

Friends of BOMBAY Hook

<http://www.friendsofbombayhook.org>

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The President's Corner
By: Frank L. Rawling, Jr.

A Season Ended ...

Once again the volunteering season has ended at the Refuge but in a way it continues. For those of us who are active volunteers the summer season is less intense the fall and spring but some of us will still be at the Refuge from time to time over the summer. But the just ended season has been a good one. Once again the Friends were the major sponsor for the Fall Festival and the Spring Festival. Both were a success but especially the Spring Festival. We were blessed with very good weather following a period of dreary weather. As a result we had excellent attendance and the Refuge Store did a banner business. Ray Brown, the Refuge Biologist lead an excellent birdwalk in the morning and then gave a talk in the auditorium on obstacles to bird migration and what humans can do to help out. During the fall and spring the Friends were active leading tours on the Refuge and birdwalks. The birdwalks were quite well attended.

The Friends also were engaged in helping the Refuge by purchasing a new water testing kit for use in the environmental education program. The Friends also purchased a set of 2 new poles and a new set of gourds for the Purple Martin Colony. The system is set up so that the gourds can be raised and lowered by a pulley system. This will make it easier and



Joel Martin checking the Purple Martin gourds

safer to check and clean the gourds. Bob Mayer, former president of the Friends and active Board member and volunteer rewrote several brochures and legends for new signage on the Refuge. You can see some of the signage on the Boardwalk and at the Towers.

The Board was also active in planning for a new Administrative and Visitor Facility and sending letters to our Congressional delegation in support of funding for the facility. Our request for funding was not successful this year but this will be an ongoing program with the new Board.

My thanks to the Board for their fine effort over the past year and my special thanks to Laura Balascio who is retiring from the Board. My thanks also to the volunteer corps. Without our volunteers the Refuge would be a poorer place.

Until the Fall, have a great and safe summer!

The Refuge Store
By: Verna Price

We had a wonderful spring in the store. The following shows sales for the period:

	<u>Credit Card</u>	<u>Cash</u>	<u>Total</u>
March	\$ 953.85	1,030.60	1,984.45
April	\$1,870.10	1,783.20	3,653.20
May	\$3,878.00	3,403.95	7,281.95

The best day for sales in the history of the Refuge Store was the spring festival, May 21, 2005. Total sales for the day were \$1,884.15. Thanks to all of you for your continued support.

We hope to have some exciting new items for fall, but do not wait until then to come visit the store.

Bird Notes

By: Frank L. Rawling, Jr.

Spring Migration

Spring Migration is always a wonderful time to visit Bombay Hook. Spring, of course, is the time that the warblers show up in large numbers and the shorebirds stop off on their way to their arctic breeding grounds. Spring on the Delmarva can be somewhat of an iffy thing and often to me, birds don't show up when you might expect. This spring in Delaware was quite cool. For example in the Wilmington area March was 4 degrees below normal and May was 5 degrees below normal. April was 1.4 degrees above normal. Precipitation was about average although the Refuge had several really wet days. Well what avian life visited the Refuge during the migration? Let's have a look.

March

The month began with the sighting of a **Bonaparte's Gull** at the north end of Sheariness on the 1st and 2nd. Early in the spring is a good time to see **American Woodcocks** and such was the case when 5 were seen along the Bear Swamp Trail on the 4th. A **Peregrine Falcon** was seen near the Allee House on the 4th as well as a **Barred Owl** near Bear Swamp. Two **Horned Larks** were seen near the Visitor Center on the 5th and a flock of **American Pipits** along the entrance road to Bear Swamp. This has been a good year for sightings of **Bald Eagles** at the Refuge and 2 were seen in the trees near Sheariness Pool on the 5th. The 6th was a day to look for ducks and **Hooded Mergansers** were seen in Finis Pool, **Buffleheads** were at Raymond Pool and some 50 **Common Mergansers** were on Sheariness. Also on the 6th a **Rough-legged Hawk** was seen over Raymond and an **American Kestrel** at Sheariness. An **Eastern Meadowlark** was seen on the 7th near the Visitor Center and on the 8th some **Lesser Scaup** were seen at Raymond Pool, a couple of **Wood Ducks** along the exit road from Bear Swamp and many **Northern Shovelers** at Sheariness. A **Red-shouldered Hawk** was seen at Finis on the 9th. **Dunlin** and **Lesser Yellowlegs** were seen on the bayside of Sheariness and Bear Swamp and a **Great Egret** showed up at Bear Swamp. A **Pied-bill Grebe** appeared at Bear Swamp on the 11th. A **Tree Swallow** was seen flying over Raymond Pool on the 12th. **Tundra Swans** as well as both **Blue** and **Green-winged Teal** were seen on the 14th. There

were still **Snow Geese** around the 15th with a flock seen along the entrance road. More **Tree Swallows** were seen on the 16th at Finis as well as numerous **Wood Ducks**. A couple of **Horned Larks** were seen along the entrance road on the 16th. The 17th brought a sighting of 2 **American Coots** at Finis. **Greater Yellowlegs** were seen at Sheariness on the 19th as well as 4 **Northern Harriers** over the saltmarsh. A pair of **Ring-necked Ducks** were seen at Finis on the 20th. An **Eastern Screech Owl** was seen in a wood duck box on the 22nd and a **Snowy Egret** was seen along the Boardwalk Trail. Waterfowl was building up on the 23rd when large numbers of **Northern Pintail**, **Northern Shoveler**, **American Black Duck**, and **Green-winged Teal** were in residence. In addition **Bufflehead** and **Common Merganser** were observed. A half-dozen **Pectoral Sandpipers** were noticed on the bayside of Sheariness on the 24th. **Wild**



Eastern Screech Owls

Turkeys were seen near the Visitor Center on the 25th as well as the first sighting of **Black-crowned Night Herons** near the north end of Sheariness Pool. Both **Savannah Sparrows** and **Swamp Sparrows** were seen in the area of Bear Swamp on the 26th. The same day a birder spotted a **Common Snipe** at Sheariness. A **Barn Swallow** was seen at the Swimming Hole on the 26th. The same observer saw an **American Golden Plover** and **Black-bellied Plovers** on that day as well as both **Yellowlegs**. An **American Bittern** was seen on the 24th and the **Wild Turkeys** were seen again on the 29th, this time at the intersection of Parson Point Road and Whitehall Neck Road. On the 30th there were approximately 1,400 **Dunlins** at Sheariness and 7 **Glossy Ibis** were seen flying over the same area.

April

The first **Black-necked Stilt** and **American Avocets** of the season showed up on the 1st. Both **Least** and **Western Sandpipers** were seen that day at Bear Swamp. An **Eastern Phoebe** was noticed at Finis Pool on the 2nd. **Tundra Swans** were seen at Sheariness on the 5th as well as a **Killdeer** observed at the Visitor Center. The same birder saw a pair of **American Kestrels** in the Raymond

Pool area and 2 pairs of **Blue-winged Teal** and a **Pied-billed Grebe** at Sheariness. A regular birder at the Refuge spotted a **Hermit Thrush** on the Boardwalk Trail on the 6th. An **Eastern Towhee** and a **Belted Kingfisher** were spotted on the 6th as well. There was still a **Peregrine**



Killdeer

Falcon and a **Bald Eagle** around the Refuge on the 9th and also a **Northern Harrier**. **Black-necked Stilts** had increased to 8 by the 10th and there were an estimated 300 **Greater** and **Lesser Yellowlegs** near Finis Pool that day. Four **Ruffs** were seen in the same area that day and a sighting of 2 **Golden Eagles** flying over the Refuge. On the 12th a **Horned Grebe** was observed at Raymond Pool and an **American Bittern** on the bayside. The first warblers of the season were 2 **Pine Warblers** seen in Finis Woods along with a **Ruby-crowned Kinglet**. A **Common Yellowthroat** was seen on the west side of Raymond Pool by the Refuge Biologist on the 13th. A **House Wren** was seen on the Boardwalk Trail on the same day and the same observer saw an aerial duel between a **Peregrine Falcon** and a **Turkey Vulture** (no word on who won!). There were still a couple of **Pectoral Sandpipers** at Sheariness on the 14th. A **Blue-gray Gnatcatcher** and a **Yellow-rumped Warbler** were seen on the 15th. The 18th saw sightings of **Hermit Thrush**, **Brown Thrasher**, **Palm Warbler**, **Eastern Towhee**, and **Least Flycatcher** along the Boardwalk Trail. There was also a **Ruff** at Raymond Pool that day. On the Refuge birdwalk on the 19th great views of a **Prothonotary Warbler** were enjoyed by all at Finis Pool. Along the Boardwalk Trail there were several **Palm Warblers** as well as a **Great Horned Owl**. A **Caspian Tern** was seen at Sheariness. The first **Willet** was seen that day at Raymond Pool. Also, **Brown-headed Cowbirds** showed up at Bear Swamp. A hen **Wild Turkey** was seen along Finis Road on the 20th and a **Veery** along the Boardwalk Trail. An **American Golden Plover** was seen among the **Black-bellied Plovers** at Bear Swamp on the 20th

and a **Yellow Warbler** on the Boardwalk Trail. **Warblers** came into their own on the 24th. Finis Woods housed **Black-throated Green** and **Black-and-White Warblers** as well as both **White-eyed** and **Red-eyed Vireos** and a **Great-crested Flycatcher**. That day a couple of **Prairie Warblers** were in the woods opposite the entrance to the Boardwalk Trail. The same area had **Palm** and **Yellow Warblers** and **Common Yellowthroat**. The usual spring migrant ducks were still around on the 24th with **Blue-winged Teal**, **Green-winged Teal** and **Northern Shoveler** all in residence. **Dunlin** and **Dowitchers** were also present. A **Sora** was seen on the 22nd at Sheariness.

May

A sighting of 2 **Ruddy Turnstones** on the saltmarsh mudflats began the month on the 3rd. The same day 2 **Yellow-crowned Night Herons** were found among the **Black-crowned Night Herons** at the usual spot at Bear Swamp. Six **American Oystercatchers** were seen at Bear Swamp on the 4th. On the 7th a pair of **Barred Owls** were seen at an unspecified location on the Refuge and a **Green Heron** was seen at the Swimming Hole. Approximately 7 **American Golden Plovers** were seen along the entrance road on the 8th. Two **Northern Waterthrush** were reported at Finis on the 9th and 4 immature **Bald Eagles** were noticed at Bear Swamp. An **Ovenbird** was observed along the Boardwalk Trail on the 9th. The same day brought a sighting of a **Blue Grosbeak**. The 10th brought 6 **Bald Eagles** to the Refuge. Other birds seen on the 10th were 2 **Blue Grosbeaks** between Bear Swamp and Sheariness, **Yellow Warblers** and **Common Yellowthroats** along the Boardwalk Trail, a **Black-and-White Warbler** opposite the trail parking area, an **Orchard oriole** at the Boardwalk Trail and both **Red-eye** and **White-eyed Vireos** at Finis. A **Yellow-breasted Chat** was seen near Sheariness



Yellow-breasted Chats

Tower on the 11th. The 12th was a banner day with the following birds seen along Parson Point Road: **Indigo Bunting**, **Black-poll Warbler**, **Hooded Warbler**, **Black-and-White Warbler**, **Scarlet Tanager**, **Black-throated Blue Warbler**, **Ovenbird**, **Northern Parula**, and a **Yel-**

low-billed Cuckoo. The **Sora** was seen again at Shearness that day. **Bobolinks** were also near the Visitor Center on the 12th. A **Wilson's Warbler** was seen at Shearness Tower on the 13th. A **Blackburnian Warbler** was along Parson Point Trail on the 14th. This was followed by a **Nashville Warbler** by the water control structure at the north end of Bear Swamp on the 16th. Two **Stilt Sandpipers** were noticed at Shearness on the 17th. A nice find was some 25 **Red Knots** at Shearness on the 20th. A **Sedge Wren** was picked up at Shearness on the 21st and a **Curlew Sandpiper** was in the same area on the 22nd. A **Caspian Tern** was observed at Raymond Pool on the 24th and 9 **Black Skimmers** were there on the 25th. The 26th saw a **Spotted Sandpiper** on the bayside of Shearness. A **Common Moorhen** was spotted at Shearness on the 27th and an adult **White-faced Ibis** also. That day the Finis area housed a **Warbling Vireo** and an **Eastern Wood Pewee**. Two **Kentucky Warblers** were along the trail to the Bear Swamp tower on the 27th. On the 29th a **Wilson's Phalarope** was at Raymond Pool and was followed by a **Red-necked Phalarope** on the 30th. The month ended with the sighting of a **Virginia Rail** with 4 chicks at Raymond Pool on the 30th.

That's it for this time, keep those sightings coming!

CHEERS AND GOOD BIRDING!!

2005-2006 Federal Duck Stamp Available July 1 at Bombay Hook

On October 5, 2004, Mark Anderson was announced the winner of the 2005-2006 Federal Duck Stamp Contest. Mark's striking design of a pair of Hooded Mergansers on a golden pool of water took 1st Place honors over 223 other entries in the competition. His winning image will grace the 2005-2006 federal waterfowl hunting stamp which is purchased by hunters and stamp collectors nationwide.

Growing up in South Dakota, Mark Anderson developed a love of the outdoors. Hunting and fishing were not only a favorite pastime, they were a way of life. As an adult, Mark's devotion to nature fueled another interest, painting. He is a self-taught wildlife artist who began painting in 1980. Like all true callings, painting became his full-time commitment by 1993.

A true outdoorsman, Mark can be seen photographing as often as hunting or fishing. He always travels with a camera and is prepared to capture "live" moments of inspiration. These excursions provide the knowledge and research necessary to realistically capture wildlife. Mark is passionate about depicting wildlife realistically. The focal point of his paintings is the wildlife itself; rural elements are incorporated to add depth and dimension. Mark has the unique ability to produce paintings that represent "anywhere USA." Although he calls South Dakota home, his work portrays scenes reminiscent of any rural environment.



By Mark Anderson

The 2005-2006 Federal Duck Stamp, available July 1, costs \$15.00 and approximately 98 cents of every duck stamp dollar goes into the Migratory Bird Conservation Fund to purchase wetlands and wildlife habitat for inclusion into the National Wildlife Refuge System - a fact that ensures this land will be protected and available for all generations to come. The purchase of the stamp provides an opportunity for every United States citizen to take a stand in the preservation of our natural heritage.

The \$15.00 stamp allows entry to all National Wildlife Refuges which charge entrance fees. Other federal passes that are available at the Visitor Center include a \$4.00 daily single visit pass, a \$12.00 yearly Bombay Hook Pass, and a \$65.00 Golden Eagle Pass which allows entry to federal areas - National Forest, Refuges, Parks, and monuments. When a U.S citizen or permanent resident becomes 62 years of age they can purchase a \$10.00 lifetime Golden Age Pass which allows entry to federal areas plus 50% discount on recreation use fees. If you already have a National Park Service Pass we can upgrade your pass to a Golden Eagle for \$15.00. The upgrade will last as long as the National Park Service pass is valid.

The Refuge Corner
Addressing the Marsh Loss at Bombay Hook
Chapter 1
By Terry Villanueva

We face many challenges and opportunities as land stewards as we strive to meet our wildlife conservation mission for the National Wildlife Refuge System. There are existing programs to help maintain wildlife habitat, relatively simple issues that can be addressed within a short amount of time, and long-term issues that are important but will take more time and effort to evaluate and resolve. Marsh loss at Bombay Hook National Wildlife Refuge is one of those long-term challenges.

The Refuge marshes are one of the largest areas of nearly unaltered marsh in the Mid-Atlantic. Many marshes along the Atlantic coast were grid-ditched for mosquito control, permanently changing the water regime on those lands. Vegetation on those sites is often significantly altered, with large stands of invasive plants such as *Phragmites* or other plants that are indicative of dryer conditions, severely impacting the quality of those lands as wildlife habitat. At Bombay Hook, we are fortunate in that most of the marsh is still functioning as it has for centuries. The vegetation is reminiscent of the prairies before they were plowed, with vast areas of native marsh grass swaying in the breeze.

These marshes provide valuable habitat for migratory birds including breeding and wintering waterfowl, shorebirds, rails, wading birds and songbirds. The tidal creeks in the marshes serve as nursery areas for marine species including fish and crabs.

We are currently faced with the potential loss of these wetlands, a resource that would be difficult and costly to replace. The two major areas of marsh loss and erosion on the Refuge occur on the eastern edge of the Refuge along the Delaware Bay, also called the bayshore, and in the interior marsh in the Leatherberry Flats and George's Island areas.

This article will focus on the interior marsh loss. We estimate that over 1,000 acres of marsh have been lost in the central portion of the marsh, primarily in the Money Marsh and Leatherberry Flats area. This area is visible from the Wildlife Drive along Shearneck Dike. This formerly vegetated area now appears to be a large expanse of open

water at high tide and a large mud flat at low tide. Additional extensive marsh loss occurs southeast of George's Island, just out of view from the Raymond Dike.



1998 Aerial Photo of Money Marsh and Leatherberry Flats shows marsh loss after snow goose eat-outs

We suspect that this loss is caused by a number of factors that are stressing the ecosystem. One factor is sea level rise due to global warming. A second factor could be land subsidence or sinking. Thirdly, the marsh may not be building up enough material to keep up with these factors due to several causes including changes in ground water flow and nutrient flow into the marsh from upstream sources. The ever-increasing snow goose and resident Canada goose numbers may have been the final straws that have tilted the scales in the direction of marsh loss.

In the 1970's, about 10,000 snow geese wintered in the Bombay Hook marshes. That number increased in the 1980's and 1990's to over 100,000 birds with a peak of over 200,000 in 1997. Snow geese can be particularly devastating to marsh vegetation as they feed by pulling up the plants by the roots. They tend to concentrate in one area of the marsh, resulting in all of the vegetation being removed in an "eat-out" area that can cover several hundred acres each year.

This problem is further exacerbated by an increasing resident Canada goose population. The resident Canada goose population may have originated from captive flocks that were used as live decoys at the beginning of the last century. Some

of these birds may also be formerly migratory birds that were injured or too weak to make the migration north to the breeding grounds in Canada. They bred here in the summer, and their numbers continue to increase. Having this large number of Canada geese here in the summer is a major change to this ecosystem. These birds feed on the tender new shoots of vegetation that grow in the “eat-out” area in the spring and summer and don’t allow the marsh vegetation to recover.



1968 Aerial Photo of Money Marsh and Leatherberry Flats

During the fall and winter, returning snow geese tend to concentrate in the “eat-out” area from previous years. You can sometimes see them lined up along the edge of the vegetation working their way in from the edge. This repeated cycle of removing the vegetation and its supporting root structure makes the areas vulnerable to erosion from the five to six foot tidal flow and waves from wind and storms, removing the upper layer of soil. Eventually, these areas become too low in elevation to grow the native *Spartina* grass, and remain as mud flat. Without the root system to support it, these areas continue to erode and break up.

The marsh loss problem is further exacerbated by the bayshore erosion that is moving in from the eastern edge of the marsh. If left unchecked, eventually the bay will breach through in the Leatherberry Flats eat-out area. This could result in a devastating flow of water coming into the marsh and could severely change the character of the marsh and further intensify the forces of erosion.

We are meeting with scientists and other potential partners to identify the causes of the marsh loss, determine the history and extent of this loss, and develop ways to stabilize

and restore the marsh. This spring, we have been out in the marsh with several scientists from the U.S. Geological Survey (USGS) to show them the problems first-hand.

Bombay Hook has been selected as one of 15 brackish sites ranging from the Gulf of Mexico to the Maritime Provinces of Canada to assess the trends in surface elevation response to different rates of subsidence and tidal range.

At each of the 15 brackish wetland sites, a wide range of variables will be measured seasonally for at least two years, then twice per year thereafter. These measurements include elevation change, vegetation structure, seasonal vegetation and litter production, and root and soil properties. The survival of coastal wetlands in the face of global change impacts will be determined by the land’s ability to maintain wetland surface elevations relative to sea-level rise.

Glenn Guntensbergen and Jim Lynch of USGS plan to begin their research by establishing instrumentation in a study plot in a healthy marsh area as a part of their existing study. They hope to later add more stations in areas that are indicative of active marsh loss to support our efforts.



Dan Soeder, of U.S. Geological Survey takes a closer look at marsh loss at Bombay Hook

Dan Souder from USGS also visited Bombay Hook to look at the marsh loss issue first hand. He is working with us in support of the effort to assess the extent of marsh loss, develop research geared at gaining an understanding of the factors that may be contributing to marsh loss, and develop and evaluate methods to stabilize the marsh. Similar work is underway at Blackwater NWR near Cambridge, MD.

Other site visits have occurred with John Wolflin and George Ruddy from the U.S. Fish and Wildlife Service, Chesapeake Bay Field Office. They bring with them valuable experience in dealing with marsh restoration.

The bottom line is that we want to preserve the remaining marsh and restore that which has been lost. I believe that saving this marsh is one of the most important efforts we should be making for long term natural resource conservation at the Refuge. This issue is too immense for us to attempt alone. To be successful we will need to work together with many partners who can bring their expertise and experience towards a common goal of saving the marsh.

Former U.S. Fish and Wildlife Director Lynn Greenwalt is known to have said “And it is your obligation to... move forward... in a way that does not denigrate, dilute, or diminish in the slightest degree that which came before you, because many thousands of men and women gave their careers, and some even their lives, for what you are working towards – saving the dirt.”

“Saving the dirt” in the marshes of Bombay Hook will be an important first step in restoring the ecosystem for the wildlife that depends on it.

Refuge Photo Contest Launched

The National Wildlife Refuge Association (NWRA) and Swarovski Optik of North America (SONA) are launching a 2005 Photo Contest - a digital photo contest designed to showcase America's national wildlife refuges.

Images can be of birds, mammals, insects, fish, other animals, plants, people, or simply refuge scenery, in short, almost any sight at a National Wildlife Refuge can be submitted for this contest. The contest begins in July and ends in December 2005.

See the Contest Prize Page for more information on Swarovski and other prizes, as well as procedure, rules, and other details at <http://www.refugenet.org/contest/ContestHome.html>.

The Tidal Salt Marsh

By: Robert W. Mayer

It covers 13,100 acres, eighty-two percent of the total area of the refuge. Yet for most visitors the tidal salt marsh is the least known feature of Bombay Hook National Wildlife Refuge.

The reason, of course, is obvious. The other eighteen percent is what refuge visitors drive through and see at close hand, and the woodlands, fields and freshwater impoundments are what define Bombay Hook for most people. The closest contact they have with the salt marsh is on Boardwalk Trail, but there the visitors' direct exposure is limited to the “high” marsh, only one of the several habitats that make up what is known as the “tidal salt marsh.”

The tidal marsh portion of the refuge stretches along Delaware Bay for about eight miles, beginning on the north at Sluice Ditch, a man-made waterway just below Woodland Beach that connects Duck Creek with Delaware Bay, and ending on the south at Port Mahon where the Mahon River meets the Bay. This intertidal zone, the area alternately flooded and drained by the rise and fall of the tide, extends inland an average of over two miles.

Flowing south through the middle of the salt marsh, its winding course more or less parallel to Delaware Bay, Duck Creek cuts through the northern portion of the marsh ending at the Leipsic River and creating Bombay Hook Island. Flowing west to east through the refuge, the Leipsic River and south of it Green Creek and the Simons River create another island in the marsh, Kent Island. Still further to the south a third island, Kelly Island, is formed by the Simons River and the Mahon River. There are two smaller islands: Needhams Island created by the Leipsic River, Boat Gut, Muddy Branch, and Little Fork; and Marshall Island created by a loop in the Leipsic River.

While three rivers the Leipsic, the Simons, and the Mahon, and two creeks, Duck and Green, are the major waterways on the refuge, there also is a web of guts (i.e., tidal streams) and man-made canals and ditches running through it. The longest is Shearneck Gut that begins near Shearneck Pool and then wends its way east and south, eventually joining Duck Creek near where it empties into the Leipsic River. Raymond Gut is more familiar to visitors of Bombay Hook since it can be seen at the end of Boardwalk Trail and along

the dike road opposite Raymond and Shearness Pools. It begins opposite Shearness Pool, is connected to Shearness Gut by Finis Brook, and flows southward to the Leipsic



River. Another major gut is Old Womans. It joins Herring Branch south of its junction with the Simons River and flows into the Mahon River.

Most of the man-made ditches and canals are found in the northern portion of the refuge. Unlike the natural guts and streams with their winding, serpentine courses, these man-made features usually follow a straight-line course. In addition to Sluice Ditch at the northern boundary, Mikes Ditch connects Shearness Gut with Duck Creek, and Slooch Ditch runs from Raymond Gut to Shearness Gut and then to Duck Creek, providing access to the marshes for snow goose hunters who launch their boats in Raymond Gut across from Shearness Pool. Dutch Neck Canal, located in the marsh across from Bear Swamp Pool also flows into Duck Creek, and it was at this juncture that the CCC (Civilian Conservation Corps) constructed a one-room, law enforcement patrol cabin in the summer of 1939. Farther south, the only significant man-made waterways are two canals, the North-South and the East-West Canals, on Kent Island.

The marsh is pocketed with small tidal ponds that provide an attractive habitat for ducks, including mallards, black ducks, gadwalls, and blue-winged teal that nest in the marsh, as well as the many migrants that visit in the fall and winter, such as green-winged teal, pintails, buffleheads, ruddy ducks, mergansers, and scaup. The Civilian Conservation Corps deepened some of these ponds on Bombay Hook and Kent Islands in 1938 and 1939 to retain water during low tides and dry periods in the summer months. This was so that banded killifish, mummichogs, and other mosquito eating fish could be introduced in these ponds as an alternative means of mosquito control.

Mud flats are still another feature of the salt marsh. While some are naturally occurring, at Bombay Hook the most visible mud flat is the portion of Money Marsh, across from the north end of Shearness Pool that was created by the feeding habits of the snow geese. Snow geese feed by pulling up cordgrass and eating the roots. So when large numbers of them feed in a marsh they can remove all vegetation, a condition biologists call "eatout," and a mud flat remains. While the mud flat is a valuable habitat for shorebirds who feed on invertebrates and small crustaceans found in the mud, tidal action erodes the naked areas and eventually creates a flooded pool at every high tide.

There is one more topographical feature of note, namely the hummock. Hummocks are upland areas, places where there is "hard ground," in the middle of a marsh. Georges Island is seen as the cluster of trees almost directly across from the Boardwalk Trail, and it is a favored place for all kinds of wildlife. Deer use it as a refuge. If you look closely on the south side of the boardwalk on Boardwalk Trail, you may see a deer trail leading to Raymond Gut. Deer swim the gut, and then cross the marsh to Georges Island. Red fox live in the marsh and use Georges Island for their dens. Fox dens also have been found in a small clump of trees near the northern border of the refuge, almost too small to call a hummock, but these are the only places where "hard ground" pokes above the marshes on the refuge.

So what we call the "tidal salt marsh" is really a number of habitats in the intertidal zone: rivers, creeks, brooks, guts, ditches, canals, ponds, mud flats, hummocks - and tidal marsh. Moreover, some areas are high marsh (also called *patens* marshes, named for the cordgrass that grows there), an area of a slightly higher elevation that floods only during the spring and fall equinoxes, during storms, or on other occasions where there is an unusually high tide. The marsh

at the Boardwalk Trail is an example of a high marsh. Low marshes, on the other hand, flood and drain with the usual twice-daily rise and fall of the tide. High and low marshes each have their own characteristics in terms of flora and fauna. For example, the cordgrass that grows in the high marsh, *Spartina patens*, grows about two feet tall; cordgrass in the low marsh, *Spartina alterniflora*, can grow to a height of nearly eight feet.

We also refer to them as the “salt” marshes, but actually the marshes at Bombay Hook are brackish marshes with salinities that range between about ten and twenty parts salt per thousand parts water (or between one-third and two-thirds ounces of salt per quart of water). Ocean water has about thirty-five parts per thousand, or about an ounce of salt in a quart of water. Salinity in the marshes decreases during periods of heavy rain, adding freshwater, and it increases during periods of draught. Therefore, the plants, insects, and animals that live in these marshes not only must be salt tolerant, but also they must tolerate varying amounts of salinity.

Perhaps the most important feature of these marshes is that they are *tidal*. Being tidal, the low marsh areas, the rivers, creeks, guts, ditches, canals, and ponds flood on each high tide, usually twice per day. They also drain again, usually twice per day. On the high tide, bay water flows into the marsh, carrying with it silt and contaminants that are filtered out by the marsh grasses. On the way out, on the low tide, these same waters carry nutrients from the marsh to the bay where they help to support various marine life in the Delaware Estuary.

The tidal range, the difference in water height between high and low tides, also changes between the marshes near the bay, at the entrance of the rivers, and on the inland edges of the marsh, such as the edge of the Boardwalk trail. The tidal range at the mouth of the Leipsic River averages nearly five and a half feet; at the Boardwalk Trail it averages between three and four feet.

The marsh itself, a vast grassland, is the dominant habitat. Salt meadow cordgrass (*Spartina patens*) is the predominant plant in the high marsh areas along with patches of salt grass (*Distichlis spicata*), while salt marsh cordgrass (*Spartina alterniflora*) dominates the low marsh. A third cordgrass species, big cordgrass, sometimes called salt reed grass, (*Spartina cynosuroides*), is seen particularly along

the edges of the marsh and guts, in both high and low marshes. These marsh grasslands produce more total vegetation per acre than almost any other habitat, more than the rain forests of the Amazon or the cornfields of Kansas.

Cordgrasses are perennials that emerge in the spring, turn from light to deep green in the summer, and then in the fall turn a golden brown before dying off. This huge biomass then falls to the marsh floor where it begins a decaying process. One result is the familiar smell of marsh gas. Another is detritus, a combination of dead plants and decomposing organisms that forms the base of the estuarine food chain. This is a rich, supportive habitat. Aquatic invertebrates feed on the detritus and in turn are food for the vertebrates such as the many fish species that breed in the marsh.

This ecosystem is home to a large number of animal species. Visitors to the Boardwalk Trail recognize the fiddler crab, or at least note the holes in the mud banks along Raymond Gut that are their homes. These small crustaceans, the male with one large claw that looks as if he were playing a fiddle, eat detritus that they extract from the mud, and dig burrows that are nearly two feet deep. They are an important food source for wading birds, especially clapper rails, the marsh birds that are sometimes heard but seldom seen. In addition to fiddler crabs, the marsh and its guts, creeks, and rivers is home to marsh crabs, mud crabs, and blue crabs.

Another inhabitant, frequently found by school children who use dip nets to explore life in the brackish pond at the Boardwalk Trail, is the nearly transparent grass shrimp. This pond also yields several species of small mosquito-eating fish: mummichug, sheephead minnow, and banded killifish, as well as an occasional Atlantic silverside. Many saltwater fish use tidal marshes as spawning grounds and nurseries for their young. Among species found in the Bombay Hook marsh are striped bass, white perch, American eel, and gizzard shad.

A kind of special bonus is the northern diamond-backed terrapin, the only turtle species on the refuge that lives in the brackish water of the tidal marsh. Once its population was seriously depleted when it was hunted for a popular dish, terrapin soup, but it has now recovered, and the females can be seen in June and July when they climb the banks of the impoundment dikes to lay their eggs.

A surprising number of mammal species are found in the tidal marsh. As expected, muskrats are abundant, and while not often seen, their presence is obvious by their houses, mounds of reeds rising above the marsh grasses. Similarly, an occasional river otter might be seen playing on a mudslide along one of the guts, and occasionally a mink may be found in tidal marsh where it feeds on fish.

Among those that we consider terrestrial mammals, white-tailed deer not only cross the marsh to Georges Island, but their trails crisscross the marsh in all directions. The use of the marsh by raccoons is evidenced by the number of raccoon tracks seen on Boardwalk Trail. And red foxes not only have their dens on Georges Island and the small clump of trees at the northern end of the refuge, but they consider the marsh a cafeteria. After all, it not only offers muskrats, one of their favorite foods, but several species of small rodents that thrive in the marsh. These include least shrews, rice rats, and meadow voles. But there is competition for these rodents: northern harriers swoop low over the marsh during the day looking for a meal, while short-eared owls search for them at night. Truly, the marsh is a dangerous place for a small rodent!

The marsh, though, really is for the birds. Snow geese rest overnight in its tidal ponds and feast during the day on its cordgrass; in the spring nesting willets are everywhere; and a boat running through Shearneck Gut in the fall sends to wing flocks of mallards, blacks, pintails, wigeon, and teal at every turn. In the spring and summer thousands of shorebirds feed on the mudflats during low tides. Glossy ibis probe the mud with their long, curved bills; great and snowy egrets and great blue heron stalk fish along the banks of guts and creeks.

Clearly the tidal marsh is Bombay Hook's greatest treasure even though it remains hidden for most visitors to the refuge.

Volunteer Hours

Volunteers -- Please inform me of volunteer hours that need to be added to your timesheet. I will tabulate the hours at the end of September

*Thank You,
Tina Watson*

Gone Fishing! ***Fishing events held July 11 and 12, 2005*** ***By: Tina Watson***



Smyrna-Clayton Boys and Girls Club

The Friends of Bombay Hook, Inc. and the Regional Office in Hadley, MA, funded a fishing event for Smyrna/Clayton and Dover Boys and Girls Clubs. Bombay Hook staff and volunteers taught 30 children how to cast, pull in the big ones, and tell fish stories. The event was held in partnership with Bob Jones, Delaware Division of Fish and Wildlife at

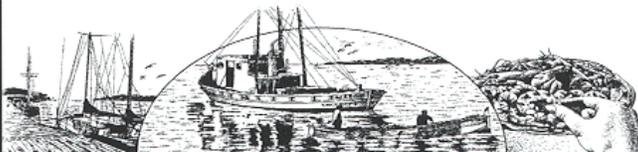


Wesley College Boys and Girls Club

the Aquatic Education Resource Center's catch and release ponds. This is the third year the event was held for various local Boys and Girls Clubs and other agencies. The children had large mouth smiles as they left with identification guides, t-shirts (donated by Great Graphics and FOB), sun visors, a picture of them with their 'catch of the day', and fishing rods.

Schedule of Events
Check the Website for upcoming events
at
www.bombayhook.fws.gov

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