

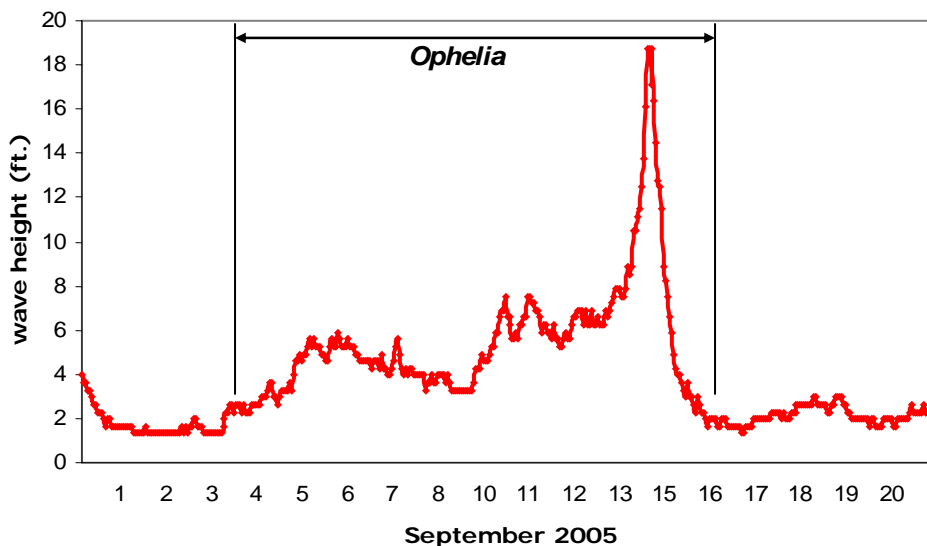
SHORELINES – November 2005
As presented to the Island Review magazine.

Hurricane *Ophelia*

After spiraling in the Southeast Atlantic for what appeared to be weeks on end, *Ophelia* strengthened into a Hurricane and made her ever-so-slow approach to land on September 14th. *Ophelia*'s landward approach kept the northern half of the cyclone over the southern reach of the N.C. coast for a whole day with the powerful northeast quadrant crossing west to east along Carteret County and the very center of the storm crossing Cape Lookout. As tropical cyclones approach, we start thinking about several key components that have a strong signature to the storm's ultimate impacts; (a) intensity, (b) duration, (c) angle of approach, (d) predicted storm surge, and (e) lunar tide at time of landfall. These factors combined in a unique way to make *Ophelia* a very interesting storm for the island communities, and possibly a storm of record for those who live, work, or play along the soundfront. Let's discuss the oceanfront impacts first.

Ophelia was notorious slow, produced very high water levels for approximately a week before landfall from the lift and push of the storm itself and prolonged northeast winds, and the eastern eye wall made landfall in Carteret County at almost dead high tide, just three days before a full moon spring tide. One of the nearest buoys located to Bogue Banks that provides wave and sea condition data is located near the mouth of New River Inlet, Onslow County (Buoy LEJ2). These data shows waves reaching a peak of over 18 foot, with a near 24 hour period of waves of over 12 foot. The waves were powerful enough to shear off a piece of the Sheraton Pier in Atlantic beach as the cable TV stations captured on tape. Interestingly, the wave height plot included in this edition of *Shorelines* also illustrates that the wave energy from *Ophelia* started to impact area beaches on September 5th with a sea swell also characterized by long wave lengths and periods (see last month's *Shorelines* for a discussion on wave period and length).

Significant Wave Height (ft) - LEJ2



Considering the combination of factors that quite frankly aligned against Bogue Banks, the beaches fared relatively well. Dune erosion was minimal with just a few eye-opening examples of scarping (vertical cliffs) along the entire beach. In some areas the scarps were immediately covered, or "masked" by the wind-blown sand once high tide subsided and the winds switched direction. In other areas, some of the pioneer dunes were

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damaged along with sand-fencing and dune plants. From our understanding, all sea turtle nests were lost during or before the storm. Amazingly, there was only a handful (within the single digits realm) of oceanfront stair cases that were damaged requiring repair along the entire island. There were no structures that were damaged by waves or oceanfront inundation. And on a related note, *Ophelia* connected the Coast Guard channel to the Bogue Inlet floodway near the Point in Emerald Isle, which has a history of closing and re-opening.

One textbook effect the island did experience is “profile deflation”, meaning that sand was taken from the upper reaches of the beach (berm, dunetoe, etc.) and translated towards offshore. This provides the beach a broader base for the waves to expend their energy. The beach berm (the dry sand part of the beach on calm days) acted as the shock absorber for the peak of the storm and the days leading up to landfall. What this likely means is that the beach berm lost some of its elevation, and high tide will run up the beach farther compared to pre-storm conditions for the next several weeks/months until some recovery occurs. Actually we have seen a good bit of recovery already as fair-weather waves gently push the sand back towards the berm and dune. Winds will also help the dunes recover.

As most of the *Island Review* readers are aware, there have been a total of 5 beach nourishment projects that have been constructed along Bogue Banks since 2001 that augmented the shock absorbing ability of the beach berm. Imagine the direct impacts to the dune and potentially public accesses, homes, and other infrastructure during the peak of the storm if the beaches were not nourished? Likewise, imagine the compromised condition the beach could have been in the week leading up to landfall with *Ophelia* spiraling near North Carolina? The lesson learned here is that beach nourishment, the wise use of dredged material from inlets, and other sand conservation measures work for storms of *Ophelia's* character.

However years from now, the legacy of *Ophelia* for Bogue Banks will almost certainly be the apparent record-setting soundside flooding. The prolonged east / northeast winds from *Ophelia* pushed a tremendous amount of water into Bogue Sound and in the island's creeks before she even began her approach to Carteret County. Couple this extra volume of water with; (a) the extra push of peak hurricane winds (90 mph gusts recorded at Cape Lookout), (b) the extra water level associated with high tide that again also occurred at landfall, and (c) any storm surge that resulted from the lift and push of water near the storm's eye in the sound. This extraordinary high water level subsided after the tide dropped and the winds switched pushing water out of Bogue Sound. The aftermath however left Island Harbor Marina in Emerald Isle with significant dock damage, soundside Salter Path was devastated, and the Atlantic Beach Causeway was also reeling from soundside flooding, not to mention the scores of piers and walkways that were damaged. The general rule of thumb for the soundside shoreline was; (a) the low spots flooded severely, and (b) the high spots suffered large-scale bluff erosion. Unfortunately the sound shoreline doesn't recover in the same manner as oceanfront shorelines because the sand supply and hydraulic/wind processes are different.

There are a couple of nice websites to visit for post-*Ophelia* photos and reports if you have the time. The Shore Protection Office has over a 100 aerial photos to view at <http://www.protectthebeach.com/photos/photohome.htm> and a post-*Ophelia* report summarizing a beach survey conducted just days after the storm at <http://www.protectthebeach.com/Monitoring/Ophelia%20Survey.pdf>. Also, The National Ocean and Atmospheric Administration has high-resolution aerial photos available at <http://ngs.woc.noaa.gov/ophelia/OPHELIA0000.HTM>.