# Saving a Salt Marsh

## Wildlife habitat makes a comeback as Prime Hook project mends Hurricane Sandy's destruction

By Lynn R. Parks | Photograph by Kevin Fleming

A new beach lies along the east edge of the Prime Hook National Wildlife Refuge near Milton. Planners hope that the beach will remain in place long enough to allow the marsh to the west to rebuild to the point that it can withstand flooding from the encroaching sea.

Just two years ago, the view from Fowler Beach Road east of Milton was very different from what it is now. What had been freshwater wetlands, artificially created and maintained as part of the Prime Hook National Wildlife Refuge, was all water. ▸

The top of the new 8,000-foot long dune at Prime Hook is planted in American beach grass to help hold the sand in place.

***"We called it Prime Hook Sound,"*** says Annabella Larsen, wildlife biologist at the refuge. "We had lost all the wetlands and everything was covered with saltwater."

Today, though, the area is home to a growing high salt marsh. More than a third of the area that was open water is now green with plants, primarily cordgrass.

"This is so impressive," says Al Rizzo, project leader at Prime Hook as well as at the Bombay Hook National Wildlife Refuge northeast of Dover. Rizzo and Larsen comment as they ride east on Fowler Beach Road, on a mission to examine the marsh's progress. "All of this growth has happened in just two years."

Rizzo says that the new saltwater marsh, in just its second growing season, is "seeing very rapid redevelopment." Scientists had thought that it would take five years or more for the marsh to grow up in plants. "But it seems to be accelerating," he says. "It's like the seeds were just lying for decades, waiting for the right conditions to grow."

A piping plover chick sits on the beach at the Prime Hook National Wildlife Refuge, next to an egg where another plover is starting to emerge. Plovers nested there last year for the first time in the refuge's history.

Larsen has no guess as to when the wetlands, now about 65 percent water, will reach 25 percent water and 75 percent soil and plants, the typical proportions of a marsh. "It's hard to predict," she says. "But it is progressing at a phenomenal rate, far exceeding all of our expectations."

There's something else happening at the refuge, a change that, Larsen notes, "made our hearts full." Last year, for the first time in the history of the refuge, a pair of piping plovers nested on its Delaware Bay beach. This year, the beach was home to eight plover nests. Out of them, a dozen chicks fledged successfully.

"That's huge for us," Larsen says.

Also in the past two summers, the refuge beach has been home to the only least tern colony in the state. More than 30 pairs of the shorebird nested there in 2016 and returned again this past summer.

The beach also had a nesting pair of American oystercatchers this year. Three eggs hatched in their nest; by the end of the summer, one hatchling was still living.

All three species — piping plover, least tern and American oystercatcher — are on the list of Delaware natives in danger of disappearing from the state. Globally, the piping plover is considered "near threatened" by the International Union for Conservation of Nature.

Both phenomena — the rebuilding marsh and the birds' newfound appreciation of Prime Hook — are the results of a $38 million project, designed to make the refuge resilient and able to handle a rising sea level. The project was started in 2013 and wrapped up late this summer. Funding was provided by the federal government: $20 million from monies to help victims of Hurricane Sandy — surge from which washed away the freshwater wetlands in October 2012 — and another $18 million from a fund set up to pay for improving coastline resiliency along the Atlantic seaboard.

Rizzo admits that the loss of the wetlands, and the hundreds of thousands of geese and ducks that visited them every year, was disheartening for employees at the refuge as well as visitors. About 80,000 people visit every year.

"Any change is hard to accept," he says.

But Larsen says that even without the damage that Sandy caused, something had to be done to save the refuge. "With climate change and sea level rise, what we had before wasn't sustainable," she explains. While the so-called superstorm caused devastation and death along the Atlantic coast, the money that followed came at just the right time for Prime Hook.

### What Sandy wrought

The 10,000-acre Prime Hook National Wildlife Refuge lies along Delaware Bay, stretching between the beachfront communities of Prime Hook and Slaughter Beach. About 4,000 acres are wetlands; the remaining acreage is woodlands, farm fields and meadows.

The refuge is divided into four units, each of which contains wetlands. In units I and IV, the northernmost and southernmost sections, the marshes are saltwater, the natural state of wetlands along the Delaware Bay coast. When Sandy hit, those marshes were inundated with water from the bay, but weren't harmed. Established





Photograph at top by Carolyn Watson, above by Julie McCall, USFWS

grasses reduced wave action; silt that washed in only helped to build up the bottom of the marsh, giving plants more space in which to anchor their roots and making the system better able to handle storms of the future.

But in units II and III, it was a different story. There, bay water breached embankments that were built shortly after the refuge was established in 1963 to create impoundments holding freshwater wetlands. By the time Sandy moved out of the area, the wetlands that were visited every year by 80,000 ducks and up to 150,000 geese — more than half of the state's waterfowl population — were gone.

Sandy was the killing blow for these wetlands. But well before the storm hit, they were suffering. Instead of accreting sediment and building up their floor, something that healthy marshes do, they were sinking. According to a University of Delaware report, by the time Sandy struck in 2012, the floor of the freshwater marshes was 7 inches lower than the floor of the adjacent saltwater marsh.

And there was another problem with the artificial wetlands. In a natural system, as sea levels rise, beaches move inland onto marshland. The marshes that they supplant also move inland, maintaining a healthy, sustainable system. But the freshwater impoundments formed a blockade. The beach in front of units II and III had no room for retreat.

> "We were always dependent on the integrity of the beach and dunes to protect the impoundments. But with these breaches, all bets were off."

"We were losing beach at the rate of 10 to 15 feet a year," Larsen says. With a narrowing beach, water from three storms, in 2006, 2008 and 2009, breached the dunes and embankments and washed into the impoundments.

"We were always dependent on the integrity of the beach and dunes to protect the impoundments," she notes. "But with these breaches, all bets were off."

When Sandy hit, scientists at the refuge were already working on a plan to restore the original saltwater marshes and put back in place a more natural system. Government funding that followed the storm meant that they were able to put that plan into action.

In October 2013, the refuge announced receipt of the two grants through the Hurricane Sandy Disaster Relief Fund. The money would repair beach and dune breaches and restore "a robust marsh environment … that will better withstand the tests of time, future storms and a changing environment."

## Rules of Engagement

The Prime Hook National Wildlife Refuge is one of more than 500 such refuges, managed by the U.S. Fish & Wildlife Service, part of the Department of the Interior. The mission of the National Wildlife Refuge System is to protect fish, wildlife and plants as well as their habitats.

"Refuges exist first and foremost for the wildlife," says Al Rizzo, project manager for Prime Hook as well as for the Bombay Hook National Wildlife Refuge northeast of Dover.

That doesn't mean people aren't welcome to visit; the Prime Hook refuge gets about 80,000 visitors a year. But visitors are expected to be there for "wildlife-dependent activities," such as hunting, study or simple observation. On the new Prime Hook beach, for example, people can examine the plants that are growing on the dune, watch for birds, or surf-fish. But they can't set up a beach chair and umbrella and read.

"We hope to see you mobile," wildlife biologist Annabella Larsen says.

She and Rizzo also hope that visitors honor the natural area and the creatures that live there. Too often, Rizzo says, refuge staff have to pick up garbage that people left behind. In addition to food wrappers and cups, that trash has included chicken parts used by crabbers for bait, bottles, even dirty diapers.

"This is a beautiful, quiet place to be," Rizzo says. "We want you to visit the refuge. But we want you to respect it." ■

Seawater moves through man-made channels, carrying silt to help rebuild the marsh. Sand dug up during excavation of the channels was put along the banks.

### Hatching a restoration plan

The marsh restoration project was designed by the Army Corps of Engineers, based on a study by Atkins, an international engineering and project management consulting firm based in London. Engineers came up with 12 possible plans and the corps and the refuge "chose the best one, based on the best available science," Rizzo says. "We had a very powerful model that gave us the ability to ask questions to ensure we were getting the right outcome."

Step 1 in healing the refuge was dredging out 25 miles of channels that at one time had meandered through the salt marshes. The channels were dug to 3 feet below mean sea level and designed to hold water about 2 feet deep. Their placement was based on historic photos that showed where channels had been before the freshwater impoundments were built. The channels were intended to restore natural tidal flow of water as well as sediment. "Studies suggest that increasing the amount of creek edge in a tidal marsh will



Photograph by Kevin Fleming

## Gravelly Welcome Mat

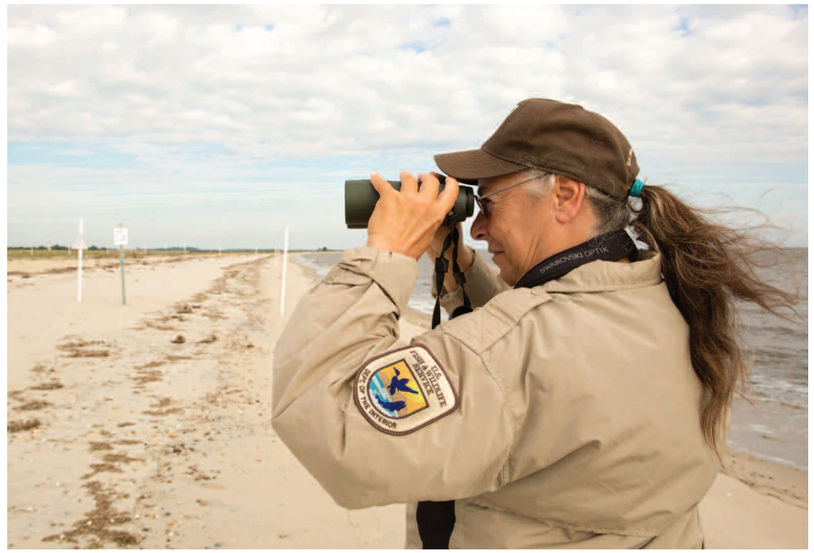
When scientists planning the restoration of the beach at Prime Hook National Wildlife Refuge were deciding the area of Delaware Bay from which to dredge sand, they opted for a spot about a mile and a half offshore. There, the sand is gravelly, the kind in which horseshoe crabs prefer to lay their eggs. It isn't the fine sand that beachgoers like to dig their feet into.

"This isn't a people beach," says Al Rizzo, project manager at the refuge.

Horseshoe crabs come ashore every spring to spawn. Wildlife biologist Annabella Larsen says that scientists wanted to make sure that the ungainly arthropods — as well as the federally threatened red knots, which feed on crab eggs during a break in their migration from the southern tip of South America to the Arctic Circle — would feel welcome. And they did. "We have had very successful spawning seasons," Larsen says.

But what scientists didn't bargain on was how attractive the gravelly beach would be to shorebirds that were looking for a place to nest. Piping plovers, American oystercatchers and least terns have set up housekeeping there both summers since the beach was constructed.

"Typically, shorebirds like more high-energy beaches for their nests, ocean beaches where the waves are bigger," Larsen says. "We have a pretty calm beach. But the birds found this sand to their liking. We didn't target them. But we got them anyway." ■



Wildlife biologist Annabella Larsen uses binoculars to check the beach and dune for life — plant as well as bird.

increase the rate at which created marshes mature," the Atkins study says.

Dredging began in the summer of 2015. Starting in the southeast corner of Unit III, three dredges slowly made their way northward, carving out the channels. The digging, which was stopped temporarily in the winter due to ice, took more than a year to complete.

In October 2015, the beach restoration portion of the restoration project was started. Sand — 1.3 million cubic yards of it, or nearly 1.7 million tons — was pumped to shore from about 1½ miles out in the bay. (See "Gravelly Welcome Mat" on page 82.) With it, the breaches that had allowed saltwater into the freshwater wetlands were filled.

In addition, a back barrier beach was constructed on the east side of the marsh, with a dune between it and the bay. On the bay side of the dune is a berm, or forebeach, which leads down to the water.

**VIEW PRIME HOOK RESTORATION**
Go to www.Reveel.it and snap a photo

In total, the new construction stretches nearly 8,000 feet along the shoreline. Its width varies, from 350 to 500 feet. The gently sloping dune is nearly 10 feet tall and is 60 feet wide from toe to toe. The forebeach is 150 feet wide.

After construction was completed, a scalloped fence was put in along the top of the dune, near its crest, to capture windblown sand to add to the dune's height. The dune was planted in American beach grass; cordgrass and switch grass were planted in the back barrier.

The final piece of the marsh re-creation puzzle was to improve tidal flow throughout the system. The state's Department of Transportation installed several culverts beneath roads that run west to east through the refuge so that water could run underneath them. Workers also removed structures that had been in place to impede water movement. A new bridge on Prime Hook Road, crossing one of the largest of the channels that were dug out, was built.

On the day that Rizzo and Larsen visit the restored wetlands and new beach, dozens of swamp mallows at the edge of the marsh are in bloom. Rizzo is keeping his eyes open, hoping to spot a saltmarsh sparrow, a small bird that breeds in salt marshes from southern Maine to Virginia and that, because of habitat loss, is vulnerable to extinction. ➤

Photograph by Carolyn Watson

The dune and back barrier are dotted with plants, including sea rocket and seaside goldenrod, natives to the Delaware coastline. (See "Seeds of Hope" on facing page.) While they can't spot it, the two scientists feel sure that the surviving American oystercatcher chick is on the beach somewhere.

A wrack line, up to 2 feet wide, stretches the length of the beach, about halfway between the water's edge and the east toe of the dune. Made up of seaweed, animal remains and other organic material that is washed onshore by the bay's waves, it is an essential food source for shorebirds.

"A lot of people might think that this is dirty," Larsen says, scratching at the line with her foot. "But there's a lot of food in there for birds."

**Our hope is that this lasts forever, but that's a human hope. That's not practical."**

### Looking ahead

Of course, none of this is permanent. "Our hope is that this lasts forever," Larsen says, "but that's a human hope. That's not practical."

While scientists disagree about rates, they agree that sea levels are rising. The latest (2014) prediction from the United Nations' Intergovernmental Panel on Climate Change says that by century's end, oceans could be from a foot to a little more than 3 feet higher than they are now. Other studies predict even higher seas.

The scientific model on which the restoration project was based (Sea Level Affecting Marshes Model, or SLAMM) used a projected sea level rise of half a meter, about 1.64 feet, by 2100. Under that scenario, the new beach — where so many shorebirds have found a home — will remain intact for about 30 years. After that, the model says, the beach and dune may start to break apart.

But that does not mean that the marsh will necessarily turn back into what Larsen calls Prime Hook Sound. By that time, the marsh may have grown to the point that it can withstand flooding.

Faced with rising water, the beach may

**Biologists have been pleasantly surprised at how quickly flowering plants have started to grow on the restored beach and wetlands. Top: Seashore mallow grows among the remains of trees that were killed by saltwater intrusion. Bottom, from left: Straw-colored flatsedge, evening primrose and sea rocket grow on the restored beach.**

## Seeds of Hope

William McAvoy is Delaware's state botanist. When he visited the new beach and dune at the Prime Hook National Wildlife Refuge this past summer, he was surprised at the variety of plants he found. In three surveys, he found 29 species of plants on the forebeach (the area to the east of the newly constructed dune) and 44 species on the back barrier (to the west of the dune). All were broadleaf herbs, grasses or sedges.

Of the plants on the forebeach, 17 were native to the area. On the back barrier, 28 were natives. Even though a number of the plants he found were non-natives, none was invasive.

"It was very impressive as to the degree of diversity that has re-established itself on the beach," McAvoy says.

Many of the plants that grow on Delaware beaches and dunes are annuals: A plant sprouts from seed, grows for one season and then dies. Annuals produce a lot of seeds, which "can remain viable for many years, even when they are floating in the ocean or buried in sand," McAvoy adds.

He also notes that the plant growth on the new beach is indicative of the resiliency of nature and its ability to reclaim an area that had been lost. "Build it and they will come," he says.

But the botanist cautions that as quickly as the plant colonies are established, they can be wiped out: "With the next storm event, they could just as quickly disappear." ■

## Benefits of Good Health

The growing salt marsh at the Prime Hook National Wildlife Refuge is a high marsh, meaning that it is infrequently inundated with seawater. Low marshes are flooded every day.

Salt marshes are ecologically important areas for a variety of reasons. They provide critical habitat for fish and crustaceans: On a recent warm day at the refuge, a bridge was lined with people hoping to take some blue crabs home for dinner.

Wetlands, which can hold large amounts of water, protect inland areas from flooding. According to a presentation at the 2016 Delaware Wetlands Conference, "Damage from Superstorm Sandy appeared reduced in communities that were buffered by coastal wetlands."

They also trap carbon that otherwise could end up in the atmosphere, where it would contribute to climate change; filter water of contaminants; and provide homes to birds and other species.

Marshes, though, are disappearing. Historically, wetlands were filled in for coastal development. Now, in addition to that, rising seas and erosion are washing them away.

In particular, "we are losing high marsh around the world," says Annabella Larsen, a wildlife biologist at the refuge.

In Delaware, nearly 600 acres of tidal wetlands were lost from 1992 through 2007. Since the 1780s, the state has lost 54 percent of its marshes.

According to the Friends of the Delaware Estuary, the loss of wetlands in the area surrounding the bay and the lower Delaware River continues at the rate of an acre a day. More than 95 percent of the marshes around the Delaware Bay and lower Delaware River are eroding, the friends group says. And they aren't accreting, or gaining, any soil, something that would happen in a healthy wetland system.

In addition, pollution and sea level rise are degrading the health of wetlands that remain. "Unhealthy wetlands provide fewer benefits than healthy wetlands," the group states. For example, "wetlands in poor health filter fewer pollutants, capture less carbon and provide less flood protection." ■

also start moving westward onto the marsh behind it. If it does, Rizzo says, the marsh will also move westward. The adjacent uplands will slowly become wetlands.

"We don't have a crystal ball," Rizzo admits. "We don't know what will happen. But we hope that the below-ground biomass is sufficient that if the beach fragments, the marsh can sustain itself."

Even if the beach and salt marsh are washed away in 30 years, he argues that the money spent in restoring them will have been worth it. For one thing, the visitors that the refuge will attract over the next three decades will bring money into the local economy. Add to that the cost savings because of the marsh's ability to prevent floods, or at least make them less severe, and the project is more economically valuable than the $38 million that it cost.

And Larsen points to the ecological benefits: "Because of the new beach, we have added 12 piping plover chicks to the mid-Atlantic population. That's important."

Last winter, the burgeoning marsh was visited by many American black ducks — birds that, while not yet threatened or endangered, are in decline — as well by a number of other birds that are marsh "obligates," species that depend on wetlands for breeding or survival.

"We are seeing a whole spectrum of birds that are in jeopardy," Larsen notes. "When all we had was open water, that didn't benefit any wildlife species. From a conservation point of view, what we have done is buy more time for a lot of species. That is certainly of value." ■

*Lynn R. Parks, a regular contributor to Delaware Beach Life, won state and national awards for her series about climate change published here in 2013.*

## To Learn More

For more information about the Prime Hook National Wildlife Refuge, visit fws.gov/refuge/Prime_Hook.

The refuge welcomes volunteers. To sign up, call 684-8419.

It also has a friends group, which supports activities at the refuge, sponsors an annual photography contest and manages a gift shop, proceeds from which benefit the refuge. Visit friendsofprimehook.com for details. ■