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BIOL 535 Wetlands Ecosystem Comparisons

Characteristics of four wetland types in the Virginia Coastal Plain

In order to better understand the diversity of wetland types in Tidewater Virginia, we compared four wetland types in Charles City and James City Counties, Virginia, with respect to biota, wetland hydrology, and soils. Three of the sites were on the grounds of VCU's Inger and Walter Rice Center for Environmental Life Sciences in Charles City County, Virginia. The other site was along Taskinas Creek in York River State Park, James City County, Virginia.

Former Lake Charles site

Three wetland types were sampled in detail at the Rice Center. The first site once lay under the waters of near the upper reach of Lake Charles and is classified by the National Wetlands Inventory (NWI) as L1UBHh: a lacustrine, limnetic, impoundment with an unconsolidated bottom—i.e., a lake (Cowardin, Carter, Golet, & LaRoe, 1979). The lake, however, has drained since the breaching of the dam during a series of large storms in 2007 and subsequent effort to take advantage of the breach to restore the natural flow of Kimages Creek into the James River (Egghart, 2009). The better classification now is PEM1E: palustrine persistent emergent wetland that is seasonally flooded or saturated. (PEM1B, same as previous except that it is permanently saturated, is also a likely candidate.)

Although some trees, such as red maple (*Acer rubrum*), sweetgum (*Liquidambar styraciflua*), and loblolly pine (*Pinus taeda*) are located around the fringes of the site and on some higher spots within it, the site is dominated by herbaceous and graminoid species, including common rush, *Juncus effusus*; whitegrass, *Leersia virginica*; Nepalese browntop, *Microstegium vimineum*; dotted smartweed, *Polygonum punctatum*; arrowleaf tearthumb, *P. sagittatum*; lizard's tail, *Saururus cernuus*; and woolgrass, *Scirpus cyperinus* (Table 1).

Soil surveys in the United States generally do not map lake sediments. That is the case for the area formerly covered by Lake Charles. Nevertheless, the most likely soil classification for the site, based on proximity and topographic position, is the Bibb fine sandy loam, which occurs just upstream of the site along the Kimages Creek floodplain (Hodges & Thomas, 2006). The Bibb series is a poorly drained soil common along floodplains in the southern Coastal Plain. Despite nearly 100 years of inundation, the color, 10YR 3/3, of the site's upper horizons (Table 2) are within the range reported for the A and Cg horizons of the Bibb series (Hodges & Thomas, 2006). The texture, clay loam, differs from the Bibb's more typical sandy loam, but that may reflect decades of depositon of fine-grained sediments on the former lake's bed.

Hydrologically, the soils were either saturated or under standing water on the site, and they displayed redoximorphic features such as oxidized root channels (Table 3). Gleying is evident at depth (Table 4).

Harris Creek

The second site, along Harris Creek in the western portion of the Rice Center grounds, is classified as PFO1R—a seasonally flooded/tidal palustrine forested wetland dominated by deciduous broad-leaved species (Cowardin, et al., 1979). The site is dominated by a mixture of tree species, including red maple, *Acer rubrum*; river birch, *Betula nigra*; green ash, *Fraxinus pennsylvanica*; American holly, *Ilex opaca*; black gum, *Nyssa sylvatica*; sycamore, *Platanus occidentalis*; and baldcypress, *Taxodium distichum* (Table 1). The understory includes the shrub spicebush, Lindera benzoin; several vines, including trumpet creeper, *Campsis radicans*; roundleaf greenbrier, *Smilax rotundifolia*; and poison ivy *Toxicodendron radicans*; and herbaceous and graminoid species, including Indian woodoats *Chasmanthium latifolium*; jewelweed, *Impatiens capensis*; and lizard's tail, *Saururus cernuus* (Table 1).

Bibb fine sandy loam is the predominant soil type along the creek (Hodges & Thomas, 2006). The color, 10YR 2/1, and texture, sandy loam, of the sites A horizon (Table 2) are within the range reported for the A horizon in the Bibb series (Hodges & Thomas, 2006).

The Harris Creek site offers considerable evidence of wetland hydrology: saturated surface soil, water marks, drift lines, sediment deposits, water-stained leaves, crawfish chimneys, and aquatic macroinvertebrate remains (Table 3). The soils gives off a sulfidic odor and has a low chroma (Table 4).

Vernal pools

The third Rice Center site, along Kimages Road just south of its junction with Virginia Route 5, contains a series of vernal pools. Not formally classified under the NWI, they are most likely PFO1C: a seasonally flooded palustrine forested wetland dominated by deciduous broad-leaved species (Cowardin, et al., 1979). The forest cover consists of red maple, *Acer rubrum*; sweetgum, *Liquidambar styraciflua*; willow oak, *Quercus phellos*; loblolly pine, *Pinus taeda*; and American holly, *Ilex opaca* (Table 1). One shrub, highbush blueberry, *Vaccinium corymbosum*, was present; along with two species of vine, crossvine, *Bignonia capreolata*, and roundleaf greenbrier, *Smilax rotundifolia*; and common rush, *Juncus effusus*, Nepalese browntop *Microstegium vimineum*, and *Sphagnum* spp. (Table 1).

The predominant soil type in the area is the Newflat silt loam, a somewhat poorly drained, clayey soil common on alluvial terraces in the southern Coastal plain (Hodges & Thomas, 2006). Onsite soil color (10YR 6/1 background, with 2.5Y 6/4 mottles) are within the ranges reported for Newflat soils, particularly in their Bt and Btg horizons; soil texture is within reported ranges, too. (Table 2).

Ponding on the surface, saturated soils, and oxidized root channels all indicate wetland hydrology (Table 3). Low chroma and redoximorphic mottling indicate hydric soils (Table 4).

Taskinas Creek

The Taskinas Creek site is classified as E2EM1P: an estuarine, persistent intertidal emergent wetland that is irregularly flooded (Cowardin, et al., 1979). The tidal salt marsh, located along Taskinas Creek, a tributary of the York River, is dominated entirely by graminoids and herbs. The primary species is smooth cordgrass, *Spartina alterniflora*. Other species include two additional cordgrasses: big, *S. cynosuroides*, and saltmeadow, *S. patens*; saltgrass, *Distichlis spicata*; eastern baccharis, *Baccharis halimifolia*; and Jesuit's bark, *Iva frutescens* (Table 1).

The soil is classified as a Bohicket muck (Hodges, Sabo, McCloy, & Staples, 1985). Bohicket muck, typically found in tidal marshes such as Taskinas Creek, is very poorly drained. Twice-daily flooding as a result of tidal action contributes to its poorly drained condition. More extreme flooding may occur during storm events, such as during Hurricane Isabel in 2003, where storm surges of 1.7 to 2 m were measured in the York River Estuary (Reay & Moore, 2005). The surface layer of the soil is a dark gray sapric muck (Table 2). Below that are dark gray clay and (at deeper levels) silty clay (Hodges, et al., 1985). The fact that we could only reach the site by boat revealed most of what we needed to know about its hydrology: if not inundated, then saturated. Oxidized root channels were present (Table 3). The soil gives off a sulfidic odor (Table 4).

Comparisons and contrasts

All three sites meet Cowardin et al.'s (1979) definition of a wetland:

> WETLANDS are lands transitional between terrestrial and aquatic systems where the water table is usually at or near the surface or the land is covered by shallow water. For purposes of this classification wetlands must have one or more of the following three attributes: (1) at least periodically, the land supports

> predominantly hydrophytes; (2) the substrate is predominantly undrained hydric soil; and (3) the substrate is nonsoil and is saturated with water or covered by shallow water at some time during the growing season of each year.

Nevertheless, the criteria that each wetland meets may vary. All four sites either have a water table at or near the surface or are covered by shallow water. All four have undrained, or at least poorly drained, hydric soils. All four have hydrophytic macrophytic vegetation, although the proportion of hydrophytic vegetation varies from site to site.

The most obvious difference among the four sites are in the type of dominant vegetation. Two are palustrine forested wetlands (Harris Creek and the vernal pools). Two are emergent wetlands dominated by herbaceous and graminoid species (Lake Charles and Taskinas Creek).

While Harris Creek and the vernal pools have much in common floristically, they have significant differences hydrologically. Harris Creek is a swamp, inundated except under the most extreme drought conditions. The vernal pools, on the other hand are seasonally flooded. Most of the year, vernal pools have little or no standing water. In fact, Harris Creek soils have more in common with those of the Lake Charles site. In terms of plant community composition, Harris Creek is fairly typical of tidal freshwater swamps in Virginia (Doumlele, Fowler, & Silberhorn, 1984). It is more difficult to make such an assessment of vernal pools—by their nature, they are very diverse—but there is no reason to believe the ones we studies are atypical.

The emergent wetlands have little in common beyond the dominant plant life form present. The Lake Charles site is a palustrine, non-tidal freshwater marsh. Taskinas Creek is an estuarine that ranges from salt marsh near the mouth to tidal freshwater marsh farther upstream (Perry & Atkinson, 2009). Floristically, hydrologically, and in other ways, the Lake Charles site and Taskinas Creek arguably represent two ends of spectrum between freshwater marshes and salt marshes (Odum, 1988).

In terms of geographic extent, vernal pools like those on the Rice Center property might not occupy much area, but they are scattered throughout Virginia (Stolt, Genthner, Daniels, & Groover, 2001). Forested swamps, such as Harris Creek with its population of baldcypress, are concentrated in the southeastern part of the state—steeper elevation gradients on the Piedmont and parts west do not favor swamp development. Non-tidal freshwater marshes such as on the former Lake Charles site may not be restricted to the Tidewater and Eastern Shore, but they are concentrated there. Tidal freshwater and salt marshes are restricted to the Tidewater and Eastern Shore, but they cover a larger area of the state. In fact, most of Virginia's wetlands—and all of its estuarine wetlands—occur on the Coastal Plain (Hayes, 1996).

The four wetlands differ in terms of the ecosystem services they provide. Swamps, such as Harris Creek, and tidal marshes, such as Taskinas Creek, are more valuable in terms of flood control, for example. Non-tidal marshes, such as the Lake Charles site, and tidal marshes are very important breeding areas and way stations for migratory species. Forested wetlands—especially vernal pools, are very important sites for the breeding of species such as amphibians and aquatic insects (Hardy & Raymond, 1980).

All are important in improving water quality. They trap sediments, bind pollutants in sediments, store them in plant tissues, or transform them into something less harmful. Wetlands may have adverse effects, too. Wetlands offer a prime environment for anaerobic bacteria to transform inorganic mercury into its organic form, methyl mercury, which is much more mobile in the environment. The latter transformations are more likely to occur in inundated sites with reduced sediment/soil conditions.

REFERENCES

Cowardin, L. M., Carter, V., Golet, F. C., & LaRoe, E. T. (1979). *Classification of Wetlands and Deepwater Habitats of the United States*. (FWS/OBS-79/31). Washington, D.C.: Fish and Wildlife Service, U.S. Dept. of the Interior.

Doumlele, D., Fowler, B., & Silberhorn, G. (1984). Vegetative community structure of a tidal freshwater swamp in Virginia. *Wetlands, 4*(1), 129-145. doi: 10.1007/bf03160492

Egghart, C. (2009). *The Walter and Inger Rice Center for Environmental Through Time: A Study in Environmental Change, Human Land Use and its Effects along the Lower James River.* Master of Environmental Studies M.A., Virginia Commonwealth University Richmond. Retrieved from http://hdl.handle.net/10156/2488

Hardy, L. M., & Raymond, L. R. (1980). The breeding migration of the mole salamander, {IAmbystoma talpoideum} in Louisiana. *Journal of Herpetology, 14*, 327-335.

Hayes, M. A. (1996). Virginia. In J. D. Fretwell, J. S. Williams & P. J. Redman (Eds.), *National Water Summary of Wetland Resources* (pp. 387-392). Washington, D.C.: United States Government Printing Office.

Hodges, R. L., Sabo, P. B., McCloy, D., & Staples, C. K. (1985). *Soil Survey of James City and York Counties and the City of Williamsburg, Virginia*. (102-B-46). Washington, D.C.: United States Department of Agriculture.

Hodges, R. L., & Thomas, P. J. (2006). *Soil Survey of Charles City County, Virginia*. Washington, D.C.: United States Department of Agriculture Retrieved from http://websoilsurvey.nrcs.usda.gov/app/.

Odum, W. E. (1988). Comparative Ecology of Tidal Freshwater and Salt Marshes. *Annual Review of Ecology and Systematics, 19*(1), 147-176. doi: doi:10.1146/annurev.es.19.110188.001051

Perry, J. E., & Atkinson, R. B. (2009). York River Tidal Marshes. *Journal of Coastal Research, 25*(Special Issue 57), 40-49. doi: 10.2112/1551-5036-57.sp1.40

Reay, W. G., & Moore, K. A. (2005). Impacts of Tropical Cyclone Isabel on Shallow Water Quality of the York River Estuary. In K. G. Sellner (Ed.), *Hurricane Isabel in Perspective* (pp. 135-144). Edgewater, Md.: Chesapeake Research Consortium.

Stolt, M. H., Genthner, M. H., Daniels, W. L., & Groover, V. A. (2001). Spatial Variability in Palustrine Wetlands. *Soil Science Society of America Journal, 65*(2), 527-535. doi: 10.2136/sssaj2001.652527x

Table 1. Plant species occurring in four wetland sites in Charles City and James City counties, Virginia.

Species	Harris Creek	Taskinas Creek	Lake Charles	Vernal Pools
Trees				
Acer rubrum	X		X	X
Betula nigra	X			
Fraxinus pennsylvanica	X			
Ilex opaca	X			X
Liquidambar styraciflua	X		X	
Nyssa sylvatica	X			X
Pinus taeda			X	X
Platanus occidentalis	X			
Quercus phellos				X
Taxodium distichum	X			
Shrubs				
Lindera benzoin	X			
Vaccinium corymbosum				X
Vines				
Bignonia capreolata				X
Campsis radicans	X			
Smilax rotundifolia	X			X
Toxicodendron radicans	X			
Herbs				
Baccharis halimifolia		X		
Chasmanthium latifolium	X			
Distichlis spicata		X		
Impatiens capensis	X			
Iva frutescens		X		
Juncus effusus			X	X
Leersia virginica			X	
Microstegium vimineum			X	X
Polygonum punctatum			X	
P. sagittatum			X	
Saururus cernuus	X			
Scirpus cyperinus			X	
Spartina alterniflora		X		
S. cynosuroides		X		
S. patens		X		
Sphagnum spp.				X

Table 2. Soil profiles from four wetland sites in Charles City and James City counties, Virginia.

Horizon	Harris Creek	Taskinas Creek[1]	Lake Charles	Vernal Pools
O	None			None
Depth		0-6 in	0-2 in	
Color		5Y 4/1 (dark gray)	10YR 3/3 (dark brown)	
Texture		muck (sapric material)		
A		—		
Depth	—		2-12 in	0-12 in
Color	10YR 2/1 (black)		10YR 5/3 (brown) background with 10YR 4/6 (dark yellowish brown) mottling	10YR 6/1 (gray) background with 2.5Y 6/4 (light yellowish brown) mottling
Texture	sandy loam		clay loam	clay loam
B	—	—		—
Depth			12-17 in	
Color			G1 6/0 (gray) background with 5YR 5/6 (olive) mottling	
Texture			—	
C	—		—	—
Depth		6-16 in		
Color		5Y 4/1 (dark gray)		
Texture		clay		

[1] Profile data obtained from the Soil Survey of James City and York Counties and the City of Williamsburg, Virginia (Hodges, et al., 1985).

Table 3. Wetland hydrology indicators in four wetland sites in Charles City and James City counties, Virginia.

Indicators	Harris Creek	Taskinas Creek	Lake Charles	Vernal Pools
Primary indicators				
Inundated	X	X	X	
Saturated surface soil	X	X	X	X
Water marks	X			X
Drift lines	X			
Sediment deposits	X			
Drainage patterns				X
Ponded				X
Secondary indicators				
Oxidized root channels		X	X	X
Water stained leaves	X			X
Crawfish chimneys	X			
Aquatic macroinvertebrate remains	X			

Table 4. Hydric soil indicators in four wetland sites in Charles City and James City counties, Virginia.

Indicators	Harris Creek	Taskinas Creek	Lake Charles	Vernal Pools
Histosol				
Histic epipedon				
Sulfidic odor	X	X		
Reducing conditions				
Redoximorphic features			X	X
Organic streaking in sandy soils				
Gleyed or low chroma	X	X	X	X
Concretions				
High organic content in surface layer in sandy soils				