Coastal Land Loss and Landscape Level Plant Community Succession: An Expected Result of Natural Tectonic Subsidence, Fault Movement, and Sea Level Rise

Kathleen S. Haggar

Riparian Inc., P.O. Box 40873, Baton Rouge, Louisiana 70835

ABSTRACT

This paper examines the natural and anthropogenic factors that are present and absent at Goose Point. Goose Point is of interest because it lacks most of the "usual (anthropogenic) suspects" typically associated with coastal land change in Louisiana. While most of Louisiana's coastal land change has been attributed to anthropogenic factors, such may not be the case everywhere. Goose Point lacks anthropogenic impacts (such as levees and pumps, oil and gas exploration canals, production pipelines, and deep draft channels to cause salt water intrusion). Moreover, it also lacks typically nominated natural cause agents (such as thick sections of unconsolidated sediments). Since studies of faults and subsidence in the 2000s by other workers, the litany of coastal land loss factors has broadened to include faulting, small earthquakes, and regional deformation associated with crustal downwarping and transform faulting, in addition to sea level rise. Goose Point therefore may be an excellent control site for comparison with coastal habitats, both marshes and coastal woodlands, which have experienced coastal land change/land loss.

Goose Point, Louisiana, is located on the north shore of Lake Pontchartrain, far away from the coastal land loss so common to southern Louisiana. Unlike New Orleans, built on sediment deposited by the Mississippi River just a few thousand years ago as a feature of the St. Bernard Delta, most of the North Shore of St. Tammany Parish is a Pleistocene terrace. In the northeastern corner of the lake there are Holocene fringing marshes. Yet, the same pattern of land loss, which would perhaps be more accurately known as "land change," is also present at Goose Point. However, the conversion of marsh to open water at Goose Point cannot be attributed to any of the typically cited factors supposedly responsible for the southern marsh losses, such as levees and pumps, development, ground water extraction, direct removal by construction of oil and gas exploration and development canals, salt water intrusion into fresh environments via man-made deep draft channels or exploration and development canals, and surface oil and gas production impacts. Further, unlike most of the south coast of Louisiana, compaction of sediment is not a significant factor at Goose Point, because there are no thick ancestral Mississippi River sediments there.

So, why does Goose Point exhibit the same signature of subsidence, the same pattern of marsh conversion to open water absent any of the "usual suspects?" Tectonic forces such as regional downwarp that provides the accommodation space for coastal sedimentary basins, transform movements associated with basement structures, buoyant salt movements in the southern Louisiana salt basin, earthquakes, and possible fault-driven subsidence along the Baton Rouge Fault System contribute to the subsidence mechanisms that, along with sea level rise, drive vegetation change and marsh loss/land change at Goose Point.

For example, the Baton Rouge Fault System trends northwest-southeast, straddling the North Shore of Lake Pontchartrain with at least four active known active fault seg-

ments in the lake. Prominent lineaments have been mapped as onshore components of the Baton Rouge–Denham Springs Fault System. Changes in relative elevation and slope of marshes alter the hydrology of the marsh. Active faults that have been observed in the marshes of southeastern Louisiana often have extensive zones of deformation associated with the downthrown block; that deformation alters marsh hydrology. Increases in water depth, frequency of inundation, and duration of inundation are all drivers of plant succession in response to lower elevations due to any combination of tectonics and rising sea level. Marsh collapse/open water results when no plants can survive the combined stresses of water depth, frequency, and duration visited on the site. Marsh salinity increases or decreases in the Goose Point Marsh are relative to the salinity of the lake and overland sheet flow from higher elevations, as well as communication with Bayou Lacombe. Landscape level slopes can be altered by movements within the zone of deformation associated with active faults that have not yet broken to the surface. Salt water intrusion alone cannot to be a driver in plant succession or marsh loss at this site because the dominant marsh plants at the site are still within their salinity tolerances. However, increased water depth and duration due to possible fault zone deformation, crustal downwarping, and sea level rise do play a role in driving plant community changes in the Goose Point marshes.

Goose Point's land change over time serves as an excellent control site for comparison with breakup of Louisiana's coastal marshes fronting the Gulf of Mexico since it lacks anthropogenic impacts typically associated with coastal land loss. However, due to PO–33, a marsh recreation project constructed in 2008 at Goose Point (and at Point Platte just to the east), its utility as a control site for distinguishing tectonic subsidence from sea level rise may have been impacted. This site should be closely monitored for sediment aggradation or export, elevation, and salinity changes over time if we are to better understand the inter relationships between coastal geology and the fate of our coastal marshes.