New Jersey Marine Sciences Consortium/New Jersey Sea Grant

STATE of the SHORE Report 2010

Welcome to the 8th Annual State of the Shore Media Event

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Executive Director, Director of Education
New Jersey Marine Sciences Consortium/New Jersey Sea Grant

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Ask a New Jerseyan what they like most about their home state and many may say it's the seasons and the changes each one brings: the renewal of spring, the colors of fall, and summer fun on the beach. And then there's winter—a season that can test New Jerseyans to their cores. This winter was a tough one; there's no denying that. This year's State of the Shore Report prepared by New Jersey Sea Grant Coastal Processes Specialist, Dr. Jon Miller, a Research Assistant Professor at Stevens Institute of Technology, bears this out and describes the effect the winter of 2009-10 had on our state's beaches. Challenging weather included multiple Nor'easters and a major snow storm even before winter had officially begun. Then there was the snow, mountains of it—just ask anyone who had to shovel out from under it. Finally, as spring approached, the calendar hinting that maybe we were finally out of the woods, we were met with a two-day mid-March blizzard that packed a wallop.

But New Jerseyans are not easily deterred. We may have grumbled and complained about the weather all winter and even threatened to pack up and move to warmer climates. But when the first warm day of spring arrived this past April, the memories of a harsh winter faded away and we flocked to the beach. With shorts and flip-flops put on so quickly it's a good bet some folks never put them away. We were already set for another summer at the Jersey Shore. When we finally arrived at the beaches we could see that winter had changed them but, as Dr. Miller will report, not so drastically that we could not enjoy them.

The resiliency of our beaches can be credited in part to decades of scientific study, including the work of the three researchers featured in this report. Their work has made significant contributions toward the ability of our coastal communities to better understand and manage their beachfronts through science-based practices including beach recovery and conservation methods that are efficient and effective. The end result are beaches that can withstand a tough winter like we just experienced yet continue to support the economies of the communities which are dependent on them for revenues generated from coastal tourism and beach recreation activities.

While most people go to the beach to relax and enjoy, Dr. Miller and Drs. Louise Wootton and Josh Kohut, choose to go to our beaches for very different reasons. They go instead to uncover the answers to our state's most pressing coastal issues and to help develop ways to ensure our beaches will be there for us to enjoy for generations to come.

Ah, summer—bring it on!

New Jersey Marine Sciences Consortium/New Jersey Sea Grant
STATE of the SHORE

New Jersey State of the Shore Report 2010

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DR. JON K. MILLER

"It was the best of times, it was the worst of times." Truer words have never been written. Although Charles Dickens' immortal words refer to French society embroiled in the throes of a revolution, they could just as easily have been written about life along New Jersey's coast. New Jersey residents have always had a tumultuous relationship with the sea, sometimes cordial, sometimes heart-rending. As Dickens continued "it was the season of Light, it was the season of Darkness, it was the spring of hope, it was the winter of despair…" words that rang all too true for New Jersey's coastal residents this past winter.

Coastal Storm Activity

After seven relatively mild winters in a row including two that rank amongst the mildest in the last half century, New Jersey's coast was battered this winter by a series of storms unprecedented in the modern historical record. Winter storm activity was analyzed using a variety of approaches employing data collected by wave and water level gauges maintained by the National Oceanographic and Atmospheric Administration (NOAA) and Stevens Institute of Technology. Of the three long-term water level gauges operated by NOAA (Cape May, Atlantic City, and Sandy Hook), only the Atlantic City gauge is situated directly on the ocean coast. Water levels measured by the gauge at Atlantic City are shown in the upper panel of Figure 1.

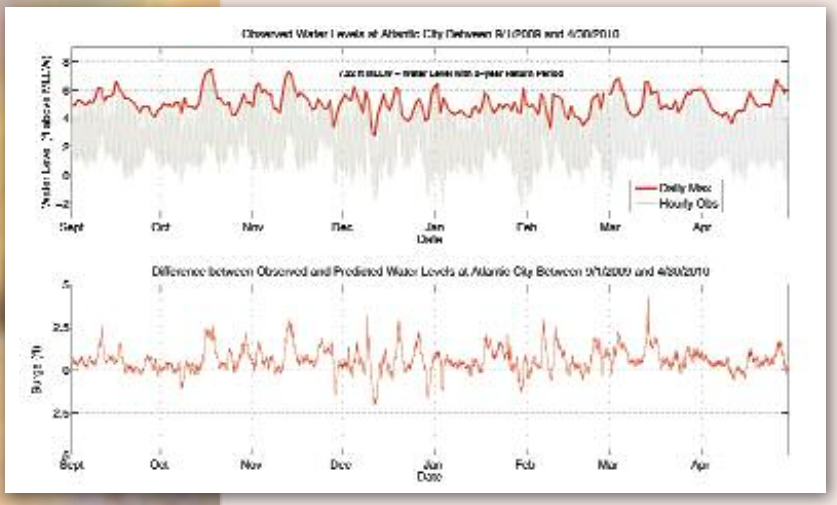

Figure 1: Measured water levels and water level differences at Atlantic City between September 1, 2009 and April 30, 2010.

Hourly observations are plotted in grey, with a thicker red line used to identify the maximum daily water level. Also included is a dashed line which indicates the water level corresponding to a 2-year return period (water level that has a 50% chance of being exceeded in any given year). The surge or difference between the predicted (astronomic) and observed water levels, is plotted separately in the lower panel of Figure 1. Wave information for the New Jersey coast is provided by three deep water gauges (44025, 44009, and 44065) operated by NOAA and several nearshore gauges (LBI, Avalon, and Ocean Grove) maintained by Stevens Institute of Technology.

The winter storm season got off to an exceptionally early and inauspicious start as the remnants of Hurricane Bill threatened the New Jersey coastline in mid-August. Fortunately, the storm passed far enough offshore that the most significant impact from the storm turned out to be some of the best surfing conditions of the past decade. The long period swell associated with the storm actually built out the beach in several communities. Rather than devastating the coast, Bill simply served as a warning of things to come.

September and the first half of October passed without much significant storm activity. In mid-October the first major storm event of the winter occurred, when a pair of Nor'easters acted in concert to elevate water levels along the coast over a period of 5 days. The combined storm resulted in moderate coastal flooding, beach erosion, and widespread power outages. Traditional stage frequency analyses based on the maximum water level reached during the event suggest the storm had a return period of approximately 5 years (20% chance of occurring in any given year), a number roughly commensurate with the amount of damage reported.

New Jersey's coastal communities barely had time to recover from the October storm when they were hit with what would become known as the "Friday the 13th Storm." Other monikers used in the press included "The Veterans Day Storm" and the "Son/Daughter of Ida"; however, given the major damage sustained during the storm, Friday the 13th Storm seems most appropriate. The storm began as the remnants of Hurricane Ida collided with and eventually became entrained into a low pressure system developing off the North Carolina coast. The resulting storm system created a powerful Nor'easter that generated water levels and storm surges that were remarkably similar (in terms of both magnitude and duration) to the mid-October storm. Again traditional water level based analyses indicate the storm had


November 2009


November 2009

a return period of approximately 5 years; however, the damage estimates in excess of $50 million suggest the storm was much more significant. The storm prompted an immediate response from then-Governor Corzine who declared a State of Emergency in six counties, a response that was followed up a month later by President Obama who signed a Presidential Disaster Declaration. The contrast between the damages inflicted and the suggested significance based on traditional analyses prompted researchers at Stevens and elsewhere to perform a reanalysis of the storm using a more complete set of parameters. By including important factors like storm duration and wave height, the reanalysis confirms that the Friday the 13th Storm was in fact much more significant than indicated by water level alone and suggests the storm had a return period closer to 20 years, making it the most significant event since the December 1992 Nor'easter.


March 2010

In December, January, and February, a series of storms continued to eat away at the coast. Although several major snow storms occurred during this time frame, the coastal impacts were more muted, with the resulting erosion due more to the cumulative impacts of the storms than any one individual storm. Hopes that New Jersey might escape the winter without another major coastal storm were quickly dashed in mid-March when a major snow storm stalled off the mid-Atlantic coast and buffeted the New Jersey coastline with tropical storm force winds and energetic waves over a period of several days. The storm resulted in the most significant storm surge of the season at just over 4 feet; however, the surge peaked during low tide during a period when the tides were transitioning from a neap phase (lower than normal). As a result, the maximum water level reached during the storm fell well short of that associated with even a modest 2-year storm. Once again however, the damage caused by the storm suggests its significance was much higher than that associated with a typical 2-year storm. The damage was so significant in fact that President Obama once again declared parts of New Jersey a major disaster area. Using the same reanalysis procedure that was applied to the November storm, a more realistic return period of 6 years was determined for the March storm.

Cumulative Impact

The severity of the storms this past winter has sparked numerous inquiries as to just how bad it was. In terms of coastal water levels as recorded by NOAA's tide gauges, the winter was in fact quite ordinary. The major factor in the amount of beach erosion and coastal damage experienced was the unprecedented level of wave activity. Figure 2 shows a comparison of the monthly average wave heights recorded this past winter (red) with the long-term averages (grey) at NOAA buoys 44009 (off Delaware Bay) and 44025 (off Sandy Hook). The average wave height recorded this winter exceeded the long term average every

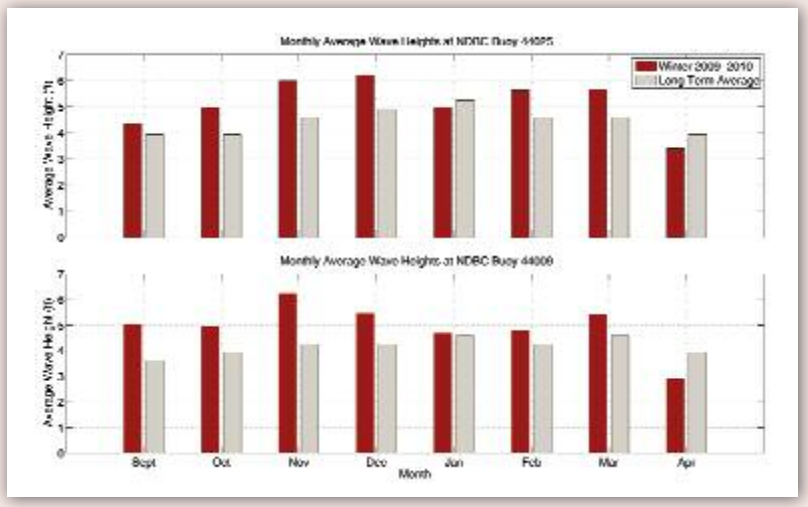

Figure 2: Comparison of the monthly average wave heights at NDBC Buoys 44025 and 44009 observed during the winter of 2009/2010 with the long-term historical averages.

month by a significant margin with the exception of April. The buoy off the southern NJ coast (44009) actually recorded the largest wave ever measured during the months of October, November, December, and February, as well as the largest wave height ever measured at the station (26.6 ft). Through analogy with the Accumulated Cyclone Energy (ACE) parameter used by NOAA to measure the relative strength of tropical cyclone seasons, two parameters the Storm Erosion Index (SEI) and the Accumulated Storm Wave Energy (ASWE) were used to compare storm seasons (July through June) over the period for which wave and water level data are available. Figure 3 shows the comparison where the values have been normalized by the maximum value. Even though the 2010 dataset is still incomplete, both the ACE and ASWE are already significantly larger than in any other given year, and in most cases are nearly double that measured in previous years.

Coastal Assessment

This "winter of despair" was undoubtedly one of the worst with respect to beach erosion and storm damage in New Jersey's recent past. One has to go back to historic storms such as the Hurricane of 1944, the Ash Wednesday Storm of 1962, and the December 1992 Nor'easter to find storms of similar magnitude and destructive potential. Fortunately, several factors helped to slightly mitigate the impacts. First, the two largest storms of the season were concentrated along different sections of the coast. While both were big enough to impact the entire state, the nature of the November storm was such that the beaches in the southern part of the state received more damage, while during the March storm the northern beaches fared worse. In addition, many of New Jersey's beaches, if not its residents, were optimally prepared to absorb Mother Nature's blow. The combination of the abnormal lull in storm activity over the past decade combined with the robust nature of New Jersey's beach nourishment program resulted in beaches that were generally wider and much healthier than they otherwise would have been.

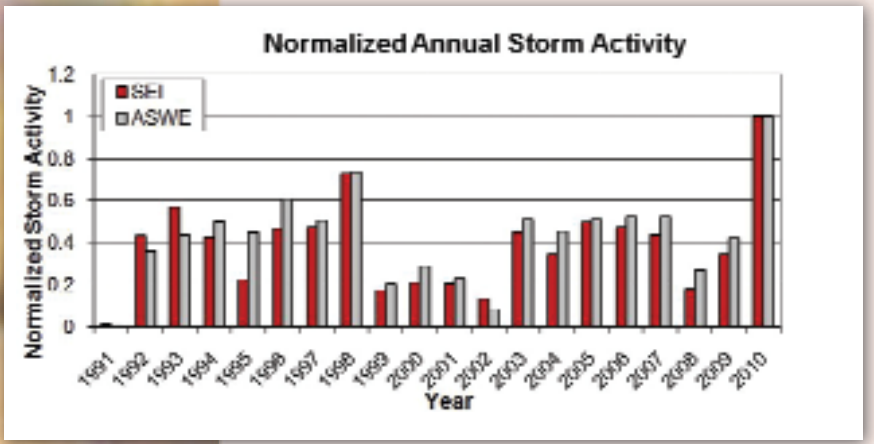

Figure 3: Annual values of accumulated Storm Erosion Index (SEI) and Accumulated Storm Wave Energy (ASWE) based on data collected at NOAA buoy 44025 and the Atlantic City tide gauge.

Summer Storm Outlook

The most recent (April 7, 2010) extended range forecast released by the Colorado State University Tropical Meteorology Project calls for an above average 2010 hurricane season, with a total of 15 named storms, 8 hurricanes, and 4 intense (Category 3 or higher) hurricanes. These numbers are significantly higher than the long term averages of 9.6 named storms, 5.9 hurricanes, and 2.3 intense hurricanes, and represent the fourth time in the last five years the April forecast has called for an above average tropical storm season. This season, an anomalous warming of Atlantic tropical sea surface temperatures, combined with weakening *El Niño* conditions over the Pacific are considered the major contributing factors. The probability of an intense hurricane strike along the U.S. east coast is given as 69%, significantly larger than the decadal average of 52%. While a direct impact from an intense hurricane remains highly unlikely in New Jersey (<0.1%), there is a realistic chance that New Jersey could be impacted by damaging tropical storm or hurricane force (40-75 mph) winds. Based on the latest forecast, the probability of New Jersey's coastal counties being impacted by tropical storm force winds is 6.6%, with a 1.9% chance the winds could reach hurricane force.

Future Outlook

Lower than average wave conditions and the lack of any significant storm activity through the better part of April gives New Jersey's residents hope that we are now entering the "spring of hope." Undoubtedly, the beaches will look different compared to last summer; however, the good news is that most communities have a strategy and have been busy preparing for the summer season. Since the natural beach recovery process can be agonizingly slow, particularly for coastal communities that rely heavily on revenues generated during the summer tourism season, many communities are attempting to accelerate the process. Some communities are promoting the recovery of the back beach and dune system by scraping newly deposited material near the shoreline up into the dune. In other cases communities are simply moving sand from locations where it has piled up during the storms to locations that have become exposed. In still others, sand is being trucked in to shore up weak spots. The appropriateness or effectiveness of each technique varies depending upon the setting. An important lesson that can be taken away from this past winter is that coastlines are dynamic landscapes and if we are to continue to successfully live in and enjoy these environments, we must find a way to plan with resiliency in mind to reduce the impacts from future storm events.

Don't miss the feature article by Jenifer Wehof and Jon Miller on the winter 2010 storm impacts on New Jersey beaches in the new online issue of the Jersey Shoreline magazine at jerseyshoreline.org.

Dunes

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Invasive organisms are becoming an increasingly important problem around the world. As humans move around the globe, they often carry seeds, plants and animals with them, either accidentally or intentionally. Sometimes the species is able to thrive in its new habitat and starts to spread rapidly. Without its native predators, or local predators adapted to keep them in check, invasive species often run rampant in their new homes.

Acre for acre, coastal dunes are the most valuable ecosystems in New Jersey. They form the first line of protection against erosion, coastal flooding and storm damage, as well as sheltering properties and ecosystems behind them from wind, sea spray and storm waves.

Dunes also provide habitat for specially adapted plants and animals, several species of which are currently listed as nationally or locally threatened or endangered such as sea beach amaranth and piping plover. Only 31.2 of the 130 miles of shoreline between Sandy Hook and Cape May Point remain undeveloped. Since many of the species found in these habitats are found nowhere else, loss of these habitats means those species are also becoming increasingly rare.

Funded in part by New Jersey Sea Grant, current research is focusing on the Asiatic sand sedge *(Carex kobomugi)*, which is invading our coastal dunes. After nearly a decade of mapping the growth of sedge within the state it is clear the sedge is expanding rapidly within New Jersey, taking over acres of dunes every year. Indeed, more than 20% of the dune areas in Island Beach State Park and at Sandy Hook are already occupied by this invasive sedge.

Besides tracking the areas affected by this species, this study will provide information about how it spreads and what its effects are on the plants and animals that are usually found in the coastal dune ecosystem. As the invasion matures, abundances of native species are reduced by 50 to 75% in areas invaded by the sedge. This can be a serious problem,

***Carex kobomugi,* the Asiatic sand sedge, has aggressively invaded the dunes at Sandy Hook and Island Beach State Park.**

not just for the plants, but for the animals that depend on them. For example, the sedge decreases abundance of seaside goldenrod, an important food resource for migrating monarch butterflies.

Invasive species may also change the dunes so they no longer provide vital services for New Jersey such as flood protection or creating a reservoir of sand for our beaches. Dune vegetation plays an important role in maintaining healthy dunes. The plants growing there trap blowing sand, thus building the dune and reducing erosion. They also stabilize sand within the dune by holding it in place with their roots and rhizomes. Because the Asiatic sand sedge is shorter in stature than native dune plants like American Beach Grass, it produces dunes that are lower and wider than New Jersey's dunes have been in the past.

Working with a number of government and non-profit agencies as well as local communities, researchers will attempt to find the best way to remove the sedge from these critical habitats and ensure that restoration of these communities after treatment follows best practices for building sustainable, resilient native communities.

In addition, this effort will help produce a variety of innovative and effective educational tools that teachers can use to build students' awareness of the problems caused by invasive species while still meeting state and national core content standards.

Rip Currents

BY JOSH KOHUT, PH.D.
Assistant Professor of Physical Oceanography, Rutgers University

Rip currents are the number one cause of ocean drowning and rescue incidents along the coasts of the United States. According to the United States Lifesaving Association, 71% of the total surf zone rescues, 12,137 incidents, in 2003 were due to rip currents. Rips are strong narrow currents perpendicular to the beach that can exceed speeds of 2 knots. Swimmers can be caught in alongshore feeder currents or the cross-shore rip itself, and be swept off the beach and into deeper waters. Different mechanisms can generate rip currents on different beaches at different times, and it is certainly possible that more than one mechanism can be at work at a given time.

With the support of the New Jersey Sea Grant program, Rutgers University has partnered with Codar Ocean Sensors (codar.com) to develop and evaluate new ocean measurements to improve rip current warnings along the New Jersey coast. This project's primary goal is to develop and evaluate nearshore measurements of currents and waves from an existing network, maintained by Mid-Atlantic Coastal Ocean Observing Regional Association (macoora.org). The network already provides continuous measures of ocean currents from the inner-shelf to the shelf break (approximately 100 miles offshore) in support of Coast Guard Search and Rescue.

This new approach enhances the processing techniques to bring the offshore measurements of currents closer to the coast. The data would benefit research focusing on nearshore wave/current interaction and could be

High frequency (HF) radars remotely measure waves and currents, allowing researchers to monitor conditions along the coast.

incorporated directly into existing National Weather Service surf zone forecasts. Presently, several NOAA National Weather Service (NWS) Weather Forecast Offices (WFOs) around the country issue rip current warnings as part of a daily surf zone forecast. Through the work conducted here, the new algorithms will be installed at each New Jersey radar site and made available to the Mount Holly WFO as additional input information for their forecasts.

Rutgers University and Stevens Institute of Technology has also been engaged in discussions with New Jersey Sea Grant about various opportunities to ensure that groups along the New Jersey coast are aware of the new data resources. The New Jersey Department of Environmental Protection and the Monmouth County Health Department are already engaged and providing valuable input for the continued development of these nearshore products. Local life guard associations along the New Jersey coast are being made aware of these new data products and will be able to access them when needed. All of these interactions will ensure that these nearshore products are built with community input and made more accessible throughout the state.

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