

**Mark your calendars...**

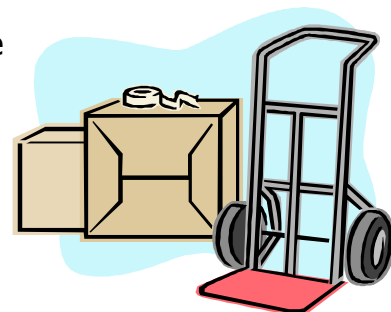
- May 7-28—Coastal Master Naturalist class (Whitney Lab). See [www.masternaturalist.org](http://www.masternaturalist.org) to register.
- May 16-18—Wild Amelia Nature Festival. See [www.wildamelia.com](http://www.wildamelia.com) for more information.
- May 23-25—Florida Folk Festival, White Springs, FL. Visit the Environmental Exhibits there! See <http://www.floridastateparks.org/folkfest/>
- More on back page!

**Moving offices**

Starting in May, the NE Florida Sea Grant Extension office will be moving to the Flagler County Extension Office in Bunnell, FL. Please make a note of the new mailing address and telephone number above. The new fax number will be 386-586-2102. My e-mail address will not change. This change in location will allow me to focus more on programming in Flagler and St Johns Counties, as my responsibilities will be transitioning from covering 4 counties to just these two. The Flagler County Extension office is located close to US 1, north of Bunnell by the Flagler County Fairgrounds.

*M. P. McGuire*

Maia McGuire, PhD  
Marine Extension Agent



**Global climate change and sea level rise**

We know from geologic records that over time, climates around the world have varied greatly, and sea level has at times been much higher than it is today. In the past two decades, there has been an increasing awareness that global climate change (previously referred to as "global warming") is having impacts on terrestrial and aquatic systems throughout the world. In 2007, the Intergovernmental Panel on Climate Change (IPCC) released reports that for the first time showed agreement among a large group of scientists that human factors are contributing to increasing the rate of global climate change. These reports are available at [www.ipcc.ch](http://www.ipcc.ch).

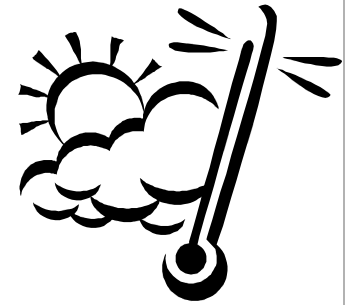
While all scientists do not concur with all sections of the IPCC reports, there is consensus that sea levels are rising, and that the rates of sea level rise have increased more rapidly since 1993 than they did in the period from 1961-1993. In the past 15 years, sea level has increased at a rate of 3 mm/year (or a little over an inch a decade). Prior to that, the rate was a little less than 2 mm/year. It is not known if the increased rate in recent years is part of a natural oscillation in rates, or if it is part of a long-term increase in sea level rise.

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# Global climate change and sea level rise



- What potential impacts could result from sea level rise in the coming decades?

It is important to realize that an increase in sea level height of one inch does not equate to an increase in the mean high tide level of one inch. Because our beaches slope (i.e. are not vertical), an increase in sea level of one inch could result in an increase in mean high tide level of one foot. This calculation is based on a beach with a 5 degree slope, similar to that of the beach at Marineland. Beaches with a greater slope will see a smaller increase in high tide level while those with a gentler slope will see a larger increase in high tide level. As the sea level rises, we expect to see increased erosion, storm surge and other hazards in coastal areas. Coastal development and sea level rise contribute to the risk of increased damage from coastal flooding in many areas. To view interactive maps of coastal areas under different sea level conditions, check out <http://www.geo.arizona.edu/dgesl/index.html>. Remember that a sea level rise of 1 meter (about 3 feet) will take over 300 years if sea level continues to increase at current rates.

- What do we know about previous sea level increases?

The last time Florida was completely submerged was about 2.5 – 4.5 million years ago. There have been more recent events where sea level was much higher than today—the most recent significant event was about 125,000 years ago, when sea levels were 4-6 meters (about 13-20 feet) higher than they are today. Prior to coastal development, as sea level rose, the primary and secondary dunes would shift inland. The coastal ridge along Old Dixie Highway in St Lucie County is an old sand dune from when sea level was higher. The limestone rock that makes up most of the state of Florida was created by coral reefs which grew at a time when the state was underwater.

- Why are some potential ecological impacts of global climate change?

There is a high probability that global climate change will allow the spread of many nuisance non-native species northward from south and central Florida into northern Florida and adjacent states. Invasive plants like Brazilian pepper will likely become more widespread, and non-native reptiles which are currently restricted to warmer parts of the state will likely be able to migrate northward.

Some native species that are pathogens may become more virulent as they are most active when temperatures are above a threshold limit. For example, the bacterium *Vibrio vulnificus*, which can be found in raw oysters, and can infect people through open wounds, is found in most coastal and estuarine waters in Florida. It is most virulent in water temperatures above 20°C (68°F). *V. vulnificus* infections are fatal in about 50% of cases.

The risks of wildfires will probably increase. Heat waves are expected to increase in frequency and intensity. While there will probably be an increase in the frequency of heavy rainfall events in some areas, there is also expected to be an increase in the areas affected by drought. Tropical cyclone (hurricane) activity is likely to increase.

- Can anything be done to slow the rate of sea level rise?

Sea level rise is linked to global climate change. The primary human influence affecting global climate change is the release of greenhouse gases, primarily carbon dioxide. Reducing our emission of carbon dioxide can help slow the rate of climate change. The Pinellas County Extension Office has a website that will help people reduce their “environmental footprint”—see [http://pinellas.ifas.ufl.edu/sustainability/at\\_home.shtml](http://pinellas.ifas.ufl.edu/sustainability/at_home.shtml).

According to the National Oceanic and Atmospheric Administration (NOAA), 70 percent of the world's beaches are currently undergoing erosion. In the Atlantic Coastal Plain, which includes NE Florida, these numbers are close to 90 percent. Erosion can undermine waterfront homes, businesses, and public infrastructure, eventually making them uninhabitable or unusable. Estimates reveal that approximately \$3 trillion of U.S. coastal development is potentially vulnerable to this erosion. Coastal erosion in the United States is responsible for approximately \$500 million per year in coastal property loss. By the year 2060, experts predict that erosion may have claimed one out of four houses within 500 feet of the U.S. shoreline. In Florida, the state's Department of Environmental Protection (DEP) estimates that approximately 59 percent of the state's beaches are currently experiencing erosion.

## Beach erosion

What causes erosion? According to the DEP, "While some of this erosion is due to natural forces and imprudent coastal development, a significant amount of coastal erosion in Florida is directly attributable to the construction and maintenance of navigation inlets. Florida has over 60 inlets around the state, many have been artificially deepened to accommodate commercial and recreational vessels and employ jetties to prevent sand from filling in the channels. A by-product of this practice is that the jetties and the inlet channels have interrupted the natural flow of sand along the beach causing an accumulation of sand in the inlet channel and at the jetty on one side of the inlet, and a loss of sand to the beaches on the other side of the inlet."

The DEP defines some beaches in Florida as being critically eroded. This means that "natural processes or human activity have caused or contributed to erosion and recession of the beach or dune system to such a degree that upland development, recreational interests, wildlife habitat, or important cultural resources are threatened or lost." In a 2007 report, FDEP identified 5.4 miles of Flagler County beaches as being critically eroded; most of this in Flagler Beach.

The impacts of coastal erosion can be many. Often the greatest concern is when buildings or roads become at risk of collapsing. Loss of beach width can mean loss of sea turtle or shore bird nesting habitat.

There are three potential strategies for dealing with beach erosion. First, and most commonly utilized, is protection of the beach by replacing lost sand through beach nourishment projects. A second strategy is to build structures that can accommodate erosion, for example floating structures or structures that are on pilings that are driven deep into the ground where they will not be impacted by erosion. Shoreline armoring can also be used to protect homes from erosion, although this has some impacts on adjacent beach areas as will be discussed below. The third strategy is retreat—moving structures further inland, away from the eroding coastline.

Beach nourishment is a highly controversial topic. Beach nourishment projects are funded and regulated through a combination of federal, state and local agencies. Steps involved in a beach nourishment project include feasibility studies, project design, beach nourishment and monitoring. Beach nourishment typically needs to be repeated every 3-7 years. The Florida DEP's Beach Management Program has proposed in its long range budget plan that there be a \$532,500 feasibility study for Flagler and Volusia County beaches in the 2009-10 fiscal year, but there are no funds budgeted for further projects through 2018. The \$532,500 would be paid for by federal (50%), state (25%) and local (25%) funds.

Shoreline armoring is regulated by the Florida DEP. Armoring includes construction of structures like seawalls, bulkheads, retaining walls, boulder revetments and geotextile revetments. A study of sea turtle nesting behavior in Jupiter, FL showed that sea turtles had lower emergence rates (where females crawl out of the water looking for a nesting site) and lower nesting success in sections of the beach that had armoring compared with adjacent areas that did not. It is also known that armoring typically results in increased erosion rates on adjacent sections of beach as wave energy is deflected by the hard structures. The deflected wave energy then results in scouring of sand from nearby beach areas. Shoreline armoring is generally permitted for homes that are vulnerable to undermining by storm erosion, for "significant public infrastructure" (e.g. roads) or for non-habitable structure whose collapse could damage homes.

Florida is by no means the only state with coastal erosion issues. A recent article in NOAA's Coastal Services magazine describes the new Texas Open Beaches Act relocation expense reimbursement program. Because of beach erosion, many beachfront homes in the state are now considered to be on state property, defined as the area between the lowest waterline and the natural line of vegetation. Between 2003 and 2007, one beach area in Texas has eroded at the rate of 11-13 feet a year. The state's solution has been to offer the owners of homes that are now on state land \$50,000 to help with the cost of demolishing the home or moving it to a new location.

Shoreline armoring can have the effect of reducing public access to beaches. The California Coastal Commission requires that property owners who obtain permits for shoreline armoring must provide a public access easement to the beach seaward of the approved armoring structure. For large seawall projects, there may be additional fees also imposed. The money collected from these fees can be used for public beach enhancements and other park projects.



Dune erosion at Fort Matanzas, October, 2007



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### More “Mark your calendars”

- July 7-11—International Coral Reef Symposium, Fort Lauderdale, FL. See <http://www.nova.edu/ncri/11icrs/index.html>
- July 8-Aug 2—Freshwater Wetlands Master Naturalist class (Duval Co.). See [www.masternaturalist.org](http://www.masternaturalist.org) to register.
- July 20-24—National Marine Educators Association Conference, Savannah, GA. See <http://www.nmeaweb.org/>
- July 29-Aug 1—“Coastal Critters” camp at Whitney Lab for 4-H youth ages 8-13. Non 4-H youth can be placed on a waiting list. Call the St Johns County 4-H office at 904-209-0430.
- Aug 5-Aug 8—Marine Science camp at Whitney Lab for 4-H youth ages 11-18. Non 4-H youth can be placed on a waiting list. Call the St Johns County 4-H office at 904-209-0430.
- Aug 5-26—Coastal Master Naturalist class (Duval Co). See [www.masternaturalist.org](http://www.masternaturalist.org) to register.

Please check the calendars at <http://calendar.ifas.ufl.edu> for other environmental education programs around the state.

Aqua Notes is provided as one of the many services relating to educational programs offered by the University of Florida/IFAS cooperative extension service. This publication is available on the Web at <http://stjohns.ifas.ufl.edu> or in an alternate format on special request. In compliance with ADA requirements, participants with special needs will be reasonably accommodated with 5 days advance notice by contacting the Flagler County Extension Service at 386-437-7464. Those needing telecommunications assistance, please call the Florida Relay Service (TDD) at 1-800-955-8771. The use of websites or product names in this publication is not a guarantee, warranty or endorsement of the sites/products named and does not signify that they are approved to the exclusion of others. For more information about this document, contact Maia McGuire at the Flagler County Extension Service at 386-437-7464.