

The Coastal Watershed Institute of Florida Gulf Coast University

The Coastal Watershed Institute was created in recognition of the FGCU's unique service area, encompassing all or portions of the following watersheds: Charlotte Harbor including the Peace and Myakka Rivers, the Caloosahatchee River and Lake Okeechobee, Estero Bay, Corkscrew Swamp, Naples Bay, Rookery Bay, the Ten Thousand Islands, and the Florida Everglades and Big Cypress Swamp. Southwest Florida is characterized by diverse and sensitive aquatic habitats as well as by the environmental pressures that accompany rapid population growth. The Institute was therefore established to focus resources on the those areas where terrestrial, freshwater, and marine environments meet - coastal watersheds - for it is these systems that must be addressed in order to manage successfully the complex environmental issues facing Southwest Florida.

The Institute is home to FGCU's Marine Science undergraduate program and also sponsors Environmental Science graduate students interested in marine and coastal watershed science. Both of these academic programs provide students with the technical training they will need for an increasingly competitive job market, and both require students to become actively involved in research as part of their educational experience.

The mission of the Coastal Watershed Institute is to address regional concerns regarding the use and conservation of coastal watersheds by supporting undergraduate and graduate education in marine science and coastal watershed study; by focusing and coordinating university research on coastal environments and the conservation of natural resources; and by disseminating information to the citizens of Southwest Florida to engage and inform them about the health of coastal watersheds and related issues.

Research being conducted by CWI faculty within the Estero Bay watershed

Tolley, S.G., Peebles, E.B., Burghart, S.E., Bachelor, B., Evans, J., and J. Nelson. 2007. Freshwater inflow and utilization of the estuarine tributaries of Estero Bay. Report to the South Florida Water Management District, 227 pp. To investigate the influence of freshwater inflow on zooplankton distribution and density in Estero Bay, 500-micron mesh plankton nets were towed monthly through the water column on a flood tide. Sampling was conducted at 16 stations over a period of two years. Decapods dominated the catch, comprising 87% of the total by number. Ichthyoplankton represented only 4% of the total catch by number but were more diverse than either decapods or gelatinous zooplankton, with 48 species being present. Gelatinous zooplankton were the least diverse of zooplankton groups but comprised 9% of the total catch. The estuarine zooplankton of Estero Bay are strongly influenced by two sources of freshwater inflow: Mullock Creek/Tenmile Canal to the north, and the Imperial River to the south. These influences were apparent in zooplankton distribution and density, which demonstrated an association with one or more tributaries during reduced inflow and became dispersed into downstream open waters of the bay during higher inflow. One management

objective should be to keep gelatinous predators (ctenophores, hydromedusae, jellyfishes) out of estuarine tributaries that serve as nursery habitat for estuarine-dependent fishes. In these confined tributary waters, gelatinous predators compete with young fish for prey and may even consume the young fish directly. It appears that relatively small amounts of inflow are effective in dispersing these predators into downstream areas.

Influence of freshwater inflow on the habitat value of oyster reefs in Southwest Florida estuaries

When assessing oyster-reef habitat in estuaries it is important to understand the influence of salinity on the spatial and temporal variability of associated organisms. How comparable is community structure among stations located at different points along the salinity gradients of estuaries or among tidal tributaries that experience different levels of freshwater inflow? Do assemblages vary seasonally in response to changing salinity and freshwater inflow? To address these questions, multivariate techniques were employed to analyze decapod crustacean and fish abundance data. Organisms were collected at three reefs along the salinity gradient of three estuaries: the Caloosahatchee River and estuary, Estero River and Bay, and Faka Union Canal and Bay. Additional collections were made from reefs located near the mouths of Estero Bay's five tidal tributaries.

Samples were dominated by the decapods *Eurypanopeus depressus* and *Petrolisthes armatus*. Commonly occurring species included the decapods *Panopeus obesus*, *Alpheus heterochaelis* and *Rhithropanopeus harrisi* and the fishes *Gobiosoma robustum*, *Lophogobius cyprinoides* and *Gobiesox strumosus*. Analysis of similarities suggested differences among stations located along the salinity gradients of all three estuaries. Community structure also varied among stations located near the mouths of the tidal tributaries of Estero Bay. Multidimensional scaling identified community structure present at upper stations as distinct from that downstream and at high-flow tributaries as distinct from that near low-flow tributaries. Upper stations and stations near high-flow tributaries were typified by *E. depressus* and gobiid fishes. Downstream stations and stations near low-flow tributaries were typified by *E. depressus* and *P. armatus*. Percent dissimilarity was greatest when upper and lower stations were compared along the salinity gradient or when low salinity and high-salinity sites were compared among tributaries. Within-station sample variability tended to be higher upstream or in association with high-flow tributaries.

Additional Readings:

Van Horn, J., and S.G. Tolley. In press. Seasonal patterns of distribution along a salinity gradient in the flatback mud crab *Eurypanopeus depressus*. *Gulf of Mexico Science*.

Tolley, S.G., Volety, A.K., Savarese, M., Walls, L., Linardich, C., and E.M. Everham III. 2006. Impacts of salinity and freshwater inflow on oyster-reef communities in Southwest Florida. *Aquatic Living Resources* 19:371-387.

Tolley, S.G., Winstead, J.T., Haynes, L., and A.K. Volety. 2006. Influence of salinity on the prevalence of the parasite *Loxothylacus panopaei* in the xanthid *Panopeus obesus* in Southwest Florida. *Diseases of Aquatic Organisms* 70: 243-250.

Tolley, S.G., and A.K. Volety. 2005. The role of oysters in habitat use of oyster reefs by resident fishes and decapod crustaceans. *Journal of Shellfish Research* 24:1007-1012.

Tolley, S.G., Volety, A.K., and M. Savarese. 2005. Influence of salinity on habitat use of oyster reefs in three Southwest Florida Estuaries. *Journal of Shellfish Research* 24:127-138.

Tolley, S.G., Volety, A.K., and M. Savarese. 2003. Shellfish research and adaptive resource management in Southwest Florida: oysters as sentinels of ecosystem health. *World Aquaculture* 34:64-66.

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Sea-level rise, oyster reef development, and their effects upon coastal evolution of southwest Florida through the late holocene.

Sea level has been rising globally since the end of the last ice age, 12,000 years before present (ybp), though not at a consistent rate. At the onset of the late Holocene, approximately 5000 ybp, sea-level rise rate decelerated considerably. During times of modest sea-level rise, coastal regions may begin to build seaward or prograde despite the rising seas. It is during the late Holocene, consequently, that our present-day estuaries developed through coastal progradation and when Southwest and South Florida developed its outer barrier islands and estuarine interior mangrove-forested islands. Progradation in Southwest Florida occurs through the development of oyster reefs at intertidal depths; mangrove propagules will then settle on a reef and eventually transform into a mangrove-forested island. As long as the rate of reef and mangrove sedimentation exceeds the rate of sea-level rise, the coast continues to build seaward.

Though sea-level rise rates have been measured from 5-10 cm / 100 years during the previous 3500 years throughout our coastal region (for Estero Bay, Henderson Bay, and the Ten Thousand Islands), the rate has accelerated by an order of magnitude since the beginning of the industrial revolution, 150 ybp. There has been much debate as to whether this recent acceleration is due to

natural perturbations or to human-induced global warming. Regardless of the cause, if the rate persists over a centennial time scale, our coastal system, as well as estuaries worldwide, will degrade or at least drastically change in character. For Southwest Florida, this means a fundamental shift in our coastal and freshwater wetland distribution and ecology and major impacts to human development.

The study of sea-level rise and coastal response requires field work and sediment coring. Sediment cores have been taken using a vibracore device from 4 subregions in Southwest Florida; from north to south, the estuarine systems are: the Caloosahatchee, Estero, Rookery Bay, and the Ten Thousand Islands. Cores of the late Holocene sedimentary package, which sits unconformably on top of either Pliocene or Pleistocene bedrock, may reach 5 meters in length. Cores are split, and facies (packages of sediment that possess unifying characteristics that are indicative of particular paleoenvironments) are described based on the sedimentologic, paleontologic, and taphonomic characteristics.

This research program attempts to accomplish 3 objectives. First, how have variable sea-level rise rates affected Southwest Florida's coastal geomorphology during the late Holocene? It appears that the inner coastal margin, i.e., the mangrove-forested fringe that lines the eastern interior of the bays, has remained static for 3000-3500 years. Yet during this time interval, the mangrove-forested islands developed within the interior of the bays. Second, how has the development of oyster reefs influenced coastal morphology? Oyster reef development appears to be critical to coastal evolution. Reefs can have fairly lengthy histories, persisting for up to 3500 years. In many reefs, a community succession appears with early reef history dominated by vermetiform gastropods (worm-like sessile snails belonging to the families Turritellidae and Vermetidae), followed by oyster-dominated assemblages. Modern vermetiform gastropods require higher salinities and can withstand greater environmental energy than the American oyster, *Crassostrea virginica*. This suggests that vermetiform reefs may have formed an initial, more Gulf-exposed barrier that eventually created the more protected estuary within which oysters later flourished. Third, can these late Holocene results help predict coastal response in the future? Present-day sea-level rise rates are comparable to those Southwest Florida experienced prior to 4500 ybp. Oyster and vermetiform reefs are not well developed in this time frame. There are occurrences of oyster reefs, but they are short-lived and not very extensive. This suggests that if accelerated rates persist, oyster reef development will decline. The Southwest coast is exhibiting signs of incipient change. These include: a set back of the previously stable inner bay margin; the transgression of mangrove forest and concomitant consumption of freshwater and brackish water prairies; and a transgressive shift of the loci of most prolific oyster reef development.