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Sea-Level Rise: Estuarine Wetlands of Mustang Island at Imminent Risk of Submergence

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Coastal areas in Texas are vulnerable to sea-level rise (SLR) because of high rates of land subsidence and flat topography. Estuarine wetlands in particular, are highly threatened by SLR because the small tidal range limits their vertical distribution. In order to offset wetland submergence induced by SLR, the rate of vertical accretion must at least equal the rate of SLR. To investigate wetland susceptibility to SLR-driven submergence, accretion rates in different wetland environments of Mustang Island (MUI), Texas, were determined using a Cesium-137 marker horizon technique. Comparisons of relative volumetric contributions of mineral and organic matter to accretion were made, as well.

Mustang Island is located in the Coastal Bend of the south-central Texas coast, bounded by the waters of the Gulf of Mexico and Corpus Christi Bay. The tide range in Texas bays and estuaries is small (<0.3 m) while wind is one of the major geomorphic agents on this storm-dominated coast, and has a major influence on tidal circulation. In addition, droughts are common in the dry-subhumid climate of the region and affect physical and biological processes. Due to high rates of subsidence, the rate of SLR in the area ranged between 3.4-5.2 mm yr^{-1} for the past fifty to sixty years. Fringing the protected bay shoreline of Mustang Island, different types of estuarine wetland environments occur at elevations below $\sim$0.5 m relative to sea level and are expressed in patterns of vegetation assemblages. Seventeen shallow, large-diameter sediment cores were taken in high marsh, high flat, low marsh and low flat environments along three morphologically different transects. Samples from the cores were taken at 1 cm intervals and analyzed using laser diffractometry to determine the granulometric parameters, and gamma spectroscopy to determine Cs-137 activity. Accretion rates were calculated based on the depth of the Cs-137 peak, interpreted as a marker horizon for year 1963. The peak depth was corrected for core compaction, while the Cs-137 activity was corrected for grain size variation. Only thirteen accretion rates could be determined in low- marshes and –flats where intense bioturbation complicated the determination of the Cesium peak. In addition, analyses of bulk density and organic content were performed, while published particle densities were used to derive relative contributions of mineral and organic matter to accretion.

SLR-induced submergence is a serious threat to the survival of MUI wetlands. High marsh environments accrete on average 1.30$\pm$0.09 mm yr^{-1}; high flat environments 1.29$\pm$0.01 mm yr^{-1}; low marsh environments 3.81$\pm$0.37 mm yr^{-1}; and low flat environments 0.69$\pm$0.1 mm yr^{-1}. Accretion in salt marsh environments was highly correlated with elevation (R^2=0.85). Inorganic matter dominates accretion on a dry-weight basis; however, volumetric contributions of wet organic and inorganic matter to accretion are approximately equal.