

**2005 Mill River Freshwater Tidal Marshes:  
2005 Vegetation Monitoring**

**May 2006**

*Prepared for*

**South Central Connecticut Regional Water Authority**

*Prepared by*

**J. Lee Rogers  
and  
Penelope Sharp**

## **Mill River Freshwater Tidal Marshes: 2005 Vegetation Monitoring**

As part of the ongoing evaluation of the lower Mill River corridor and the potential environmental effects of public water supply withdrawals, the South Central Connecticut Regional Water Authority conducts annual monitoring of plant communities in the freshwater tidal marsh. This marsh, created in part by downstream tidegates belonging to the City of New Haven, is an unusual vegetation type that contributes significantly to the biological diversity and wildlife populations in the lower Mill River and East Rock Park.

The Water Authority's Environmental Study Team (EST), in its 1999 assessment of potential impacts of the proposed treatment plant, recommended that vegetation in the marsh be monitored annually or biennially, both prior to construction of the plant to provide baseline data and after the plant is placed in operation. Data from these vegetation studies, along with monitoring of soil salinity, river flow, water quality, and aquatic life in the lower Mill River, will be used to evaluate environmental impacts of treatment plant operation.

The new treatment plant was placed in operation on April 20, 2005. Prior to the operation of this plant, baseline data were collected from 1998 through 2004 (J.L. Rogers and P. Sharp 2005: "2004 Vegetation Monitoring in the Mill River Freshwater Tidal Marshes: A Summary of Six Years of Baseline Data Collection," prepared for the South Central Connecticut Regional Water Authority). The baseline sampling provided information on variation in plant communities in the marsh during six years (no monitoring was performed in 1999) when there were no withdrawals for water-supply use.

### **Vegetation Sampling Methods**

In 2005, Penni Sharp and Vincent Kay conducted quantitative vegetation sampling of the Mill River marshes on September 20. Monitoring in 1998 and 2001-2003 was also done in the last half of September; in 2000 and 2004, the marshes were monitored 2-4 weeks earlier. Soil water salinity measurements are made in spring and again in late summer from three monitoring wells on each transect, installed in September 2000.

Vegetation sampling is conducted along two permanent transects. The upstream or northern transect, MR-N, is about 2,000 feet below the Whitney dam, just south of the East Rock Park footbridge and about 700 feet north of the East Rock Road bridge. This transect passes through one of the largest and most varied parts of the marsh. The downstream transect, MR-S, passes through a narrower and less varied marsh community about 300 feet south of the East Rock Road bridge.

Permanent transects at both sites are approximately perpendicular to the river, with marker stakes placed every 5 meters. Transect MR-N is 100 m in length, but only 18 of the surveyed stakes are sampled regularly; the stake at the upland origin of the transect is outside the tidal area, while the two stakes closest to the river are typically inundated and can be sampled only during unusually low flow conditions. Transect MR-S is 55 m long and ends at a low levee at the river; since it does not extend into the typically inundated low marsh along

the river's edge, all 12 stakes are sampled regularly. Vegetation sampling is performed by extending 5-meter sampling chains south from each stake perpendicular to the permanent transect. A dowel rod is inserted into the vegetation at 0.5 m. intervals along the sampling chain, for a total of 10 sampling points per chain, and all species touching the rod (or an imaginary upward extension of it) are recorded. Maps of these transects, and a detailed description of the methodology, appear in the report by Lee Rogers included in the *Lake Whitney Water Treatment Plant Environmental Evaluation: Volume Two* (January 1999).

## **Results**

### **Precipitation and Soil Conditions**

The 2005 growing season in the lower Mill River was unusually dry. From April through September 2005, rainfall in the vicinity of the Mill River marshes was only 16.79 inches, lower than in any year of baseline sampling; since 6.14 inches of this precipitation occurred in April, the summer was extremely dry. The average for April-September during the six years of baseline sampling was about 25 inches, close to the 94-year average of about 23 inches at the Whitney gage. Previously, the driest year in which monitoring was performed was 2001, when the area received a little over 20 inches of precipitation during the growing season; however, in 1999, when vegetation was not sampled, growing season rainfall was a little over 16 inches.

Withdrawals from Lake Whitney at the new treatment plant began in April 2005. Withdrawals were guided by a Management Plan intended to protect downstream and upstream environmental resources. Throughout most of the spring and summer, daily withdrawal rates were low. From April 20 through September 30, withdrawals averaged only 18% of the registered daily diversion amount permitted by the Connecticut Department of Environmental Protection (CH2MHill 2005: "2005 Water Quality Monitoring, Mill River, Hamden and New Haven, CT." Prepared for the Regional Water Authority.) Lake Whitney remained above spillway level through the end of August, but the lake was drawn down below the spillway in early September, at which time the downstream flow release was activated at 4.2 million gallons per day, in accordance with the Management Plan. By the time of sampling (September 20), the lake had returned to a few inches above spillway level.

Soil water in the transect monitoring wells was sampled on April 8 and July 21, 2005, during both high and low tide conditions. Monitoring well data for 2005 and for 2004, a year of normal rainfall, are included in Appendix A. Salinity in the Mill River adjacent to the transects was 0.1 ppt (parts per thousand) in all samples, even under summer drought conditions in 2005. Soil salinities in monitoring well MRN-1, furthest from the river, were 0.2 ppt at both sampling periods during both high and low tides. Only one measurement in 2005 reached 0.3 ppt (MW2 at site MRS, July low tide), whereas in previous years there have been three or more measurements at this level. Peak soil salinity measurements reached 0.4-0.5 ppt in the previous dry year of 2001 and as high as 0.7 ppt in 2002. Overall, the drought conditions of the 2005 growing season did not appear to cause elevated soil salinities, and salinity throughout the marsh has remained below 0.5 ppt as an annual average. This is considered the limit of tolerance for freshwater marsh plants.

**2005 Vegetation Monitoring Results**

Vegetation monitoring results in 2005 were generally similar to those observed in previous years. The 2005 data, along with those obtained during the baseline years, are summarized in the tables below.

Table 1 shows the total number of species and total percent cover measured on each transect during the six years of sampling. Total percent cover is generally more than 100 percent, as it is obtained by adding the percent cover for all species, several of which may be encountered at one sampling point. Table 1 also shows growing-season precipitation conditions: for purposes of this table, rainfall more than 2 inches below the long-term growing-season average of 23 inches was considered “low,” 21-25 inches “normal,” and above 25 inches “high.” Since the time of sampling could also affect species distribution, the approximate sampling date for each year is also included in the table.

**Table 1  
Mill River Freshwater Tidal Marsh  
Precipitation, Total Cover, and Number of Species on Each Transect, 1998-2005**

Year	Sampling date	Growing-season rainfall	Transect MR-N			Transect MR-S		
			Total Cover		Total # spp.	Total Cover		Total # spp.
			Percent	Rank		Percent	Rank	
1998	9/21	26.18” - high	215.6	7	31	228.3	7	23
2000	8/18	27.99” - high	259.4	6	29	244.2	6	17
2001	9/24	20.25” - low	359.4	2	40	258.3	4	27
2002	9/24	24.15” - normal	315.0	4	28	279.0	3	23
2003	9/25	27.58” - high	290.0	5	31	256.7	5	21
2004	9/7	24.29” - normal	366.7	1	26	338.3	2	17
2005	9/20	16.79” - low	348.3	3	32	359.2	1	27

This table illustrates the variability in the structure of the marsh communities from year to year under baseline conditions. Total percent cover can be taken as a surrogate for overall community diversity, since it reflects the presence of multiple species at each sampling point. As Table 1 shows, this figure is highest in years of low to normal rainfall and lowest in the three years when growing-season precipitation was above normal. The total number of species encountered on the transects showed a similar pattern in most years. This negative association of species diversity with precipitation is expected: In drier years, species that might be limited by excessive wetness can survive in the marsh, and plants ordinarily confined to the higher areas of the marsh can grow closer to the river, thus appearing at more sampling points along with species normally found in the lower marshes.

Complete vegetation monitoring results for 2005 are presented in Appendix B, along with a description of the vegetation zonation on each transect. The actual counts of each species encountered at each sampling chain are shown in appendix Table N (MR-N transect) and Table S (MR-S transect), which show the data collected on the north and south transects, respectively. The appendix tables illustrate zonation in the marshes, providing a profile of the two marsh areas. The marshes are subdivided into zones based on topography and vegetation, as described in the vegetation report in the *Lake Whitney Water Treatment Plant Environmental Evaluation: Volume Two* (Rogers 1999).

Tables 2 and 3 show the changes in percent cover on transects MR-N and MR-S respectively for selected dominant and common species over the years since monitoring began. Herbaceous and shrub species are shown separately for each transect. (Percent cover is the percentage of all points sampled at which a species occurred.)

**Table 2**  
**Percent Cover of Dominant Species – Transect MR-N**

Dominant Species	Year (Growing Season Precipitation)						
	2005 (low)	2004 (normal)	2003 (high)	2002 (normal)	2001 (low)	2000 (high)	1998 (high)
<b>HERBS</b>							
<i>Typha angustifolia</i>	57.2	46.7	44.4	47.2	51.7	46.7	45.0
<i>Impatiens capensis</i>	34.4	66.7	40.6	45.0	42.8	23.3	13.9
<i>Lythrum salicaria</i>	31.7	30.6	15.6	20.6	17.2	17.8	7.2
<i>Leersia oryzoides</i>	30.6	22.2	11.1	8.9	11.7	3.3	2.2
<i>Mikania scandens</i>	24.4	15.6	30.6	48.3	28.9	21.7	31.1
<i>Thelypteris palustris</i>	20.0	14.4	16.7	13.3	17.8	11.1	0.0
<i>Polygonum sagittatum</i>	13.9	20.0	1.7	0.0	10.6	0.0	0.0
<i>Onoclea sensibilis</i>	8.9	6.1	8.3	5.6	7.2	7.2	2.2
<i>Peltandra virginica</i>	6.7	7.2	6.1	2.8	3.9	3.3	2.2
<i>Bidens conata</i>	6.7	0.0	0.0	0.0	0.0	0.0	3.3
<i>Bohemeria cylindrica</i>	6.1	15.6	6.7	5.6	10.6	5.0	8.3
<i>Polygonum hydropiper</i>	4.4	12.2	3.9	3.9	4.4	0.0	0.0
<i>Cuscuta gronovii</i>	4.4	8.9	5.0	1.1	3.9	0.0	0.0
<i>Pilea pumila</i>	1.1	5.0	0.0	0.0	0.0	0.0	1.1
<b>SHRUBS</b>							
<i>Cornus amomum</i>	37.8	46.1	40.6	45.6	37.8	47.2	41.1
<i>Viburnum dentatum</i>	14.4	8.3	20.0	20.0	25.6	17.8	15.6
<i>Hibiscus moscheutos</i>	9.4	6.1	7.8	5.0	5.0	5.0	2.8
<i>Cephalanthus occidentalis</i>	3.3	0.0	5.6	2.8	5.0	3.3	1.7

**Table 3**  
**Percent Cover of Dominant Species – Transect MR-S**

Dominant Species	Year (Growing Season Precipitation)						
	2005 (low)	2004 (normal)	2003 (high)	2002 (normal)	2001 (low)	2000 (high)	1998 (high)
<b>HERBS</b>							
<i>Typha angustifolia</i>	76.7	83.3	75.0	81.7	80.0	78.3	66.7
<i>Impatiens capensis</i>	48.3	74.2	56.7	69.2	42.5	42.5	32.5
<i>Mikania scandens</i>	45.8	33.3	21.7	31.7	28.3	35.8	65.0
<i>Lythrum salicaria</i>	23.3	11.7	14.2	10.8	15.8	6.7	0.8
<i>Polygonum arifolium</i>	15.8	21.7	12.5	0.0	8.3	0.0	9.2
<i>Polygonum sagittatum</i>	11.7	12.5	5.8	2.5	2.5	4.2	0.0
<i>Cuscuta gronovii</i>	11.7	2.5	0.0	4.2	8.3	0.0	3.3
<i>Bohemeria cylindrica</i>	10.0	13.3	6.7	5.8	5.8	5.8	1.7
<i>Peltandra virginica</i>	10.0	13.3	12.5	8.3	8.3	10.8	1.7
<i>Pilea pumila</i>	9.2	14.2	0.0	0.0	0.0	0.0	0.0
<b>SHRUBS</b>							
<i>Viburnum dentatum</i>	15.0	11.7	12.5	11.7	10.0	14.2	8.3
<i>Cornus amomum</i>	12.5	12.5	9.2	5.0	8.3	8.3	5.8
<i>Hibiscus moscheutos</i>	5.0	6.7	3.3	5.0	4.2	4.2	2.5

Percent cover of all species encountered on the transects during 2005 and the six years of baseline sampling is provided in Appendix C. For each transect, this information is arranged both in decreasing order of percent cover in 2005 and alphabetically by scientific name.

### Discussion

In general, monitoring results in the freshwater marsh communities were similar to those in previous year. The variability of plant community in the marshes over the baseline years was discussed in last year's summary report (Rogers and Sharp, 2005). As reported in that study, the marsh communities at these sites not only show patterns of variation related to differences in climate from year to year, but they also show different patterns at the two study sites. The 2005 sampling showed a continuation of trends observed during the baseline years.

Narrow-leaved cattail (*Typha angustifolia*) is the dominant species at both sites. At the downstream site, MR-S, percent cover by this species in 2005 remained within the typical range (70-85%) observed during the baseline period (1998-2004). At the upstream site, MR-N, its 2005 percent cover, 57%, was higher than during any year of the baseline study, when it remained between 44 and 52%. The annual climbing composite *Mikania scandens* is closely associated with the cattail community. Percent cover by this species remained within the typical baseline range at MR-N, but showed a sharp increase at MR-S in 2005.

Purple loosestrife (*Lythrum salicaria*) is an introduced species that has become a serious nuisance in many northeastern wetlands. It increased slowly at both Mill River sites over the years of the baseline study. In 2004 it showed a large increase in percent cover at MR-N, from 21% or less in previous years to 31%. In 2005, it remained about the same, at 32%. At MR-S, purple loosestrife did not increase in 2004, remaining on the 10-15% range of most of the baseline years; in 2005, however, it increased to 23%.

The common annual herbaceous species in the tidal marsh communities are very variable from year to year. The most abundant species, spotted jewelweed (*Impatiens capensis*), was half to two-thirds as abundant at the Mill River sites in 2005 as in 2004. Spring precipitation through April was very similar in these two years, but lower precipitation in May 2005 (see Appendix Table A-2) may have affected germination and establishment, or the very dry June in 2004 may have made more of the marsh area available for establishment of jewelweed seedlings.

Both of the marsh communities are mosaics of emergent marsh dominated by cattails and shrub thickets consisting mainly of silky dogwood (*Cornus amomum*) and northern arrowwood (*Viburnum dentatum*). At MR-S, most of the marsh is in herbaceous vegetation. The percent cover of dogwood on the study transect increased slowly over the baseline period from about 6% in 1998 to 12.5% in 2004, remaining at 12.5% in 2005. At MR-N, where woody species cover about half the marsh community, silky dogwood has remained around 40-50% throughout the baseline period. In 2005, it covered about 38% of the study transect, down from its 46% cover in 2004. Other shrub species at this site vary somewhat from year to year, in part a reflection of the growth or death of individual plants, but have also remained fairly stable over time.

## Conclusions

Under baseline conditions, plant communities in the Mill River tidal marshes were variable from year to year, yet remained fairly stable between 1998 and 2004. During this period, however, there was a gradual increase in the introduced species purple loosestrife (*Lythrum salicaria*). The sharpest increase of the baseline period, especially at site MR-S, occurred between 1998 and 2000, when no sampling was done during the intervening dry year of 1999. In 2005's very dry growing season, another sharp increase in purple loosestrife was seen on the MR-S transect. On the MR-N transect, however, there was no similar increase in 2005; instead, the species increased substantially in 2004, when overall growing season precipitation was essentially normal.

A sharp increase in percent cover by introduced species was one of the possible future changes identified in the last report (Rogers and Sharp 2005) identified as a potential indicator of loss of stability in the marsh community. As noted above, results with regard to this indicator were mixed at the two sites. The other indicators list (increase in shrub cover, loss of cover by the dominant cattail association, or loss of cover by the low-marsh dominant *Peltandra virginica*) were not observed in the 2005 sample, despite the low rainfall and initiation of treatment-plant withdrawals. To date there is no evidence to suggest that these withdrawals at the low levels experienced in 2005 have adversely affected marsh communities.

## **Mill River Freshwater Tidal Marshes**

### **Appendices**

#### **Appendix A: Precipitation and Salinity in the Mill River Marshes**

Table A1: Lake Whitney Precipitation, 1998 - 2005

Table A2: Groundwater Monitoring Well Data, 2003-2005

#### **Appendix B: Transect Descriptions and 2005 Vegetation Monitoring Results**

##### **1. MR-N Transect**

Table N: Mill River Freshwater Tidal Marsh Vegetation, North Site (MR-N) –  
Frequency by Species and Zone: 2005

##### **2. MR-S Transect**

Table S: Mill River Freshwater Tidal Marsh Vegetation, South Site (MR-S) –  
Frequency by Species and Zone: 2005

#### **Appendix C: Vegetation Sampling Data, 1998 - 2005**

##### **1. MR-N Transect**

List of Species by Percent Cover in 2005

Alphabetical List of Species and Percent Cover

##### **2. MR-S Transect**

List of Species by Percent Cover in 2005

Alphabetical List of Species and Percent Cover



## Appendix A Precipitation and Salinity in the Mill River Marshes

**Table A1  
Lake Whitney Precipitation, 1998-2005**

<b>Year</b>	<b>Jan</b>	<b>Feb</b>	<b>Mar</b>	<b>Apr</b>	<b>May</b>	<b>Jun</b>	<b>Jul</b>	<b>Aug</b>	<b>Sep</b>	<b>Oct</b>	<b>Nov</b>	<b>Dec</b>	<b>Total</b>	<b>G.S.*</b>
<b>1998</b>	5.00	4.69	5.59	3.98	5.51	8.30	1.11	4.92	2.36	3.23	1.81	0.95	47.45	26.18
<b>1999</b>	6.85	4.76	3.90	1.50	2.75	0.32	1.22	3.42	7.05	3.86	2.91	2.41	40.95	16.26
<b>2000</b>	2.44	1.89	4.14	4.68	3.31	5.95	7.04	2.72	4.29	0.44	4.45	2.41	43.76	27.99
<b>2001</b>	1.62	2.05	7.29	1.53	5.32	4.26	2.87	3.43	2.84	1.18	1.03	2.18	35.60	20.25
<b>2002</b>	1.67	1.27	4.09	3.45	5.56	3.35	1.90	3.16	6.73	4.20	4.15	4.06	43.59	24.15
<b>2003</b>	1.47	2.48	4.13	2.92	4.11	6.57	1.57	5.47	6.94	5.36	2.18	3.62	46.82	27.58
<b>2004</b>	1.38	2.09	3.08	5.77	2.69	0.88	2.95	4.52	7.48	1.97	3.19	3.27	39.27	24.29
<b>2005</b>	3.61	2.31	3.16	6.14	1.31	2.68	2.83	1.35	2.48	14.03	3.90	4.25	48.05	16.79
<b>8-yr Aver.</b>	<b>3.01</b>	<b>2.69</b>	<b>4.42</b>	<b>3.75</b>	<b>3.82</b>	<b>4.04</b>	<b>2.69</b>	<b>3.62</b>	<b>5.02</b>	<b>4.28</b>	<b>2.96</b>	<b>2.89</b>	<b>43.19</b>	<b>22.93</b>
<b>94-yr Aver.</b>	<b>3.67</b>	<b>3.25</b>	<b>4.36</b>	<b>4.14</b>	<b>3.93</b>	<b>3.57</b>	<b>3.62</b>	<b>3.96</b>	<b>3.74</b>	<b>3.697</b>	<b>4.02</b>	<b>3.98</b>	<b>45.92</b>	<b>22.96</b>

\* Growing season precipitation, April-October.

**Table A2  
Groundwater Monitoring Well Data, 2004 and 2005**

	Groundwater Salinity (ppt)							
	2005				2004			
	4/8/05 (high flow)		7/21/05 (low flow)		4/6/04 (high flow)		7/29/04 (low flow)	
<b>Monitor well</b>	<b>Low tide</b>	<b>High tide</b>	<b>Low tide</b>	<b>High tide</b>	<b>Low tide</b>	<b>High tide</b>	<b>Low tide</b>	<b>High tide</b>
<b>MRN-1</b>	0.2	0.2	0.2	0.1	0.3	0.3	0.2	0.3
<b>MRN-2</b>	0.1	0.1	0.2	0.2	0.1	0.1	0.2	0.2
<b>MRN-3</b>	0.1	0.1	0.1	0.2	0.1	0.1	0.1	0.2
<b>River@ MR-N</b>	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
<b>MRS-1</b>	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.2
<b>MRS-2</b>	0.1	0.1	0.2	0.2	0.1	0.1	0.1	0.2
<b>MRS-3</b>	0.1	0.1	0.3	0.1	0.1	0.1	0.1	0.1
<b>River@ MR-S</b>	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1

## Appendix B

### Transect Descriptions and 2005 Vegetation Monitoring Results

#### MR-N Transect

The upstream or northern transect, MR-N, is about 2,000 feet below the Whitney dam, just south of the East Rock Park footbridge and about 700 feet north of the East Rock Road bridge. This transect passes through one of the largest and most varied parts of the marsh. As surveyed, the transect is about 100 meters long; approximately 75 meters of this length passes through high marsh, a mosaic of shrubs and emergent marsh (primarily cattails), which is seasonally or occasionally flooded but not subject to daily tidal inundations. About 25 meters of low marsh bordering the river is alternately flooded and exposed as a result of daily tidal fluctuations in the river; portions of the low marsh are often inaccessible due to flooding by tidal action or high river flows. On transect MR-N, sampling begins at the second stake, since the stake at the origin of the transect is located within a swale with little vegetation other than canopy trees overhanging from the adjacent upland forest. A total of 18 stakes are sampled, for a total of 18 chains and 180 sampling points; two additional stakes were installed and surveyed on the riverward end of this transect but are typically inundated and have not been accessible for sampling.

As shown in Table N, the upper marsh on transect MR-N is dominated by spotted jewelweed (*Impatiens capensis*), which gradually gives way to narrow-leaved cattail (*Typha angustifolia*), an emergent marsh plant tolerant of relatively high salinities. Cattail dominates the middle marsh, along with the climbing composite *Mikania scandens*. The transect then passes through a broad area where emergent marsh intermingles with shrub thickets, apparently depending on small changes in elevation; this area appears in Table N as three zones, "Shrub thicket," "Shrub/marsh" (the lowest area), and "Dogwood thicket." In the higher areas of this complex, silky dogwood (*Cornus amomum*) dominates, intermixed with several herbaceous species, including cattail, mikania, jewelweed, and goldenrod (*Solidago gigantea*). Swamp rosemallow (*Hibiscus moscheutos*) is also among the shrubs in this area. In the lower swale, northern arrowwood (*Viburnum dentatum* var. *recognitum*) is the dominant shrub; buttonbush (*Cephalanthus occidentalis*), a shrub highly tolerant of periodic inundation, appears in the lowest and wettest areas. Cattails (*T. angustifolia*) are absent in the low shrub/marsh, and jewelweed (*I. capensis*) is the dominant herbaceous species. As the ground rises slightly on the riverward side, there is a dense thicket of silky dogwood (*C. amomum*), again intermixed with cattails as well as jewelweed. Below this rise, the substrate descends fairly rapidly toward the river. Silky dogwood is still common on higher ground, but cattails disappear in the low marsh, which is subject to frequent tidal inundation. *Mikania scandens*, purple loosestrife (*Lythrum salicaria*), and jewelweed occur among the dogwood, but give way to arrow arum (*Peltandra virginiana*), and then (beyond stake 18) to other species tolerant of regular submersion, including arrowhead (*Sagittaria* sp.), pickerel weed (*Pontederia* sp. ), and white waterlily (*Nymphaea odorata*).



**MR-S Transect**

The downstream transect, MR-S, passes through a narrower and less varied marsh community about 300 feet south of the East Rock Road bridge. This transect is about 55 meters long from upland edge to river. The high marsh, about 45 meters wide, consists primarily of cattail marsh, with shrub thickets on elevated hummocks. The remaining 10 meters of the transect is in low marsh bordering the river. For transect MR-S, sampling begins at the origin of the permanent transect (stake 1) and extends through stake 12, for a total of 12 chains and 120 sampling points.

As shown in Table S, sampling at site MR-S, begins in an area of transition between upland forest and marsh, dominated by spicebush (*Lindera benzoin*), silky dogwood (*Cornus amomum*), and multiflora rose (*Rosa multiflora*); jewelweed is the dominant herb. In the upper marsh, narrow-leaved cattail (*Typha angustifolia*) and jewelweed (*Impatiens capensis*) are dominant, while in the middle marsh, jewelweed becomes less common and cattails share dominance with *Mikania scandens*. The transect then crosses a small rise or hummock, where a few shrubs such as swamp rosemallow (*Hibiscus moscheutos*) intermix with the cattail community. Beyond this is low marsh, where cattails and jewelweed are replaced by arrow arum. The last sampling chain crosses part of a small levee adjacent to the river, where a large silver maple (*Acer saccharinum*) and other upland species occur.

Table S: MILL RIVER SOUTH (MR-S) VEGETATION FREQUENCY BY SPECIES AND ZONE, 2005

Vegetation Zone:	Trans.shrub		Upper marsh			Middle marsh			Hummock		Lower marsh		2005		
	1	2	3	4	5	6	7	8	9	10	11	12	Total	%Cover	
<i>Lindera benzoin</i>	7												7	5.8	
<i>Acer rubrum</i>	5												5	4.2	
<i>Impatiens capensis</i>	4	7	4	2	7	8	2	7	3	5	6	3	58	48.3	
<i>Parthenocissus quinquefolia</i>	1												1	0.8	
<i>Symplocarpus foetidus</i>													0	0.0	
<i>Cornus amomum</i>	2	8									5		15	12.5	
<i>Bidens connatus</i>		1									1	1	3	2.5	
<i>Chelone glabra</i>		1											1	0.8	
<i>Polygonum arifolium</i>				2	3	6	5	2			1		19	15.8	
<i>Cuscuta gronovii</i>		3	1	3	2				1		3	1	14	11.7	
<i>Viburnum dentatum</i>			9	7								2	18	15.0	
<i>Leersia oryzoides</i>		3											3	2.5	
<i>Pilea pumila</i>			2	2	6	1							11	9.2	
<i>Typha angustifolia</i>		9	8	7	10	10	10	10	10	10	8		92	76.7	
<i>Mikania scandens</i>				3	5	6	10	10	10	8	3		55	45.8	
<i>Peltandra virginica</i>											3	9	12	10.0	
<i>Lythrum salicaria</i>			1	6	4	4	3				5	5	28	23.3	
<i>Bohemeria cylindrica</i>				1	4	2	2				3		12	10.0	
<i>Epilobium coloratum</i>					2	1							3	2.5	
<i>Onoclea sensibilis</i>				3									3	2.5	
<i>Polygonum sagittatum</i>				2	7	2			1		1	1	14	11.7	
<i>Symplotrichum sp.</i>						1					1		2	1.7	
<i>Hibiscus moscheutos</i>										6			6	5.0	
<i>Helenium autumnale</i>											2		2	1.7	
<i>Apios americana</i>											2		2	1.7	
<i>Mimulus ringens</i>					1	2							3	2.5	
<i>Polygonum hydropiper</i>												1	1	0.8	
<i>Acer saccharinum</i> *												10	10	8.3	
													<b>TOTALS</b>	<b>400</b>	<b>333.3</b>

\* Overhanging canopy of tree rooted on adjacent levee

## **Appendix C**

### **Mill River Freshwater Tidal Marshes: Vegetation Sampling Data 1998-2005**

#### **1. MR-N Transect**

List of Species by Percent Cover in 2005

Alphabetical List of Species and Percent Cover

#### **2. MR-S Transect**

List of Species by Percent Cover in 2005

Alphabetical List of Species and Percent Cover

MR-N Transect - Summary of Species by Percent Cover														
1998* - 2005														
Species	1998		2000		2001		2002		2003		2004		2005	
	Total	%Cover	Total	%Cover	Total	%Cover	Total	%Cover	Total	%Cover	Total	%Cover	Total	%Cover
<i>Typha angustifolia</i>	81	45.0	84	46.7	93	51.7	85	47.2	80	44.4	84	46.7	103	57.2
<i>Cornus amomum</i>	74	41.1	85	47.2	68	37.8	82	45.6	73	40.6	83	46.1	68	37.8
<i>Impatiens capensis</i>	25	13.9	42	23.3	77	42.8	81	45.0	73	40.6	120	66.7	62	34.4
<i>Lythrum salicaria</i>	13	7.2	32	17.8	31	17.2	37	20.6	28	15.6	55	30.6	57	31.7
<i>Leersia oryzoides</i>	4	2.2	6	3.3	21	11.7	16	8.9	20	11.1	40	22.2	55	30.6
<i>Mikania scandens</i>	56	31.1	39	21.7	52	28.9	87	48.3	55	30.6	28	15.6	44	24.4
<i>Thelypteris palustris</i>	0	0.0	20	11.1	32	17.8	24	13.3	30	16.7	26	14.4	36	20.0
<i>Viburnum dentatum</i>	28	15.6	32	17.8	46	25.6	36	20.0	36	20.0	15	8.3	26	14.4
<i>Polygonum sagittatum</i>	0	0.0	0	0.0	19	10.6	0	0.0	3	1.7	36	20.0	25	13.9
<i>Hibiscus moscheutos</i>	5	2.8	9	5.0	9	5.0	9	5.0	14	7.8	11	6.1	17	9.4
<i>Onoclea sensibilis</i>	4	2.2	13	7.2	13	7.2	10	5.6	15	8.3	11	6.1	16	8.9
<i>Bidens connata</i>	6	3.3	0	0.0	1	0.6	0	0.0	0	0.0	0	0.0	12	6.7
<i>Peltandra virginica</i>	4	2.2	6	3.3	7	3.9	5	2.8	11	6.1	13	7.2	12	6.7
<i>Boehmeria cylindrica</i>	15	8.3	9	5.0	19	10.6	10	5.6	12	6.7	28	15.6	11	6.1
<i>Apios americana</i>	0	0.0	3	1.7	4	2.2	0	0.0	0	0.0	1	0.6	8	4.4
<i>Cuscuta gronovi</i>	0	0.0	0	0.0	7	3.9	2	1.1	9	5.0	16	8.9	8	4.4
<i>Polygonum hydropiper</i>	0	0.0	0	0.0	8	4.4	7	3.9	7	3.9	22	12.2	8	4.4
<i>Epilobium coloratum</i>	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	4	2.2	7	3.9
<i>Cephalanthus occidentalis</i>	3	1.7	6	3.3	9	5.0	5	2.8	10	5.6	0	0.0	6	3.3
<i>Parthenocissus quinquefolia</i>	11	6.1	13	7.2	12	6.7	0	0.0	10	5.6	7	3.9	6	3.3
<i>Solidago gigantea</i>	3	1.7	9	5.0	9	5.0	13	7.2	2	1.1	5	2.8	6	3.3
<i>Verbena hastata</i>	1	0.6	0	0.0	1	0.6	0	0.0	0	0.0	0	0.0	6	3.3
<i>Polygonum arifolium</i>	3	1.7	6	3.3	5	2.8	1	0.6	4	2.2	4	2.2	5	2.8
<i>Viburnum lentago</i>	7	3.9	5	2.8	4	2.2	5	2.8	4	2.2	3	1.7	5	2.8
<i>Toxicodendron radicans</i>	4	2.2	0	0.0	4	2.2	10	5.6	7	3.9	6	3.3	4	2.2
<i>Iris pseudacorus</i>	6	3.3	5	2.8	7	3.9	7	3.9	1	0.6	1	0.6	3	1.7
<i>Symptotrichum sp.</i>	0	0.0	0	0.0	13	7.2	20	11.1	8	4.4	9	5.0	3	1.7
<i>Mimulus ringens</i>	0	0.0	0	0.0	0	0.0	0	0.0	1	0.6	0	0.0	2	1.1
<i>Pilea pumila</i>	2	1.1	0	0.0	0	0.0	0	0.0	0	0.0	9	5.0	2	1.1
<i>Pontederia cordata</i>	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	2	1.1
<i>Eupatorium maculatum</i>	4	2.2	1	0.6	1	0.6	3	1.7	1	0.6	4	2.2	1	0.6
<i>Sambucus canadensis</i>	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	0.6
<i>Bidens frondosa</i>	0	0.0	0	0.0	6	3.3	0	0.0	2	1.1	2	1.1	0	0.0
<i>C. amomum</i> SDLG ***	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
<i>Chelone glabra</i> ***	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
<i>Cirna latifolia</i>	6	3.3	0	0.0	0	0.0	2	1.1	0	0.0	0	0.0	0	0.0
<i>Eupatorium perfoliatum</i>	0	0.0	0	0.0	2	1.1	0	0.0	0	0.0	2	1.1	0	0.0
<i>Geum rivale</i>	4	2.2	1	0.6	0	0.0	1	0.6	0	0.0	3	1.7	0	0.0
<i>Helenium autumnale</i>	0	0.0	0	0.0	8	4.4	3	1.7	0	0.0	2	1.1	0	0.0
<i>Laportea sp.</i>	0	0.0	0	0.0	0	0.0	0	0.0	1	0.6	0	0.0	0	0.0
<i>Lobelia cardinalis</i>	0	0.0	6	3.3	6	3.3	0	0.0	0	0.0	2	1.1	0	0.0
<i>Lycopus uniflorus</i> ***	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
<i>Nymphæa odorata</i>	8	4.4	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
<i>Panicum clandestinum</i> ***	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
<i>Polygonum scandens</i> ***	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
<i>Quercus sp</i> SDLG	1	0.6	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
<i>Rorippa palustris</i>	0	0.0	0	0.0	0	0.0	0	0.0	1	0.6	0	0.0	0	0.0
<i>Rosa multiflora</i>	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
<i>Sagittaria rigida</i>	7	3.9	4	2.2	4	2.2	0	0.0	0	0.0	0	0.0	0	0.0
<i>Scutellaria lateriflora</i>	0	0.0	0	0.0	1	0.6	0	0.0	0	0.0	0	0.0	0	0.0
<i>Sium suave</i>	0	0.0	0	0.0	0	0.0	0	0.0	1	0.6	2	1.1	0	0.0
<i>Solanum dulcamara</i>	0	0.0	0	0.0	0	0.0	2	1.1	0	0.0	0	0.0	0	0.0
<i>Solidago uliginosa</i>	1	0.6	0	0.0	0	0.0	3	1.7	0	0.0	0	0.0	0	0.0
<i>Strophostyles helvola</i>	2	1.1	0	0.0	15	8.3	0	0.0	1	0.6	0	0.0	0	0.0
<i>Symplocarpus foetidus</i>	0	0.0	1	0.6	1	0.6	0	0.0	0	0.0	4	2.2	0	0.0
<i>Trifolium sp.</i>	0	0.0	0	0.0	0	0.0	0	0.0	1	0.6	0	0.0	0	0.0
<i>Verbena urticifolia</i>	0	0.0	0	0.0	0	0.0	1	0.6	0	0.0	0	0.0	0	0.0
<i>Veronica novaboracensis</i>	0	0.0	1	0.6	1	0.6	0	0.0	1	0.6	2	1.1	0	0.0
<i>Viburnum dentatum</i> SDLG	0	0.0	0	0.0	2	1.1	0	0.0	0	0.0	0	0.0	0	0.0
<b>TOTALS</b>	<b>388</b>	<b>215.6</b>	<b>438</b>	<b>243.3</b>	<b>618</b>	<b>343.3</b>	<b>567</b>	<b>315.0</b>	<b>522</b>	<b>290.0</b>	<b>660</b>	<b>366.7</b>	<b>627</b>	<b>348.3</b>
<b>Number of Species</b>	<b>31</b>		<b>29</b>		<b>40</b>		<b>28</b>		<b>31</b>		<b>26</b>		<b>32</b>	

\* A slightly different transect in this area was also sampled in 1991; the 1991 results are available in previous reports.

\*\*\* Occurred in 1991 sample only

MR-N Transect - Alphabetical List of Species and Percent Cover														
1998* - 2005														
Species	1998		2000		2001		2002		2003		2004		2005	
	Total	%Cover	Total	%Cover	Total	%Cover	Total	%Cover	Total	%Cover	Total	%Cover	Total	%Cover
<i>Apios americana</i>	0	0.0	3	1.7	4	2.2	0	0.0	0	0.0	1	0.6	8	4.4
<i>Bidens connata</i>	6	3.3	0	0.0	1	0.6	0	0.0	0	0.0	0	0.0	12	6.7
<i>Bidens frondosa</i>	0	0.0	0	0.0	6	3.3	0	0.0	2	1.1	2	1.1	0	0.0
<i>Boehmeria cylindrica</i>	15	8.3	9	5.0	19	10.6	10	5.6	12	6.7	28	15.6	11	6.1
<i>Cephalanthus occidentalis</i>	3	1.7	6	3.3	9	5.0	5	2.8	10	5.6	0	0.0	6	3.3
<i>Chelone glabra</i> ***	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
<i>Cinna latifolia</i>	6	3.3	0	0.0	0	0.0	2	1.1	0	0.0	0	0.0	0	0.0
<i>Cornus amomum</i>	74	41.1	85	47.2	68	37.8	82	45.6	73	40.6	83	46.1	68	37.8
<i>C. amomum</i> SDLG ***	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
<i>Cuscuta gronovi</i>	0	0.0	0	0.0	7	3.9	2	1.1	9	5.0	16	8.9	8	4.4
<i>Epilobium coloratum</i>	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	4	2.2	7	3.9
<i>Eupatorium maculatum</i>	4	2.2	1	0.6	1	0.6	3	1.7	1	0.6	4	2.2	1	0.6
<i>Eupatorium perfoliatum</i>	0	0.0	0	0.0	2	1.1	0	0.0	0	0.0	2	1.1	0	0.0
<i>Geum rivale</i>	4	2.2	1	0.6	0	0.0	1	0.6	0	0.0	3	1.7	0	0.0
<i>Helenium autumnale</i>	0	0.0	0	0.0	8	4.4	3	1.7	0	0.0	2	1.1	0	0.0
<i>Hibiscus moscheutos</i>	5	2.8	9	5.0	9	5.0	9	5.0	14	7.8	11	6.1	17	9.4
<i>Impatiens capensis</i>	25	13.9	42	23.3	77	42.8	81	45.0	73	40.6	120	66.7	62	34.4
<i>Iris pseudacorus</i>	6	3.3	5	2.8	7	3.9	7	3.9	1	0.6	1	0.6	3	1.7
<i>Laportea</i> sp.	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
<i>Leersia oryzoides</i>	4	2.2	6	3.3	21	11.7	16	8.9	20	11.1	40	22.2	55	30.6
<i>Lobelia cardinalis</i>	0	0.0	6	3.3	6	3.3	0	0.0	0	0.0	2	1.1	0	0.0
<i>Lycopus uniflorus</i> ***	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
<i>Lythrum salicaria</i>	13	7.2	32	17.8	31	17.2	37	20.6	28	15.6	55	30.6	57	31.7
<i>Mikania scandens</i>	56	31.1	39	21.7	52	28.9	87	48.3	55	30.6	28	15.6	44	24.4
<i>Mimulus ringens</i>	0	0.0	0	0.0	0	0.0	0	0.0	1	0.6	0	0.0	2	1.1
<i>Nymphaea odorata</i>	8	4.4	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
<i>Onclea sensibilis</i>	4	2.2	13	7.2	13	7.2	10	5.6	15	8.3	11	6.1	16	8.9
<i>Panicum clandestinum</i> ***	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
<i>Parthenocissus quinquefolia</i>	11	6.1	13	7.2	12	6.7	0	0.0	10	5.6	7	3.9	6	3.3
<i>Peltandra virginica</i>	4	2.2	6	3.3	7	3.9	5	2.8	11	6.1	13	7.2	12	6.7
<i>Pilea pumila</i>	2	1.1	0	0.0	0	0.0	0	0.0	0	0.0	9	5.0	2	1.1
<i>Polygonum arifolium</i>	3	1.7	6	3.3	5	2.8	1	0.6	4	2.2	4	2.2	5	2.8
<i>Polygonum hydropiper</i>	0	0.0	0	0.0	8	4.4	7	3.9	7	3.9	22	12.2	8	4.4
<i>Polygonum sagittatum</i>	0	0.0	0	0.0	19	10.6	0	0.0	3	1.7	36	20.0	25	13.9
<i>Polygonum scandens</i> ***	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
<i>Pontederia cordata</i>	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	2	1.1
<i>Quercus</i> sp SDLG	1	0.6	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
<i>Rorippa palustris</i>	0	0.0	0	0.0	0	0.0	0	0.0	1	0.6	0	0.0	0	0.0
<i>Rosa multiflora</i>	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
<i>Sagittaria rigida</i>	7	3.9	4	2.2	4	2.2	0	0.0	0	0.0	0	0.0	0	0.0
<i>Sambucus canadensis</i>	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	0.6
<i>Scutellaria lateriflora</i>	0	0.0	0	0.0	1	0.6	0	0.0	0	0.0	0	0.0	0	0.0
<i>Sium suave</i>	0	0.0	0	0.0	0	0.0	0	0.0	1	0.6	2	1.1	0	0.0
<i>Solanum dulcamara</i>	0	0.0	0	0.0	0	0.0	2	1.1	0	0.0	0	0.0	0	0.0
<i>Solidago gigantea</i>	3	1.7	9	5.0	9	5.0	13	7.2	2	1.1	5	2.8	6	3.3
<i>Solidago uliginosa</i>	1	0.6	0	0.0	0	0.0	3	1.7	0	0.0	0	0.0	0	0.0
<i>Strophostyles helvola</i>	2	1.1	0	0.0	15	8.3	0	0.0	1	0.6	0	0.0	0	0.0
<i>Symplocarpus foetidus</i>	0	0.0	1	0.6	1	0.6	0	0.0	0	0.0	4	2.2	0	0.0
<i>Symplotrichum</i> sp.	0	0.0	0	0.0	13	7.2	20	11.1	8	4.4	9	5.0	3	1.7
<i>Thelypteris palustris</i>	0	0.0	20	11.1	32	17.8	24	13.3	30	16.7	26	14.4	36	20.0
<i>Toxicodendron radicans</i>	4	2.2	0	0.0	4	2.2	10	5.6	7	3.9	6	3.3	4	2.2
<i>Trifolium</i> sp.	0	0.0	0	0.0	0	0.0	0	0.0	1	0.6	0	0.0	0	0.0
<i>Typha angustifolia</i>	81	45.0	84	46.7	93	51.7	85	47.2	80	44.4	84	46.7	103	57.2
<i>Verbena hastata</i>	1	0.6	0	0.0	1	0.6	0	0.0	0	0.0	0	0.0	6	3.3
<i>Verbena urticifolia</i>	0	0.0	0	0.0	0	0.0	1	0.6	0	0.0	0	0.0	0	0.0
<i>Vernonia novaboracensis</i>	0	0.0	1	0.6	1	0.6	0	0.0	1	0.6	2	1.1	0	0.0
<i>Viburnum lentago</i>	7	3.9	5	2.8	4	2.2	5	2.8	4	2.2	3	1.7	5	2.8
<i>Viburnum dentatum</i>	28	15.6	32	17.8	46	25.6	36	20.0	36	20.0	15	8.3	26	14.4
<i>Viburnum dentatum</i> SDLG	0	0.0	0	0.0	2	1.1	0	0.0	0	0.0	0	0.0	0	0.0
<b>TOTALS</b>	<b>388</b>	<b>215.6</b>	<b>438</b>	<b>243.3</b>	<b>618</b>	<b>343.3</b>	<b>567</b>	<b>315.0</b>	<b>522</b>	<b>290.0</b>	<b>660</b>	<b>366.7</b>	<b>627</b>	<b>348.3</b>
<b>Number of Species</b>	<b>31</b>		<b>29</b>		<b>40</b>		<b>28</b>		<b>31</b>		<b>26</b>		<b>32</b>	

\* A slightly different transect in this area was also sampled in 1991; the 1991 results are available in previous reports.

\*\*\* Occurred in 1991 sample only



MR-S Transect - Summary of Species by Percent Cover in 2005														
1998 - 2005														
Species	1998		2000		2001		2002		2003		2004		2005	
	Total	%Cover	Total	%Cover	Total	%Cover	Total	%Cover	Total	%Cover	Total	%Cover	Total	%Cover
<i>Typha angustifolia</i>	80	66.7	94	78.3	96	80.0	98	81.7	90	75.0	100	83.3	92	76.7
<i>Impatiens capensis</i>	39	32.5	51	42.5	51	42.5	83	69.2	68	56.7	89	74.2	58	48.3
<i>Mikania scandens</i>	78	65.0	43	35.8	34	28.3	38	31.7	26	21.7	40	33.3	55	45.8
<i>Lythrum salicaria</i>	1	0.8	8	6.7	19	15.8	13	10.8	17	14.2	14	11.7	28	23.3
<i>Polygonum arifolium</i>	11	9.2	0	0.0	10	8.3	0	0.0	15	12.5	26	21.7	19	15.8
<i>Viburnum dentatum</i>	10	8.3	17	14.2	12	10.0	14	11.7	15	12.5	14	11.7	18	15.0
<i>Cornus amomum</i>	7	5.8	10	8.3	10	8.3	6	5.0	11	9.2	15	12.5	15	12.5
<i>Cuscuta gronovii</i>	4	3.3	0	0.0	10	8.3	5	4.2	0	0.0	3	2.5	14	11.7
<i>Polygonum sagittatum</i>	0	0.0	5	4.2	3	2.5	3	2.5	7	5.8	15	12.5	14	11.7
<i>Boehmeria cylindrica</i>	2	1.7	7	5.8	7	5.8	7	5.8	8	6.7	16	13.3	12	10.0
<i>Peltandra virginica</i>	2	1.7	13	10.8	10	8.3	10	8.3	15	12.5	16	13.3	12	10.0
<i>Pilea pumila</i>	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	17	14.2	11	9.2
<i>Acer saccharinum</i> *	10	8.3	10	8.3	10	8.3	10	8.3	10	8.3	9	7.5	10	8.3
<i>Lindera benzoin</i>	7	5.8	9	7.5	5	4.2	5	4.2	5	4.2	7	5.8	7	5.8
<i>Hibiscus moscheutos</i>	3	2.5	5	4.2	5	4.2	6	5.0	4	3.3	8	6.7	6	5.0
<i>Acer rubrum</i>	0	0.0	0	0.0	4	3.3	4	3.3	5	4.2	5	4.2	5	4.2
<i>Bidens connatus</i>	0	0.0	0	0.0	3	2.5	0	0.0	0	0.0	0	0.0	3	2.5
<i>Epilobium coloratum</i>	0	0.0	1	0.8	0	0.0	2	1.7	1	0.8	3	2.5	3	2.5
<i>Leersia oryzoides</i>	4	3.3	10	8.3	3	2.5	1	0.8	3	2.5	0	0.0	3	2.5
<i>Minulus ringens</i>	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	0.8	3	2.5
<i>Onoclea sensibilis</i>	1	0.8	2	1.7	6	5.0	0	0.0	0	0.0	3	2.5	3	2.5
<i>Apios americana</i>	0	0.0	1	0.8	1	0.8	0	0.0	0	0.0	0	0.0	2	1.7
<i>Helenium autumnale</i>	0	0.0	0	0.0	1	0.8	0	0.0	0	0.0	0	0.0	2	1.7
<i>Symptotrichum sp.</i>	0	0.0	0	0.0	0	0.0	1	0.8	0	0.0	1	0.8	2	1.7
<i>Chelone glabra</i>	0	0.0	0	0.0	2	1.7	1	0.8	3	2.5	2	1.7	1	0.8
<i>Parthenocissus quinquefolia</i>	2	1.7	0	0.0	0	0.0	0	0.0	0	0.0	1	0.8	1	0.8
<i>Polygonum hydropiper</i>	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	0.8
<i>Carex crinata</i>	0	0.0	0	0.0	0	0.0	1	0.8	0	0.0	0	0.0	0	0.0
<i>Cinna latifolia</i>	3	2.5	0	0.0	2	1.7	0	0.0	0	0.0	0	0.0	0	0.0
<i>Cornus amomum</i> SDLG	0	0.0	1	0.8	1	0.8	2	1.7	0	0.0	0	0.0	0	0.0
<i>Geum lacinatedum</i>	1	0.8	0	0.0	0	0.0	0	0.0	2	1.7	0	0.0	0	0.0
<i>Lobelia cardinalis</i>	0	0.0	0	0.0	1	0.8	0	0.0	0	0.0	0	0.0	0	0.0
<i>Lonicera morowii</i>	0	0.0	0	0.0	0	0.0	4	3.3	0	0.0	0	0.0	0	0.0
<i>Lycopus americana</i>	0	0.0	0	0.0	0	0.0	0	0.0	1	0.8	0	0.0	0	0.0
<i>Mentha arvensis</i>	2	1.7	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
<i>Rosa multiflora</i>	2	1.7	5	4.2	1	0.8	5	4.2	1	0.8	0	0.0	0	0.0
<i>Sambucus canadensis</i>	1	0.8	0	0.0	1	0.8	0	0.0	0	0.0	0	0.0	0	0.0
<i>Solanum dulcamara</i>	0	0.0	0	0.0	0	0.0	0	0.0	1	0.8	0	0.0	0	0.0
<i>Solidago uliginosa</i>	2	1.7	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
<i>Strophostylus helvola</i>	2	1.7	1	0.8	0	0.0	1	0.8	0	0.0	0	0.0	0	0.0
<i>Symplocarpus foetidus</i>	0	0.0	0	0.0	1	0.8	0	0.0	0	0.0	1	0.8	0	0.0
<i>Toxicodendron radicans</i>	0	0.0	0	0.0	0	0.0	2	1.7	0	0.0	0	0.0	0	0.0
<i>V. dentatum</i> SDLG	0	0.0	0	0.0	0	0.0	2	1.7	0	0.0	0	0.0	0	0.0
<i>Vernonia novaboracensis</i>	0	0.0	0	0.0	1	0.8	0	0.0	0	0.0	0	0.0	0	0.0
<b>TOTALS</b>	<b>274</b>	<b>228.3</b>	<b>293</b>	<b>244.2</b>	<b>310</b>	<b>258.3</b>	<b>324</b>	<b>270.0</b>	<b>308</b>	<b>256.7</b>	<b>406</b>	<b>338.3</b>	<b>400</b>	<b>333.3</b>
<b>Number of Species</b>	<b>23</b>		<b>17</b>		<b>27</b>		<b>23</b>		<b>21</b>		<b>17</b>		<b>27</b>	

\* Overhanging branches of tree rooted on adjacent levee

MR-S Transect - Alphabetical List of Species and Percent Cover														
1998 - 2005														
Species	1998		2000		2001		2002		2003		2004		2005	
	Total	%Cover	Total	%Cover	Total	%Cover	Total	%Cover	Total	%Cover	Total	%Cover	Total	%Cover
<i>Acer rubrum</i>	0	0.0	0	0.0	4	3.3	4	3.3	5	4.2	5	4.2	5	4.2
<i>Acer saccharinum</i> *	10	8.3	10	8.3	10	8.3	10	8.3	10	8.3	9	7.5	10	8.3
<i>Apios americana</i>	0	0.0	1	0.8	1	0.8	0	0.0	0	0.0	0	0.0	2	1.7
<i>Bidens connatus</i>	0	0.0	0	0.0	3	2.5	0	0.0	0	0.0	0	0.0	3	2.5
<i>Bohemeria cylindrica</i>	2	1.7	7	5.8	7	5.8	7	5.8	8	6.7	16	13.3	12	10.0
<i>Carex crinata</i>	0	0.0	0	0.0	0	0.0	1	0.8	0	0.0	0	0.0	0	0.0
<i>Chelone glabra</i>	0	0.0	0	0.0	2	1.7	1	0.8	3	2.5	2	1.7	1	0.8
<i>Cinna latifolia</i>	3	2.5	0	0.0	2	1.7	0	0.0	0	0.0	0	0.0	0	0.0
<i>Cornus amomum</i>	7	5.8	10	8.3	10	8.3	6	5.0	11	9.2	15	12.5	15	12.5
<i>Cornus amomum</i> SDLG	0	0.0	1	0.8	1	0.8	2	1.7	0	0.0	0	0.0	0	0.0
<i>Cuscuta gronovii</i>	4	3.3	0	0.0	10	8.3	5	4.2	0	0.0	3	2.5	14	11.7
<i>Epilobium coloratum</i>	0	0.0	1	0.8	0	0.0	2	1.7	1	0.8	3	2.5	3	2.5
<i>Geum lacinatedum</i>	1	0.8	0	0.0	0	0.0	0	0.0	2	1.7	0	0.0	0	0.0
<i>Helenium autumnale</i>	0	0.0	0	0.0	1	0.8	0	0.0	0	0.0	0	0.0	2	1.7
<i>Hibiscus moscheutos</i>	3	2.5	5	4.2	5	4.2	6	5.0	4	3.3	8	6.7	6	5.0
<i>Impatiens capensis</i>	39	32.5	51	42.5	51	42.5	83	69.2	68	56.7	89	74.2	58	48.3
<i>Leersia oryzoides</i>	4	3.3	10	8.3	3	2.5	1	0.8	3	2.5	0	0.0	3	2.5
<i>Lindera benzoin</i>	7	5.8	9	7.5	5	4.2	5	4.2	5	4.2	7	5.8	7	5.8
<i>Lobelia cardinalis</i>	0	0.0	0	0.0	1	0.8	0	0.0	0	0.0	0	0.0	0	0.0
<i>Lonicera morowii</i>	0	0.0	0	0.0	0	0.0	4	3.3	0	0.0	0	0.0	0	0.0
<i>Lycopus americana</i>	0	0.0	0	0.0	0	0.0	0	0.0	1	0.8	0	0.0	0	0.0
<i>Lythrum salicaria</i>	1	0.8	8	6.7	19	15.8	13	10.8	17	14.2	14	11.7	28	23.3
<i>Mentha arvensis</i>	2	1.7	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
<i>Mikania scandens</i>	78	65.0	43	35.8	34	28.3	38	31.7	26	21.7	40	33.3	55	45.8
<i>Mimulus ringens</i>	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	0.8	3	2.5
<i>Onoclea sensibilis</i>	1	0.8	2	1.7	6	5.0	0	0.0	0	0.0	3	2.5	3	2.5
<i>Parthenocissus quinquefolia</i>	2	1.7	0	0.0	0	0.0	0	0.0	0	0.0	1	0.8	1	0.8
<i>Peltandra virginica</i>	2	1.7	13	10.8	10	8.3	10	8.3	15	12.5	16	13.3	12	10.0
<i>Pilea pumila</i>	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	17	14.2	11	9.2
<i>Polygonum arifolium</i>	11	9.2	0	0.0	10	8.3	0	0.0	15	12.5	26	21.7	19	15.8
<i>Polygonum hydropiper</i>	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	1	0.8
<i>Polygonum sagittatum</i>	0	0.0	5	4.2	3	2.5	3	2.5	7	5.8	15	12.5	14	11.7
<i>Rosa multiflora</i>	2	1.7	5	4.2	1	0.8	5	4.2	1	0.8	0	0.0	0	0.0
<i>Sambucus canadensis</i>	1	0.8	0	0.0	1	0.8	0	0.0	0	0.0	0	0.0	0	0.0
<i>Solanum dulcamara</i>	0	0.0	0	0.0	0	0.0	0	0.0	1	0.8	0	0.0	0	0.0
<i>Solidago uliginosa</i>	2	1.7	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
<i>Strophostylus helvoia</i>	2	1.7	1	0.8	0	0.0	1	0.8	0	0.0	0	0.0	0	0.0
<i>Symplocarpus foetidus</i>	0	0.0	0	0.0	1	0.8	0	0.0	0	0.0	1	0.8	0	0.0
<i>Symptotrichum</i> sp.	0	0.0	0	0.0	0	0.0	1	0.8	0	0.0	1	0.8	2	1.7
<i>Toxicodendron radicans</i>	0	0.0	0	0.0	0	0.0	2	1.7	0	0.0	0	0.0	0	0.0
<i>Typha angustifolia</i>	80	66.7	94	78.3	96	80.0	98	81.7	90	75.0	100	83.3	92	76.7
<i>Vernonia novaboracensis</i>	0	0.0	0	0.0	1	0.8	0	0.0	0	0.0	0	0.0	0	0.0
<i>Viburnum dentatum</i>	10	8.3	17	14.2	12	10.0	14	11.7	15	12.5	14	11.7	18	15.0
<i>V. dentatum</i> SDLG	0	0.0	0	0.0	0	0.0	2	1.7	0	0.0	0	0.0	0	0.0
<b>TOTALS</b>	<b>274</b>	<b>228.3</b>	<b>293</b>	<b>244.2</b>	<b>310</b>	<b>258.3</b>	<b>324</b>	<b>270.0</b>	<b>308</b>	<b>256.7</b>	<b>406</b>	<b>338.3</b>	<b>400</b>	<b>333.3</b>
<b>Number of Species</b>	<b>23</b>		<b>17</b>		<b>27</b>		<b>23</b>		<b>21</b>		<b>17</b>		<b>27</b>	

\* Overhanging branches of tree rooted on adjacent levee