C: Millet stands in this unit were robust, despite good roto-tilling activities by snow geese. Lower seed yields were attributed to higher soil salinities due to salt water intrusion events in Unit II this year. Millet average heights were around 1.0 meter and seed estimates were 1021 pounds per acre. Also note the sandier colored spots in the background near the treeline. These were Phragmites treatment areas. Most of these areas revegetated with thick mats of chufa and stunted millet plants. (Second photo below)



PMH4A. This is a front view of Unit's IV subunit off Route 16 depicting a condition of semipermanent water that was maintained from early June in an attempt to help sustain mosquito eating fish in nearby OMWM sites. The second photo shows a back view of PMH4A with patches of sprangletop, bareground, wild millet, chufa, cattail, sea purslane, Hibiscus and Phragmites.