

2002 Vegetation Monitoring in Mill River Freshwater Tidal Marshes January 2003

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As part of the ongoing evaluation of the lower Mill River corridor and the potential environmental effects of the Whitney Water Treatment Plant, the South Central Connecticut Regional Water Authority is conducting 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 biological diversity and wildlife populations in the lower Mill River and East Rock Park.

The Water Authority's Environmental Evaluation Team (1999), assessing the impacts of the proposed treatment plant, recommended that vegetation in the marsh be monitored annually or biennially prior to construction of the plant to provide baseline data, as well as after the plant is placed in operation. Data from these studies are to be evaluated against measurements of soil salinity, river flow, and water quality in the lower Mill River to evaluate environmental impacts of treatment plant operation and the possible need to implement management measures to mitigate any adverse effects.

In 2002, Penni Sharp and Vincent Kay conducted quantitative vegetation sampling of the Mill River marshes on September 24. Vegetation monitoring was conducted along two permanent transects also monitored in 1998, 2000, and 2001; preliminary sampling in the area of the northern transect was also performed in 1991. Soil water salinity measurements were taken in spring and late summer from monitoring wells (three on each transect) installed in 2000.

The upstream or northern transect, MR-N, is located 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 best-developed 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 transect are often inaccessible due to flooding by tidal action or high river flows.

The downstream transect, MR-S, passes through a narrower and less varied section of the marsh about 300 feet south of the East Rock Road bridge. It 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.

Vegetation Sampling Method

Permanent transects at both sites are approximately perpendicular to the river, with marker stakes placed every 5 meters. Maps of these transects, and a detailed description of the methodology, appear in the 1999 report by Lee Rogers included in the Water Authority's *Lake Whitney Water Treatment Plant Environmental Evaluation: Volume Two* (January 1999). In vegetation sampling, 5-meter sampling chains are extended to the south at right angles from each stake on 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, for canopy species, an imaginary upward extension of it) are recorded.

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; however, stake 12 is typically inundated, and the frequencies of the sparse vegetation on the last sampling transect may be estimated rather than measured precisely. On transect MR-N, sampling begins at stake 2, since stake 1 (which was sampled in 2001) is located within a swale with little vegetation other than canopy trees overhanging from the adjacent upland forest. A total of 18 stakes have been sampled, for a total of 18 chains and 180 sampling points; however, a total of 21 stakes have been installed and surveyed on this transect, and, because the drop-off from stake 18 to the river is fairly gradual, it is possible that one or two additional riverward stakes may be accessible for future sampling under drier conditions.

Results and Discussion

River and Soil Conditions

Precipitation was normal to above normal during the 2002 growing season, as in the previous two years. Similarly, river flows were fairly typical at the time of sampling. Baseline data from these years provides a contrast with 1998, when the growing season was unusually dry.

Data on Mill River salinity collected by CH2MHill in August and September 2002 showed that during periods of high flow (e.g., 8/30/02 and 9/6/02, following precipitation events), the salt wedge does not appear to reach upstream to Orange Street, as both the surface and bottom layer of the water column remained below 1 ppt (parts per thousand). During periods of lower flow, however, surface water at Orange Street, which is about 1,300 feet downstream of transect MR-S, reached 6 ppt salinity or higher, while salinity in lower layers was frequently 8-15 ppt. At the East Rock Park footbridge, upstream of transect MR-N, surface water salinities reached nearly 2 ppt on September 24 during a period of low river flow. In the plunge pool just below the dam, continuous monitoring during August and September showed that salinities remained below 0.14 ppt throughout the period.

Soil water in the transect monitoring wells was sampled on April 26 and July 24, 2002, during both high and low tide conditions. A [table](#) showing soil water salinity measurements is appended to this report. At the spring sampling, soil water salinity in all six monitoring wells and in the river adjacent to the two transects was 0.1 to 0.2 ppt, well below the 0.5 ppt considered to be limiting (as an annual average) for freshwater marsh vegetation. In July, soil water salinity in one of the three monitoring wells on transect MR-N reached 0.7 ppt at both low and high tide; one of the three wells on transect MR-S showed salinities of 0.7 ppt at low tide and 0.5 ppt at high tide. Salinities in the other wells remained below 0.5 ppt, and surface water salinities in the adjacent river were 0.1-0.2 ppt at both low and high tides. The soil water monitoring schedule is intended to show typical high flow and low flow conditions during the growing season, since an annual average salinity below 0.5 ppt is generally considered necessary to maintain freshwater marsh communities. It appears that occasional excursions of soil water salinity above 0.5 ppt late in the growing season do not adversely affect freshwater marsh plants of the lower Mill River.

Vegetation

Vegetation monitoring results for 2002 are shown in the appendix tables. [Tables N](#) and [S](#) show the data collected on the north and south transects, respectively, recorded by sampling chain to show zonation in the marshes. These tables thus provide a profile of the two marsh areas. They have been subdivided into zones based on topography and vegetation, as described in the vegetation report in the Water Authority's *Lake Whitney Water Treatment Plant Environmental Evaluation: Volume Two* (Rogers 1999).

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*; purple loosestrife (*Lythrum salicaria*) is a subdominant in this area. 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*) is the dominant shrub, with buttonbush (*Cephalanthus occidentalis*), a shrub highly tolerant of periodic inundation, appearing in the lowest and wettest areas. Cattails are absent on this part of the transect. As the ground rises slightly on the riverward side, there is a dense thicket of silky dogwood, again intermixed with cattails and 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, purple loosestrife, and jewelweed continue to 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*).

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, and multiflora rose (*Rosa multiflora*); jewelweed is the dominant herb. In the upper marsh, narrow-leaved cattail and jewelweed are dominant, while in the middle marsh, jewelweed becomes less common and cattails share dominance with mikania. The transect then crosses a small rise or hummock, where a few shrubs such as swamp rosemallow intermix with the cattail community. Beyond this is low marsh, where cattails and impatiens are replaced by arrow arum. The last sampling chain on this transect also crosses part of a small levee adjacent to the river, where a large silver maple (*Acer saccharinum*) is located.

Summary [tables](#) in the appendix compare the current data to that collected in previous years of monitoring. Separate [tables](#) list the species sampled at each site by year in both alphabetical order and in order of their percent cover in the current sample.

For transect MR-N, it should be noted that the 1991 sampling was done before the permanent transect locations were determined, and hence cannot be compared directly to the later data. The [tables](#) indicate that *Typha angustifolia*, although slightly less abundant than in 2001, remain dominant at about 47 percent cover on the transect. In 2002, however, cattails yielded first place to *Mikania scandens*, which, at 48 percent, showed a sharp increase in cover compared

with previous years, when it remained at about 20 to 30 percent. Last year's report noted that there were numerous seedlings of this species present at the time of fall monitoring, a condition that had not previously been observed. These seedlings may not be winter hardy, but if they did survive the winter, this may account for this species increased cover in 2002.

The third most abundant species at MR-N in 2000 was silky dogwood (*Cornus amomum*), at 46 percent cover; this represents an increase over the 38 percent in 2001, but is lower than its 2000 value of 47 percent. The other dominant shrub, northern arrowwood (*Viburnum dentatum*), had 20 percent cover; this is down from 2001 because an additional landward stake in a transitional shrub area was sampled last year, but it is a small increase over the 18 percent recorded in 2000. Fourth in abundance was jewelweed (*Impatiens capensis*) at 45 percent cover. This is only a slight increase over 2001, but substantially higher than in previous years, when this species was generally below 25 percent cover. Our studies in other wetlands have shown that percent cover by this species changes dramatically from year to year, probably in response to environmental conditions in the spring, at the time of seedling establishment.

Purple loosestrife (*Lythrum salicaria*), an introduced nuisance plant, was the fifth most abundant at MR-N in 2002 at 21 percent cover. This is a small increase over its 17-18 percent cover in 2000-2001, but a substantial increase over 1998's 7 percent cover, when a dry growing season may have helped to keep it in check. Several species that were fairly abundant in the 2001 sample were not recorded this year: Arrow-leaved tearthumb (*Polygonum sagittatum*), another highly variable herbaceous species, had 11 percent cover in 2001; wild bean (*Strophostylus helvola*), a leguminous vine, had 8 percent cover in 2001; and Virginia creeper (*Parthenocissus quinquefolia*), a woody vine, had 7 percent cover in 2001. Overall percent cover for the site, obtained by totalling the percent cover for all species, provides an index of the general health and species diversity of the community. In 2002 this value was 318, a decrease from the 343 observed in 2001, but substantially higher than the 216 observed in the dry year of 1998.

At MR-S, narrow-leaved cattail (*Typha angustifolia*) remained strongly dominant, with 82 percent cover, a slight increase over last year and substantially greater than the low of 67 percent in 1998. In contrast, *Mikania scandens*, at 32 percent cover, showed a small increase over 2001 but was down from a 1998 high of 65 percent. *Impatiens capensis* was the second most abundant species at this site in 2002, with 68 percent cover; its previous high was about 43 percent. The dominant shrubs, *Viburnum dentatum*, with 12 percent cover in 2002, and *Cornus amomum* with 5 percent, have remained fairly constant, with no evidence of trends over the years of monitoring. *Lythrum salicaria*, with 11 percent cover in 2002, was down from its 2001 cover of 16 percent, but, as at MR-N, substantially increased over 1998, when it was at less than 1 percent. The overall percent cover at site MR-S was 265, slightly higher than the 258 in 2001 but a substantial increase over the 228 recorded in the dry year of 1998.

Conclusions

The results of repeated sampling along permanent transects at two sites in the lower Mill River marshes provide a range of baseline data that quantitatively describe the marsh community in terms of natural or successive changes and responses to high (2000), normal (2001, 2002), and low (1998) precipitation conditions during the growing season. The vegetation sampling performed over this period indicate that the narrow-leaved cattails that dominate much of the marsh have remained relatively constant in their percent cover, while other herbaceous species, including *Impatiens capensis*, *Mikania scandens*, *Polygonum sagittatum*, and ferns, are quite variable from year to year, presumably in response to precipitation and other environmental conditions. These changes are not clearly correlated with overall precipitation during the growing season and are probably related largely to rainfall and other conditions in the marsh early in the growing season during germination and seedling establishment.

Shrub cover on these marshes, primarily by *Cornus amomum* and *Viburnum recognitum*, varies somewhat from year to year, but has shown no marked directional trend that might indicate successional change or overall drying of the marsh. Shrub cover in the samples does appear to be influenced by overall precipitation, tending to be higher in wet years and lower in dry years.

Evidence as to whether purple loosestrife (*Lythrum salicaria*) is invading these marshes is thus far inconclusive. Overall, there has been an increase in cover by this species, especially at site MR-N, but it does not appear to be moving into new areas of the marsh. Additionally, the growth of this plant appears to be substantially influenced by precipitation, and it may be that a series of relatively wet years after 1998 have provided unusually favorable conditions for its growth. It is noteworthy that another introduced plant, *Phragmites australis*, has not invaded these sites, despite the presence of abundant sources in nearby disturbed areas. Such an invasion is unlikely as long as the marshes remain relatively undisturbed.

Subsequent baseline sampling, to be conducted annually prior to the construction and operation of the proposed treatment plant, will enhance this data base and help to differentiate between year-to-year phenological changes and long-term successional trends. This data base showing variations in vegetation under existing conditions will be useful in evaluating whether future changes can be attributed to the effects of treatment plant operation on river flows. Future continued monitoring of river water and soil water chemistry will help to establish whether any such changes occur secondary to changes in water salinity that may be caused by reductions in freshwater flows due to treatment plant operations.

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Appendix Tables

Groundwater Monitoring Well Data

Mill River Freshwater Tidal Marsh Groundwater Monitoring Well Data 2002

Salinity of Groundwater and River Water Under Various Tidal and Flow Conditions

Monitoring Well (Upland to River)	Groundwater Salinity (ppt)			
	4/26/02 (High flow)		7/24/02 (Low flow)	
	Low tide	High tide	Low tide	High tide
MRN - 1	0.2	0.2	0.2	0.1
MRN - 2	0.1	0.1	0.7	0.7
MRN - 3	0.2	0.2	0.3	0.2
River @ MRN	0.1	0.1	0.2	0.1
MRS - 1	0.1	0.1	0.2	0.2
MRS - 2	0.1	0.1	0.2	0.2
MRS - 3	0.1	0.1	0.7	0.5
River @ MRS	0.1	0.1	0.1	0.1

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Table N: Mill River North (MR-N) Vegetation Frequency by Species and Zone, 2002

Vegetation Zone:	Upper marsh	Mid. marsh	Shrub thicket	Shrub / marsh	Dogwood thicket	Low marsh	2002													
Species	* Chain no.: Chains are 5 m. apart and 5 m. long, with 10 sampling points per chain: Total 180 points																Total	% Cover		
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18		
<i>Cinna latifolia</i>	2																		2	1.1

<i>Iris pseudacorus</i>	7																		7	3.9
<i>Viburnum lentago</i>	5																		5	2.8
<i>Polygonum arifolium</i>										1									1	0.6
<i>Impatiens capensis</i>	1	1	9	6		2	6	5	1	5	5	5	8	2	7				81	45.0
<i>Onoclea sensibilis</i>	2	4	3						1										10	5.6
<i>Mikania scandens</i>				1	1	9	8	9		5	10	2	5	7	9	5	7		87	48.3
<i>Typha angustifolia</i>		9	1	1	1	9	9	1	2	2			3	7	1	3			85	47.2
<i>Lythrum salicaria</i>		4		3		7	6		1	3		1		2		6	2	2	37	20.6
<i>Todxicodendron radicans</i>		2	8																10	5.6
<i>Dryopteris thelypteris</i>		3	5	7	8									1					24	13.3
<i>Bohemeria cylindrica</i>					4	1			1				1	1	2				10	5.6
<i>Cuscuta gronovii</i>						1									1				2	1.1
<i>Hibiscus moscheutos</i>							2	5	2										9	5.0
<i>Aster simplex</i>										5		9	5		1				20	11.1
<i>Cornus</i>								3	1	7		8	10	5	10	10	10	9	82	45.6

<i>Typha angustifolia</i>		8	10	6	10	10	10	10	10	10	10	4	98	81.7
<i>Strophostylus helvola</i>		1											1	0.8
<i>Mikania scandens</i>				2	9	9	10	7			1		38	31.7
<i>Peltandra virginica</i>			1								1	8	10	8.3
<i>Lythrum salicaria</i>			1	6							4	2	13	10.8
# <i>Carex crinata</i>				1									1	0.8
<i>Bohemeria cylindrica</i>				4	1			1			1		7	5.8
<i>Epilobium coloratum</i>							1	1					2	1.7
<i>Polygonum sagittatum</i>									1		2		3	2.5
<i>Hibiscus moscheutos</i>										6			6	5.0
<i>Cornus amomum seedling</i>				1							1		2	1.7
# <i>Lonicera morrowii</i>												4	4	3.3
# <i>Toxicodendron radicans</i>												2	2	1.7
<i>Acer saccharinum</i> *												10	10	8.3
TOTALS													324	270.0

* Overhanging canopy of tree rooted on adjacent levee

Species recorded on transect for first time in current year

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MR-N Transect - Alphabetical List of Species and Percent Cover, 1991-2002

Species	1991*		1998		2000		2001		2002	
	Total	%Cover	Total	%Cover	Total	%Cover	Total	%Cover	Total	%Cover
<i>Acer rubrum</i> **	0	0.0	0	0.0	15	8.3	11	6.1	0	0.0
<i>Apios americana</i>	0	0.0	0	0.0	3	1.7	4	2.2	0	0.0
<i>Aster simplex</i>	0	0.0	0	0.0	0	0.0	13	7.2	20	11.1
<i>Aster umbellatus</i>	2	1.1	0	0.0	0	0.0	0	0.0	0	0.0
<i>Bidens connata</i>	0	0.0	6	3.3	0	0.0	1	0.6	0	0.0
<i>Bidens frondosa</i>	0	0.0	0	0.0	0	0.0	6	3.0	0	0.0
<i>Bohemeria cylindrica</i>	3	1.7	15	8.3	9	5.0	19	10.6	10	5.6
<i>C. amomum SDLNG</i>	3	1.7	0	0.0	0	0.0	0	0.0	0	0.0
<i>Cephalanthus occidentalis</i>	10	5.6	3	1.7	6	3.3	9	5.0	5	2.8
<i>Chelone glabra</i>	1	0.6	0	0.0	0	0.0	0	0.0	0	0.0
<i>Cinna latifolia</i>	3	1.7	6	3.3	0	0.0	0	0.0	2	1.1
<i>Clethra alnifolia</i> **	0	0.0	0	0.0	5	2.8	8	4.4	0	0.0
<i>Cornus amomum</i>	52	28.9	74	41.1	85	47.2	68	37.8	82	45.6

<i>Cuscuta gronovii</i>	5	2.8	0	0.0	0	0.0	7	3.9	2	1.1
<i>Dryopteris thelypteris</i>	0	0.0	0	0.0	20	11.1	32	17.8	24	13.3
<i>Eupatoriadelphus maculatus</i>	7	3.9	4	2.2	1	0.6	1	0.6	3	1.7
<i>Eupatorium perfoliatum</i>	0	0.0	0	0.0	0	0.0	2	1.1	0	0.0
<i>Geum lacinatum</i>	2	1.1	4	2.2	1	0.6	0	0.0	1	0.6
<i>Helenium autumnale</i>	0	0.0	0	0.0	0	0.0	8	4.4	3	1.7
<i>Hibiscus moscheutos</i>	7	3.9	5	2.8	9	5.0	9	5.0	9	5.0
<i>Ilex verticillata</i> **	0	0.0	0	0.0	4	2.2	4	2.2	0	0.0
<i>Impatiens capensis</i>	49	27.2	25	13.9	42	23.3	77	42.8	81	45.0
<i>Iris pseudacorus</i>	0	0.0	6	3.3	5	2.8	7	3.9	7	3.9
<i>Leersia oryzoides</i>	6	3.3	4	2.2	6	3.3	21	11.7	16	8.9
<i>Lobelia cardinalis</i>	0	0.0	0	0.0	6	3.3	6	3.3	0	0.0
<i>Lycopus uniflorus</i>	2	1.1	0	0.0	0	0.0	0	0.0	0	0.0
<i>Lythrum salicaria</i>	38	21.1	13	7.2	32	17.8	31	17.2	37	20.6
<i>Mikania scandens</i>	44	24.4	56	31.1	39	21.7	52	28.9	87	48.3
<i>Mimulus ringens</i>	3	1.7	0	0.0	0	0.0	0	0.0	0	0.0
<i>Nymphaea odorata</i>	0	0.0	8	4.4	0	0.0	0	0.0	0	0.0

<i>Onoclea sensibilis</i>	12	6.7	4	2.2	13	7.2	13	7.2	10	5.6
<i>Panicum clandestinum</i>	1	0.6	0	0.0	0	0.0	0	0.0	0	0.0
<i>Parthenocissus quinquefolia</i>	6	3.3	11	6.1	13	7.2	12	6.7	0	0.0
<i>Peltandra virginica</i>	9	5.0	4	2.2	6	3.3	7	3.9	5	2.8
<i>Pilea pumila</i>	0	0.0	2	1.1	0	0.0	0	0.0	0	0.0
<i>Polygonum arifolium</i>	31	17.2	3	1.7	6	3.3	5	2.8	1	0.6
<i>Polygonum hydropiper</i>	3	1.7	0	0.0	0	0.0	8	4.4	7	3.9
<i>Polygonum sagittatum</i>	0	0.0	0	0.0	0	0.0	19	10.6	0	0.0
<i>Polygonum scandens</i>	8	4.4	0	0.0	0	0.0	0	0.0	0	0.0
<i>Quercus sp</i> <i>SDLNG</i>	0	0.0	1	0.6	0	0.0	0	0.0	0	0.0
<i>Rosa multiflora</i>	12	6.7	0	0.0	0	0.0	0	0.0	0	0.0
<i>Sagittaria rigida</i>	0	0.0	7	3.9	4	2.2	4	2.2	0	0.0
<i>Scutellaria lateriflora</i>	0	0.0	0	0.0	0	0.0	1	0.6	0	0.0
<i>Smilax rotundifolia</i> **	0	0.0	0	0.0	5	2.8	6	3.3	0	0.0
# <i>Solanum dulcamara</i>	0	0.0	0	0.0	0	0.0	0	0.0	2	1.1

<i>Solidago gigantea</i>	2	1.1	3	1.7	9	5.0	9	5.0	13	7.2
<i>Solidago uliginosa</i>	2	1.1	1	0.6	0	0.0	0	0.0	3	1.7
<i>Strophostylus helvola</i>	2	1.1	2	1.1	0	0.0	15	8.3	0	0.0
<i>Symplocarpus foetidus</i>	0	0.0	0	0.0	1	0.6	1	0.6	0	0.0
<i>Todxicodendron radicans</i>	7	3.9	4	2.2	0	0.0	4	2.2	10	5.6
<i>Typha angustifolia</i>	95	52.8	81	45.0	84	46.7	93	51.7	85	47.2
<i>U.I. small grass</i>	4	2.2	0	0.0	0	0.0	0	0.0	0	0.0
<i>Urtica dioica</i>	13	7.2	0	0.0	0	0.0	0	0.0	0	0.0
<i>Verbena hastata</i>	2	1.1	1	0.6	0	0.0	1	0.6	0	0.0
<i>#Verbena urticifolia</i>	0	0.0	0	0.0	0	0.0	0	0.0	1	0.6
<i>Vernonia novaboracensis</i>	0	0.0	0	0.0	1	0.6	1	0.6	0	0.0
<i>Viburnum lentago</i>	0	0.0	7	3.9	5	2.8	4	2.2	5	2.8
<i>Viburnum dentatum</i>	8	4.4	28	15.6	32	17.8	46	25.6	36	20.0
<i>Viburnum dentatum SDLG</i>	0	0.0	0	0.0	0	0.0	2	1.1	0	0.0
TOTALS	454	252.2	388	215.6	461	256.1	617	342.8	567	315.0

* 1991 sample location is not identical to transect surveyed in 1998 and sampled in subsequent years.

** These species occur in an overhanging canopy and were sampled in 2000 and 2001 only.

Occurred in sample for first time in 2002

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MR-N Transect - Summary of Species by Percent Cover in 2002, 1991-2002

Species	1991*		1998		2000		2001		2002	
	Total	%Cover	Total	%Cover	Total	%Cover	Total	%Cover	Total	%Cover
<i>Mikania scandens</i>	44	24.4	56	31.1	39	21.7	52	28.9	87	48.3
<i>Typha angustifolia</i>	95	52.8	81	45.0	84	46.7	93	51.7	85	47.2
<i>Cornus amomum</i>	52	28.9	74	41.1	85	47.2	68	37.8	82	45.6
<i>Impatiens capensis</i>	49	27.2	25	13.9	42	23.3	77	42.8	81	45.0
<i>Lythrum salicaria</i>	38	21.1	13	7.2	32	17.8	31	17.2	37	20.6
<i>Viburnum dentatum</i>	8	4.4	28	15.6	32	17.8	46	25.6	36	20.0
<i>Dryopteris thelypteris</i>	0	0.0	0	0.0	20	11.1	32	17.8	24	13.3
<i>Aster simplex</i>	0	0.0	0	0.0	0	0.0	13	7.2	20	11.1
<i>Leersia oryzoides</i>	6	3.3	4	2.2	6	3.3	21	11.7	16	8.9
<i>Solidago gigantea</i>	2	1.1	3	1.7	9	5.0	9	5.0	13	7.2
<i>Bohemeria cylindrica</i>	3	1.7	15	8.3	9	5.0	19	10.6	10	5.6
<i>Onoclea sensibilis</i>	12	6.7	4	2.2	13	7.2	13	7.2	10	5.6

<i>Todxicodendron radicans</i>	7	3.9	4	2.2	0	0.0	4	2.2	10	5.6
<i>Hibiscus moscheutos</i>	7	3.9	5	2.8	9	5.0	9	5.0	9	5.0
<i>Iris pseudacorus</i>	0	0.0	6	3.3	5	2.8	7	3.9	7	3.9
<i>Polygonum hydropiper</i>	3	1.7	0	0.0	0	0.0	8	4.4	7	3.9
<i>Cephalanthus occidentalis</i>	10	5.6	3	1.7	6	3.3	9	5.0	5	2.8
<i>Peltandra virginica</i>	9	5.0	4	2.2	6	3.3	7	3.9	5	2.8
<i>Viburnum lentago</i>	0	0.0	7	3.9	5	2.8	4	2.2	5	2.8
<i>Eupatoriadelphus maculatus</i>	7	3.9	4	2.2	1	0.6	1	0.6	3	1.7
<i>Helenium autumnale</i>	0	0.0	0	0.0	0	0.0	8	4.4	3	1.7
<i>Solidago uliginosa</i>	2	1.1	1	0.6	0	0.0	0	0.0	3	1.7
<i>Cinna latifolia</i>	3	1.7	6	3.3	0	0.0	0	0.0	2	1.1
<i>Cuscuta gronovii</i>	5	2.8	0	0.0	0	0.0	7	3.9	2	1.1
<i>#Solanum dulcamara</i>	0	0.0	0	0.0	0	0.0	0	0.0	2	1.1
<i>Geum lacinatedum</i>	2	1.1	4	2.2	1	0.6	0	0.0	1	0.6
<i>Polygonum arifolium</i>	31	17.2	3	1.7	6	3.3	5	2.8	1	0.6
<i>#Verbena</i>	0	0.0	0	0.0	0	0.0	0	0.0	1	0.6

<i>urticifolia</i>										
<i>Acer rubrum</i> **	0	0.0	0	0.0	15	8.3	11	6.1	0	0.0
<i>Apios americana</i>	0	0.0	0	0.0	3	1.7	4	2.2	0	0.0
<i>Aster umbellatus</i>	2	1.1	0	0.0	0	0.0	0	0.0	0	0.0
<i>Bidens connata</i>	0	0.0	6	3.3	0	0.0	1	0.6	0	0.0
<i>Bidens frondosa</i>	0	0.0	0	0.0	0	0.0	6	3.0	0	0.0
<i>C. amomum</i> SDLNG	3	1.7	0	0.0	0	0.0	0	0.0	0	0.0
<i>Chelone glabra</i>	1	0.6	0	0.0	0	0.0	0	0.0	0	0.0
<i>Clethra alnifolia</i> **	0	0.0	0	0.0	5	2.8	8	4.4	0	0.0
<i>Eupatorium</i> <i>perfoliatum</i>	0	0.0	0	0.0	0	0.0	2	1.1	0	0.0
<i>Ilex verticillata</i> **	0	0.0	0	0.0	4	2.2	4	2.2	0	0.0
<i>Lobelia cardinalis</i>	0	0.0	0	0.0	6	3.3	6	3.3	0	0.0
<i>Lycopus uniflorus</i>	2	1.1	0	0.0	0	0.0	0	0.0	0	0.0
<i>Mimulus ringens</i>	3	1.7	0	0.0	0	0.0	0	0.0	0	0.0
<i>Nymphaea</i> <i>odorata</i>	0	0.0	8	4.4	0	0.0	0	0.0	0	0.0
<i>Panicum</i> <i>clandestinum</i>	1	0.6	0	0.0	0	0.0	0	0.0	0	0.0
<i>Parthenocissus</i> <i>quinquefolia</i>	6	3.3	11	6.1	13	7.2	12	6.7	0	0.0
<i>Pilea pumila</i>	0	0.0	2	1.1	0	0.0	0	0.0	0	0.0

<i>Polygonum sagittatum</i>	0	0.0	0	0.0	0	0.0	19	10.6	0	0.0
<i>Polygonum scandens</i>	8	4.4	0	0.0	0	0.0	0	0.0	0	0.0
<i>Quercus sp</i> <i>SDLNG</i>	0	0.0	1	0.6	0	0.0	0	0.0	0	0.0
<i>Rosa multiflora</i>	12	6.7	0	0.0	0	0.0	0	0.0	0	0.0
<i>Sagittaria rigida</i>	0	0.0	7	3.9	4	2.2	4	2.2	0	0.0
<i>Scutellaria lateriflora</i>	0	0.0	0	0.0	0	0.0	1	0.6	0	0.0
<i>Smilax rotundifolia</i> **	0	0.0	0	0.0	5	2.8	6	3.3	0	0.0
<i>Strophostylus helvola</i>	2	1.1	2	1.1	0	0.0	15	8.3	0	0.0
<i>Symplocarpus foetidus</i>	0	0.0	0	0.0	1	0.6	1	0.6	0	0.0
<i>U.I. small grass</i>	4	2.2	0	0.0	0	0.0	0	0.0	0	0.0
<i>Urtica dioica</i>	13	7.2	0	0.0	0	0.0	0	0.0	0	0.0
<i>Verbena hastata</i>	2	1.1	1	0.6	0	0.0	1	0.6	0	0.0
<i>Vernonia novaboracensis</i>	0	0.0	0	0.0	1	0.6	1	0.6	0	0.0
<i>Viburnum dentatum</i> <i>SDLG</i>	0	0.0	0	0.0	0	0.0	2	1.1	0	0.0
TOTALS	454	252.2	388	215.6	461	256.1	617	342.8	567	315.0

* 1991 sample location is not identical to transect surveyed in 1998 and sampled in subsequent

years.

** These species occur in an overhanging canopy and were sampled in 2000 and 2001 only.

Occurred in sample for first time in 2002

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MR-S Transect - Alphabetical List of Species and Percent Cover, 1998-2002

Species	1998		2000		2001		2002	
	Total	%Cover	Total	%Cover	Total	%Cover	Total	%Cover
<i>Acer rubrum</i>	0	0.0	0	0.0	4	3.3	4	3.3
<i>Acer saccharinum</i> *	10	8.3	10	8.3	10	8.3	10	8.3
<i>Apios americana</i>	0	0.0	1	0.8	1	0.8	0	0.0
# <i>Aster umbellatus</i>	0	0.0	0	0.0	0	0.0	1	0.8
<i>Bidens frondosa</i>	0	0.0	0	0.0	3	2.5	0	0.0
<i>Bohemeria cylindrica</i>	2	1.7	7	5.8	7	5.8	7	5.8
# <i>Carex crinata</i>	0	0.0	0	0.0	0	0.0	1	0.8
<i>Chelone glabra</i>	0	0.0	0	0.0	2	1.7	1	0.8
<i>Cinna latifolia</i>	3	2.5	0	0.0	2	1.7	0	0.0
<i>Cornus amomum</i>	7	5.8	10	8.3	10	8.3	6	5.0
<i>Cornus amomum</i> seedling	0	0.0	1	0.8	1	0.8	2	1.7
<i>Cuscuta gronovii</i>	4	3.3	0	0.0	10	8.3	5	4.2

<i>Epilobium coloratum</i>	0	0.0	1	0.8	0	0.0	2	1.7
<i>Geum lacinatum</i>	1	0.8	0	0.0	0	0.0	0	0.0
<i>Helenium autumnale</i>	0	0.0	0	0.0	1	0.8	0	0.0
<i>Hibiscus moscheutos</i>	3	2.5	5	4.2	5	4.2	6	5.0
<i>Impatiens capensis</i>	39	32.5	51	42.5	51	42.5	83	69.2
<i>Leersia oryzoides</i>	4	3.3	10	8.3	3	2.5	1	0.8
<i>Lindera benzoin</i>	7	5.8	9	7.5	5	4.2	5	4.2
<i>Lobelia cardinalis</i>	0	0.0	0	0.0	1	0.8	0	0.0
<i>#Lonicera morowii</i>	0	0.0	0	0.0	0	0.0	4	3.3
<i>Lythrum salicaria</i>	1	0.8	8	6.7	19	15.8	13	10.8
<i>Mentha arvensis</i>	2	1.7	0	0.0	0	0.0	0	0.0
<i>Mikania scandens</i>	78	65.0	43	35.8	34	28.3	38	31.71
<i>Onoclea sensibilis</i>	1	0.8	2	1.7	6	5.0	0	0.0
<i>Parthenocissus quinquefolia</i>	2	1.7	0	0.0	0	0.0	0	0.0
<i>Peltandra virginica</i>	2	1.7	13	10.8	10	8.3	10	8.3
<i>Polygonum arifolium</i>	11	9.2	0	0.0	10	8.3	0	0.0
<i>Polygonum sagittatum</i>	0	0.0	5	4.2	3	2.5	3	2.5

<i>Typha angustifolia</i>	80	66.7	94	78.3	96	80.0	98	81.7
<i>Impatiens capensis</i>	39	32.5	51	42.5	51	42.5	83	69.2
<i>Mikania scandens</i>	78	65.0	43	35.8	34	28.3	38	31.7
<i>Viburnum dentatum</i>	10	8.3	17	14.2	12	10.0	14	11.7
<i>Lythrum salicaria</i>	1	0.8	8	6.7	19	15.8	13	10.8
<i>Acer saccharinum</i> *	10	8.3	10	8.3	10	8.3	10	8.3
<i>Peltandra virginica</i>	2	1.7	13	10.8	10	8.3	10	8.3
<i>Bohemeria cylindrica</i>	2	1.7	7	5.8	7	5.8	7	5.8
<i>Cornus amomum</i>	7	5.8	10	8.3	10	8.3	6	5.0
<i>Hibiscus moscheutos</i>	3	2.5	5	4.2	5	4.2	6	5.0
<i>Cuscuta gronovii</i>	4	3.3	0	0.0	10	8.3	5	4.2
<i>Lindera benzoin</i>	7	5.8	9	7.5	5	4.2	5	4.2
<i>Rosa multiflora</i>	2	1.7	5	4.2	1	0.8	5	4.2
<i>Acer rubrum</i>	0	0.0	0	0.0	4	3.3	4	3.3
# <i>Lonicera morowii</i>	0	0.0	0	0.0	0	0.0	4	3.3
<i>Polygonum sagittatum</i>	0	0.0	5	4.2	3	2.5	3	2.5
<i>Cornus amomum seedling</i>	0	0.0	1	0.8	1	0.8	2	1.7

<i>Epilobium coloratum</i>	0	0.0	1	0.8	0	0.0	2	1.7
<i>#Toxicodendron radicans</i>	0	0.0	0	0.0	0	0.0	2	1.7
<i>#V. dentatum seedling</i>	0	0.0	0	0.0	0	0.0	2	1.7
<i>#Aster umbellatus</i>	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
<i>Chelone glabra</i>	0	0.0	0	0.0	2	1.7	1	0.8
<i>Leersia oryzoides</i>	4	3.3	10	8.3	3	2.5	1	0.8
<i>Strophostylus helvola</i>	2	1.7	1	0.8	0	0.0	1	0.8
<i>Apios americana</i>	0	0.0	1	0.8	1	0.8	0	0.0
<i>Bidens frondosa</i>	0	0.0	0	0.0	3	2.5	0	0.0
<i>Cinna latifolia</i>	3	2.5	0	0.0	2	1.7	0	0.0
<i>Geum lacinatum</i>	1	0.8	0	0.0	0	0.0	0	0.0
<i>Helenium autumnale</i>	0	0.0	0	0.0	1	0.8	0	0.0
<i>Lobelia cardinalis</i>	0	0.0	0	0.0	1	0.8	0	0.0
<i>Mentha arvensis</i>	2	1.7	0	0.0	0	0.0	0	0.0
<i>Onoclea sensibilis</i>	1	0.8	2	1.7	6	5.0	0	0.0
<i>Parthenocissus quinquefolia</i>	2	1.7	0	0.0	0	0.0	0	0.0
<i>Polygonum</i>	11	9.2	0	0.0	10	8.3	0	0.0

<i>arifolium</i>									
<i>Sambucus canadensis</i>	1	0.8	0	0.0	1	0.8	0	0.0	
<i>Solidago uliginosa</i>	2	1.7	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	
<i>Vernonia novaboracensis</i>	0	0.0	0	0.0	1	0.8	0	0.0	
TOTALS	274	228.3	293	244.2	310	258.3	324	270.0	

Occurred in sample for first time in 2002

* Overhanging branches of tree rooted on adjacent levee