York River Tidal Marshes

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ABSTRACT

The York River has nine tidal wetland community types that are distributed along gradients of salinity and tidal inundation. These range from the Saltmarsh Cordgrass community dominated by *Spartina alterniflora* to the Tidal Freshwater Mixed community that can have over 50 species in one marsh. These tidal marshes provide a number of important functions and values to the estuarine systems including: high primary productivity, important habitat value, erosion buffering and filtering capacity useful for trapping sediments, pollutants and nutrients. The tidal marsh communities within the four Chesapeake Bay Virginia National Estuarine Research Reserve sites are situated along the York system in polyhaline, mesohaline, oligohaline and freshwater salinity regimes. They are largely pristine vegetation communities and have been documented to have abundant fauna characteristic of their individual community types. Changes in the vegetation communities of each site have been documented over time; however more research is needed on the potential effects of projected sea level rise on these habitats and the roles of watershed sedimentation and nutrient enrichment, vegetation succession, and invasive species on the persistence and value of these tidal marsh areas.

INTRODUCTION TO TIDAL MARSHES OF THE YORK RIVER

The York River has a large number of wetland communities that are distributed along gradients of salinity and tidal inundation (Wass and Wright, 1969, Perry and Atkinson, 1997). The vegetation communities in these wetlands depend on a wetlands location along these gradients (Odum *et al.*, 1984, Odum, 1988, Perry and Atkinson, 1997). In turn, tidal and salinity gradients can vary both spatially and temporally (Odum *et al.*, 1984, Hull and Titus, 1986, Odum, 1988).

The combined stress of inundation and salt water, while limiting the types of biota that can survive in the marshes of the lower portion of the bay, also provide for a diverse number of tidal wetland habitats. In upstream reaches the water column salinity is low to non-existent. Without the stress of salinity, more species of vascular plants are able to survive (Anderson *et al.*, 1968, Wass and Wright, 1969, Odum *et al.*, 1984, Perry and Atkinson, 1997). In these tidal fresh water zones, over 50 species ha^{-1} may be common (Doumlele, 1981, Odum *et al.*, 1984, Odum, 1988, Perry and Atkinson, 1997, Perry and Hershner, 1999). Here tidal inundation can be the principal factor affecting community composition and function. In the lower portion of the river only a few vascular plants are able to tolerate the combined effects of tidal inundation and high salt content of the water. For a comprehensive comparison of tidal salt marshes and freshwater marshes of Chesapeake Bay see Odum (1988).

The tidal wetlands of the Chesapeake Bay perform a number of important ecological functions that are attributed high value by humans. The most important of these functions and values are primary production and detritus availability, wildlife and waterfowl support, shoreline erosion buffering, and water quality control.

Primary productivity in tidal marshes can reach 4 metric ton $ha^{-1} y^{-1}$, with an average range of 0.4-2.4 metric ton $ha^{-1} y^{-1}$. This high level of primary productivity results in a high level of detritus production, which is the basis of a major marine food pathway, which includes crabs, other shellfish, and finfish. In addition to providing food, tidal marshes provide spawning and nursery habitat. It has been estimated that 95% of Virginia's annual harvest of fish (commercial and sport) from tidal waters is dependent to some degree on wetlands (Wass and Wright, 1969). Some of the important wetland-dependent fisheries in the Chesapeake Bay include blue crabs, oysters, clams, striped bass, spot, croaker, and menhaden.

The Chesapeake Bay is home to approximately 1 million waterfowl each winter. The ducks and geese benefit both directly and indirectly from the productivity and habitat provided by the Bay's marshes. Marsh-nesting birds include Virginia and clapper rails, mallard and black ducks, willet, marsh wren, seaside sparrow, red-winged blackbird, boat-tailed grackle, and northern harrier (Watts, 1992). Chesapeake Bay marshes are also used by herons and egrets year-round, and by transient shorebirds such as yellowlegs, semi-palmated sandpiper, least sandpiper, dowitcher, dunlin, and sharp-tailed sparrow (Watts, 1992). Muskrats are the most visible marsh-dependent mammals.

Tidal marshes dissipate incoming wave energy, thereby providing a buffer against shoreline erosion. Knutson *et al.*, (1982), studying *Spartina alterniflora* marshes in the Chesapeake Bay, found that over 50% of wave energy was dissipated within the first 2.5 meters of the marshes. Rosen (1980) found that marsh margins form the least erodible shorelines.

Marshes in the Chesapeake Bay play a very important role in maintaining and improving water quality by trapping sediment from upland runoff and from the water column, thereby reducing siltation of shellfish beds, submerged aquatic vegetation beds, and navigation channels. Pollutants may also be filtered from runoff and the water column, and taken up by marsh plants.

Over one half of all Virginians live on the coastal plain that makes up a little under a third of the state's landmass (Colgan, 1990, Mason, 1993). This population pressure has resulted in increased impacts to salt marshes. Wetlands Watch, a Virginia NGO, has estimated that Virginia could lose between 50% and 80% of its remaining vegetated tidal wetlands by the year 2107 due to sea level rise (www.wetlandswatch.org, 2007). As sea level rises, homeowners will want to harden their shores to protect against property loss. This hardening may stop any shoreward progression of tidal marshes and more than likely increase tidal marsh losses.

DISTRIBUTION AND BIOTA OF YORK RIVER MARSHES

Nine common vegetated marsh types have been described in the tidal freshwater, oligohaline, mesohaline, and polyhaline sections of the York River (VMRC 1980, Perry *et al.*, 2001). These are arranged in the York River landscape along a salinity gradient with the polyhaline marshes at the mouth and tidal freshwater marshes further upstream from the saltwater influence (Wass and Wright, 1969, Odum *et al.*,1984, Perry and Atkinson, 1997).

All of the marshes within the CBNERRVA are high in biomass productivity and are important as wildlife, finfish, and shellfish habitat. A brief description of each community type is presented below. For a more in-depth study of the tidal marshes of the York River see Wass and Wright (1969), Silberhorn (1999), EPA (1983), and Perry and Atkinson (1997).

MARSH TYPES

Saltmarsh Cordgrass (a.k.a. Smooth Cordgrass) Community

The saltmarsh cordgrass community dominates the poly- and mesohaline areas of the York River (Figure 1). The community is comprised of dense, often mono-specific stands of *Spartina alterniflora* (saltmarsh or smooth cordgrass). Physiographical distribution ranges from mean sea level (MSL) to approximately mean high water (MHW). A stout, erect species, *S. alterniflora* often is represented by two forms: a tall form, 1.2-2 m (4-6ft) in height along the waters edge or along levees; and a short form 0.7 m (2ft) or less in height found in poorly drained areas behind levees or at elevations slightly higher than mean high water (Silberhorn, 1999). Other vegetative communities occur landward of the saltmarsh cordgrass communities including the saltmeadow, black needlrush, saltbush, and panne communities.

Figure 1. Saltmarsh cordgrass (*Spartina alterniflora*) (Photo courtesy of VIMS CCRM)

Natural succession of the saltmarsh cordgrass community for temperate climates analogous to the York River was first described in the 19th century (Mudge, 1862, Shaler, 1885) and is an important aspect of the marsh in respect to our current rise in sea level. These early researchers noted trees were positioned in an upright position at the bottom of saltmarsh peat. Mudge (1862) concluded that the stumps indicated that the area was once located at an elevation above MHW. He further noted *Spartina patens* rootstock, a species normally found at an elevation above mean high water, well below that elevation. He hypothesized, therefore, that saltmarshes "grew" (i.e., accreted) through the gradual accumulation of cordgrass rootstock. Several studies have shown that peat accumulation over time is responsible for the horizontal soil profile found in mid-Atlantic saltmarshes (Blum and Christensen, 2004). Primary succession normally occurs on a protected sand beach or overwash area. As the plant community matures, a solid subterranean root-mat develops. With sea level rises, the root-mat becomes anaerobic and creates reduced chemical conditions in the soil. Low redox conditions make it difficult, if not impossible, for aerobic soil microbes to survive. Without the presence of soil oxygen, biological degradation of the dead root material is considerably slower. The net effect is an increased amount of organic material in the soil and an increase in elevation in response to relative sea level rise (Redfield and Ruben, 1962, Redfield, 1972). Oertel *et al.*, (1989) have shown that a similar process has occurred and is responsible for the saltmarshes of the barrier islands of Virginia. Similar processes of marsh overwash and development are ongoing on a smaller scale within the Chesapeake Bay and its tributaries.

Saltmeadow Community

The saltmeadow community dominates areas of slightly increased elevation located landward of the saltmarsh cordgrass community in meso- to polyhaline waters. It also occurs on the higher portion of natural levees. The dominant vegetation is either *Spartina patens* (saltmeadow hay; Figure 2) or *Distichlis spicata* (salt grass) or a mix of both. Topographically, these "meadows" often remind one of grassland prairies or hay fields. Historically, these marshes have been used as a source of cattle fodder, both grazing and haying, throughout the mid-Atlantic and New England states (Teal and Teal, 1969). Both dominant plants form characteristically dense, low, 0.3-0.7 m (1-2 ft), wiry meadows typically with swirls or cow-licks.

Black Needlerush Community

The black needlerush community (Figure 3) is found interspersed among the saltmeadow community, and is common in the high marsh of some meso- and oligohaline areas. *Juncus roemerianus* (black needlerush) nearly always grows in mono-specific stands. The dark green (almost black), leafless stem tapers to a sharp point, giving the plant it's well deserved

Figure 2. Saltmeadow hay (*Spartina patens*) (Photo courtesy of VIMS CCRM)

name. The black needlerush community is normally located behind and/or interspersed within the Salt Marsh community. The boundary is usually distinct (Eleuterius, 1976, Montague *et al*., 1990). Stout (1984) divided black needlerush into three communities based upon elevation and soil salinity influences (modified from Uchytil, 1992): (1) Saline needlerush marsh. Found in eury- to mesohaline waters. Common associates include smooth cordgrass, saltmeadow cordgrass (*S. patens*), giant cordgrass (*S. cynosuroides*), saltgrass *Distichlis spicata*), and glasswort (*Salicornia* spp.). (2) Brackish needlerush marsh. Transitional between Meso- to oligohaline marshes. Associates include smooth cordgrass, giant cordgrass, saltmeadow cordgrass, sea lavender (*Limonium caroliniana*), threesquare, and common arrowhead (*Sagittaria latifolia*). (3) Intermediate needlerush marsh, transitional between brackish and tidal freshwater marsh. Associates include common reed (*Phragmites australis* v. australis, P. a. v. *americanus*) and softstem bulrush (*Scheonoplectus tabernaemontani*).

Figure 3. Black needlerush (*Juncus romerianus*) (Photo courtesy of VIMS CCRM)

Saltbush Community

Landward of the salt meadow and needlerush marshes one encounters the only tidal saltmarsh community dominated by woody vascular plants. The saltbush community is dominated by two shrubs: *Iva frutescens* (salt bush; Figure 4) in the lowest physiographic range, and *Baccharis halimifolia* (groundsel tree; Figure 5) in the higher physiographic range of the marsh. This type of vegetation usually delineates the upward boundary of the tidal marsh. The shrubs usually reach heights of 1 to 4 m (3-12.5ft.).

Figure 4. Saltbush (*Iva frutescens*) (Photo courtesy of VIMS CCRM)

Figure 5. Groundsel Tree (*Baccharis halimifolia*) (Photo courtesy of VIMS CCRM)

Big Cordgrass Community

The big cordgrass community, dominated by *Spartina cynosuroides*, (big cordgrass; Figure 6) is found slightly above MHW, but is variable in range (Silberhorn, 1999). It usually forms dense, mono-specific stands in low salinity (oligohaline) marshes. This is one of the tallest grass species of our tidal wetlands, usually reaching 2-4 m (6-12 ft) in height. Its stems are stout, leafy, and have a distinct coarse branched flower (seed) head. The leaves have saw-like margins that easily lacerate human skin.

Figure 6. Big Cordgrass (*Spartina cynosuroides*) (photo courtesy VIMS CCRM)

Cattail Community

Although there are several species of cattails in the mid-Atlantic region, there is only one, *Typha angustifolia* (narrow-leaved cattail; Figure 7) that is common in the saline tidal reaches. The community is usually found in isolated stands in brackish marshes, often near the upland margin where there is freshwater seepage. In freshwater areas, *T. latifolia* (broad-leaved cattail) may also be present and is often an indicator of high nutrient loads.

Figure 7. Narrow-leaved Cattail (*Typha angustifolia*)

Reed Grass Community

The reed grass community has become quite controversial. The community is dominated by reed grass (*Phragmites australis* ssp. *australis*, *P. a.* ssp. *americanus*; Figure 8), a species considered invasive by many wetlands scientists, regulators, and managers. The community is usually located above MHW and is almost always associated with topographic or other disturbance such as the placement of dredged sediments or other fill material, plant die-back or surface erosion. The species usually cannot tolerate poly- or mesohaline conditions below MHW (Silberhorn, 1999). It is a tall, stiff grass up to 4 m (12 ft) in height with short, wide leaves tapering abruptly to a pointed, purplish plume-like (feathery) flower head that turns brown in seed.

Figure 8. Reed Grass (*Phragmites australis* ssp. *australis*) (Photo courtesy of VIMS CCRM)

Salt Panne Community

Salt pannes (Figure 9) are shallow depressions, which often form within the interiors of large saltmarsh cordgrass communities. They are usually the result of wrack accumulation that kills the cordgrass or of "eatouts" caused by muskrats or snow geese. These areas normally become hyper-saline and are sparsely vegetated. They are dominated by several halophytic species of saltworts (*Salicornia virginica*, *S. europea* and *S. bigelovii*). These are succulent plants 1.5-30 cm (6-12 in) tall. By late summer, these plants may turn a dark red, giving those portions of the marsh a striking contrast to the yellow-greens of the surrounding grasses.

Figure 9. Salt panne with *Salicornia virginica*