Examination of the Characteristics of a Freshwater Wetland at Brookhaven National Laboratory

Linda Dowd[1], Caroline Singler[2], and Dr. Tim Green[3]

[1]Riverhead High School, Riverhead, NY 11901 [2]Lincoln-Sudbury Regional High School, Sudbury, Ma 01776

[3]Brookhaven National Laboratory, Upton, NY 11973

ABSTRACT

Wetland delineation is an important aspect of freshwater resource management, and use and development of wetlands are often subject to government regulation. The purpose of this study was to gain an understanding of the components that characterize a Long Island freshwater wetland. We followed standard protocols to delineate the boundaries of a wetland site at Brookhaven National Laboratory. We set transects, identified floral species in all strata, and cross referenced flora to the New York Department of Environmental Conservation's list of obligatory and facultative wetland plants. Soil cores confirmed the presence of hydric soils. Physical evidence of water inundation included watermarks and multi trunked vegetation. Transect locations were marked using GPS and mapped using GIS. Studies of local wetlands by school groups are highly motivating experiences that allow the teacher to blend earth science, biology, environmental science, and technology. Studies of changes in wetland communities over time may suggest natural or human impacts, which could lead to further research.

INTRODUCTION

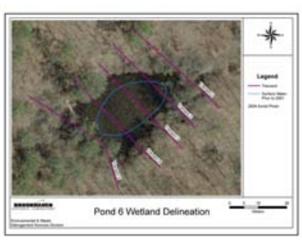
To the untrained eye wetlands often appear as vast wastelands; however, wetlands play crucial roles in natural freshwater systems. They help control water flow, filter pollutants, and provide habitat and breeding grounds for many types of plants and animals. Early settlers and Native Americans recognized the value of wetlands and fed on the vegetation and animals that were indigenous to these areas. Salt grass was a nutritious feed for grazing animals.[1] Draining and filling of wetlands to create more usable land began with the industrial revolution and continued through the twentieth century resulting in a loss of 60% of wetlands in the State of New York.[2] Increased awareness of the negative impacts of these changes resulted in efforts to preserve and protect wetlands at the federal, state and local levels. Subsequent to the passage of the Clean Water Act in 1972 the United States Army Corps of Engineers (ACOE) developed guidelines for wetland delineation.[3] The New York Department of Environmental Conservation (DEC) used the ACOE methods to develop its freshwater delineation manual.[4]

Wetlands are transitional areas between terrestrial and aquatic systems where the water table is usually at or near the surface or the land is covered with shallow water. Other supporting criteria for wetland determination include the presence of hydrophytic plant communities, hydric soils and hydrology; the most important criteria are the plant communities.[1] Plants that thrive in wetlands have adaptations that allow them to survive in saturated soils that are depleted in oxygen. Plant indicator status is based on the probability that a plant will occur in wetlands, as summarized in the table below.[5]

Plant Indicator Status	Symbol	Likelihood of Occurrence
Obligate Wetland	OBL	Almost always in wetlands
Facultative Wetland	FACW	Nearly always in wetlands
Facultative	FAC	Equally likely in wetlands/non-wetlands
Facultative Upland	FACU	Occasionally in wetlands
Obligate Upland	UPL	Almost always in non-wetlands

METHODS

This study followed field protocols from the DEC Freshwater Delineation Manual[4]. Pre inspection of the site using local maps and aerial photographs provided an approximate outline. We measured the site and established the position of five transects across the width of the study area. Vegetation was examined and described at two meter intervals along each transect. We examined all plant life within 1.5 meters of the transect from the ground surface to the canopy and identified flora, then determined its indicator status[5].



2004 Aerial photograph of study area with 2008 transect locations

Soil core samples were collected up to 45cm deep where stark differences in flora existed. We examined the samples for texture, moisture, and color and based on the Munsell color chart[6], noting the depth of any change in horizon. Hydric soils have an extensive organic layer more than 20 cm thick with a great deal of decomposition and dark color with a low chroma rating. Hydric soils may also exhibit gleying and mottling in the subsoil. Gleyed soil has a grayish appearance; mottled soil shows specks of yellow, orange and brown. These color variations occur because of anaerobic conditions caused by saturation (1).

We looked for evidence of the site's hydrology indicating at least seasonal inundation and/or soil saturation. Common indicators include: standing water on surface; saturated soils within 43 cm of surface; water marks on the trunks of trees in the higher elevations of the area; drainage patterns; coatings of water borne sediments; water stained leaves; and oxidized sediments at or near channels of roots.

Study area looking north from middle of meadow

Study area looking south from north end of meadow

MATERIALS

50 meters measuring tape, metric ruler, pin flags, various field guides, canopy densitometer, soil sampling tube, sharpshooter shovel (for larger pits), notebook, pen, sample bags, camera, Munsell® soil color chart

RESULTS

The table below summarizes the vegetation and soil data for the study area.

Plant Species (Most common species in bold.)

Stratum	Common Name	Scientific Name	Indicator Status[5]
Trees	**Pin Oak**	*Quercus palustris* Münchh.	FACW
	Red Maple	*Acer rubrum* L. var. *trilobum*	FACW
	Gray Birch	*Betula populifolia* Marsh.	FAC
	Black Gum (Tupelo)	*Nyssa sylvatica* Marsh.	FAC
	White Oak	*Quercus alba* L.	FACU-
	Pitch Pine	*Pinus rigida* Mill.	FACU
Shrubs	**Highbush Blueberry**	*Vaccinium corymbosum* L.	FACW-
	Lowbush Blueberry	*Vaccinium augustifolia* Aiton	FACU-
Ground Cover	**Woolgrass**	*Scirpus cyperinus*	FACW
in Meadow	**grasses/sedges**	*Scirpus(?)*	
	Moss	*Sphagnum*	

Soils

Average Depth (cm)	Soil Description	Soil Color[6]
0-24	Black, organic rich, moist, highly rooted, cohesive	10YR 2/1
24-42	Very dark brown, moist, mixture of organic material and mineral matter, fine sand and silt	10YR 2/2
42-45	Dark grayish brown, moist clayey silt, no organic matter	10YR 4/2

We found consistent placement of facultative wetland (FACW) plants along each of the five transects. Starting at the outside of any particular transect was the tree zone, which was a higher elevation. As we walked along a transect to the interior, highbush blueberry shrubs clearly marked the transition from tree zone to grassy meadow. Many shrubs and some trees had multiple trunks. A predominant and attractive grass called woolgrass was often the first grass observed inside the line of highbush blueberry. As we made our way to the midpoint of a transect the ground gently sloped down and grasses diminished in height, with patches of decomposing leaf litter in the lowest areas. This general schema was repeated along each of the five transects.

Highbush Blueberry

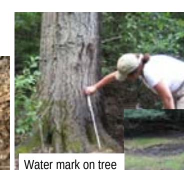
Woolgrass on perimeter of meadow

Woolgrass

Examination of soil pits and core samples revealed black, organic-rich soils to depths of approximately 24 cm, underlain by dark brown silty subsoil to approximately 45 cm. We encountered a layer of dark grayish brown silty clay at approximately 45 cm in one pit. All soils were very moist but not fully saturated at the time of this study; soils showed no gleying or mottling. We observed water marks on tree trunks within the shrub line and areas with flattened, dead grasses and decomposing leaf litter in surface depressions. Small gullies and scouring marked the surface in the lowest part of the meadow.

Soil Profile

Soil Core



Water mark on tree

Water stained leaves

Surface scour in meadow

DISCUSSION

Wetlands are generally characterized by the amount of area saturated with water. However, when a study is conducted during the dry season, more specific criteria are needed for wetland classification. Although aerial photographs and past observations indicated that this area normally contains surface water, there was no surface water during the summer of 2008. However, field investigation indicated that the site meets the three basic criteria for wetland classification: hydrophytic vegetation, hydric soils, and wetland hydrology. We identified facultative wetland species covering more than 50% of the area. Moist, low chroma, organic rich soils are field indicators of hydric soils. Water marks on trees, water-stained leaf litter, and surface gullies and scouring are all signs of past inundation that are indicative of wetland hydrology.

Wetlands are extremely important and environmentally sensitive ecosystems. High school students should be made aware of their innate beauty and their critical role in the overall ecology of an area. This type of study can be easily adapted to a variety of high school science curricula. Earth Science classes can learn basic mapping techniques and use of GPS and GIS. Students can investigate soil characteristics and wetland hydrology. Biology students can learn taxonomy and the use of dichotomous keys by identifying wetland vegetation. Wetland studies have numerous applications to Environmental Science courses, including studies of soil and water quality and assessment of human impacts on natural systems.

REFERENCES

[1] Tiner, Ralph W. In Search of Swampland. 2005. Piscataway: Rutgers University Press.

[2] Association of State Wetland Managers, "State Wetland Programs", 2004. [Online]. Available: http://www.aswm.org/swp/newyork9.htm

[3] Department of the Army, "Corps of Engineers Wetlands Delineation Manual", 1987. [Online]. Available: http://www.wetlands.com/regs/tlpge02e.htm

[4] New York State Department of Environmental Conservation, "New York State Freshwater Wetland Delineation Manual", 1995. [Online]. Available: www.dec.ny.gov/docs/wildlife_pdf/wdelman.pdf

[5] United States Department of Agriculture Natural Resources Conservation Service, PLANTS Database, "Wetland Indicator Status". [Online]. Available: http://plants.usda.gov/wetinfo.html

[6] Munsell® Soil Color Charts. 2000. New York: gretagmacbeth.

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