Early Vegetational Changes on a Forested Wetland Constructed for Mitigation

--Matthew C. Perry, Peter C. Osenton, and Cynthia B. Sibrel

ABSTRACT

Changes in vegetation were studied on 15 acres (6 hectares) of a 35 acre (14.2 hectare) forested wetland constructed for mitigation in Anne Arundel County, Maryland from 1994-96. Sampling at four different elevations (levels) determined that grasses initially dominated the area, but decreased from 59 percent in 1994 to 51 percent in 1995 and 30 percent in 1996. Herbaceous non-grass plants (forbs) increased from 19 percent to 56 percent in the three-year period. Areas with no plant cover decreased from 21 percent in 1994 to 11 percent in 1995, and 10 percent in 1996. Woody plants which comprised 2 percent of the cover in 1994, increased to 4 percent in 1995, and remained at 4 percent in 1996. The increase of woody plants was mainly from volunteer plants. Monitoring of the transplanted trees and shrubs indicated 35 percent mortality and little growth of surviving plants. The volunteer woody plant that provided most of the cover was Black Willow (*Salix nigra*). Differences in the vegetation were observed among the four levels. No differences were observed for the major vegetation classes (grasses, forbs, woody, and no cover) between plots that were planted and those that were not planted with woody plants. The dominant grass species was Redtop (*Agrostis stolonifera*), which comprised 51 percent of the cover in 1994 and 42 percent cover in 1995 and 23 percent in 1996. Other species that were common were Bush Clover (*Lespedeza cuneata*), Japanese Clover (*Lespedeza striata*) and Flat Pea (*Lathyrus sylvestris*). All four of these dominant species were part of the original seed mixtures that were distributed on the site. A total of 134 species of plants was recorded on the site indicating a fairly diverse community for a newly established habitat.

INTRODUCTION

The Sands Road Wetland Mitigation Project, located in Anne Arundel County, Maryland, was initiated in 1992 by the Maryland State Highway Administration (SHA). The project was constructed to satisfy mitigation requirements for impacts from 13 highway construction projects in Maryland including routes MD 3, MD 4, MD 202, MD 214, US 29, and US 50. The project created 72 acres (32.4 hectares) of wetlands making it the largest mitigation project conducted in Maryland to date. Total cost for construction was approximately $2.5 million.

Several types of wetlands are included in the project including 56 acres (22.7 hectares) of forested wetlands, 7 acres (2.8 hectares) of scrub-shrub wetlands, 4 acres (1.6 hectares) of freshwater tidal emergent wetlands, and 4.6 acres (1.9 hectares) of non-tidal emergent wetlands. Approximately 15 acres (6.1 hectares) of upland areas surrounding the created wetland were planted with trees as a buffer to the area and about 52 acres (22.7 hectares) of existing forested wetlands and upland habitats have been protected as part of the project.

The design of the site was unique in that it included terraced construction that resulted in four levels (Levels A-D) that differ from each other by approximately 5 feet (1.5 meters). These levels, separated by earthen berms, were created to retain runoff during small precipitation events, while also maintaining and enhancing the existing surface hydrology for larger precipitation events. The upper level (Level D) receives surface water runoff from the adjacent Sands Road and a trailer park and discharges into the Patuxent River. Additionally, Level B drains directly into the Patuxent. Level C drains to Level A where the surface water is discharged into the Patuxent River (Figure 1).

The wetland site was constructed on an old sand and gravel mining area that was left in a disturbed condition with no topsoil. The SHA chose to improve the soil condition by adding wood chips from all

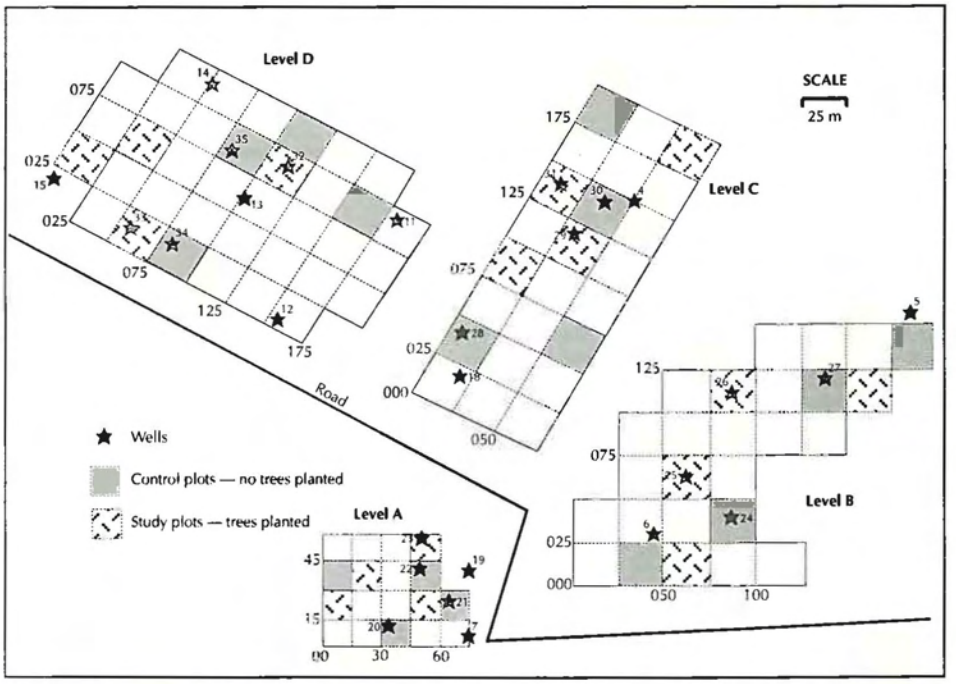

Figure 1. Experimental design of the Sands Road constructed forested wetland area showing four levels, study sections, and groundwater monitoring wells.

woody vegetation removed from the site and adding composted sewage sludge (COMPRO) from off the site. Originally the intent was to spread the wood chips and COMPRO over the whole site, however, the actual outcome was that wood chips were concentrated in certain areas at a depth of 6-18 inches and the COMPRO was spread just where trees were to be planted. A modified manure spreader was used to obtain a band of COMPRO 4 feet (1.2 meters) wide and 2 inches (5 cm) deep. The bands were separated by 10 feet (3.1 meters). The COMPRO and soil were mixed with a soil auger during planting. Approximately 50,000 bare-root trees and shrubs were planted during the fall of 1993 and spring of 1994.

METHODS

The methods used at the Sands Road constructed forested wetland are similar to those used at five other sites in central Maryland with a few exceptions (Perry and others 1995, Perry and others 1996). One difference is that the Sands Road wetlands are being studied on four different levels. This allows for comparisons of survival of nursery-grown trees and shrubs and the changes in ground cover of all plants at potentially different hydrological regimes. Another major difference is that this site contains areas that were not planted with nursery-grown trees and shrubs, which allows researchers to measure vegetational changes in a more natural situation. These unplanted areas acted as the control for the study.

A total of 36 ground water monitoring wells were measured with an electronic well meter on a biweekly basis to determine ground water levels throughout the year. Eighteen of these wells were established by SHA and an additional 18 were established by staff of Patuxent Wildlife Research Center. Data from only the wells located within the study sites on all four levels (Figure 1) were used in this report.

The four elevations were staked in 1993 with metal poles in a grid pattern to facilitate the study of the plants. Levels B, C, and D were staked in a 25 x 25 meter (27.5 x 27.5 yard) grid system, whereas, Level A was staked in a 15 x 15 meter (16.5 x 16.5 yard) grid system (Figure 1). Level A was smaller than the other levels and, therefore, the smaller grid system was appropriate. Four sections that were planted and four sections that were not planted on each of the four levels were randomly selected to be studied for vegetational changes. Each of the eight sections were then gridded in a one meter (1.1 yard) grid system and on each of these sections, 10 quadrats were randomly selected. This resulted in 80 quadrats on each level. The meter-square quadrats were permanently staked with PVC tubes to facilitate annual sampling.

All 320 quadrats were sampled in August 1994, 1995, and 1996 and plant species identified and percent cover estimated for each species. Water and bare ground, not covered by vegetation, were also estimated in percentiles for each quadrat, bringing total for quadrat to 100 percent. Woody vegetation under one meter in height was included in the percent cover of the quadrat. Woody vegetation over one meter in height was also estimated for percent cover of the quadrat, but was recorded separately from the other plant cover in the quadrat and listed as canopy cover.

RESULTS

Groundwater levels indicate a seasonal hydroperiod at the four levels (Figures 2 and 3). There were differences between the levels, with Level A, lowest in elevation, having the highest ground water in the spring (Figure 3). All levels had large areas of surface water during much of the

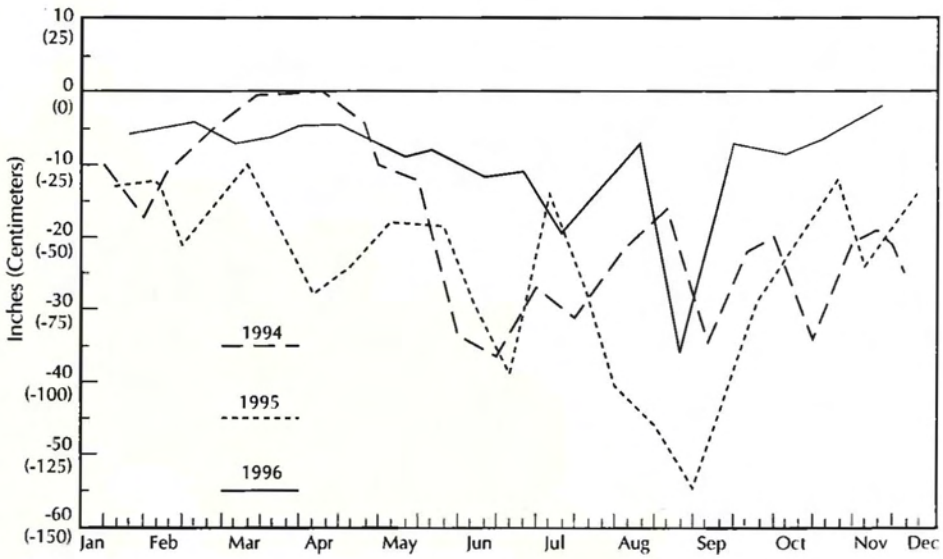

Figure 2. Seasonal fluctuations of groundwater levels (averages on the four levels) based on biweekly readings of 27 wells at Sands Road constructed forested wetland from 1994 to 1996.

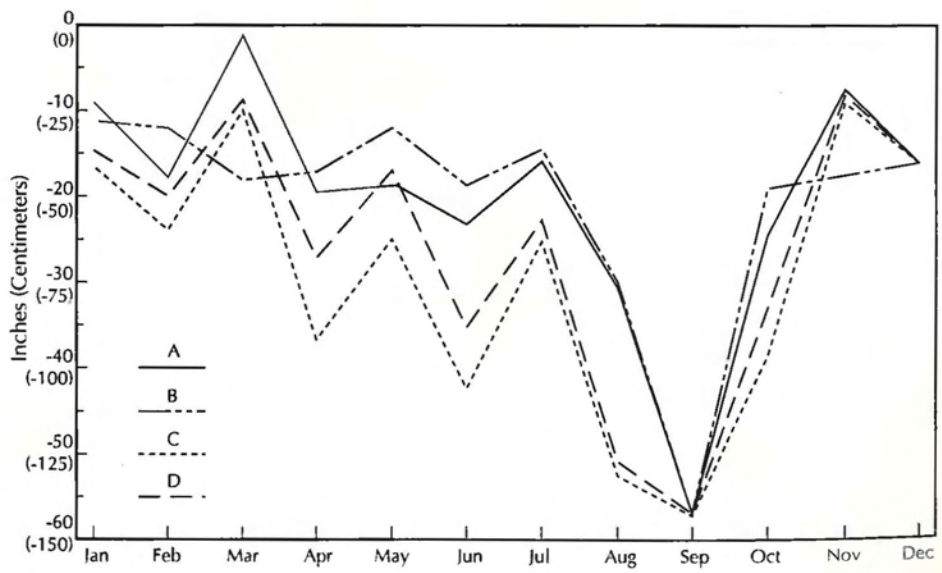

Figure 3. Seasonal fluctuation of groundwater levels based on biweekly well readings for the four levels at Sands Road constructed wetland in 1995.

year, although these areas were greatly reduced in size during the summer months.

Combined data of quadrat sampling for the four levels revealed that grasses were initially the predominant vegetation, but declined from 59% in 1994, to 51% in 1995, and 30% in 1996 (Figure 4). Forbs increased from 19% to 56% during the three years, while areas with no vegetative cover decreased from 21% to 10%. Woody vegetation increased from 2% to 4% during the three years mainly due to the colonization of the area by Black Willow (*Salix nigra*). Woody transplants had approximately 35 percent mortality and did not constitute a major portion of the ground cover. Black Willow was most abundant on Level A (Table 1), which had the highest ground water elevations early in the growing season. Differences in plant composition were detected among levels, but no differences were detected between planted and non-planted sections within levels.

Redtop (*Agrostis stolonifera*) was the dominant grass in all years, but declined from 51% of total cover in 1994, to 42% in 1995, and to 23% in 1996 (Table 1). Redtop was most abundant in Level D where it formed 82%, 79%, and 44% of the cover in the three years (Table 1). Other grass species commonly recorded were Switchgrass (*Panicum virgatum*), and two species of Foxtail (*Setaria faberii* and *S. glauca*).

Important legumes included Flat Pea (*Lathyrus sylvestris*), Bush Clover (*Lespedeza cuneata*), and Japanese Clover (*Lespedeza striata*). In general, grasses declined in cover over the three years while the legumes increased (Table 1). Redtop, Switchgrass, Flat Pea, and Bush Clover were all part of the original seed mixture used for erosion control purposes, in accordance with construction specifications for the area.

Two forbs, Pennsylvania Smartweed (*Polygonum pensylvanicum*) and Cattail (*Typha latifolia*), on the study site were considered important because of their steady increase in cover. These two wetland forbs were most common on Level A which was the wettest level based on ground water (Figure 3). Purple Gerardia (*Agalinus purpurea*), Tick-seed Sunflower (*Bidens polylepis*), and Partridge Pea (*Cassia fasciculata*) were most abundant on Level B, which had a wet sandy/gravelly substrate (Table 1).

The number of plant species recorded at Sands Road increased from 95 in 1994 to 118 in 1995 and 134 in 1996. Level B had the greatest number of species (n=80) (Table 2). Many of these species are those that are typically found in an open emergent wetland and should disappear when woody plants become more dominant (Mitsch and Gosselink 1993). The woody plants should increase transpiration (reducing ground water elevations) and develop a canopy that will increase shading of herbaceous vegetation, resulting in more typical forest habitat (Mitsch and Gosselink 1993).

Table 1. Percent ground cover by major plant species[1] recorded in one meter quadrats on four levels during the month of August in 1994, 1995, and 1996 at the Sands Road forested wetland created as a wetland bank.

	Level A			Level B			Level C			Level D		
	1994	1995	1996	1994	1995	1996	1994	1995	1996	1994	1995	1996
Agalinus purpurea (Purple Gerardia)	-	-	-	8	3	2	-	1	2	-	-	1
Agrostis stolonifera (Redtop)	44	16	18	24	19	4	54	53	31	82	79	44
Bidens polylepsis (Tick-seed Sunflower)	-	-	1	5	6	7	-	-	4	-	-	1
Cassia fasciculata (Partridge Pea)	1	-	-	4	3	2	2	1	-	-	-	-
Lathyrus sylvestris (Flat Pea)	3	10	7	-	-	1	-	1	2	-	1	1
Lespedeza cuneata (Bush Clover)	12	27	29	-	4	19	-	2	9	-	2	8
Lespedeza striata (Japanese Clover)	-	-	-	6	12	16	2	10	15	-	-	8
Panicum virgatum (Switchgrass)	3	17	13	-	-	1	-	1	1	-	-	-
Polygonum pensylvanicum (Pennsylvania Smartweed)	3	6	1	2	1	-	1	1	1	-	-	-
Salix nigra (Black Willow)	3	7	5	1	1	1	1	3	1	-	-	1
Setaria faberii (Foxtail Grass)	-	-	-	11	2	1	3	3	1	-	-	1
Typha latifolia (Broad-leaved Cattail)	1	3	4	-	-	-	-	1	1	-	2	3
no cover	23	6	15	28	20	14	23	11	6	9	7	9

[1]Plants were considered major if they had a minimum of five percent ground cover on any elevation during any year of the study.

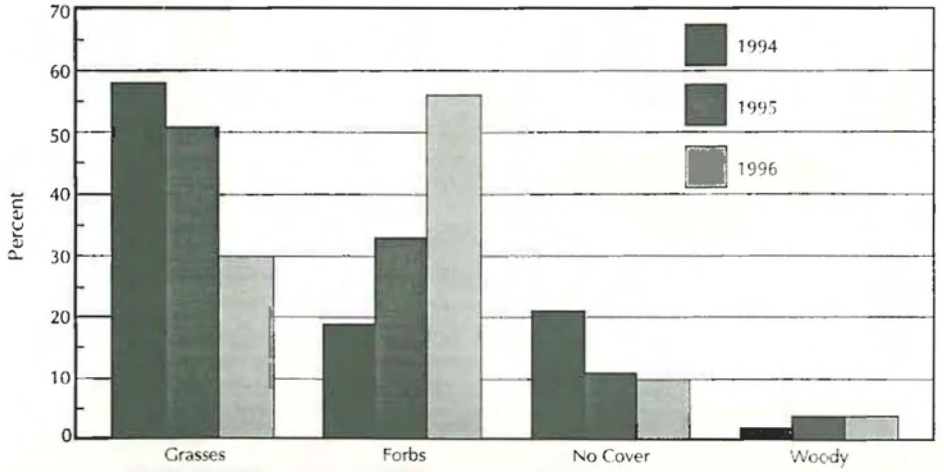

Figure 4. Major groups of ground cover at Sands Road constructed forested wetland based on meter square sampling during 1994, 1995, and 1996.

Table 2. Number of species, total and by level, recorded in one meter quadrats (in August of 1994, 1995, and 1996) at Sands Road forested constructed wetland.

	1994	1995	1996
Total for site	95	118	134
Level A	47	68	68
Level B	50	80	80
Level C	57	63	69
Level D	29	40	74

CONCLUSIONS

The Sands Road forested wetland, constructed by the SHA in 1992-93 has developed into a habitat that has the potential to be a successful forested wetland providing many of the functions of a natural forested wetland. At present 134 plant species have been identified on this constructed site and they represent a diverse group of grasses, forbs, and woody plants. At present the dominant plant groups are grasses and forbs, but this should change as woody plants get larger and eventually dominate the plant community of the site.

In spite of the unique native wetland flora that has developed on this site it may be many years before this area can be considered to have the characteristics and functions of a forested wetland (Welsch and others 1995). Managers dealing with mitigation might want to consider other alternatives to obtain the goal of "no net loss" within a shorter time frame. ❀

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