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**Plant inventory of wetlands with potential for *Phragmites australis* invasion on the shores of
Grand Traverse Bay, Michigan**

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ABSTRACT The invasive presence of *Phragmites australis*, the common reed, has detrimental effects on native biodiversity and wetland ecosystem processes, in addition to negative social and economic effects (Getsinger et al. 1999). As private landowners along the Grand Traverse Bay, Michigan, follow the suggestions of the Grand Traverse Regional Land Conservancy, the United States Fish and Wildlife Service, and other organizations to remove *Phragmites* from their property, a comprehensive list of local, native wetland species with which to replace the invasive grass is a practical need. The inventory provided by this study includes 139 species, in addition to an evaluation of the six inventory sites using the Floristic Quality Assessment (Herman et al. 2001).

KEY WORDS: biodiversity, coastal wetlands, Floristic Quality Assessment, Lake Michigan, *Phragmites australis*, wetland plant inventory

INTRODUCTION

Phragmites australis (hereafter referred to as *Phragmites*) is an invasive grass that has spread into wetlands throughout eastern North America, presenting social, economic, and ecological problems (Getsinger et al. 1999). *Phragmites* propagates vegetatively at impressive rates. During a single growing season, the grass can grow up to 10 feet in height, extending its roots up to 60 feet horizontally (Saltonstall 2005, Haslam 1972). Because it takes root at water's edge, in many cases extending into a lake, it quickly takes over shorelines, ruining views, reducing recreational opportunities, and lowering property values. In addition, *Phragmites* can be a fire hazard (Getsinger et al. 1999). Ecologically, its ability to outcompete native species significantly reduces the biodiversity and native species richness of coastal wetlands (Ailstock, Normann & Bushmann 2001, Silliman and Bertness 2004, Minchton, Simpson & Bertness 2006, Trebitz 2007) and large stands can alter established trophic interactions within an ecosystem (Gratton & Benno 2006). Thus, it is not only harmful to other plants, but can change entire habitats.

Phragmites does not respect property lines. Because it spreads so rapidly, *Phragmites* in one area is a threat to neighboring wetland communities as well. According to the United States Fish and Wildlife Service, the removal of *Phragmites* is "one step toward a greater goal of restoring native wetland plant communities and protecting fish and wildlife habitat" (Getsinger et al. 1999).

However, the removal of *Phragmites* is not enough. Bare, sandy soil presents prime habitat for the invasive grass to establish itself (Haslam 1972, Wilcox and Whillians 1999, Ailstock et al. 2001, Tulbure and Johnston 2010). Many forms of disturbance can lead to bare, sandy soil, including shoreline development and decreases in lake water levels (Minchton and Bertness 2003, Tulbure and Johnston 2010, respectively). However, it is important to understand

that the removal of *Phragmites* is a disturbance as well. Leaving soil bare can encourage the reestablishment of this invasive grass. To prevent its spread, recommendations have been made to replant native species soon after the removal of *Phragmites* to cover invasion-prone soils (Wilcox and Whillians 1999, Ailstock et al. 2001, Tulbure and Johnston 2010).

The floristic composition of a wetland varies from place to place. While previous scientific studies have indicated the need for *Phragmites* removal (Detenbeck et al. 1999, Getsinger et al. 2007, Minchton & Bertness 2003), few have been able to provide specific replacement options for the invasive grass. The purpose of our study, at the request of the Grand Traverse Regional Land Conservancy (GTRLC), is to provide a list of native wetland species specific to wetland communities along the Grand Traverse Bay to guide the selection of appropriate native species to replace *Phragmites*.

MATERIALS AND METHODS

We took inventory of six different sites along the Grand Traverse Bay (Fig. 1). The majority of sites are publicly owned, except for Tucker Point, which is privately owned.

Transect Procedure

We completed three transects at each site. Each transect began at the water's edge, unless *Phragmites*, dead or alive, was seen growing out into the water. The end of each transect was determined by the clear vegetation shift marking the boundary between the wetland and the rest of the beach. Thus, all sites were surveyed from water's edge (or *Phragmites* edge) to the wetland's edge, indicated by an obvious shift in vegetation to dune or forest species. Each transect was 1 m wide.

We positioned a .25-m² quadrat every meter along a transect, identifying every species therein. Any unknown species was labeled and photographed to aid in later identification. Dead plants, with the exception of *Phragmites*, were not recorded. We conducted a final site walk-through to include any species that may have escaped the transects. The transects helped identify smaller species, while the general site walk-through picked up the larger species, such as willows.

Growing Season Limitations

Sampling was limited to a period from mid-June to mid-July 2011. Limited sampling time caused problems in the identification of certain wetland species, as many species had not flowered on the initial visit. We placed a colored twist-tie on unknown plants--without flowers or other identifying characteristics--to aid in identification during subsequent visits. The GPS coordinates of each transect were recorded using a Garmin Map76 GPS. The coordinates and a detailed transect log facilitated relocation of tagged plants.

Identification

Most plants were identified on site, but grasses, sedges, and many other plants were identified from photographs and collected specimens. Fassett's *Grasses of Wisconsin* (1951), Newcomb's *Wildflower Guide* (1977), Soper and Heimbürger's *Shrubs of Ontario* (1985), Crow and Hellquist's *Aquatic and Wetland Plants of Northeastern North America* (2001), *Ferns of Northeastern and Central North America* (Cobb et al. 2005), the University of Michigan online herbarium and the Au Sable Institute of Environmental Studies herbarium were all used to key out and verify species found during surveys. Scientific names follow the Floristic Quality Assessment's inventory (Herman et al. 2001), which is not entirely consistent with either Voss's *Michigan Flora* (1997) or Gleason and Cronquist's *Manual of Vascular Plants* (1991).

Data Analysis

In addition to the general inventory, the Floristic Quality Assessment (FQA) was used to provide additional information for each site. Each location was assessed for average coefficients of conservatism (\bar{C}), the overall ranking on the Floristic Quality Index (*FQI*), and the Wetland Index ranking (\bar{W}) as described in the FQA (Herman et al. 2001). The FQA was chosen to evaluate sites because it evaluates the inventory from a statewide perspective and can help better understand site history.

Coefficient of conservatism (C) values have been predetermined in the FQA. The value represents the probability that a specific species will occur in a habitat unaltered from supposed pre-settlement conditions. Lower coefficients describe plants that are widespread and not specifically tied to sites representing supposed pre-European settlement conditions. Higher values describe plants with a higher probability of growing in pristine, rare habitats. Non-native species are listed but have received a null C value (Herman et al. 2001). The C values are not applied to a plant itself, but to the presence of a plant. For example, *Phalaris arundinacea*, or reed canary, has a C value of zero. It received this value because its presence is not indicative of a floristically unique habitat (Herman et al. 2001). The C values can be averaged for a site to give an overall idea of its quality.

The FQI is a way of using these C coefficients to describe the overall quality of a site based on its specific set of species. It attempts to standardize the values so that the number of species does not inhibit comparison, as it is often related to site size. The Floristic Quality Assessment states that sites "floristically important from a statewide perspective" will have an FQI value greater than 35. In this study, the FQI is used to compare site quality. It is important to note that this value speaks to potential quality, not actual quality, as it does not include non-native or invasive species.

Finally, the wetness index (\bar{W}) was calculated for each site to ensure that each site represents primarily wetland species. The Wetness Index is simply an average of the Wetness coefficients provided by the FQA (W). Each species in Michigan has been assigned a value -5 to 5. These values represent probabilities that a given species will occur in a wetland. A value of -5 for a species means that it occurs "almost always," or 99% of the time, in a wetland. A value of 5 means that the species occurs "almost never" in a wetland (Herman et al. 2001). An index value less than zero indicates that the majority of the species in an inventory are truly wetland species. The index is simple to calculate and provides a check that the transects and areas surveyed are

representative of true wetlands where *Phragmites* could propagate (Haslam 1972, Minc and Albert 2002, Galatowitsch, Anderson, and Ascher 1999).

Studies show that the FQA and its components effectively describe wetlands and are useful in monitoring the progress of restoration projects (Bourdaughs et al. 2006, Lopez & Fennessy 2002). Thus, it is the primary tool for evaluating the inventory presented in this study.

RESULTS

We recorded a total of 139 different species in the transects and site walk-throughs. Of these, 92 are listed by the FQA as native wetland plant species (Table 1). Thirty-three non-native species were also recorded (Table 2). Species are listed in the tables by the number of sites in which they occurred. Only 15 species remain unidentified, primarily due to the study's timing with the growing season. The composition of each site inventory based on the native, non-native and unidentified categories is shown in Figure 2. *Phragmites* itself was found at four of six inventory sites. Where present, obvious management has taken place. A more detailed breakdown of all the species found at each site is found in Appendix A.

The overall floristic quality of each site is represented by the \bar{C} , FQI and \bar{W} values (Table 3). The average C value for all sites is 3.6. The average FQI value is 24, ranging from 20 to 28 for all sites (Fig. 3). The distributions of C values that build the FQI at each site are shown in Figure 4. All \bar{W} values were less than zero.

DISCUSSION

Inventory

The inventory undertaken in this study is not exhaustive, but represents the majority of species present in these northern Michigan wetlands. The limited time span of study and the large area covered prevent it from being exhaustive. However, the list is a significant start that can be

useful to the GTRLC's efforts. Species recorded but not identified include plants without flowers at the completion of this study or germinating plants too small to be confidently identified.

Of the 93 native species, 50 were found at three or more inventory sites. It is possible that several species were missed throughout the survey, particularly when it comes to grasses and sedges or the germinating seedlings of incoming species. For this reason, even if a single individual was found at only one site, it is included in the comprehensive list. Beyond this list, Table 2 reveals the presence of other non-native/invasive species, including purple loosestrife. Their presence should not be overlooked, as they could also cause concern in the future.

Floristic Quality Assessment

The \bar{C} values for each site indicate that none represent floristically rare or undisturbed habitat. However, the consistency in the \bar{C} values demonstrates the usefulness of all sites in representing coastal wetlands along the Grand Traverse Bay. As previously noted, \bar{C} values are not a good mode of comparison for sites, as they do not take into account the number of species present at a site, which is in part a function of size (Herman et al. 2001). For this reason, Maple Bay Natural Area and Pelizarri Natural Area have the same \bar{C} value but different *FQI* values. At first glance, it seems questionable that Pelizarri Natural Area, which showed the lowest number of species, also had the lowest *FQI* value. However, the *FQI* shows its potential, as Tucker Point, which has a smaller number of species than Acme Township Park, has a higher *FQI* value. This leads us to believe that the *FQI* is an effective means of comparison of potential site quality.

The *FQI* values for all sites are under 35, indicating that they are not floristically exceptional from a statewide perspective. However, because the *FQI* scale goes well beyond 35, the relative similarity in values for these six sites indicates that the inventory represents a common quality of habitat. This is good news for the inventory, as it seeks to represent a common habitat. A comparison of the six sites shows that Tucker Point and Deepwater Point represent the

highest quality sites. They could serve as potential models for landowners interested in restoring wetlands on their property after the removal of *Phragmites*.

The \overline{W} values for all sites were less than 0, indicating that the majority of species found belong in this study's wetland inventory. Of the 15 species recorded in the upland category (W value of 5, less likely to occur in a wetland), 12 were non-native. Because they are not native, they do not have C values assigned to them, and are not included in the \overline{C} or FQI calculations, or the final native species list (Table 1).

This inventory can serve as a benchmark for future studies. Should a study such as this take place on a regular basis, it would be possible to see the development and the effects of human disturbance (either positive or negative) on the protected wetland communities along Grand Traverse Bay.

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Table 1. Native species recorded at all wetland inventory sites with their Floristic Quality Assessment coefficients of conservatism and wetness, Grand Traverse Bay, Michigan.

<i>Scientific Name</i>	Common Name	C	W	Wetness	Number of sites present
<i>Carex flava</i>	Sedge	4	-5	OBL	6
<i>Euthamia graminifolia</i>	Grass-leaved goldenrod	3	-2	FACW	6
<i>Juncus balticus</i>	Baltic rush	4	-5	OBL	6
<i>Phalaris arundinacea</i>	Reed canary	0	-4	FACW+	6
<i>Potentilla anserina</i>	Silverweed	5	-4	FACW+	6
<i>Salix petiolaris</i>	Meadow willow	1	-4	FACW+	6
<i>Scirpus americanus</i>	Three-square	10	-5	OBL	6
<i>Solidago canadensis</i>	Canada goldenrod	1	3	FACU	6
<i>Typha latifolia</i>	Broad-leaved cattail	1	-5	OBL	6
<i>Acer rubrum</i>	Red maple	1	0	FAC	5
<i>Ammophila breviligulata</i>	Marram grass	10	5	UPL	5
<i>Asclepias incarnata</i>	Swamp milkweed	6	-5	OBL	5
<i>Asclepias syriaca</i>	Common milkweed	1	5	UPL	5
<i>Carex retrorsa</i>	Sedge	3	-5	OBL	5
<i>Cornus stolonifera</i>	Red-osier dogwood	2	-3	FACW	5
<i>Eleocharis obtusa</i>	Spike-rush	3	-5	OBL	5
<i>Elymus canadensis</i>	Canada wild-rye	7	1	FAC-	5
<i>Eupatorium maculatum</i>	Joe-Pye weed	4	-5	OBL	5
<i>Eupatorium perfoliatum</i>	Boneset	4	-4	FACW+	5
<i>Lycopus uniflorus</i>	Northern Bugle weed	2	-5	OBL	5
<i>Oenothera biennis</i>	Common evening primrose	2	3	FACU	5
<i>Calamagrostis canadensis</i>	Blue-joint grass	3	-5	OBL	4
<i>Equisetum laevigatum</i>	Smooth scouring rush	2	-3	FACW	4
<i>Lactuca canadensis</i>	Tall lettuce	2	2	FACU+	4
<i>Poa palustris</i>	Fowl meadow grass	3	-4	FACW+	4
<i>Salix exigua</i>	Sandbar willow	1	-5	OBL	4
<i>Vitis riparia</i>	Riverbank grape	3	-2	FACW-	4
<i>Bidens frondosa</i>	Common beggar ticks	1	-3	FACW	3
<i>Cakile edentula</i>	Sea rocket	5	3	FACU	3
<i>Campanula aparinoides</i>	Marsh bellflower	7	-5	OBL	3
<i>Carex bebbi</i>	Bebb's sedge	4	-5	OBL	3
<i>Carex hystericina</i>	Sedge	2	-5	OBL	3
<i>Carex stricta</i>	Hummock sedge	4	-5	OBL	3
<i>Fragaria virginiana</i>	Wild strawberry	2	1	FAC-	3
<i>Fraxinus nigra</i>	Black ash	6	-4	FACW+	3
<i>Impatiens capensis</i>	Spotted touch-me-not	2	-3	FACW	3
<i>Juncus effusus</i>	Soft-stemmed rush	3	-5	OBL	3
<i>Lycopus americanus</i>	Common water horehound	2	-5	OBL	3
<i>Polygonum lapathifolium</i>	Nodding smartweed	0	-4	FACW+	3
<i>Populus balsamifera</i>	Balsam poplar	2	-3	FACW	3
<i>Salix amygdaloides</i>	Peach willow	3	-3	FACW	3

<i>Salix myricoides</i>	Blue-leaved willow	9	-3	FACW	3
<i>Scirpus acutus</i>	Hard stem bulrush	5	-5	OBL	3
<i>Scirpus atrovirens</i>	Bulrush	3	-5	OBL	3
<i>Solidago rugosa</i>	Rough goldenrod	3	-1	FAC+	3
<i>Thuja occidentalis</i>	White cedar	4	-3	FACW	3
<i>Aster puniceus</i>	Swamp aster	5	-5	OBL	2
<i>Betula papyrifera</i>	White birch	2	2	FACU+	2
<i>Caltha palustris</i>	Marsh marigold	6	-5	OBL	2
<i>Carex garberi</i>	Sedge	8	-3	FACW	2
<i>Cicuta maculata</i>	Water hemlock	4	-5	OBL	2
<i>Galium palustre</i>	Marsh bedstraw	3	-5	OBL	2
<i>Juncus alpinus</i>	Rush	5	-5	OBL	2
<i>Juncus marginatus</i>	Grass-leaved rush	8	-3	FACW	2
<i>Liparis loeselii</i>	Leosel's Twayblade	5	-4	FACW+	2
<i>Lobelia kalmii</i>	Kalm's Lobelia	10	-5	OBL	2
<i>Populus deltoides</i>	Eastern cottonwood	1	-1	FAC+	2
<i>Potamogeton gramineus</i>	Variable pondweed	5	-5	OBL	2
<i>Salix candida</i>	Hoary willow	9	-5	OBL	2
<i>Salix cordata</i>	Sand-dune willow	10	-1	FAC+	2
<i>Salix eriocephala</i>	Willow	2	-3	FACW	2
<i>Salix pyrifolia</i>	Balsam willow	8	-4	FACW+	2
<i>Utricularia vulgaris</i>	common bladderwort	6	-5	OBL	2
<i>Verbena hastata</i>	Blue vervain	4	-4	FACW+	2
<i>Veronica anagallis-aquatica</i>	Water speedwell	4	-5	OBL	2
<i>Acer negundo</i>	Box elder	0	-2	FACW-	1
<i>Alnus rugosa</i>	Tag alder	5	-5	OBL	1
<i>Artemisia campestris</i>	Wormwood	5	0	FAC	1
<i>Carex leptalea</i>	Sedge	5	-5	OBL	1
<i>Carex vulpinoidea</i>	Sedge	1	-5	OBL	1
<i>Cicuta bulbifera</i>	Water hemlock	5	-5	OBL	1
<i>Cirsium muticum</i>	Swamp thistle	6	-5	OBL	1
<i>Equisetum fluviale</i>	Water horsetail	7	-5	OBL	1
<i>Equisetum variegatum</i>	Variegated scouring rush	8	-3	FACW	1
<i>Galium tinctorium L.</i>	stiff bedstraw	5	-5	OBL	1
<i>Hieracium aurantiacum</i>	Orange hawkweed	8	5	UPL	1
<i>Lathyrus japonicus</i>	Beach pea	10	4	FACU-	1
<i>Lemna minor</i>	Lesser duckweed	5	-5	OBL	1
<i>Panicum lindheimeri</i>	Panicum lindheimerigrass	8	-5	OBL	1
<i>Populus tremuloides</i>	Trembling aspen	1	0	FAC	1
<i>Prunella vulgaris</i>	Heal-all	0	0	FAC	1
<i>Quercus alba</i>	White oak	5	3	FACU	1
<i>Quercus rubra</i>	Red oak	5	3	FACU	1
<i>Ranunculus hispidus</i>	Swamp buttercup	5	0	FAC	1
<i>Ranunculus sceleratus</i>	Ranunculus sceleratus	1	-5	OBL	1
<i>Rubus fruticosus</i>	Blackberry	1	2	FACU+	1
<i>Sagittaria latifolia</i>	Common arrowhead	1	-5	OBL	1
<i>Salix bebbiana</i>	Bebb's willow	1	-4	FACW+	1

<i>Scutellaria galericulata</i>	Marsh skullcap	5	-5	OBL	1
<i>Teucrium canadense</i>	Germander	4	-2	FACW-	1
<i>Veronica serpyllifolia</i>	Thyme-leaved speedwell	0	-3	FACW	1

Table 2. Non-native or invasive species recorded at all wetland inventory sites with their Floristic Quality Assessment coefficients of conservatism and wetness, Grand Traverse Bay, Michigan.

<i>Scientific Name</i>	Common Name	C	W	Wetness	Number of sites present
<i>Epilobium hirsutum</i>	Hairy willow herb	*	-4	FACW+	6
<i>Arctium minus</i>	Common burdock	*	5	UPL	5
<i>Centaurea maculosa</i>	Spotted knapweed	*	5	UPL	5
<i>Hieracium caespitosum</i>	King-Devil hawkweed	*	5	UPL	5
<i>Typha angustifolia</i>	Narrow-leaved cattail	*	-5	OBL	5
<i>Festuca arundinacea</i>	Tall fescue	*	2	FACU+	4
<i>Myosotis scorpioides</i>	Forget-me-not	*	-5	OBL	4
<i>Phragmites australis</i>	Phragmites	0	-4	FACW	4
<i>Taraxacum officinale</i>	Dandelion	*	3	FACU	4
<i>Cirsium vulgare</i>	Bull thistle	*	4	FACU-	3
<i>Daucus carota</i>	Queen Anne's Lace	*	5	UPL	3
<i>Lythrum salicaria</i>	Purple Loosestrife	*	-5	OBL	3
<i>Mentha spicata</i>	Spearmint	*	-4	FACW+	3
<i>Nasturtium officinale</i>	Watercress	*	-5	OBL	3
<i>Sedum acre</i>	Sedum	*	5	UPL	3
<i>Silene cucubalus</i>	Bladder campion	*	5	UPL	3
<i>Sonchus oleraceus</i>	Common sow thistle	*	3	FACU	3
<i>Trifolium pratense</i>	Red clover	*	2	FACU+	3
<i>Typha xglauca</i>	Hybrid cattail	*	-5	OBL	3
<i>Artemisia vulgaris</i>	Common wormwood/Mugwort	*	5	UPL	2
<i>Cirsium arvense</i>	Canada thistle	*	3	FACU	2
<i>Elaeagnus umbellata</i>	Autumn olive	*	3	FACU	2
<i>Polygonum persicaria</i>	Lady's thumb, heart's ease	*	-3	FACW	2
<i>Tragopogon dubius</i>	Goat's beard	*	5	UPL	2
<i>Ulmus pumila</i>	Siberian elm	*	5	UPL	2
<i>Chrysanthemum leucanthemum</i>	Ox-eye daisy	*	5	UPL	1
<i>Coronilla varia</i>	Coronilla varia	*	5	UPL	1
<i>Lathyrus sylvestris</i>	Everlasting pea	*	5	UPL	1
<i>Medicago lupulina</i>	Black medic	*	1	FAC-	1
<i>Melilotus alba</i>	White sweet clover	*	3	FACU	1
<i>Plantago lanceolata</i>	English plantain	*	0	FAC	1
<i>Salix purpurea</i>	Basket willow	*	3	FACW	1
<i>Sonchus asper</i>	Spiny leaved sow thistle	*	0	FAC	1

Table 3. Floristic Quality Assessment values for each wetland inventory site, Grand Traverse Bay

Site	\bar{C}	FQI	\bar{W}
Maple Bay Natural Area (MB)	3.6	24	-2
Deepwater Point (DP)	3.7	28	-3
Acme Township Park (AT)	3	23	-2
Pelizarri Natural Area (P)	3.6	20	-1
Tucker Point (TP)	4	28	-2
Old Mission State Park (OM)	3.5	23	-1
Average	3.6	24	

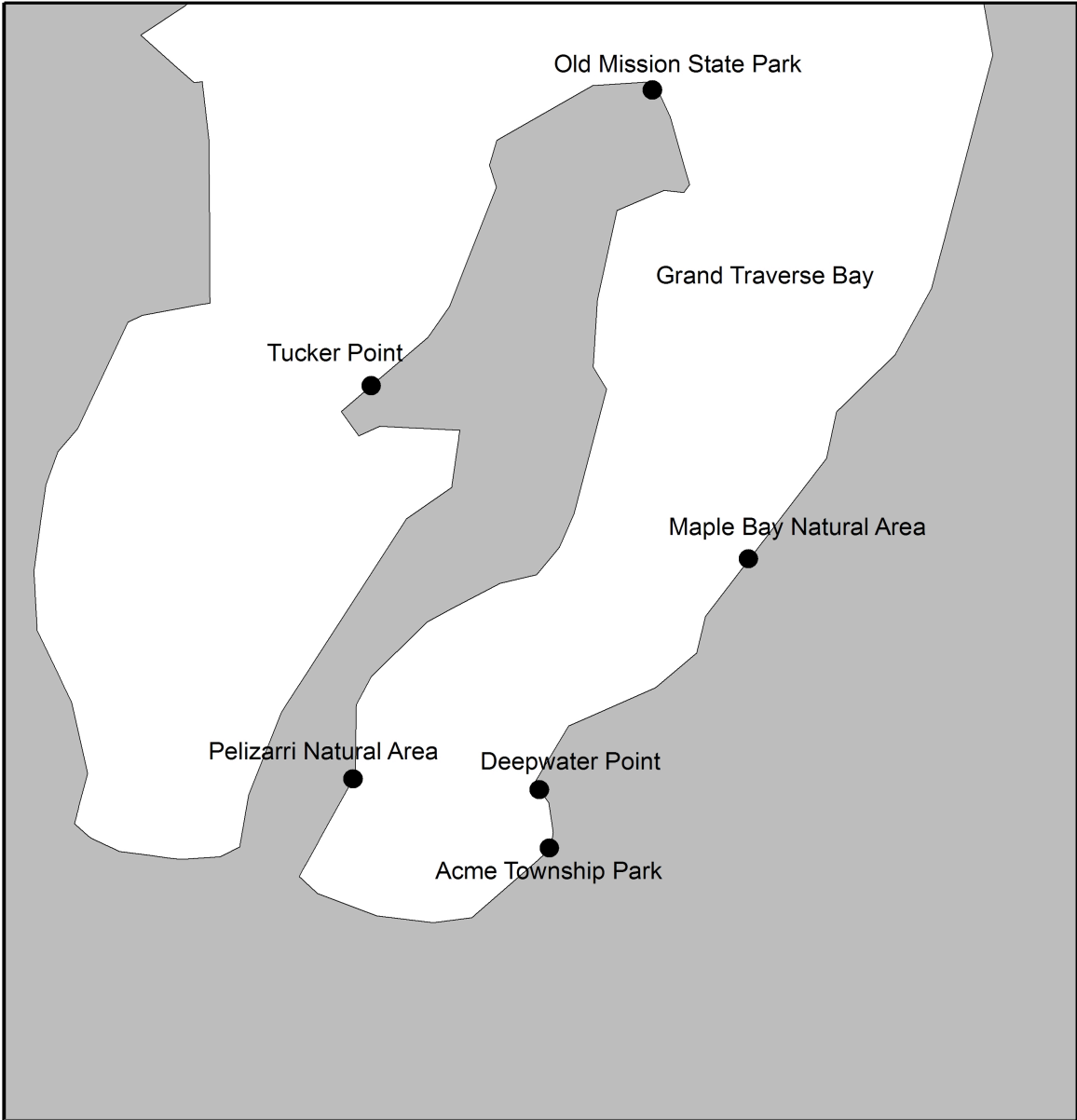
Figure Legend

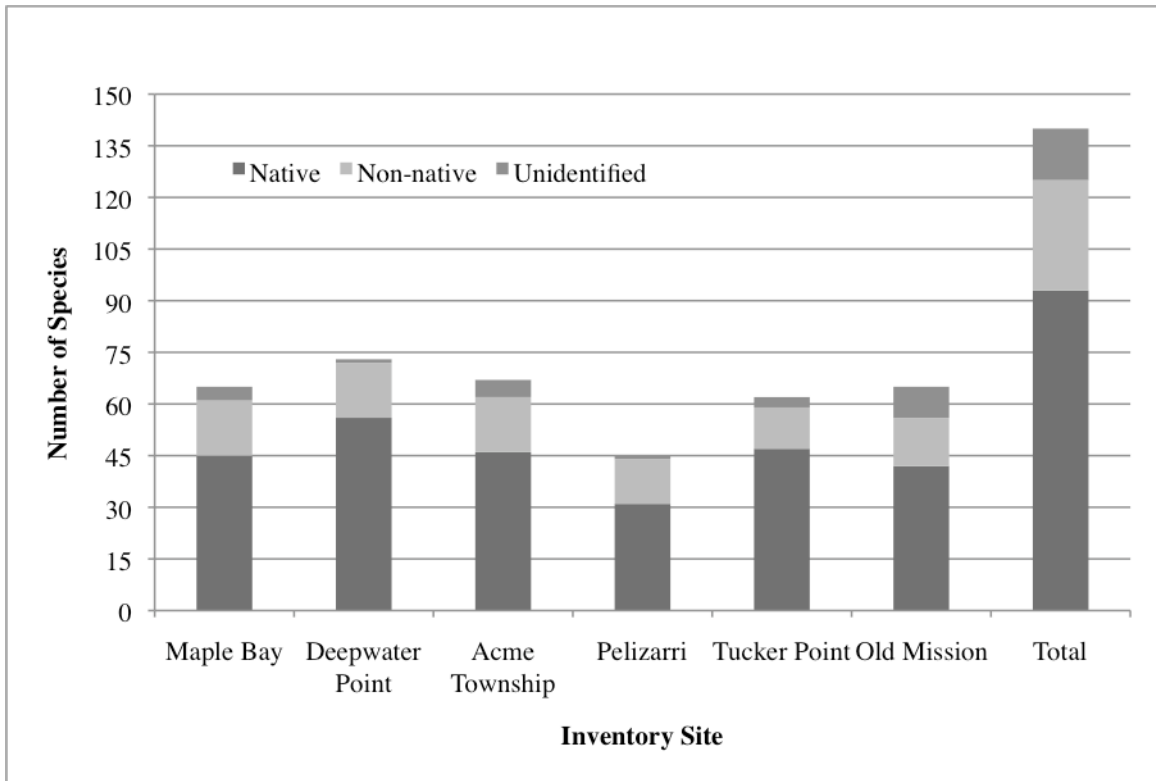
Figure 1. Inventory sites. Grand Traverse Bay and Old Mission Peninsula, west of Mancelona and northeast of Traverse City, Michigan. Courtesy Rob Keys.

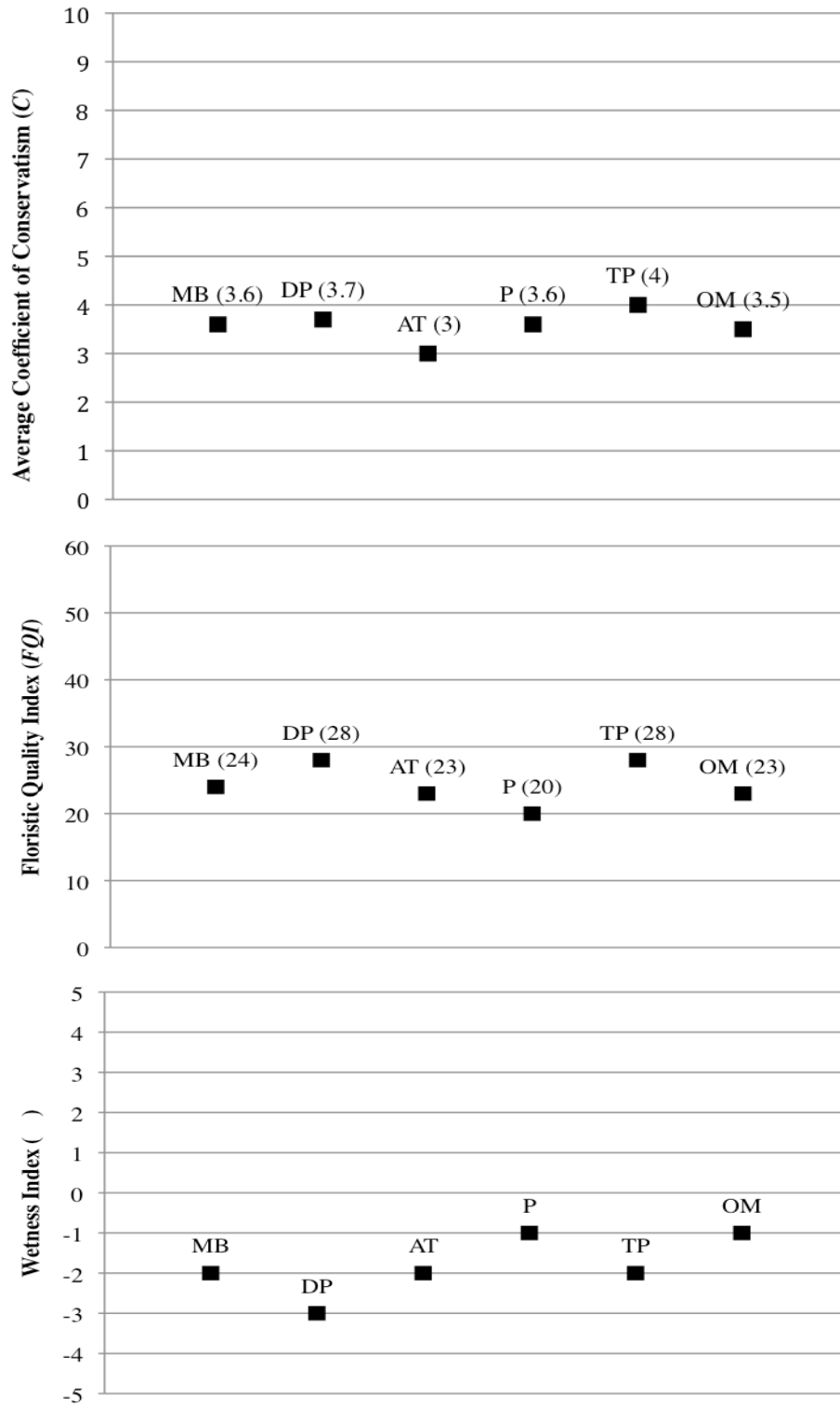
Figure 2. Wetland species counts for all inventory sites and overall inventory, Grand Traverse Bay.

Figure 3. Floristic Quality Assessment value rankings for all wetland inventory sites, Grand Traverse Bay.

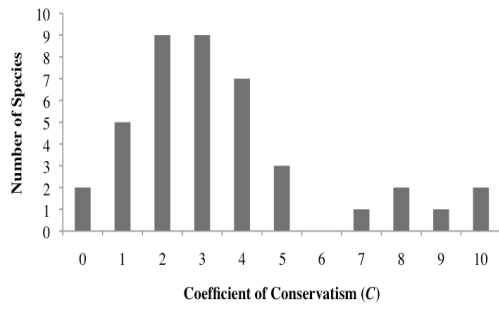
Figure 4. Distributions of *C* values that lead to the Floristic Quality Index (*FQI*) for each wetland inventory site, Grand Traverse Bay.



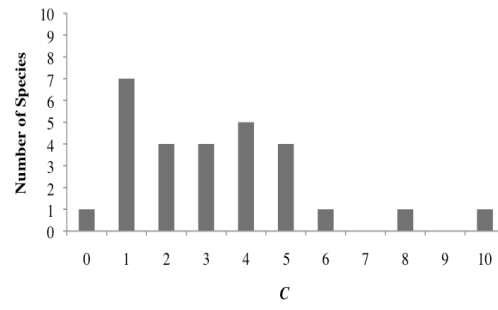




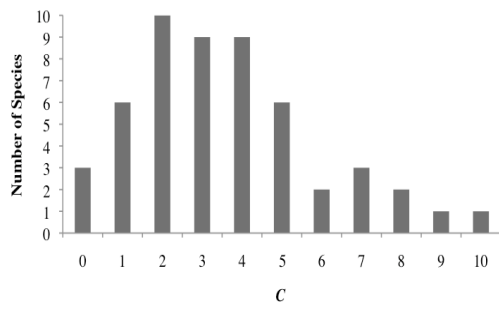
Maple Bay Natural Area (FQI 24)



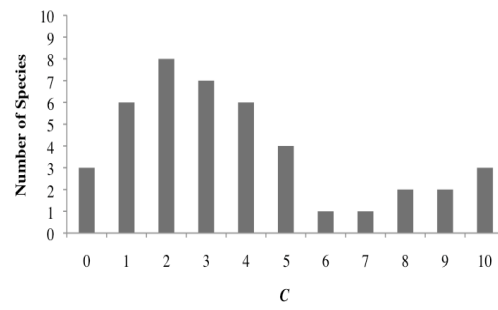
Pelizarri Natural Area (FQI 20)



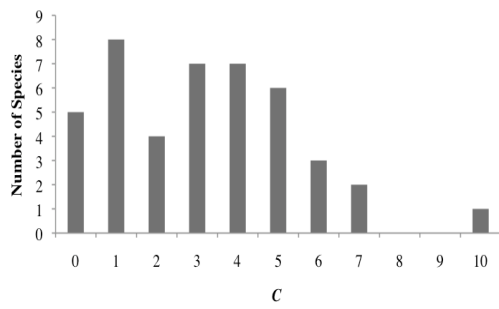
Deepwater Point (FQI 28)



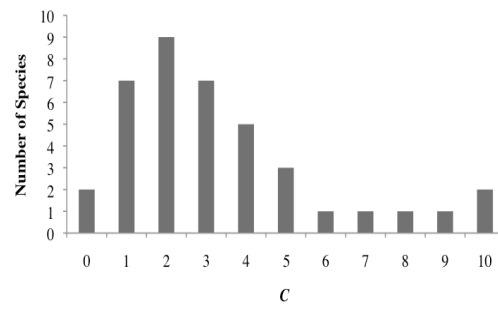
Tucker Point (FQI 28)



Acme Township Park (FQI 23)



Old Mission State Park (FQI 23)



APPENDIX A

The following is a list of plant species recorded during all transects at all sites during the inventory of wetlands along the Grand Traverse Bay of Lake Michigan. In addition to the plant names and the locations at which they were found, we have included the Coefficient of Conservatism (*C*) and Wetness (*W*) values as indicated in the Floristic Quality Assessment (FQA).

All scientific and common names are based off of the FQA's list. Site names have been abbreviated as follows: Maple Bay Natural Area (MB), Deepwater Point (DP), Acme Township Park (AT), Pelizarri Natural Area (P), Tucker Point (TP), and Old Mission State Park (OM).

Scientific Name	Common Name	<i>C</i>	<i>W</i>	Wetness	MB	DP	AT	P	TP	OM
<i>Acer negundo</i>	Box elder	0	-2	FACW-			X			
<i>Acer rubrum</i>	Red maple	1	0	FAC	X	X	X		X	X
<i>Alnus rugosa</i>	Tag alder	5	-5	OBL			X			
<i>Ammophila breviligulata</i>	Marram grass	10	5	UPL		X	X	X	X	X
<i>Arctium minus</i>	Common burdock	*	5	UPL	X	X	X		X	X
<i>Artemisia campestris</i>	Wormwood	5	0	FAC	X					
<i>Artemisia vulgaris</i>	Common wormwood/ mugwort	*	5	UPL				X		X
<i>Asclepias incarnata</i>	Swamp milkweed	6	-5	OBL	X	X	X	X	X	
<i>Asclepias syriaca</i>	Common milkweed	1	5	UPL	X		X	X	X	X
<i>Aster puniceus</i>	Swamp aster	5	-5	OBL		X		X		
<i>Betula papyrifera</i>	Paper birch	2	2	FACU+					X	X
<i>Bidens frondosa</i>	Common beggar ticks	1	-3	FACW		X	X	X		
<i>Cakile edentula</i>	Sea rocket	5	3	FACU			X	X		X
<i>Calamagrostis canadensis</i>	Blue-joint grass	3	-5	OBL	X	X			X	X
<i>Caltha palustris</i>	Marsh marigold	6	-5	OBL		X	X			
<i>Campanula aparinoides</i>	Marsh bellflower	7	-5	OBL	X	X	X			
<i>Carex bebbi</i>	Bebb's sedge	4	-5	OBL	X	X	X			
<i>Carex flava</i>	Sedge	4	-5	OBL	X	X	X	X	X	X
<i>Carex garberi</i>	Sedge	8	-3	FACW	X				X	
<i>Carex hystericina</i>	Sedge	2	-5	OBL	X	X				X
<i>Carex leptalea</i>	Sedge	5	-5	OBL		X				
<i>Carex retrorsa</i>	Sedge	3	-5	OBL	X	X	X		X	X
<i>Carex stricta</i>	Hummock sedge	4	-5	OBL	X	X	X			
<i>Carex vulpinoidea</i>	Sedge	1	-5	OBL		X				
<i>Centaurea maculosa</i>	Spotted knapweed	*	5	UPL	X	X	X		X	X
<i>Chrysanthemum leucanthemum</i>	Ox-eye daisy	*	5	UPL				X		
<i>Cicuta bulbifera</i>	Water hemlock	5	-5	OBL		X				
<i>Cicuta maculata</i>	Water hemlock	4	-5	OBL		X	X			
<i>Cirsium arvense</i>	Canada thistle	*	3	FACU				X		X
<i>Cirsium muticum</i>	Swamp thistle	6	-5	OBL			X			
<i>Cirsium vulgare</i>	Bull thistle	*	4	FACU-			X	X		X
<i>Cornus stolonifera</i>	Red-osier dogwood	2	-3	FACW	X	X	X	X	X	
<i>Coronilla varia</i>	Coronilla varia	*	5	UPL			X			

Scientific Name	Common Name	C	W	Wetness	MB	DP	AT	P	TP	OM
<i>Elaeagnus umbellata</i>	Autumn olive	*	3	FACU			X		X	
<i>Eleocharis obtusa</i>	Spike-rush	3	-5	OBL	X	X	X		X	X
<i>Elymus canadensis</i>	Canada wild-rye	7	1	FAC-	X	X	X		X	X
<i>Epilobium hirsutum</i>	Hairy willow herb	*	-4	FACW+	X	X	X	X	X	X
<i>Equisetum fluviale</i>	Water horsetail	7	-5	OBL		X				
<i>Equisetum laevigatum</i>	Smooth scouring rush	2	-3	FACW		X		X	X	X
<i>Equisetum variegatum</i>	Variegated scouring rush	8	-3	FACW		X				
<i>Eupatorium maculatum</i>	Joe-Pye weed	4	-5	OBL	X	X	X	X	X	X
<i>Eupatorium perfoliatum</i>	Boneset	4	-4	FACW+	X	X	X		X	X
	Grass-leaved goldenrod	3	-2	FACW	X	X	X	X	X	X
<i>Euthamia graminifolia</i>	goldenrod	3	-2	FACW	X	X	X	X	X	X
<i>Festuca arundinacea</i>	Tall fescue	*	2	FACU+	X	X	X			X
<i>Fragaria virginiana</i>	Wild strawberry	2	1	FAC-	X	X				X
<i>Fraxinus nigra</i>	Black ash	6	-4	FACW+				X	X	X
<i>Galium palustre</i>	Marsh bedstraw	3	-5	OBL	X	X				X
<i>Galium tinctorium L.</i>	Stiff bedstraw	5	-5	OBL					X	
<i>Hieracium aurantiacum</i>	Orange hawkweed	8	5	UPL				X		
<i>Hieracium caespitosum</i>	King-Devil hawkweed	*	5	UPL	X	X		X	X	X
<i>Impatiens capensis</i>	Spotted touch-me-not	2	-3	FACW		X			X	X
<i>Juncus alpinus</i>	Rush	5	-5	OBL					X	X
<i>Juncus balticus</i>	Baltic rush	4	-5	OBL	X	X	X	X	X	X
<i>Juncus effusus</i>	Soft-stemmed rush	3	-5	OBL		X	X		X	
<i>Juncus marginatus</i>	Grass-leaved rush	8	-3	FACW	X	X				
<i>Lactuca canadensis</i>	Tall lettuce	2	2	FACU+	X	X	X	X		
<i>Lathyrus japonicus</i>	Beach pea	10	4	FACU-					X	
<i>Lathyrus sylvestris</i>	Everlasting pea	*	5	UPL				X		
<i>Lemna minor</i>	Lesser duckweed	5	-5	OBL		X				
<i>Liparis loeselii</i>	Leosel's Twayblade	5	-4	FACW+	X		X			
<i>Lobelia kalmii</i>	Kalm's Lobelia	10	-5	OBL		X				X
	Common water horehound	2	-5	OBL	X	X				X
<i>Lycopus americanus</i>	horehound	2	-5	OBL	X	X	X		X	X
<i>Lycopus uniflorus</i>	Northern Bugle weed	2	-5	OBL		X			X	X
<i>Lythrum salicaria</i>	Purple Loosestrife	*	-5	OBL		X			X	X
<i>Medicago lupulina</i>	Black medic	*	1	FAC-					X	
<i>Melilotus alba</i>	White sweet clover	*	3	FACU		X				
<i>Mentha spicata</i>	Spearmint	*	-4	FACW+	X		X	X		
<i>Myosotis scorpioides</i>	Forget-me-not	*	-5	OBL	X	X	X	X		
<i>Nasturtium officinale</i>	Watercress	*	-5	OBL	X	X	X			
	Common evening primrose	2	3	FACU	X	X	X		X	X
<i>Oenothera biennis</i>	primrose	2	3	FACU	X	X	X		X	X
	Panicum lindheimerigrass	8	-5	OBL					X	
<i>Panicum lindheimeri</i>	lindheimerigrass	8	-5	OBL					X	
<i>Phalaris arundinacea</i>	Reed canary	0	-4	FACW+	X	X	X	X	X	X
<i>Phragmites australis</i>	Phragmites	0	-4	FACW		X	X		X	X

Scientific Name	Common Name	C	W	Wetness	MB	DP	AT	P	TP	OM
<i>Poa palustris</i>	Fowl meadow grass	3	-4	FACW+	X	X	X	X		
<i>Polygonum lapathifolium</i>	Nodding smartweed Lady's thumb, heart's ease	0	-4	FACW+	X		X		X	
<i>Polygonum persicaria</i>		*	-3	FACW			X			X
<i>Populus balsamifera</i>	Balsam poplar	2	-3	FACW				X	X	X
<i>Populus deltoides</i>	Eastern cottonwood	1	-1	FAC+					X	X
<i>Populus tremuloides</i>	Trembling aspen	1	0	FAC				X		
<i>Potamogeton gramineus</i>	Variable pondweed	5	-5	OBL		X	X			
<i>Potentilla anserina</i>	Silverweed	5	-4	FACW+	X	X	X	X	X	X
<i>Prunella vulgaris</i>	Heal-all	0	0	FAC		X				
<i>Quercus alba</i>	White oak	5	3	FACU				X		
<i>Quercus rubra</i>	Red oak	5	3	FACU						X
<i>Ranunculus hispidus</i>	Swamp buttercup Ranunculus	5	0	FAC					X	
<i>Ranunculus sceleratus</i>	sceleratus	1	-5	OBL			X			
<i>Rubus fruticosus</i>	Blackberry	1	2	FACU+			X			
<i>Sagittaria latifolia</i>	Common arrowhead	1	-5	OBL		X				
<i>Salix amygdaloides</i>	Peach willow	3	-3	FACW	X			X	X	
<i>Salix bebbiana</i>	Bebb's willow	1	-4	FACW+						X
<i>Salix candida</i>	Hoary willow	9	-5	OBL	X				X	
<i>Salix cordata</i>	Sand-dune willow	10	-1	FAC+	X				X	
<i>Salix eriocephala</i>	Willow	2	-3	FACW		X			X	
<i>Salix exigua</i>	Sandbar willow	1	-5	OBL	X			X	X	X
<i>Salix myricoides</i>	Blue-leaved willow	9	-3	FACW		X			X	X
<i>Salix petiolaris</i>	Meadow willow	1	-4	FACW+	X	X	X	X	X	X
<i>Salix purpurea</i>	Basket willow	*	3	FACW					X	
<i>Salix pyrifolia</i>	Balsam willow	8	-4	FACW+					X	X
<i>Scirpus acutus</i>	Hard stem bulrush	5	-5	OBL	X		X	X		
<i>Scirpus americanus</i>	Three-square	10	-5	OBL	X	X	X	X	X	X
<i>Scirpus atrovirens</i>		3	-5	OBL	X	X	X			
<i>Scutellaria galericulata</i>	Marsh skullcap	5	-5	OBL			X			
<i>Sedum acre</i>	Sedum	*	5	UPL	X		X		X	
<i>Silene cucubalus</i>	Bladder champion	*	5	UPL	X				X	X
<i>Solidago canadensis</i>	Canada goldenrod	1	3	FACU	X	X	X	X	X	X
<i>Solidago rugosa</i>	Rough goldenrod Spiny leaved sow thistle	3	-1	FAC+		X	X			X
<i>Sonchus asper</i>		*	0	FAC		X				
<i>Sonchus oleraceus</i>	Common sow thistle	*	3	FACU	X	X	X			
<i>Taraxacum officinale</i>	Dandelion	*	3	FACU	X		X	X		X
<i>Teucrium canadense</i>	Germander	4	-2	FACW-				X		
<i>Thuja occidentalis</i>	White cedar	4	-3	FACW		X		X	X	
<i>Tragopogon dubius</i>	Goat's beard	*	5	UPL					X	X
<i>Trifolium pratense</i>	Red clover	*	2	FACU+		X	X	X		
<i>Typha angustifolia</i>	Narrow-leaved cattail	*	-5	OBL	X	X	X	X		X
<i>Typha latifolia</i>	Broad-leaved cattail	1	-5	OBL	X	X	X	X	X	X
<i>Typha xglauca</i>	Hybrid cattail	*	-5	OBL	X	X	X			

Scientific Name	Common Name	C	W	Wetness	MB	DP	AT	P	TP	OM
<i>Utricularia vulgaris</i>	Common bladderwort	6	-5	OBL		X	X			
<i>Verbena hastata</i>	Blue vervain	4	-4	FACW+	X	X				
<i>Veronica anagallis-aquatica</i>	Water speedwell	4	-5	Obl					X	X
	Thyme-leaved									
<i>Veronica serpyllifolia</i>	speedwell	0	-3	FACW			X			
<i>Vitis riparia</i>	Riverbank grape	3	-2	FACW-	X			X	X	X