2000 Vegetation Monitoring in Mill River Freshwater Tidal Marshes
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Prepared for
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INTRODUCTION

Annual vegetation monitoring of Mill River freshwater tidal marshes was conducted on August 18 and 19, 2000, by Penni Sharp and Vincent Kay. Quantitative vegetation sampling was performed along two transects approximately perpendicular to the river that were surveyed and staked in early 1998 and used for vegetation sampling in September of that year.

The upstream, or northern, transect, MR-N, is located about 2000 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 emergent marsh (primarily cattails) and shrubs, 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 by river water and exposed as a result of daily tidal fluctuations; portions of the low marsh transect are often inaccessible due to flooding by tidal action or high river flows. A transect at approximately this same location was also sampled in September 1991, prior to establishment and surveying of the permanent transect, using the same methodology described below.

The downstream transect, MR-S, passes through a narrower and less varied section of the marsh about 300' 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.

METHODS

Vegetation Sampling

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 meter intervals along the sampling chain (for a total of 10 sampling points/chain), and all species touching the rod (or 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 have been estimated rather than measured precisely. On transect MR-N, sampling begins at the origin of the permanent transect (stake 1) and extends to stake 18, 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. Tree and shrub species growing outside the upland edge of the wetland but overhanging stake 1 were not included in the earlier samples but were counted in 2000.

River and Soil Conditions

A short-term monitoring study of salinity in the reach of the Mill River adjoining the wetland transects was conducted in July and August 2000 for the Water Authority by CH2MHill, as part of an ongoing monitoring study of water chemistry in the river. In addition, the Authority had six slotted PVC monitoring wells installed in the wetlands in August 2000 to permit monitoring of groundwater salinity and pH within the root zone. The monitoring wells are located near the beginning (MW1), middle (MW2), and end (MW3) of each transect, and will be mapped during the next sampling cycle. Monitoring well measurements were taken on September 8, 2000. Salinity was measured using a YSI 30 conductivity meter. Plastic indicator strips were used in the field to measure pH. This monitoring will be repeated twice a year, near the times of spring high water and summer low water, to evaluate annual variations in water chemistry.

RESULTS AND DISCUSSION

The 2000 vegetation samples showed differences, some rather marked, from previous samples on the two transects. These changes are largely due to normal variations in climate and river flow, as well as to an ongoing process of natural succession in the wetlands. Some variation, however, may be attributable to differences in sampling: The 2000 sampling was done about 3 weeks earlier than the sampling in previous years. On transect MR-N, as discussed under "Methodology" above; points sampled in 1991, before the permanent transect was established, are thought to be significantly different because the 1991 transect, although starting at the same point, deviated slightly in orientation from the transect that was subsequently surveyed and staked.

River and Soil Conditions

Precipitation was relatively high during the summer of 2000, resulting in higher than normal river flows at the time of sampling. Rainfall during the summer of 2000 totaled about 15.7 inches, similar to the 14.3 inches for the summer of 1998, the previous sampling year, but over three times the 5 inches that fell in the dry summer of 1999. However, 1998 was marked by a very dry July; in addition, 2000 sampling was performed about three weeks earlier than in 1998, shortly after some major precipitation events; hence, wetland conditions and river flows when the 2000 monitoring was done reflected this recent precipitation.

Data on Mill River salinity collected by CH2M HILL in August 2000, after a period of high rainfall, showed that river salinities remained well below 0.5 ppt to below the Orange Street bridge, about 1500 feet downstream of transect MR-S, even at high tide. In July 2000, when river flows were somewhat lower, the salt water intrusion migrated upstream somewhat at high tide, but salinities still remained below 0.l5 ppt at the southernmost limit of the tidal marsh, which is about 1000 feet downstream of transect MR-S.

Soil water sampling in the monitoring wells on September 8 began about 1hour 20 minutes after morning high tide on transect MR-N and was completed about an hour later; sampling on transect MR-S began about 3 hours 20 minutes after high tide and was completed about an hour and 20 minutes later, or about 1.5 hours before afternoon low tide. The results of soil water monitoring are shown in Table 3. Soil water salinities were generally 0.1-0.2 parts per thousand (ppt), although the well nearest the river on transect MR-N had a salinity of 0.3 ppt, still well below the 0.5 ppt, as an average annual salinity value, tolerated by most freshwater wetland species. Salinity readings from the surface water of the river were higher at MR-N (0.2 ppt) than at MR-S (0.1 ppt), possibly because the latter sample was taken later on an outgoing tide. Soil water pH in the wetland was between 5.0 and 6.0.

Vegetation

Table 1 (MR-N) and Table 2 (MR-S) show results of the 2000 sampling and for the prior sampling period.The results show that a number of species increased on both transects (hence, presumably throughout the wetland) from 1998 to 2000. These included the emergent marsh species narrow-leaved cattail (*Typha angustifolia*), rice cutgrass (*Leersia oryzoides*), and purple loosestrife (*Lythrum salicaria*), the transitional herb jewelweed (*Impatiens capensis*), and shrub species silky dogwood (*Cornus amomum*) and northern arrowwood (*Viburnum recognitum*).

Perhaps the most conspicuous increase was that of the invasive introduced species, purple loosestrife. Percent cover by this species increased from 0.8 to 6.7 on MR-S and from 7.2 to 17.8 on MR-N. These numbers appear to confirm invasion of the tidal marsh by loosestrife. However, it is notable that loosestrife cover on MR-N in 1991 was 21.1 percent. These data can’t be directly compared to the later results, due to minor differences in transect layout; they suggest, however, that the population density of purple loosestrife at this site may be strongly affected by antecedent precipitation conditions rather than an inexorable invasion by this opportunistic species. Data from future monitoring should cast additional light on the behavior of purple loosestrife in the Mill River marshes.

Increases in other emergent species, including cattails and rice cutgrass, are probably due largely to relatively high water levels in the wetland in 2000, though they may also reflect effects of the intervening dry year of 1999. Cover by these species on MR-N was similar in 1991 to the percentages observed in 2000. The increase in jewelweed is probably similarly explained, the higher water levels creating broader transition zones, such as under the edges of shrub thickets; on transect MR-N, jewelweed coverage was much higher in 1991 than in either of the two later years. Relatively small increases in the shrubs silky dogwood and northern arrowwood, are probably due to natural succession, with shrub thickets continuing to expand at the margins and thicken internally, despite wetter conditions that are (presumably) temporary.

In contrast, climbing hempweed (Mikania scandens) decreased at both transect sites, despite the increase in cover by cattails, with which it was found in very close association in the 1998 sample. This change was particularly marked on transect MR-S, where cattail cover is very high: cattail cover increased from 66.7 to 78.3 percent, but cover by climbing hempweed decreased from 65.0 to 35.8 percent. This suggests that the hempweed, a trailing, vine-like composite which in 1998 densely festooned most of the cattails on the transects, prefers drier footing than was available in these marshes in August 2000. The earlier sampling time in 2000 (August vs. September) may also have contributed to lower cover by hempweed.

Some species also showed increases at only one of the sites. On transect MR-S, arrow arum (Peltandra virginica) had the most marked increase, from 1.7 to 10.8 percent cover, while it increased only minimally, from 2.2 to 3.3 percent on MR-N. This difference is probably due to higher water levels in the river providing more favorable habitat for this low-marsh species; the necessity to estimate cover on the lowest transects because of inundation, as well as the earlier sampling time, may also have contributed to the difference. False nettle (Bohemeria cylindrica), a transitional herb of the high marsh, also increased on transect MR-S with no corresponding gain on MR-N. Multiflora rose (Rosa multiflora), a transitional shrub that does not occur on the northern transect, showed a small increase on transect MR-S.

CONCLUSIONS

Baseline vegetation sampling in the Mill River tidal freshwater marsh was carried out in 1998 and 2000 under varying conditions of climate and river flow, with precipitation in the weeks prior to sampling somewhat higher during the latter summer. This repeated baseline monitoring has begun to establish the range of variation in the marsh community resulting from normal climatic difference. Vegetation was not monitored during the summer of 1999, but it is likely that unusually dry growing season produced some longer-term effects that were reflected in the 2000 sample. Earlier sampling in 2000, as well as normal successional changes would also account for some of the variation between the 2000 and 1998 samples.

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. Ongoing 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 flow.

Table 1

MR-N Transect - Summary of Species and Percent Cover

1991* - 2000

Species	1991		1998		2000	
	Total	% Cover	Total	% Cover	Total	% Cover
Acer rubrum **	0	0.0	0	0.0	15	8.3
Clethra alternafolia **	0	0.0	0	0.0	5	2.8
Ilex verticillata **	0	0.0	0	0.0	4	2.2
Smilax rotundifolia **	0	0.0	0	0.0	5	2.8
Viburnum recognitum	8	4.4	28	15.6	32	17.8
Iris pseudacorus	0	0.0	6	3.3	5	2.8
Viburnum lentago	0	0.0	7	3.9	5	2.8
Polygonum arifolium	31	17.2	3	1.7	6	3.3
Impatiens capensis	49	27.2	25	13.9	42	23.3
Strophostylus helvola	2	1.1	2	1.1	0	0.0

Onoclea sensibilis	12	6.7	4	2.2	13	7.2
#Symplocarpus foetidus	0	0.0	0	0.0	1	0.6
#Apios americana	0	0.0	0	0.0	3	1.7
Mikania scandens	44	24.4	56	31.1	39	21.7
Bidens connata	0	0.0	6	3.3	0	0.0
Typha angustifolia	95	52.8	81	45.0	84	46.7
Lythrum salicaria	38	21.1	13	7.2	32	17.8
Todxicodendron radicans	7	3.9	4	2.2	0	0.0
#Dryopteris thelypteris	0	0.0	0	0.0	20	11.1
Bohemeria cylindrica	3	1.7	15	8.3	9	5.0
Pilea pumila	0	0.0	2	1.1	0	0.0
Urtica dioica	13	7.2	0	0.0	0	0.0
Parthenocissus quinquefolia	6	3.3	11	6.1	13	7.2
Cuscuta gronovii	5	2.8	0	0.0	0	0.0
Hibiscus moscheutos	7	3.9	5	2.8	9	5.0
# Vernonia novaboracensis	0	0.0	0	0.0	1	0.6
Polygonum scandens	8	4.4	0	0.0	0	0.0
Cornus amomum	52	28.9	74	41.1	85	47.2
C. amomum SDLNG	3	1.7	0	0.0	0	0.0
Chelone glabra	1	0.6	0	0.0	0	0.0
Geum lacinatum	2	1.1	4	2.2	1	0.6

Solidago gigantea	2	1.1	3	1.7	9	5.0
Solidago uliginosa	2	1.1	1	0.6	0	0.0
Verbena hastata	2	1.1	1	0.6	0	0.0
Leersia oryzoides	6	3.3	4	2.2	6	3.3
Cinna latifolia	3	1.7	6	3.3	0	0.0
Rosa multiflora	12	6.7	0	0.0	0	0.0
Panicum clandestinum	1	0.6	0	0.0	0	0.0
Mimulus ringens	3	1.7	0	0.0	0	0.0
Aster umbellatus	2	1.1	0	0.0	0	0.0
Lycopus uniflorus	2	1.1	0	0.0	0	0.0
Polygonum hydropiper	3	1.7	0	0.0	0	0.0
U.I. small grass	4	2.2	0	0.0	0	0.0
Cephalanthus occidentalis	10	5.6	3	1.7	6	3.3
Eupatoriadelphus maculatus	7	3.9	4	2.2	1	0.6
Peltandra virginica	9	5.0	4	2.2	6	3.3
#Lobelia cardinalis	0	0.0	0	0.0	6	3.3
Sagittaria rigida	0	0.0	7	3.9	4	2.2
Quercus sp SDLNG	0	0.0	1	0.6	0	0.0
Nymphaea odorata	0	0.0	8	4.4	0	0.0
TOTALS	454	252.2	388	215.6	461	256.1

* 1991 sample location is not identical to transect surveyed and staked in 1998.

** These species occur in an overhanging canopy and were not sampled in previous years.

Occurred in sample for first time in 2000

Table 2

MR-S Transect - Summary of Species and Percent Cover

1998 - 2000

Species	1998		2000	
	Total	% Cover	Total	% Cover
Typha angustifolia	80	66.7	94	78.3
Impatiens capensis	39	32.5	51	42.5
Mikania scandens	78	65.0	43	35.8
Viburnum recognitum	10	8.3	17	14.2
Peltandra virginica	2	1.7	13	10.8
Cornus amomum	7	5.8	10	8.3
Leersia oryzoides	4	3.3	10	8.3
Acer saccharinum	10	8.3	10	8.3
Lindera benzoin	7	5.8	9	7.5
Lythrum salicaria	1	0.8	8	6.7
Bohemeria cylindrica	2	1.7	7	5.8
Rosa multiflora	2	1.7	5	4.2
#Polygonum sagittatum	0	0.0	5	4.2
Hibiscus moscheutos	3	2.5	5	4.2
Onoclea sensibilis	1	0.8	2	1.7

Strophostylus helvola	2	1.7	1	0.8
#Apios americana	0	0.0	1	0.8
#Epilobium coloratum	0	0.0	1	0.8
#Cornus amomum seedling	0	0.0	1	0.8
Sambucus canadensis	1	0.8	0	0.0
Parthenocissus quinquefolia	2	1.7	0	0.0
Cuscuta gronovii	4	3.3	0	0.0
Solidago uliginosa	2	1.7	0	0.0
Polygonum arifolium	11	9.2	0	0.0
Cinna latifolia	3	2.5	0	0.0
Geum lacinatum	1	0.8	0	0.0
Mentha arvensis	2	1.7	0	0.0
TOTALS	274	228.3	293	244.2

Occurred in sample for first time in 2000

Table 3

Mill River Marsh Groundwater Chemistry

September 8, 2000

MW#(1)	Salinity (ppt)	pH
MRN-MW1	0.2	6.0
MRN-MW2	0.1	5.0
MRN-MW3	0.3	6.0
MRS-MW1	0.2	5.8

MRS-MW2	0.2	5.8
MRS-MW3	0.2	6.0

(1) Monitoring well locations: MRN = Mill River North Transect; MRS = Mill River South Transect; MW1 = monitoring well closest to upland edge of marsh; MW2 = monitoring well near middle of marsh transect; MW3 = monitoring well closest to river.