Shifting Sands: The Nature of Island Migration

appeared in:

Wildlife in North Carolina. Sep 2010

In 1585, when Sir Richard Greenville first stepped foot upon the barrier islands of North Carolina, he walked into a world wholly different from the lavish resort communities that we now know as the Outer Banks. Aside from the glitz and trappings of a vacation destination, the barrier islands of the days of English exploration were far more numerous and restless than the seemingly subdued versions we sunburn on today. As mere ribbons of sand, the age old axiom of "change is the only constant" is not simply a cliché on these beaches but a law of physics.

With each passing storm, the emerald green waves of the Atlantic that rush upon our beaches turn back another page of history that the sands have hidden beneath their all encompassing embrace. The beaches of our islands are littered with the results: tree stumps protruding from the edge of the surf, clay, pebbles, rocks, coquina boulders, shelves of ink black peat moss, and chunks of coal. Even the shells have their story to tell if only one would listen.

Each of these enigmatic relics harkens back to a time long ago. Some, such as the tree trunks and peat moss reveal to us the recent past back to the days when European colonies were lost on our islands. Others however, can only be understood in the context of tens of thousands of years. Yet all of these artifacts coalesce into one story: that of islands migrating.

With wind and water as dance partner, sand is ever shifting. Anyone who has ever taken a stroll down the beach during a stout Northeast wind can attest to this. For those who bore witness to Hurricane Isabel's storm surge on Hatteras Island or the Ashe Wednesday storm of 1962, they know all to well the precarious nature of sand and the harsh realities of life on a sandbar. Be it a hurricane, nor'easter, or just the general northeast pattern of winds that blows in off the ocean for much of the year, all of these processes are continuously working together to transfer sand from the beach to behind the islands. This is barrier island migration in the simplest of explanations.

For barrier islands to migrate, four things must occur: the ocean side of the island must move landward, the back of the island must grow wider, the island must continually be built up in elevation with sand, and the shoreline of the mainland must keep pace with the island's migration.

Though the steady onslaught of winds that attack our shoreline throughout much of the fall, winter, and spring helps to drive this process, overwash brought on by hurricanes and large nor'easters is the real engineer of migration. As a storm surge pushes across the islands, sand is transferred with the waves and deposited either near the center of the island, or completely

over and out into the sound behind the islands. The storm surge that crossed Hatteras during Isabel deposited so much sand in the Village that the over all elevation of the town was raised by about two meters. The vast stretches of great dunes that once covered much of the Outer Banks prior to recent decades were all a product of this constant building up. This process of overwash is what satisfies the first three tenets of barrier island migration.

All things considered, it is ultimately rising sea levels that force islands to migrate to begin with, otherwise the island would drown. As sea levels rise, high tides are higher and storm surges are farther reaching, therefore the faster the rate of rise, the faster the island turns over. As for the mainland shoreline keeping pace with this migration, it is simply a matter of rise over run, which on the North Carolina coastal plain is roughly a 1:2000 ft ratio, meaning for every one foot gained in sea level, the mainland shoreline will lose roughly 2,000 feet. In other words, if current predictions of a three foot rise in sea level over the next century are correct, than everything within a mile of our sounds today will be underwater in 90 years.

The oddities that sometimes are revealed upon our beaches are therefore a testament to this change. Obviously forests do not grow out of the ocean or the beaches. Therefore the stumps that can be found in areas such as Swan Beach, South Nags Head, and Pea Island were all once apart of a maritime forest growing along the sound side of the islands. As the island continued to migrate however, these forests were buried, and entombed beneath the sand.

Many people refer to these trees and stumps as part of a petrified forest. Hardened by time they may be, however there is nothing petrified about this wood. The preservation that is at work here is much less complex. To begin with, the stumps we find on our beaches are typically red cedar and live oak – two of the predominant tree species in our maritime forests today. Both of these trees produce wood that was highly prized for ship building due to its strong resistance to decay. Second, as the sand filled into the forest, the trees were buried in a low oxygen environment. Without oxygen, there is no aerobic bacterium that is needed to breakdown the dead plant matter. Lastly, this is a maritime environment we are talking about here, one where there is no shortage of salt to preserve things.

Based upon radiocarbon dating of stumps and peat moss, these organic windows into the past are probably in the neighborhood of 200-500 years old. This means that between 200-500 years ago, what is now the beachfront was actually the very backside of the islands, while the beach itself was up to a mile further out to sea. Over that period of time, the islands more or less rolled over top of themselves, and the wave energy is now exposing these once buried forests along the shore.

During the height of the last ice age some 20,000 years ago, as much of the Earth's water was locked up in glaciers and continental ice sheets, the coastline of North Carolina was some forty miles east of where our islands now sit. As the Pleistocene era began to fade away and the Earth began it's transition into the Holocene, sea levels rose, river valleys were flooded out creating the sounds, barrier islands were created and almost immediately they where launched

into their steady march to where they now sit.

As these islands migrated to the west, the river beds that carried the glacial waters and sediment from the Appalachian Mountains and piedmont region were covered up. Sonar imaging of the sounds and ocean still reveals these beds to us today right up to the edge of the continental shelf. Remnants of these old rivers litter some of our beaches as do stumps on others. The pea gravel that makes up so much of the beaches in places like Kill Devil Hills, Nags Head, and Topsail Island, is actually the sediment of these river beds that lie below the islands.

Every morning visitors scamper along the edge of the sea where land meets water and two worlds collide, in search of sea shells. As most avid "shellers" can attest, the oyster shell is one of the more common of these calcium carbonate exoskeletons that can be found on our beaches. The problem however, is that oysters don't live in the ocean. They are in fact an estuarine species, meaning they live in the sounds along the backside of the islands – a.k.a. estuaries. But if they don't live in the ocean, how then did they come to make up the majority of the beach shells? As the islands migrated in a westerly fashion through the estuaries behind them, great oyster beds were buried in the process. Now so many years later they are being unearthed by wave action and tossed back up onto our beaches.

Like the peat moss and tree stumps, these oyster shells have been radiocarbon dated as well. Based upon such studies, researchers have determined that the majority of oyster shells found on the barrier islands are around seven to nine thousand years old. If you think that's old, shells found on Hatteras Island and Shackleford Banks have been dated to forty thousand years, while the giant oyster shells found on North Topsail Beach and randomly on other islands are actually a species that went extinct around 23 million years ago! This is the part where you are supposed to say, "Whoa."

Oysters are not alone in this regards. The fact of the matter is, that the vast majority of shells found on the beaches of our barrier islands are not marine species, but instead, like the oyster, are only found in estuaries. Therefore, also like the oysters, most of these shells are several thousands of years old as well. So next time you're walking along the beach looking for shells, think of yourself not as "shelling," but as fossil hunting.

The impact of barrier island migration is not limited to those strange peculiarities that dot our beaches however. The extensive network of marshes, the shallow nature of the sounds that allows for light to penetrate its depth and milfoil and widgeon grass to flourish, was all created by the same processes that drive migration. From over wash fans to the natural succession of inlets being opened and closed, the constant movement of sand allows for the back island shoaling that fosters our famous waterfowl habitat.

Following the end of the Civil War, union soldiers who had fought in eastern North Carolina began flooding back into the area for its natural wonders. Folks from all over the Northeast came much as they do now to our islands. At the time however it was not the euphoric

warmth of the summer sun they were after. It was the cold. It was the frigid winds, the sleet, snow, freezing rain, and that which every big cold front brings with it: waterfowl. The framework of modern history and tourism on many of our islands was built upon duck hunting and the movement of sand that made this sport what it is today in Eastern Carolina.

For life to not only survive but to thrive on these ever changing precarious ribbons of sands is a testament to the adaptability of life itself. Howling winds of hurricane force, storm surges that momentarily connect sea with sound, the constant saturation of salt, and the ever present notion of a world migrating right overtop of you. This is "life on a sandbar" – though the bumper sticker neglects to include this bit in the fine print.

All of this is changing though. The marshlands that bring in hundreds of thousands of waterfowl each year are no longer being created. Those that remain must be heavily managed to keep the ecosystem in its most beneficial stage of succession. The islands, instead of moving with the rising sea, they are drowning. Overwash no longer makes its way across these magnificent sandbars. Sand dunes built in the 1930's along our beaches stop all but the largest of storms. When new sand is deposited inland, it is mined and brought back out to the beaches to reform dunes thereby speeding the rate of beach erosion. Much of the sound side is bulk headed, and the ocean side presents a wall of homes. Inlets that are opened from storms such as Hurricane Isabel are promptly closed. The islands have been beaten into submission.

Yet, the ocean continues to rise. Unceasingly, unwavering, the dominion of Poseidon is spreading, his kingdom growing. We might be able to hold back the sand, but we cannot hold back the rising ocean. And for this reason, the barrier islands of North Carolina are once again experiencing a great moment of change. Those such as Core Banks and Masonboro will thrive, as humans have not imposed their architectural will upon their shores. Others, such as the Outer Banks, and the rest of the developed islands will be engulfed by the emerald waters of the Atlantic. Without migration, the islands cannot adapt to the rising sea. Without migration, they are drowning.

Yet as noted above, when it comes to these islands, change really is the only constant. The sands have been drowned before. The islands have broken apart and reformed into long ribbons numerous times. As the narrow stretches break in two and new inlets are created where once there was a highway, the natural fluctuations of tides will bring in the sand and shoals will once again form where humans would not allow. These shoals will continue to build until new islands are formed. The longshore current will continue to force the inlet to migrate in a southerly direction and the mosaic of shoals will join back together with the Banks, making them wider, stronger, and more resilient than before. One day, hundreds of years from now, the artifacts of our civilization will begin to be washed back ashore on these beaches and someone will ponder their origins and the nature of island migration.