BOMBAY HOOK NATIONAL WILDLIFE REFUGE
ANNUAL WATER MANAGEMENT PROGRAM-2003

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I. Introduction

This program describes the results of 2002's water management and outlines the planned management regimes for 2003. Water management objectives and techniques are discussed in detail in the refuge's Water Management Plan dated December 1995. All water management units (WMU's), including both the four major impoundments as well as the smaller moist soil units will continue to be managed as one dynamic wetlands complex. The objectives for each area are based on water management capabilities within each unit as well as providing a variety of freshwater habitats to the overall benefit of migratory bird resources not only for this specific refuge but rather the entire flyway. Consideration is given to a diversity of wildlife species within our managed wetlands but our primary emphasis will continue to be to provide optimum habitat for wetland dependent migratory birds, in particular, waterfowl and shorebirds.

II Highlights of 2002's Water Management Program

Although the rainfall yearly total was well above normal, distribution was far from ideal. During July and August the entire state was locked in a very significant drought. Farmers felt the greatest effects of the hot, dry period but adverse impacts to emergent vegetation in refuge impoundments following drawdown was quite evident as well. The dry period depleted the soil moisture and concentrated salts which resulted in many bare areas and reduced plant vigor in others. Conversely more than adequate rainfall occurred during the spring and late fall. (However, drawdowns were accomplished where proposed although to lower levels soil moisture levels than optimum) Greatfully, abundant fall rains enabled us to reflood the units to optimum levels by late October.

One application of mosquito larvicide (methoprene) was applied to portions of Raymond and Shearness Pool by Delaware Mosquito Control during late summer. This was the first time these units have been treated since 2000.

Two hundred acres of *Phragmites* was aerially treated with Rodeo on September 3rd within Raymond, Shearness, and Bear Swamp Pools.

New aluminum catwalks, and stoplogs were installed in Raymond and Shearness Pools making it much easier and safer to manipulate water levels in these two units. Also, an aluminum fish exclosure device was installed in each of these structures to lessen the incursion of carp into the pools during drawdown. Although many carp still were able to enter the pool they apparently exited as well since no die-offs were noted during drawdown. Further, dewatering was much simpler since we didn't have to manipulate

and keep clean the cumbersome old fish screens each day. This project was completed with the assistance of Ducks Unlimited.

Resident Canada geese continue to be a concern and now are estimated at 600-700 birds during the late summer peak. They continued to utilize Shearness, Raymond, Bear Swamp and Finis Pools as well as some adjacent crop fields where depredation is getting more noticeable each year. They obviously deplete a considerable amount of moist soil vegetation which could be better utilized by migratory birds. Where once nesting by these birds was confined to the impoundments, primarily Bear Swamp, they now are distributed over the entire 13,000 acre saltmarsh as well making nest locating a mammoth task.

For the past ten years we have utilized the vegetative plot method of collecting vegetation data in Raymond, Shearness, and Bear Swamp Pools. Data from the sampling effort was loaded into theVEGDATA program developed by the South Zone Biologist. Summary tables of our sampling efforts for 2002 and the two previous years are included in this report and results from the previous nine years are included within the appendix maintained in the refuge biologist's office. In addition, nine years of water level data and ten years of weekly bird survey data is maintained in the WATERLEV and CENSUS databases.

For the third year we contracted with herptologist Jim White of the Delaware Nature Education Society to conduct frog surveys over 13 points established among the refuge's freshwater wetlands. Hopefully, this survey will continue on an annual basis utilizing the Region's standard survey protocol.

This year marked the first year of our participation in the region's invasive species monitoring project. Although most of this year's emphasis was on mapping invasives in upland non-cropland fields we did begin mapping *Phragmites* stands within Raymond and Shearness Pool with the aid of GPS units and transfering the data to ARCVIEW.

III. As mentioned previously precipitation was actually well above normal for the year but distribution was far from optimum. The year began with a dry January and February which was basically a continuation of 2001's weather. Many moist soil units never became adequately flooded . Ice cover in the large units was only significant for the first two weeks of January. By March precipitation picked up and the period through June was actually quite wet. July and August were extremely dry and hot. The dry, hot conditions baked the pool bottoms in Raymond and Shearness and depleted soil moisture. Fall precipitation was more than adequate and enabled us to reflood the major impoundments to and above objective levels by late October.

2002 Weather Data

TEMPERATURE (F)

Month	Maximum	Minimum	Precip. (In)	Snowfall (In)	Avg. Precip(In)
January	71	18	2.57	2.5	3.10
February	73	19	0.61	tt	3.00
March	72	17	4.40		3.90
April	90	29	4.45		3.30
May	87	39	3.79		3.60
June	94	52	4.82		3.40
July	96	55	2.82		4.20
August	95	60	2.28		4.50
September	87	54	5.81		3.50
October	85	37	8.82		3.00
November	73	23	6.20		3.40
December	62	16	4.92	7.00	3.60
		TOTALS	51.52	9.5	42.50

IV Effects of Past Year's Water Levels on the Ecology of the Management Units

Below is a discussion of the conditions and events which were observed in each unit during the past year. Tables are included for each of the four major impoundments (Units 1-4) of planned and actual water levels during 2002 as well as planned levels for 2003. Results of this year's vegetation monitoring for units 1,2 & 4 are also included. Appendix data consisting of weekly surveys of waterfowl, shorebirds, and wading birds is stored in

the biologist's computer within the CENSUS database. This data is used to evaluate each year's water management program and to document changes when new procedures are instituted.

A. Bear Swamp Pool (BMH1)–240 acres

Plans for 2002 were to manage the pool in a manner that would favor the establishment and maintenance of submergent vegetation in at least a portion of the pool while attempting a partial drawdown to expose the higher elevations of the pool and favor plants other than fleabane. It was our hope that annuals would establish themselves on areas exposed during April and May. Plans included maintaining standing water over lower portions of the unit to maintain the submergents. Unfortunately Mother Nature did not cooperate. Lower than objective water levels were recorded to start the year and only began to rise during April. The partial drawdown rapidly developed into a total drawdown during the summer. Objective levels were finally achieved during the fall. Annual plant production, particularly sprangletop and panic grass was significantly more abundant than the previous two years. However, the total drawdown eliminated any chance for submergent growth. Further, there was slight (1%) increase in fleabane cover but this was not unexpected with the drop in bareground coverage from 53 to 34 %. Water column salinities in the pool varied from 1ppt during April to 20 ppt during August. Late summer soil samples yield soluble salt readings from 4 to 8 ppt with pH's of 5.4-6.8.

Waterfowl use was highest during early fall since this unit began to have available water first. Pintails, green-winged teal and mallards were the most abundant duck species with snow geese and canada geese using the area both for resting and feeding. Shorebird use during late summer was significant with up to 1000 peeps commonly recorded there. Least sandpipers, semi-palmated sandpipers and dowitchers were the most commonly recorded species.

B. Shearness Pool (BMH-2)–560 acres

Objectives for 2002 included a partial spring drawdown to encourage shorebird use following a complete elimination of surface water by July with re-flooding beginning gradually in late August through the remainder of the year. We were partially successful in establishing this water regime. Water levels to begin the year were well below objective and thus did not flood the back portions of the pool and western coves adequately to attract winter and spring waterfowl.

However, de-watering went well although the dry conditions after drawdown were not conducive to excellent emergent plant growth. Concentration of soil salts is suspected as a retardant which resulted in an increase in bareground coverage within the pool from 10 to 24%. Significant declines in sprangletop and panic grass were noted. The northeastern portion of the pool developed a robust stand of alkalai bulrush which far exceeded that seen in previous years. Millet coverage was identical to the previous year. Water column salinity levels during the year varied from 1ppt in mid-April to 18 in mid-August. Soil salinities during the summer varied between 3.5 to 7.0 ppt. Shorebird use during May and August was relatively high with up to 800 birds recorded during each survey. Dunlin, least sandpipers, semi-palmated sandpipers and plovers and black bellied plovers were the most abundant species. Waterfowl use, though impressive did not yield the spectacular numbers of previous years. Canada geese, snows and tundra swans often roosted in the pool during the fall with average populations of 1000, 5000, and 100 respectively. Peaks of 3700 pintails were recorded during late October but green-winged teal numbers were well below previous year's totals averaging less than 1000 birds. Teal numbers throughout the refuge remained low this year.

C. Finis Pool (BMH3)–205 acres

The nature of rainfall distribution during 2002 resulted in a water regime which differed significantly from that which was proposed. Higher than normal levels predominated through the spring period and prevented the planned April partial drawdown from occurring. Summer water levels were below objective with fall levels being at or near objective levels. Cattail and swamp loosestrife seem to be making significant in roads into the percentages of vegetative cover in the western portions of the unit. Bidens and smartweed production was below recent previous years. Fall use by waterfowl was relatively light. However, grebes, least bitterns, green herons and egrets were present in low to moderate numbers. Beaver remained active throughout the unit. Wood duck brood use remained at lower levels than were observed during the mid-90's. Some significant mallard use was noted during late December when up to 200 birds were recorded.

D. Raymond Pool (BMH4)–95 acres

Although the drawdown timing and objective levels were reasonably approximated for this pool the mid summer drought greatly effected plant growth within the unit.

pH readings? may be very low due to oxidation.

Much of the central portion of the unit dried excessively and actually became dusty. Little to no vegetation occurred over most of the pool. Soils cracked and spikerush was found at very low levels and similar to that of 2001. Soil salinities varied between 6 and 8 ppt which is relatively low considering the length of the dry period. Despite the low productivity of the pool center good emergent growth was recorded in all of the pool coves. Millet and panic grass was abundant and produced robust seed heads. Softstem bulrush was reduced however in the back portion of the pool and in the northeast corner.

This unit continued to be the best for shorebird useage with thousands of dowitchers, dunlin, and semipalmated sandpipers present during portions of May. Smaller numbers of avocets(usually less than 100), semipalmated plovers, and stilts were recorded during spring as well and in smaller numbers during the fall. Heavy snow goose feeding during the fall removed most standing emergents by years end. Duck use by mallards, shovellers and pintails was good but lack of spikerush probably contributed to lower feeding activity than in previous years.

E. Moist Soil Units

A total of 28 small moist soil units varying in size from 1 to 12 acres were managed primarily for late winter and spring waterfowl and shorebird habitat. The ability to hold water varies markedly from unit to unit and all are rainfall dependent. All units had ample water supply through May and each was utilized by waterfowl, shorebirds, and wading birds to some extent. Units 5,6,7,14, and 15 were the most productive often holding dozens of puddle ducks. Following is a summary of habitat notes on selected moist soil units during the past year.

BMH5-(A-Pool)-12 acres–Much of this unit was mowed during late summer.

BMH6-(B-Pool)-8 acres–No manipulation of this unit during 2002.

BMH7-(Straughn Pool)-2 acres–The rank cattail stand in this unit was completely mowed during late summer.

BMH8-(Hourglass Pool)–2 acres–.No manipulation of this unit during 2002.

BMH10–1 acre–No manipulation of this unit during 2002.

BMH12–(Cottman Pool)–1 acre–Cattail mowed over 95% of the pool surface during late summer.

BMH13–2acres–.Willow within this unit was mowed during late summer.

BMH14–2 acres–Cattail and phragmites in this unit was mowed during late summer.

BMH216 &221–10 acres total– Phragmites and cocklebur were mowed in these units during late summer.

BMH222 (Steamboat 7.5 acres)-Johnsongrass and thistle within this unit were treated with glyphosate during the summer.

F. Tidal Marsh (12,000+acres)

No active habitat management of the saltmarsh other than waterfowl hunting was attempted during 2000. We continue to monitor the extent of the snow goose eat-outs within the marsh and have continued to permit hunting there to reduce marsh destruction. Although the major portions of Money Marsh and Leatherberry Flats are still denuded annually the total extent of the eat-outs has not expanded significantly during the past 8 years. The same basic areas are denuded each year. Permanent vegetation transects within the Bombay Hook tidal marshes were run during late summer for the thirteenth consecutive year.

V. Objectives and Plans for 2003 Water Level Management

Within our proposed management scheme for 2003 desirable productive waterfowl habitat will be available for migrating and wintering species from the time of arrival in the late summer to departure in the spring. In addition, some brood habitat will be available within our managed wetlands as well. Other wetland dependent species groups such as waders, shorebirds, grebes, and rails will benefit as well from our proposed water regimes. In particular, the management emphasis within Raymond Pool will center on providing high quality shorebird feeding and resting habitat for both spring and fall migrants.

Our planned water management regimes for 2003 will be nearly identical to those proposed for 2002 since objective levels were not achieved, for the most part, during the year.

Bear Swamp Pool (BMH1) will be managed in a manner that will favor the establishment

and maintenance of submergent vegetation in at least a portion of the pool. However, a partial spring drawdown will be attempted to expose the higher elevations and favor plants other than fleabane. Hopefully, annuals will establish on areas exposed during April and May. This strategy will also provide some shorebird habitat within the unit. The unit will not be completely de-watered to maintain the submergents and to insure some freshwater habitat will be available during early fall waterfowl migration.

Shearness Pool (BMH2) will be managed similarly to 2000 with a spring partial drawdown to encourage shorebird use following a complete elimination of surface water by July. Re-flooding will commence in late August (water permitting) and be gradually increased through the remainder of the year.

Finis Pool (BMH3) management strategy will be an attempt to duplicate the emergent vegetation production, especially smartweeds and beggarsticks, achieved during 1992 and 1993. Although spring rainfall amounts can be the major determining factor when attempting lower spring levels we will attempt to gradually reduce winter levels to achieve drawdown during early April. Beginning in June levels will be permitted to rise gradually. Levels will be permitted to gradually increase through the fall. By December water levels should exceed 5.30 as that level has been found to create ideal conditions during that time for winter mallards, blacks and gadwall.

Raymond Pool (BMH4) will be managed similarly to the 2001 plan and will be focused on spring shorebird habitat and Fall waterfowl feeding opportunities. Fall levels slightly below those planned for 2001 should provide Fall shorebird habitat as well while still flooding spikerush stands and providing good early Fall pintail and teal habitat.

All moist soil units (BMH5-222) will be managed primarily to provide alternative wetland habitat for migratory water birds during the winter and spring period while at the same time providing valuable reptile and amphibian habitat. Most units will be allowed to de-water naturally if rainfall distribution is normal during the summer although stoplogs can be pulled in units 7,14, & 15 if water levels remain too high during the summer months.

No active management other that snow goose hunting will be conducted within the saltmarsh.

Monitoring of passerine birds via point counts within the saltmarsh and vegetation monitoring will continue.

- Address increasing resident Canada goose impacts?
- Review E.B. Forsythe water mgmt program @ mosquito control.

WATER LEVEL ELEVATIONS DURING 2002
&
PLANNED ELEVATIONS 2003

RAYMOND POOL–BMH4

DATE	PLANNED ELEVATIONS 2002	ACTUAL ELEVATIONS 2002	PLANNED ELEVATIONS 2003
01/01	1.60	1.20	1.60
01/15	1.60	1.18	1.60
02/01	1.60	1.30	1.60
02/15	1.50	1.40	1.50
03/01	1.40	1.20	1.40
03/15	1.30	1.20	1.30
04/01	1.20	1.58	1.20
04/15	1.15	1.06	1.15
05/01	1.10	1.00	1.00
05/15	1.00	1.00	0.75
06/01	0.90	0.75	0.60
06/15	0.80	0.72	0.70
07/01	0.80	0.60	0.70
07/15	0.90	0.60	0.60
08/01	0.80	BG	0.60
08/15	0.70	BG	0.70
09/01	0.80	0.88	0.80
09/15	1.00	0.80	0.90
10/01	1.20	0.70	1.00
10/15	1.30	0.98	1.00
11/01	1.40	1.60	1.10
11/15	1.40	1.78	1.20
12/01	1.50	1.50	1.30
12/15	1.50	1.50	1.40
12/31	1.60	1.68	1.50

WATER LEVEL ELEVATIONS DURING 2002
&
PLANNED ELEVATIONS 2003

FINIS POOL–BMH3

DATE	PLANNED ELEVATIONS 2002	ACTUAL ELEVATION 2002	PLANNED ELEVATION 2003
01/01	5.60	4.80	5.60
01/15	5.60	4.96	5.60
02/01	5.70	5.22	5.70
02/15	5.70	5.26	5.70
03/01	5.50	5.30	5.50
03/15	4.50	5.30	4.50
04/01	4.00	5.62	4.00
04/15	3.50	5.48	3.50
05/01	3.00	5.67	3.00
05/15	3.50	5.50	3.50
06/01	4.00	5.46	4.00
06/15	4.00	5.00	4.00
07/01	4.00	4.75	4.00
07/15	4.30	4.50	4.30
08/01	4.30	4.00	4.30
08/15	4.30	4.00	4.30
09/01	4.50	4.20	4.50
09/15	4.80	4.20	4.80
10/01	5.00	4.60	5.00
10/15	5.00	4.75	5.00
11/01	5.30	4.80	5.30
11/15	5.50	5.10	5.50
12/01	5.70	5.50	5.70
12/15	5.80	5.60	5.80
12/31	5.80	6.06	5.80

WATER LEVEL ELEVATIONS DURING 2002
&
PLANNED ELEVATIONS 2003

SHEARNESS POOL–BMH2

DATE	PLANNED ELEVATIONS 2002	ACTUAL ELEVATION 2002	PLANNED ELEVATION 2003
01/01	1.60	0.80	1.60
01/15	1.60	0.88	1.60
02/01	1.70	0.98	1.70
02/15	1.70	1.04	1.70
03/01	1.70	0.90	1.70
03/15	1.70	0.92	1.70
04/01	1.70	1.40	1.60
04/15	1.70	1.70	1.50
05/01	1.65	1.68	1.20
05/15	1.65	1.36	1.10
06/01	1.60	0.76	1.00
06/15	1.50	0.84	0.80
07/01	1.25	0.00	0.50
07/15	1.00	0.00	0.50
08/01	0.80	0.50	0.50
08/15	0.60	0.50	0.70
09/01	0.60	0.56	0.75
09/15	0.60	0.25	0.90
10/01	0.80	0.36	1.00
10/15	1.00	0.70	1.00
11/01	1.20	1.50	1.20
11/15	1.20	2.50	1.30
12/01	1.30	2.72	1.30
12/15	1.40	2.56	1.40
12/31	1.50	2.72	1.50

WATER LEVEL ELEVATIONS DURING 2002
&
PLANNED ELEVATIONS 2003

BEAR SWAMP POOL–BMH1

DATE	PLANNED ELEVATION 2002	ACTUAL ELEVATION 2002	PLANNED ELEVATION 2003
01/01	1.80	1.00	1.80
01/15	1.80	1.26	1.80
02/01	1.85	1.34	1.85
02/15	1.85	1.30	1.85
03/01	1.75	1.28	1.75
03/15	1.50	1.24	1.50
04/01	1.25	1.54	1.25
04/15	1.00	1.52	1.00
05/01	1.00	1.38	1.00
05/15	1.00	0.80	1.00
06/01	1.10	0.60	1.10
06/15	1.10	0.66	1.10
07/01	1.10	0.40	1.10
07/15	1.10	BG*	1.10
08/01	1.10	BG	1.10
08/15	1.10	BG	1.10
09/01	1.10	0.28	1.10
09/15	1.15	0.18	1.15
10/01	1.20	0.20	1.20
10/15	1.25	0.46	1.25
11/01	1.30	0.86	1.30
11/15	1.35	1.06	1.35
12/01	1.40	1.40	1.40
12/15	1.45	1.52	1.45
12/31	1.50	1.48	1.50

* = Below gage

RESULTS OF 2002 VEGETATION SURVEY

Raymond Pool–BMH4 (34 plots)

Veg Number	Common Name	%Cover 2002	% Cover 2001	% Cover 2000
127	Alkalai bulrush	0	0	0
107	Salt marsh fleabane	0	0	0
172	Goldenrod	2	0	0
21	Beggarticks	0	0	1
60	Bedstraw	0	0	0
UK	Unknown	0	0	0
129	Three-square bulrush	1	1	3
76	Rushes	0	1	2
82	Rice cutgrass	0	1	1
148	Cyperus	1	1	1
138	Salt Meadow Grass	3	2	4
130	Softstem bulrush	0	2	4
136	Cordgrass	2	3	2
UK	Unknown	0	3	0
49	Spikerush	5	3	29
UK	Unknown	0	4	0
101	Panic Grass	11	4	21
46	Walter millet	9	13	4
0	Bareground	63	60	33

RESULTS OF 2002 VEGETATION SURVEY

Shearness Pool–BMH2 (115 sample plots)

Veg Number	Common Name	%Cover 2002	%Cover 2001	% Cover 2000
136	Cordgrass	1	0	0
106	Common Reed	1	0	0
146	Southern wild rice	0	0	0
60	Bedstraw	0	0	0
110	Smartweeds	0	0	0
129	Three-square bulrush	2	0	1
66	Rose Mallow	2	0	1
49	Spikerush	1	1	0
127	Alkalai bulrush	6	2	0
141	Cattail	3	3	1
148	Cyperus	1	3	1
21	Beggarticks	3	7	2
46	Walter millet	9	9	3
0	Bareground	24	10	17
167	Sprangletop	13	27	21
101	Panic Grass	31	38	50

RESULTS OF 2002 VEGETATION SURVEY

Bear Swamp Pool–BMH1 (70 sample plots)

Veg Number	Common Name	%Cover 2002	% Cover 2001	% Cover 2000
60	Bedstraw	1	0	0
119	Poison Ivy	1	0	0
129	Three-square bulrush	2	0	0
101	Panic grass	5	0	1
18	Groundsel Tree	0	0	0
209	Sago Pondweed	0	0	0
66	Rose Mallow	1	0	2
21	Beggarticks	0	0	0
46	Walter millet	1	0	0
76	Rushes	0	1	0
uk#1	Unknown	2	1	0
165	Ferns	3	2	0
106	Common Reed	0	3	2
167	Sprangletop	18	3	0
148	Cyperus	3	3	4
166	Umbrella Grass	2	5	6
142	Cattail	6	6	2
49	Spikerush	6	10	3
107	Salt Marsh fleabane	12	11	3
0	Bareground	34	53	70

2003 Impoundment Vegetation Surveys

Raymond, Shearness and Bear Swamp Pools were surveyed for vegetation species and pool bottom coverage during the period August 25 through September 10, 2003. Sampling techniques employed the protocol as contained in the Moist Soil Management Advisor developed by the Gaylord Lab and the National Ecology Research Center and was the identical technique as that used during the previous years beginning in 1992. Impoundment frequency and cover reports for the current year (2003) as well as reports for 2001 & 2002 are appended to this report for comparison.

Summary of 2003 Surveys

The abundant rainfall during the 2003 growing season contrasted very distinctly with the drought conditions present during 2002. All three impoundments surveyed this year remained in a much moister condition throughout the summer and resulted in difficult conditions for traversing the pool surfaces.

Raymond Pool

Significant increases in plant coverage, notably spikerush, was quite evident in this unit this year. Coverage increased to 51% during 2003 compared with 5% during 2002. Total bareground was reduced from 63% during 2002 to only 20% during 2003. Softstem bulrush made huge gains and increased in pool bottom coverage from 0% during 2002 to 11% during 2003. However, declines in walteri millet were noted as only 1% coverage was recorded during 2003 (down from 9%).

This unit is in great shape for arriving teal and pintails. The spikerush should be eagerly sought by early arrivals. The bulrush will be a quickly devoured by arriving snow geese.

Phragmites was only present in scattered patches and seems to be under control with annual touch up sprays of glyphosate.

Resident canada goose grazing was heavy and significant but overall the spikerush seems to be good shape.

Shearness Pool

Heavy, persistent rainfall and runoff through this unit from Finis Branch altered plant coverage significantly. Bear ground increased from 24 to 37% from 2002. Sprangletop decreased from 13 to 7%. Millet declined from 9 to 3 %. Alkalai bulrush continued to expand slightly from 6 to 8% with virtually all of it occurring in the northeast quadrat of the pool. No significant increases were noted in cattail or Phragmites although the large cattail beds in the back of the pool could probably provide better future wildlife benefits if they could be burned. Last year's spraying with glyphosate seems to have killed all but a few scattered patches of the Phragmits.

Although the sampling technique used records plant coverage it does not measure plant height or

Ross Cory

seed production. However, in conducting this survey it was very evident that plant height has been greatly reduced over much of the interior unit due to canada goose grazing. A rough estimate would place grazing impacts at 25% of the unit. Much of panic grass, and millet was less than 8 inches high and had experience obvious grazing impacts to the extent that seed production by these two species would be expected to be greatly reduced.

Bear Swamp

Higher water levels in this unit throughout the summer resulted in many areas not being exposed to any drying conditions. Although some scattered patches of submergent vegetation was evident in permanently flooded areas many were either bare or contained algae mats. Sampling data showed an increase in bare ground from 36% to 53% . Decreases were noted in fleabane (12 to 6%) and in sprangletop from18 to 4. No notable changes were noted in Phragmites or cattail. Canada goose grazing was evident here as well but much less significant than that seen in Shearness.

Cattail beds in the western portion of the pool experienced some signifcant digging and feeding activity. This investigator could not ascertain if this was due to nutria or just and increase in muskrat and raccoon activity.

Recommendations

Resident canada geese are expanding extremely rapidly and this year's adverse impacts to emergent aquatic vegetation was far greater than any noted previously. A significant rapid reduction in goose numbers is needed to prevent further degradation of these and other valuable habitats on the refuge. It is further recommended that vegetation monitoring be continued in the managed wetlands and if possible include some measure of grazing in the evaluation. Perhaps a plus could be recorded at each sampling point that has exhibited grazing impacts.

E. Franklin Smith 9/12/03

E. Franklin Smith

Impoundment Vegetation Frequency & Cover Report

Org. Number : 51550
Refuge Name : Bombay Hook NWR

Report Date : 09/12/03

Unit #: bmh4 Raymond Pool

Growing Year : 2003

Begin DrawDown : -0-
Finish DrawDown: -0-

Soil Type : 1 = Organic Soil
Soil Salinity (ppt) : -0-

Seed Bed Treatment : -0 = -0-

Veg. Number	Common Name	% Cover	Frequency
162	Sowthistle	0	3
166	Umbrella Grass	0	3
172	Goldenrod	0	3
148	Cyperus	0	6
21	Beggarticks	1	6
82	Rice cutgrass	1	6
46	Walter millet	1	12
76	Rushes	1	12
129	Three-square bulrush	2	6
142	Cattail	2	12
136	Cordgrass	2	3
138	Salt Meadow Grass	3	3
130	Softstem Bulrush	11	32
101	Panic grass	12	21
0	Bare Ground	20	65
49	spikerush	51	68
1003	Desirable Veg.	-0-	21
1000	Salt Tolerant Veg.	-0-	3
1001	Moderate Salt Veg.	-0-	12
1002	Freq. > 80% BareGrd.	-0-	6
-0-	-0-	-0-	3

Number of Sample Plots = 34.

Note About SeedBed Treatment During the Growing Year
Date of Treatment: -0-

No SEEDBED TREATMENT note was entered into the Database.

Impoundment Vegetation Frequency & Cover Report

Org. Number : 51550 Report Date : 09/12/03
Refuge Name : Bombay Hook NWR

Unit #: bmh4 Raymond Pool Growing Year : 2002

Begin DrawDown : -0- Soil Type : 1 = Organic Soil
Finish DrawDown: -0- Soil Salinity (ppt) : -0-

Seed Bed Treatment : -0 = -0-

Veg. Number	Common Name	% Cover	Frequency
107	Salt Marsh fleabane	0	3
130	Softstem Bulrush	0	3
127	Alkali bulrush	0	3
129	Three-square bulrush	1	21
148	Cyperus	1	9
136	Cordgrass	2	3
172	Goldenrod	2	6
138	Salt Meadow Grass	3	3
49	spikerush	5	44
46	Walter millet	9	24
101	Panic grass	11	15
0	Bare Ground	63	79
1003	Desirable Veg.	-0-	18
1000	Salt Tolerant Veg.	-0-	6
1001	Moderate Salt Veg.	-0-	3
1002	Freq. > 80% BareGrd.	-0-	59
	TOTAL COVER	97	

Number of Sample Plots = 34.

Note About SeedBed Treatment During the Growing Year
Date of Treatment: -0-

No SEEDBED TREATMENT note was entered into the Database.

Impoundment Vegetation Frequency & Cover Report

Org. Number : 51550 Report Date : 09/12/03
Refuge Name : Bombay Hook NWR

Unit #: bmh4 Raymond Pool Growing Year : 1901

Begin DrawDown : -0- Soil Type : 1 = Organic Soil
Finish DrawDown: -0- Soil Salinity (ppt) : -0-

Seed Bed Treatment : -0 = -0-

Veg. Number	Common Name	% Cover	Frequency
172	Goldenrod	0	3
21	Beggarticks	0	3
60	Bedstraw	0	3
uk2	-0-	0	3
129	Three-square bulrush	1	18
76	Rushes	1	3
82	Rice cutgrass	1	6
148	Cyperus	1	6
138	Salt Meadow Grass	2	3
130	Softstem Bulrush	2	3
136	Cordgrass	3	3
fw	-0-	3	6
49	spikerush	3	26
uk1	-0-	4	6
101	Panic grass	4	15
46	Walter millet	13	38
0	Bare Ground	60	76
1000	Salt Tolerant Veg.	-0-	3
1002	Freq. > 80% BareGrd.	-0-	62
1003	Desirable Veg.	-0-	21
-0-	-0-	-0-	3

Number of Sample Plots = 34.

Note About SeedBed Treatment During the Growing Year
Date of Treatment: -0-

No SEEDBED TREATMENT note was entered into the Database.

Impoundment Vegetation Frequency & Cover Report

Org. Number : 51550 Report Date : 09/12/03
Refuge Name : Bombay Hook NWR

Unit #: bmh2 Shearness Pool Growing Year : 2003

Begin DrawDown : -0- Soil Type : 1 = Organic Soil
Finish DrawDown: -0- Soil Salinity (ppt) : -0-

Seed Bed Treatment : -0 = -0-

Veg. Number	Common Name	% Cover	Frequency
106	Common Reed	0	2
110	Smartweeds	0	1
uk1	-0-	0	3
129	Three-square bulrush	1	3
121	Dock	1	1
66	Rose Mallow	1	7
21	Beggarticks	1	9
49	spikerush	3	17
46	Walter millet	3	19
141	Cattail	4	12
167	Sprangletop	7	27
127	Alkali bulrush	8	23
148	Cyperus	9	40
101	Panic grass	25	34
0	Bare Ground	37	69
1003	Desirable Veg.	-0-	74
1002	Freq. > 80% BareGrd.	-0-	25
1001	Moderate Salt Veg.	-0-	23
-0-	-0-	-0-	1
	TOTAL COVER	100	

Number of Sample Plots = 116.

Note About SeedBed Treatment During the Growing Year
Date of Treatment: -0-

No SEEDBED TREATMENT note was entered into the Database.

Impoundment Vegetation Frequency & Cover Report

Org. Number : 51550 Report Date : 08/28/02
Refuge Name : Bombay Hook NWR

Unit #: bmh2 Shearness Pool Growing Year : 2002

Begin DrawDown : -0- Soil Type : 1 = Organic Soil
Finish DrawDown: -0- Soil Salinity (ppt) : -0-

Seed Bed Treatment : -0 = -0-

Veg. Number	Common Name	% Cover	Frequency
162	Sowthistle	0	1
130	Softstem Bulrush	0	1
49	spikerush	1	4
136	Cordgrass	1	1
121	Dock	1	1
106	Common Reed	1	3
148	Cyperus	1	9
66	Rose Mallow	2	10
129	Three-square bulrush	2	4
21	Beggarticks	3	9
141	Cattail	3	12
127	Alkali bulrush	6	19
46	Walter millet	9	29
167	Sprangletop	13	33
0	Bare Ground	24	60
101	Panic grass	31	42
1003	Desirable Veg.	-0-	85
1001	Moderate Salt Veg.	-0-	19
1002	Freq. > 80% BareGrd.	-0-	15
-0-	-0-	-0-	1
	TOTAL COVER	98	

Number of Sample Plots = 114.

Note About SeedBed Treatment During the Growing Year
Date of Treatment: -0-

No SEEDBED TREATMENT note was entered into the Database.

Impoundment Vegetation Frequency & Cover Report

Org. Number : 51550 Report Date : 09/12/03
Refuge Name : Bombay Hook NWR

Unit #: bmh2 Shearness Pool Growing Year : 2001

Begin DrawDown : -0- Soil Type : 1 = Organic Soil
Finish DrawDown: -0- Soil Salinity (ppt) : -0-

Seed Bed Treatment : -0 = -0-

Veg. Number	Common Name	% Cover	Frequency
146	Southern Wild Rice	0	1
60	Bedstraw	0	1
110	Smartweeds	0	1
129	Three-square bulrush	0	2
66	Rose Mallow	0	4
49	spikerush	1	3
127	Alkali bulrush	2	12
141	Cattail	3	9
148	Cyperus	3	27
21	Beggarticks	7	21
46	Walter millet	9	48
0	Bare Ground	10	27
167	Sprangletop	27	39
101	Panic grass	38	55
1001	Moderate Salt Veg.	-0-	12
1003	Desirable Veg.	-0-	90
1002	Freq. > 80% BareGrd.	-0-	4
-0-	-0-	-0-	2
	TOTAL COVER	100	

Number of Sample Plots = 115.

Note About SeedBed Treatment During the Growing Year
Date of Treatment: -0-

No SEEDBED TREATMENT note was entered into the Database.

Impoundment Vegetation Frequency & Cover Report

Org. Number : 51550 Report Date : 09/12/03
Refuge Name : Bombay Hook NWR

Unit #: bmh1 Bear Swamp Pool Growing Year : 2003

Begin DrawDown : -0- Soil Type : 1 = Organic Soil
Finish DrawDown: -0- Soil Salinity (ppt) : -0-

Seed Bed Treatment : -0 = -0-

Veg. Number	Common Name	% Cover	Frequency
110	Smartweeds	0	1
162	Sowthistle	0	1
133	Foxtail	0	1
76	Rushes	0	1
21	Beggarticks	0	3
209	Sago Pondweed	0	4
172	Goldenrod	1	1
165	Ferns	1	4
129	Three-square bulrush	1	9
46	Walter millet	1	6
41	Swamp Loosestrife	1	4
66	Rose Mallow	1	14
130	Softstem Bulrush	1	1
106	Common Reed	1	4
60	Bedstraw	1	6
204	Marsh St John Wort	1	9
119	Poison Ivy	2	6
101	Panic grass	2	14
142	Cattail	3	20
167	Sprangletop	4	17
ukg	-0-	6	9
107	Salt Marsh fleabane	6	32
148	Cyperus	6	30
166	Umbrella Grass	8	17
49	spikerush	10	19
0	Bare Ground	53	72
1001	Moderate Salt Veg.	-0-	20
1002	Freq. > 80% BareGrd.	-0-	46
1003	Desirable Veg.	-0-	32
1000	Salt Tolerant Veg.	-0-	32
-0-	-0-	-0-	1

Number of Sample Plots = 69.

Note About SeedBed Treatment During the Growing Year
Date of Treatment: -0-

No SEEDBED TREATMENT note was entered into the Database.

Impoundment Vegetation Frequency & Cover Report

Org. Number : 51550 Report Date : 09/12/03
Refuge Name : Bombay Hook NWR

Unit #: bmh1 Bear Swamp Pool Growing Year : 2002

Begin DrawDown : -0- Soil Type : 1 = Organic Soil
Finish DrawDown: -0- Soil Salinity (ppt) : -0-

Seed Bed Treatment : -0 = -0-

Veg. Number	Common Name	% Cover	Frequency
21	Beggarticks	0	1
220	Water Horehound	0	1
41	Swamp Loosestrife	0	3
106	Common Reed	0	3
130	Softstem Bulrush	0	3
18	Groundsel Tree	0	1
uk2	-0-	0	1
66	Rose Mallow	1	12
65	Swamp timothy	1	1
uk	-0-	1	1
46	Walter millet	1	10
60	Bedstraw	1	3
119	Poison Ivy	1	4
ukg	-0-	1	1
162	Sowthistle	1	9
129	Three-square bulrush	2	6
166	Umbrella Grass	2	10
148	Cyperus	3	27
165	Ferns	3	7
101	Panic grass	5	9
142	Cattail	6	15
49	spikerush	10	25
107	Salt Marsh fleabane	12	48
167	Sprangletop	18	45
0	Bare Ground	34	54
1000	Salt Tolerant Veg.	-0-	46
1001	Moderate Salt Veg.	-0-	15
1002	Freq. > 80% BareGrd.	-0-	27
1003	Desirable Veg.	-0-	55
-0-	-0-	-0-	1

Number of Sample Plots = 67.

Note About SeedBed Treatment During the Growing Year
Date of Treatment: -0-

No SEEDBED TREATMENT note was entered into the Database.

Number of Sample Plots = 70.

Note About SeedBed Treatment During the Growing Year
Date of Treatment: -0-

No SEEDBED TREATMENT note was entered into the Database.

Impoundment Vegetation Frequency & Cover Report

Org. Number : 51550 Report Date : 09/12/03
Refuge Name : Bombay Hook NWR

Unit #: bmh1 Bear Swamp Pool Growing Year : 2001

Begin DrawDown : -0- Soil Type : 1 = Organic Soil
Finish DrawDown: -0- Soil Salinity (ppt) : -0-

Seed Bed Treatment : -0 = -0-

Veg. Number	Common Name	% Cover	Frequency
129	Three-square bulrush	0	1
101	Panic grass	0	1
18	Groundsel Tree	0	1
209	Sago Pondweed	0	3
66	Rose Mallow	0	4
21	Beggarticks	0	1
46	Walter millet	0	4
76	Rushes	1	1
uk1	-0-	1	1
165	Ferns	2	3
106	Common Reed	3	4
167	Sprangletop	3	11
148	Cyperus	3	24
166	Umbrella Grass	5	21
142	Cattail	6	23
49	spikerush	10	24
107	Salt Marsh fleabane	11	36
0	Bare Ground	53	71
1001	Moderate Salt Veg.	-0-	23
1002	Freq. > 80% BareGrd.	-0-	51
1003	Desirable Veg.	-0-	14
1000	Salt Tolerant Veg.	-0-	36