

about 2.93 g of mineralized carbon, including shell material that was not part of the marketed clams. Clam leases in full production produced about 10,030 kg of mineralized carbon/ha/yr, which compared favorably with carbon fixation rates in Florida pine plantations. Unlike pine trees, however, which return to CO₂ in a matter of decades, shells can persist indefinitely under ordinary circumstances. Given these results, the restoration of molluscan populations and natural reefs should be considered part of the solution to atmospheric CO₂ reduction.

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OBSERVATIONS OF ENTRAINMENT SEDIMENT DEPOSITION WITHIN MANGROVE FORESTS ALONG THE SHARK RIVER IN EVERGLADES NATIONAL PARK

Everglades estuarine mangrove sediments are primarily comprised of autochthonous root peat. However, we observed river bank tidal flooding caused entrainment of local surface sediments, transporting and depositing these sediments into the forest interior. These surface sediments appear to be a mixture of mineral storm deposits, detached peat sediment and other surface detritus. We investigated the fate of these transported, tidally affected sediments to evaluate surface deposition patterns within the estuarine mangrove forest. We established three surface sediment collection transects, placing each perpendicular from the river bank along the Shark River in Everglades National Park. Each transect had three sampling plots placed at 2, 10 and 30m from the river bank. Each plot contained 25 glazed white ceramic tiles (5cm x 5cm), forming a square grid (0.25m²), in which each tile was set flush into the forest sediment surface. After an initial sampling period of 42 days (May-June), sediment deposition was collected from the surface of the tiles. Sediment samples were oven dried at 50°C and weighed. Preliminary results indicate that tiles at 2m had more surface sediment deposits ($M \pm 1 \text{ SE}, 482.6 \pm 941.1 \text{ g/m}^2$) than tiles at 10m ($230.8 \pm 204.5 \text{ g/m}^2$) and 30m ($320 \pm 256.5 \text{ g/m}^2$). Most of the entrained sediments appear to remain on-site and are not transported back into the estuary. Tidal flooding may preferentially move transported sediment further in-land into the forest, increasing the surface sediment height, possibly mitigating sea-level rise impacts in the coastal mangrove. Due to the high variability, further sampling and analysis is being conducted to improve our understanding of surface sediment depositional patterns in these forests.

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TREE VS. TIDE: THRESHOLDS TO MANGROVE SEEDLING ESTABLISHMENT ON TIDAL FLATS

Mangroves are highly productive ecosystems that provide a variety of ecosystem services, including soft coastal protection. However it is estimated that one quarter of the original mangrove cover has been lost worldwide due to human activities (World Atlas of Mangroves 2010). A quantitative understanding of the underlying principles controlling mangrove seedling establishment is needed to explain mangrove dynamics and improve restoration efforts. With an array of laboratory and field experiments we elucidate the abiotic processes that limit colonization of tidal flats by South East Asian mangrove pioneer species. We will demonstrate quantitatively how: 1) early anchorage of mangrove propagules is depending on windows of opportunity with low disturbance by hydrodynamics; 2) further seedling establishment and stability is limited by mixing and erosion of the upper sediment layer; and 3) sediment dynamics vary in magnitude from the mudflat to the forest. Present findings explain how the physical state of a tidal flat, characterized by hydrodynamic forcing and sediment movement, determines whether an area can be colonized or not. This fundamental understanding offers opportunities for innovative mangrove restoration approaches.

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ZOOPLANKTON RESPONSE TO HYPOXIA IN THE CHESAPEAKE BAY

Hypoxia is a common occurrence in fresh and salt water worldwide and can have negative effects on local fish and zooplankton including in the Chesapeake Bay. Copepods, specifically *Acartia tonsa*, are the most abundant type of zooplankton in the mesohaline

reaches of the Bay. They occupy the base of the food web in many aquatic systems, including in Chesapeake Bay, and play a large role in transferring energy and material to higher trophic levels. We compared copepod behavior and fitness at both a hypoxic and anoxic site over three seasons, spring, summer and fall. It is hypothesized that low oxygen water will reduce the fitness of copepods and alter the migration behavior. To test this hypothesis, we observed copepod behavior and fitness using nets and traps, and we focused on migration patterns, population dynamics and RNA/DNA ratios.

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CHESAPEAKE BAY PROGRAM PHASE 5.3.2 WATERSHED MODELING APPLICATION

An HSPF-based watershed model has been used to simulate nutrient and sediment loading to the Chesapeake Bay for more than two decades. Over time, the Chesapeake Bay Watershed Model has increased in complexity commensurate with the management challenges in Chesapeake Bay restoration. In response, the Chesapeake Bay Program developed a software solution that builds upon the existing HSPF model structure. The software system, consisting of pre-processors, an external transfer module, and post-processors, was devised to conveniently generate and update parameter files essential to the operation of a complex watershed modeling system and to implement land use and non-point source management changes on any time scale. The Phase 5.3.2 software has been applied at the Chesapeake Bay Program to model management scenarios and their corresponding effects on loading of nitrogen, phosphorus, and sediment to the estuary. The Phase 5.3.2 Watershed Model, data, and analysis tools are developed using a community modeling framework. The source code, data libraries, and model documentation are provided through the Chesapeake Community Modeling Program for the user community.

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ASSUMPTIONS, METHODS OF EXTRACTING AND APPLICATION OF JUVENILE RED SNAPPER OTOLITH CHEMICAL SIGNATURES IN THE NORTHERN GULF OF MEXICO

Otolith chemical signatures provide powerful natural tags of fish populations and have been employed to estimate the contribution of different nursery areas to adult populations. Red Snapper, *Lutjanus campechanus*, is a long-lived, demersal reef fish that supports one of the most economically important reef fisheries in the northern Gulf of Mexico. Understanding which nursery areas provide recruitment to the fishery is critical for fisheries management. First, experiments were conducted to test whether coring and pulverizing juvenile red snapper otoliths affected their chemical signatures. Coring had a significant effect on elemental signatures (Hotelling's Paired T2, $p=0.015$). This difference was associated with a systematic difference of slightly higher ratios in cored versus whole otoliths; however, no significant difference existed when residuals were tested. Coring had a significant effect on stable isotope signatures (Hotelling's Paired T2, $p=0.007$). These differences were associated with a systematic difference of slightly higher $\delta^{13}\text{C}$ and $\delta^{18}\text{O}$ values in whole right versus cored left otoliths. Analysis of residuals revealed no difference when analysis was conducted on residuals instead of raw data. Second, a method to remove cores of adult otoliths was designed to allow cores to be removed as a single piece, which permitted each core to be decontaminated prior to preparing the core for elemental and stable isotope analyses. Lastly, tests were conducted to compare interspecific and regional variation between two congeners, red snapper and lane snapper (*Lutjanus synagris*), to determine if lane snapper otolith chemical signatures could be used as a proxy for red snapper signatures. Signatures were significantly different among regions (MANOVA, $p<0.001$) and between species nested within region (MANOVA, $p<0.001$), suggesting that lane snapper chemical signatures do not serve as an accurate proxy for red snapper signatures.

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WASTEWATER TREATMENT PLANTS AND EARTHQUAKES: WHAT ARE THE 'BLOOMING' SEAWEEDS TRYING TO TELL US?

Historically, massive *Ulva* and *Gracilaria* blooms in the eutrophic Avon-Heathcote Estuary of Christchurch, New Zealand have significantly affected both the estuary's aesthetic value and its ecosystem function. With the diversion of Christchurch city's wastewater discharge away from the estuary in March 2010 it was expected there would be close to a 10-fold reduction in nitrogen(N)-loading, which in turn promised a reduction in algal biomass. A