

SHORELINES – October 2005
As presented to the *Island Review* magazine.

Wave-ology 101

September 10th currently marks the climatological peak of Hurricane season. Even barring a direct or near direct hit, this year's water-borne cyclones have and will likely continue to impact our beaches. How may you ask? Have we experienced strong winds? Nope. A storm surge? Not even close. Big waves? Not yet...well sort of.

When we think of "big" waves, we usually think about the height of the wave. In an idealized open ocean setting, the **wave height** is measured from the crest (top) to the trough (bottom) and the **wave length** is the horizontal distance between any point on the wave and the corresponding point on the adjacent wave (ex. – distance from crest to crest). However, as a wave approaches the shore, its interference with the seafloor causes it to slow and steepen as the wave length *shortens* and the height *increases* before breaking.

Wave heights become difficult to precisely measure and quantify in the surf zone because; (a) their shape contorts as mentioned above, and (b) the surf zone is not the greatest nor safest location to place expensive equipment. Even the wave experts, surfers, have their own mystical vernacular for wave heights and as with any variety of language, there are regional and local dialects that become a constant source of confusion. Is it waist-high today or three foot big? What might be considered a small and un-rideable wave for California surfers could be considered as a good wave for the East Coast. And don't forget that Hawaiian wave riders like to measure the size (height) of the wave from the back. So the same wave could be considered a 6 foot wave from the water looking towards the beach and a 15 foot wave to a person standing on land looking at that same wave crashing on the beach or coral.

These issues aside, one perspective of wave phenomena that is often ignored yet could be one of the best indicators of strength is known as the **wave period** – the time that elapses for one wavelength to pass a point. So now we have three variables --- two distance-type measurements (wave height and length) and one variable related to time (wave period). Actually the longer the wave period, the more energy wind has transferred to the ocean by its duration, speed, and distance of water which it has blown in one direction.

As a rule of thumb, wave periods over 10 seconds for the East Coast usually indicates an organized swell generated from a long distance away. Shorter period swells usually indicate more disorganized conditions located closer to the coast. Equally as important is that long period swells travel with more energy below the ocean surface and are less steep so they can easily pass through opposing winds and seas with very little decay. And interestingly, as a swell breaks at the coast, the wave length shortens and the height increases as mentioned above, yet its period remains the same (i.e., the speed of forward motion remains constant). This equates to more "power".

Longer wave periods have several other effects that the careful beach observer can recognize. The **wave runup** or distance the broken wave rolls up the beach, increases with the wave period. Longer swells allow the wave to reach much higher on the beach or into the dunes. It can give the appearance of higher storm tides when there is little increase over normal tide elevations. On many beaches, longer period swell also increases the likelihood and severity of rip currents. Rip currents cause far more drownings and near-drownings than any other threat on the beach and when a long period swell does arrive, it is wise to exercise extra caution. The visual signs of rip currents are also subtle but with practice can be learned. The National Weather Service has a great rip current website at <http://www.ripcurrents.noaa.gov> for additional information.

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One wave type that has an extremely high wave period is a Tsunami. Tsunamis are formed usually as a result of a displacement along the seafloor or underwater avalanches producing waves that may only be 2 feet high. Actually, boaters may not even recognize the wave in the open ocean. However their wavelengths could be hundreds of miles long with wave periods of 30 minutes to even hours that produces waves over 60 foot high once the wave(s) are compressed onto the shore. The resulting wave runup can be catastrophic. This is a stark difference to typical wind-generated swells on the ocean, which might have a wave height of 8 feet, a period of 8 seconds and a wavelength of a couple hundred feet.

It's not uncommon for Bogue Banks to feel a swell from a hurricane with 1-3 foot waves with long periods (12 seconds) despite the cyclone forming and traveling hundreds of miles away. Something a casual observer may not even recognize on his/her morning walk on the beach. This type of swell was experienced in Bogue Banks in August on a couple of occasions and could very well be experienced again during the peak Hurricane month of September. So to rhetorically answer the question posed in the introduction, have we experienced "big" cyclone waves this year? Well sort of... height no, period yes. Let's hope it stays that way and be safe.