UNDERSTANDING MECHANISMS FOR COASTAL MARSH SUSTAINABILITY IN THE FACE OF SEA LEVEL RISE

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SURFACE ELEVATION CHANGE

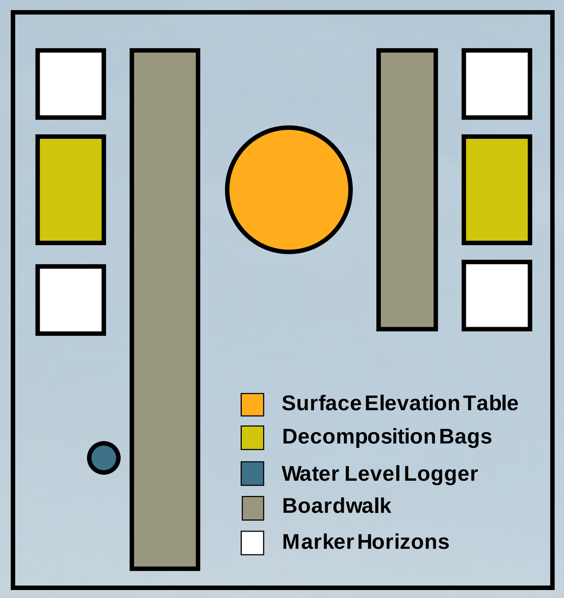

Figure 1. Sample station design and study components.

To gain elevation and remain within the tidal frame, marshes must accrete soil through sediment deposition or organic matter accumulation mediated by belowground productivity. Beneath the surface, subsidence and decomposition decrease elevation. The balance between elevation gains and losses is crucial for maintaining marsh surface elevation and improving long term sustainability. Evaluating changes in surface elevation among plant community will provide insight into differences in species' physiology, response to permanent flooding, and contribution to overall surface elevation.

FIELD SITES: J.D. Murphree Wildlife Management Area – Port Arthur, Texas
Rockefeller Wildlife Refuge – Grand Chenier, Louisiana

At each field site (FIG. 2), in permanently flooded impoundments, sample stations (FIG. 1) were placed in monodominant stands of *Phragmites australis, Scirpus californicus,* or *Typha* spp. (FIG. 3). Four sample stations were placed in each community type. At each station, rod-surface elevation tables (SETs) will be used to assess changes in surface elevation. Feldspar marker horizons will be used to assess accretion rates. Accretion rates and surface elevation change will be used to determine local subsidence rates. Installation and monitoring of SETs will occur according to standard protocols (Lynch et al. 2015).

CARBON FLUX

In addition to elevation losses due to increased decomposition, lowering the water level in marshes leads to oxidation of soil organic matter that releases carbon into the atmosphere. While many studies have evaluated the seasonality of carbon flux, few have sought to illuminate differences in carbon flux based on water level management strategies or plant community.

To provide insight into elevation losses caused by periodic drawdowns and the influence of plant community on carbon flux rates, we will place 6 static carbon flux chambers (Krauss et al. 2016) in monodominant plant communities (two per community) within a managed, periodically drawn down marsh. Six additional static carbon flux chambers will be placed in the same plant communities within a managed, but permanently flooded impoundment. Sampling will take place monthly over a two years period.

HYDROLOGY AND INDIVIDUAL PLANT DIFFERENCES

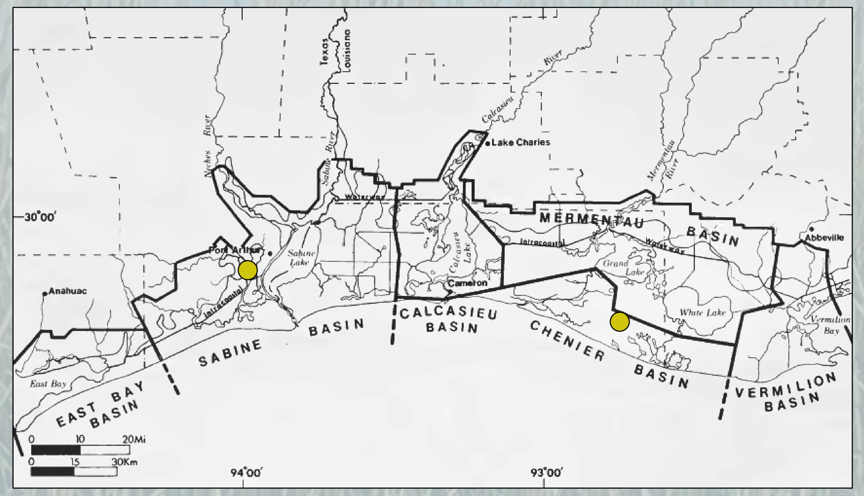

Figure 2. The Chenier Plain of Louisiana and Texas. Orange dots represent study sites at J.D. Murphree WMA in Port Arthur, Texas and Rockefeller Wildlife Refuge in Grand Chenier, Louisiana (Figure adapted from Gosselink et al. 1979).

Coastal wetland loss is prevalent in the Chenier Plain of Texas and Louisiana (FIG. 2). Historically, marshes in this region were able to keep up with steady rates of sea level rise (SLR) through sediment-driven accretion (Nyman et al. 1993). Now, altered sediment inputs and hydrology, along with high rates of sea level rise (SLR) are impacting the feedback systems that influence marsh surface elevation. Management practices designed to improve wildlife habitat such as water level manipulation, prescribed burning, and herbicide usage also affect processes governing marsh elevation, though the mechanism of how this occurs is only partially understood.

In the Chenier Plain, many impounded marshes are experiencing significant elevation losses following years of intensive management for waterfowl. As these areas experience longer, more frequent flooding, plant communities transition to flood-tolerant, perennial emergents that produce little food for waterfowl. Despite their apparent lack of wildlife value, there is interest in managing impounded marshes for perennial emergent vegetation in the hope of increasing soil elevation through organic matter accumulation and, ultimately, long-term marsh sustainability.

To that end, this study will examine the effects of management regime and perennial plant community type (FIG. 3) on processes that govern marsh surface elevation. By examining the relationships between the processes that drive marsh sustainability and evaluating the influence of plant community and water level on marsh surface elevation, we will gain a better understanding of how marshes behave under permanently inundated conditions. Ultimately, we hope to inform alternative management strategies to increase soil elevation gains in and sustainability of coastal marshes in the Chenier Plain.

Figure 3. *Phragmites australis* (A), *Scirpus californicus* (B), and *Typha* spp. (C).

DECOMPOSITION RATES AND BELOWGROUND BIOMASS

Marshes that are periodically drawn down often experience elevation loss due to increased organic decomposition as the marsh surface is exposed to air. As drawdowns continue, soil organic matter is oxidized and elevation decreases. Eventually, drainage becomes more difficult and vegetation becomes flood-stressed. Stressed plants decrease their belowground productivity and accretion, and inadequate accretion combined with increasing decomposition rates contribute to eventual marsh loss.

To better understand the mechanism driving elevation losses and differences among plant species' decomposition and belowground productivity, we will use root and rhizome decomposition bags to evaluate nutrient dynamics, decomposition rates, and belowground productivity. Roots and rhizomes were collected from each plant community and placed in single-species decomposition bags (FIG. 4). Filled bags for each species will be inserted 20 cm into the soil within the same species community. Bags will be collected every 2 weeks for a month, monthly for 6 months, and every 4 months for 3 years. Changes in nitrogen, carbon, phosphorus, silica, and fiber content will be measured for each sampling. Belowground productivity will be measured by weighing live roots that grow into the known-volume of decomposition bags as per Blum 1993.

Figure 4. *Phragmites australis* roots and rhizomes (A), *Typha* spp. roots and rhizomes before placement in decomposition bags (B), and decomposition bags prior to filling (C).

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