A Survey and Characterization of Michigan's Coastal Fen Communities: Year One Progress Report

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EXECUTIVE SUMMARY

In 2009, Michigan Natural Features Inventory (MNFI) began a two-year project to study the biotic and abiotic characteristics and conservation status of coastal fen, an imperiled wetland community associated with the Great Lakes shoreline. MNFI biologists conducted vegetation sampling, floristic inventories, and rare species surveys at eight sites scattered across the range of the community in summer 2010. A total of 169 1 m x 1 m vegetation plots were sampled along a total of eight transect lines. Approximately 142 vascular plant species were identified in plots, and approximately 165 total vascular plant taxa, including 154 native taxa, were identified in the eight coastal fen sites during meander surveys. Vegetation at all sites was overwhelmingly dominated by herbs and shrubs <0.5 m in height, although sampling was biased towards characterizing ground layer structure. Primary threats to the ecological integrity of the sampled coastal fens were invasive species, off-road vehicle use, and hydrologic alteration.

Assessment of abiotic variables indicated the coastal fen sites were characterized by a diverse, patchy substrate of lacustrine sand, clay, limestone gravel and cobble, peat, and marl. All substrates ranged from circumneutral to moderately alkaline, reflecting the underlying limestone and dolostone substrates. Vegetation structure and dominance patterns were related to the nature of the substrate. Crayfish burrows, which may be an indicator of dragonfly presence, were generally uncommon, although one site was characterized by an abundance of burrows.

A total of nine new element occurrences were documented during the 2010 surveys, including five natural communities (three coastal fens, one northern fen, and one limestone cobble shore), and four populations of rare insects, consisting of two occurrences of a leafhopper (*Flexamia delongi*, state special concern), one occurrence of red-legged spittlebug (*Flexamia ignipectus*, state special concern), and one occurrence of Kansan leafhopper (*Dorydiella kansana*, state special concern). None of the rare insect species were previously identified as survey targets in coastal fen. A total of 15 previously documented element occurrences were updated, including seven natural communities and eight populations of rare plant taxa.

In 2011, additional coastal fen sites will be sampled and surveyed for rare taxa. Following the collection of plot data, statistical analyses will be used to compare all sites sampled in 2010 and 2011. Analyses will also focus on elucidating the relationship of vegetation structure and composition to soil characteristics, in order to gain better understanding of the several vegetation zones that typically occur in coastal fens. The collection and analysis of additional data will allow us to refine the classification of coastal fen, and will provide a valuable reference for the review of the state and global conservation status of the community.

INTRODUCTION

Coastal fen is a unique wetland community occurring on the Great Lakes shoreline that was recently described by the Michigan Natural Features Inventory (MNFI) (Kost et al. 2007, Cohen et al. 2010). This sedge-, rush-, and shrub-dominated community is restricted in Michigan to calcareous substrates along Lakes Huron and Michigan north of the climatic tension zone, where occurrences are concentrated in Mackinac, Charlevoix, Alpena, Cheboygan, and Presque Isle Counties (Kost et al. 2007, Cohen et al. 2010). Coastal fen occurs where marl and organic soils accumulate in protected coves and abandoned coastal embayments. The community supports a diversity of calciphilic plant species due to the limestone-derived soils.

At the inception of this study in 2009, fewer than 20 occurrences of coastal fen were documented across its North American range in Michigan, Wisconsin, and Ontario, Canada, and the community is considered globally and state imperiled (G1G2/S2; Appendix 1) due to the low number of documented sites (NatureServe 2010). Coastal fen is an important habitat that sustains considerable biodiversity, including seven vascular plant species and 14 animal species currently listed as endangered, threatened, or special concern in Michigan (Cohen et al. 2010; Table 1). Among these species are one federally threatened plant, Houghton's goldenrod (*Solidago houghtonii*), one federally endangered animal, Hine's emerald dragonfly (*Somatochlora hineana*), and one species that is a candidate for federal listing, eastern massasauga rattlesnake (*Sistrurus catenatus catenatus*). These species and the coastal fen community are threatened by a variety of factors, including shoreline development, drainage, off-road vehicle use, invasive species, and climate change. Among invasive species, common reed (*Phragmites australis*), narrow-leaved cat-tail (*Typha angustifolia*), hybrid cat-tail (*T.* x*glauca*), purple loosestrife (*Lythrum salicaria*), and glossy buckthorn (*Rhamnus frangula*) pose especially significant threats to the integrity of coastal fen (Cohen et al. 2010).

Table 1. Rare species associated with coastal fen, modified from Cohen et al. (2010).

Plant Species	**Common Name**	**State Status/Federal Status**
Cacalia plantaginea	prairie Indian-plantain	SC
Carex richardsonii	Richardson's sedge	SC
Carex scirpoidea	bulrush sedge	T
Drosera anglica	English sundew	SC
Iris lacustris	dwarf lake iris	T/T
Pinguicula vulgaris	butterwort	SC
Solidago houghtonii	Houghton's goldenrod	T/T
Animal Species	**Common Name**	**State Status/Federal Status**
Botaurus lentiginosus	American bittern	SC
Catinella exile	Pleistocene catinella	T
Circus cyaneus	northern harrier	SC
Emys blandingii	Blanding's turtle	SC
Euconulus alderi	land snail	T
Haliaeetus leucocephalus	bald eagle	SC
Pandion haliaetus	osprey	SC
Planogyra asteriscus	eastern flat-whorl	SC
Sistrurus c. catenatus	eastern massasauga	SC/candidate
Somatochlora hineana	Hine's emerald dragonfly	E/E
Somatochlora incurvata	incurvate emerald	SC
Vertigo elatior	tapered vertigo	SC
Vertigo morsei	six-whorl vertigo	E

Animal Species	Common Name	State Status/Federal Status
Vertigo pygmaea	crested vertigo	SC

The development of appropriate protection and restoration strategies for coastal fen relies on the availability of a current status assessment of the community and its associated biota. Thus, this two-year status assessment of coastal fen was designed to improve our understanding of coastal fen in Michigan, focused on the following objectives:

1) Characterize vegetative structure, composition, soils, and landscape context of previously identified coastal fen occurrences throughout the range of the community by sampling sites representing a range of quality,

2) Improve our understanding of rare biota associated with coastal fen by conducting systematic surveys for target species, including the federally endangered Hine's emerald dragonfly,

3) Identify, prioritize, and sample previously undocumented coastal fen occurrences through aerial photo interpretation of shoreline in the project area,

4) Produce detailed management and protection recommendations for coastal fen and associated rare biota, and

5) Revise classification and statewide and global conservation status of coastal fen.

METHODS

In 2010, surveys focused on coastal fens currently tracked in MNFI's statewide database. Many of these sites were classified as northern fen prior to the completion of an updated natural community classification (Kost et al. 2007). Sites were selected to encompass the entire known Michigan distribution of coastal fen, and to represent the range of element occurrence ranks. A total of eight sites were selected for vegetation sampling and rare species surveys, representing four counties and two ecoregional sub-subsections (Albert 1995) (Table 2, Figure 1).

Table 2. 2010 sample sites.

Survey Site	County	Ecoregional Sub-subsection	Community Type (pre-study)	EO Rank (pre-study)
El Cajon Bay	Alpena	VII.6.3	Coastal Fen	A
Whitefish Bay	Alpena	VII.6.3	Great Lakes Marsh	BC
Squaw Bay	Alpena	VII.6.3	Coastal Fen/Great Lakes Marsh	B
Thompson's Harbor	Presque Isle	VII.6.3	Coastal Fen	A
Waugoshance Point	Emmet	VII.6.3	Coastal Fen/Great Lakes Marsh	A
Dudley Bay East	Mackinac	VIII.1.1	undocumented	undocumented
Dudley Bay West	Mackinac	VIII.1.1	Coastal Fen	B
St. Martin Point	Mackinac	VIII.1.1	undocumented	undocumented

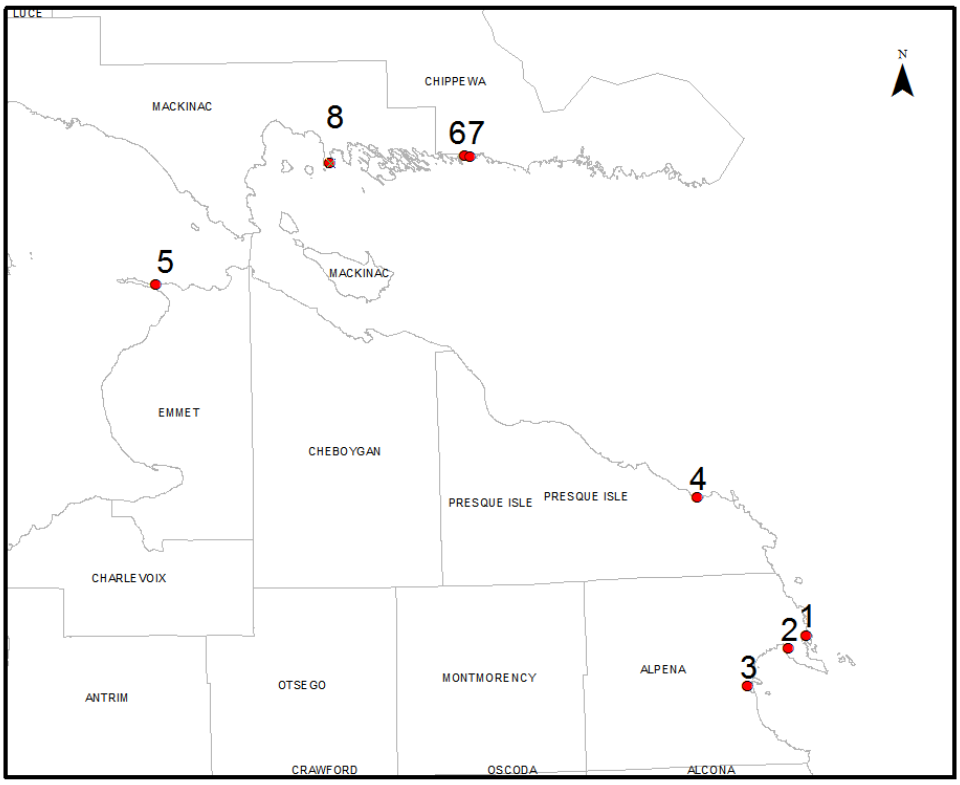

Figure 1. Map of sampled coastal fen sites. 1, El Cajon Bay; 2, Whitefish Bay; 3, Squaw Bay; 4, Thompson's Harbor; 5, Waugoshance Point; 6, Dudley Bay West; 7, Dudley Bay East; 8, St. Martin Point.

Vegetation and Environmental Sampling

At each site, a belt transect of variable length was placed from the inland margin of the open coastal wetland feature to the shoreline. Belt transects were placed roughly perpendicular to the shoreline in order to adequately sample different vegetation zones that often develop parallel to the shoreline in response to water levels. Belt transects were placed subjectively within each site to traverse the maximum number of vegetation zones per transect. Emphasis was placed on characterizing low shrub and ground layer vegetation, as tall shrub and tree distribution was highly variable and patchy within each site. Each belt transect was sampled using a 1 m x 1 m sampling frame, placed at random one-meter intervals on a randomly selected side of the transect. Plot locations were determined using a random numbers table consisting of values from 1-10 or 1-20 based on the length of the transect. Sample frequency was designed to capture multiple vegetation plots per vegetation zone.

In each plot, all vascular plant species were identified, and percent cover was visually estimated for each species. Species not identified in the field were collected for later identification. Cover values were separated into five strata: ground layer, low shrub (0.5-1 m height), tall shrub (1-3 m height), understory (3-10 m height), and overstory (>10 m height). Cover of shrub and tree species were visually estimated for each stratum present in each plot. Shrub and tree cover were

also estimated using line-intercept data, in which the total linear coverage of each shrub or tree species >0.5 m in height that intersected the transect line was measured.

Other environmental variables visually estimated within each plot included percent moss cover, percent bare mineral soil cover, percent marl cover, percent bare peat cover, percent cobble cover, percent wood cover, and percent open water. Average water depth, measured in centimeters, was assessed by placing a metric ruler in the inundated zone of each plot, averaging multiple measurements if water depth varied within the plot. The number of crayfish burrows was counted in each plot. Crayfish burrows are utilized by larvae of the federally endangered Hine's emerald dragonfly (*Somatochlora hineana*), and may serve as indicators of potential habitat for that species (Lee et al. 2006). A 1.5 m soil auger was used to assess the soil profile within each distinctive vegetation zone along each transect. Soil type, texture, pH, and depth of organic or marl layer(s) was recorded for each soil sample.

Following transect sampling, meander surveys were conducted to develop comprehensive vascular plant species lists. These lists serve to characterize the botanical diversity of each site, and can be used to determine whether plot sample intensity was sufficient to capture the majority of the plant species present at a site. In addition, meander surveys were conducted for rare plant species associated with coastal fen (Table 1).

Sample Data Analysis

For each plot, the following summary data were calculated:

1) total # species
2) vascular plant cover
    a. overall vascular plant cover
    b. ground layer cover
    c. shrub 0.5-1m cover
    d. shrub/tree 1-3m cover
    e. shrub/tree 3-10m cover
    f. overall 0.5m+ shrub/tree cover

For each site, the following summary data were calculated:

1) total # species
2) average # species per plot
2) range in species number per plot
3) species frequency
4) species relative frequency
5) species average cover
6) species total cover
7) species relative cover
8) species importance value (Kron 1989)
9) Floristic Quality Assessment (Herman et al. 2001)
10) average percent moss cover
11) average percent bare mineral soil cover
12) average percent bare peat soil cover
13) average percent wood cover
14) average percent cobble cover
15) average percent open water cover

16) average depth of water
17) average number of crayfish burrows

Following completion of 2011 sampling, additional data analyses will be conducted to elucidate relationships of vascular plant species presence and cover to environmental variables, and to compare coastal fen sites across the range of distribution following the collection of data from additional sites. In addition, line-intercept data on shrub and tree cover will be analyzed and compared to plot-based results.

Rare Animal Surveys

The main emphasis of the study was to characterize the vegetation and abiotic characteristics associated with coastal fen. However, once transect sampling was completed at each site, targeted surveys for rare animals was conducted. Because of the one-time visit to the site, only those rare species that had the best chance of occurring at a site were targeted (Table 1). At all times, however, we recorded incidental findings of rare species. For some of the bird species, presence was noted, but presence alone does not meet the specifications for Element Occurrence (EO) status. For example, we noted merlins at Dudley Bay East, but did not discover their nest site, which is required for EO status.

At all sites, we used meander surveys within the coastal fen habitat to identify dragonflies and butterflies. All species were recorded either by observation with close-focusing binoculars or netting with an aerial insect net, followed by identification and release. Some individuals were collected as voucher specimens. Some rare insects (such as spittlebugs and leafhoppers) are best sampled through a process known as sweep sampling. A standard sweep sample consisted of approximately 100 swings of a sweepnet, with one swing taken with each step. Warm season grasses and other specific host plants were swept when encountered during either the vegetation transect surveys or while meandering through the site to complete the plant species lists. The contents of the net were emptied into a large killing jar charged with ethyl acetate. When the specimens had stopped moving they were transferred to a zip-lock plastic bag and placed into a cooler. Bagged samples were then frozen until they could be processed later in the lab. Processing consisted of sorting all insects from the vegetation, pinning larger specimens, and pointing smaller ones. Those specimens that appeared similar to the targeted rare elements were labeled and keyed or directly compared to specimens contained in the Michigan Natural Features Inventory Reference Collection. All insect vouchers are currently in the MNFI Insect Reference Collection, Rose Lake Research Center, Bath, Michigan. Due to the intensity of the surveys we spent several hours at most of the sites, and at least one insect sweep sample was taken at every site.

RESULTS

Vegetation and Environmental Sampling

Across all sites, the number of species per plot ranged from 0-27, and average number of species per plot ranged from 7.7 at Waugoshance Point to 15.3 at Thompson’s Harbor (Table 3). Average total vascular plant cover ranged from 31.4% per plot at El Cajon Bay to 60.1% per plot at Thompson’s Harbor (Table 4). At all sites, the majority of vascular plant cover was comprised of ground layer species.

Table 3. Minimum, maximum, and average number of vascular plant species per plot per site.

Site	Min # species	Max # species	Avg # species
El Cajon Bay	4	23	12.1
Whitefish Bay	3	23	12.0
Squaw Bay	3	17	8.9
Thompson's Harbor	7	27	15.3
Waugoshance Point	0	16	7.7
Dudley Bay West	8	19	11.7
Dudley Bay East	4	22	13.1
St. Martin Point	4	25	14.5
Totals	**0**	**27**	**11.9**

Table 4. Average vascular plant cover (%) of each stratum per site.

Site	Ground layer cover	Shrub cover 0.5-1m	Shrub cover 1-3m	Shrub/tree cover 3-10m	Total vascular plant cover
El Cajon Bay	30.2	0.3	0.9	0.0	31.4
Whitefish Bay	32.4	0.3	4.5	0.0	37.2
Squaw Bay	36.5	0.0	1.6	0.0	38.l
Thompson's Harbor	57.2	2.9	0.0	0.0	60.1
Waugoshance Point	36.9	0.6	0.0	0.0	37.5
Dudley Bay West	38.6	5.9	8.6	2.5	55.7
Dudley Bay East	32.3	7.3	1.5	0.0	41.0
St. Martin Point	54.1	2.9	0.0	0.0	57.0
Averages	**39.8**	**2.5**	**2.1**	**0.3**	**44.8**

Four species occurred in greater than 50% of all plots: twig-rush (*Cladium mariscoides*), shrubby cinquefoil (*Potentilla fruticosa*), Ohio goldenrod (*Solidago ohioensis*), and beak-rush (*Rhynchospora capillacea*) (Table 5). Eleven species averaged >1% cover, led by twig-rush, beak-rush, beaked spike-rush (*Eleocharis rostellata*), and shrubby cinquefoil (Table 6). The most important species, as determined by averaging relative cover and relative frequency, were twig-rush, beak-rush, shrubby cinquefoil, and beaked spike-rush (Table 7). For each site, the ten most frequently encountered species, ten species comprising greatest average cover, and ten most important species are provided in tables in the individual site descriptions below. An overall list of all vascular plant species sampled ranked by importance value is provided in Appendix 2.

Table 5. Eleven most frequently encountered vascular plant species, overall.

Species	Common name	Frequency (%)
Cladium mariscoides	twig-rush	72.8
Potentilla fruticosa <0.5m	shrubby cinquefoil	65.1
Solidago ohioensis	Ohio goldenrod	64.5
Rhynchospora capillacea	beak-rush	52.7
Thuja occidentalis <0.5m	northern white-cedar	46.2
Hypericum kalmianum <0.5m	Kalm's St. John's-wort	45.6
Parnassia glauca	grass-of-Parnassus	37.3
Panicum lindheimeri	panic grass	37.3
Juncus balticus	Baltic rush	36.7
Eleocharis rostellata	beaked spike-rush	34.9
Schoenoplectus pungens	three-square	34.9

Table 6. Vascular plant species comprising >1% average cover, overall.

Species	Common name	Average cover (%)
Cladium mariscoides	twig-rush	7.7
Rhynchospora capillacea	beak-rush	7.7
Eleocharis rostellata	beaked spike-rush	4.9
Potentilla fruticosa <0.5m	shrubby cinquefoil	3.8
Solidago ohioensis	Ohio goldenrod	2.1
Juncus balticus	Baltic rush	2.1
Calamagrostis canadensis	bluejoint grass	1.5
Thuja occidentalis 1-3m	northern white-cedar	1.2
Myrica gale <0.5m	sweet gale	1.1
Potentilla fruticosa 0.5-1m	shrubby cinquefoil	1.1
Sarracenia purpurea	pitcher-plant	1.0

Table 7. Ten most important vascular plant species, overall.

Species	Common name	Relative Cover (%)	Relative Frequency (%)	Importance Value
Cladium mariscoides	twig-rush	18.2	6.1	12.2
Rhynchospora capillacea	beak-rush	18.1	4.4	11.2
Potentilla fruticosa <0.5m	shrubby cinquefoil	9.1	5.5	7.3
Eleocharis rostellata	beaked spike-rush	11.6	2.9	7.3
Solidago ohioensis	Ohio goldenrod	4.9	5.4	5.2
Juncus balticus	Baltic rush	4.9	3.1	4.0
Calamagrostis canadensis	bluejoint grass	3.5	1.7	2.6
Thuja occidentalis <0.5m	northern white-cedar	0.9	3.9	2.4
Sarracenia purpurea	pitcher-plant	2.4	2.1	2.3
Hypericum kalmianum <0.5m	Kalm's St. John's-wort	0.3	3.8	2.1

Nearly half of total plots contained moss cover. Bare mineral soil and marl were encountered in approximately 25% of plots; unvegetated peat, cobble, and wood were less frequently encountered (Table 8). Approximately 30% of plots were at least partially inundated, although water depths were typically shallow. Site-specific environmental data and substrate descriptions are provided in the individual site descriptions.

Table 8. Environmental variables, frequency and average value per plot, overall.

Environmental variable	Frequency (%)	Average % cover
Moss cover	47.9	8.7
Unvegetated mineral soil	24.9	3.8
Unvegetated marl	26.6	1.6
Unvegetated peat	3.6	0.1
Unvegetated cobble	13.0	4.6
Unvegetated wood	8.9	1.2
Open water	29.6	17.4
Water depth	29.6	1.3 cm
Crayfish burrows	12.4	0.3 burrows

The number of native vascular plant species per site (not counting species identified only to genus) ranged from 54 to 99 (Table 9). Native mean *C* values were similar among sites, ranging from 6.0 to 6.9. Native FQI ranged from 47.2 to 62.8 (Table 9). Complete Floristic Quality

Assessments for each site are provided in Appendix 3. A total of approximately 165 vascular plant taxa were documented within the eight sites, including 153 native taxa and 12 adventive taxa (Appendix 4).

Table 9. Floristic Quality Assessment (FQA) summary for all sites.

Site	Native species	Total species*	Native mean C	Mean C with adventives	Native FQI	FQI with adventives
El Cajon Bay	73	76	6.5	6.3	55.9	54.8
Whitefish Bay	70	74	6.9	6.5	57.8	56.3
Squaw Bay	61	62	6.2	6.1	48.8	48.4
Thompson's Harbor	99	103	6.3	6.1	62.8	61.6
Waugoshance Point	54	54	6.4	6.4	47.2	47.2
Dudley Bay West and East	77	79	6.0	5.8	52.3	51.6
St. Martin Point	75	76	6.1	6.1	53.2	52.9
Averages	**72.7**	**74.9**	**6.3**	**6.2**	**54.0**	**53.3**

*Total species does not include species identified to genus only (the totals reported in the individual site descriptions include all species, including unidentified species, and thus deviate slightly from the numbers reported above).

Rare Element Surveys

A total of nine new element occurrences were identified during 2010 surveys, including five communities and four rare insect populations (Table 10). In addition to the new occurrences, a total of 15 previously identified element occurrences were encountered, including seven coastal fens and eight rare plant populations. Tables of all newly documented and updated element occurrences for each site are provided in the individual site descriptions. Data for newly documented and updated element occurrences will be transcribed and entered into the MNFI Biotics database. A summary of all animal species observed in the coastal fens is provided in Appendix 5.

Table 10. Newly documented element occurrences, 2010.

Site	Scientific name	Common name	State Status
El Cajon Bay	*Dorydiella kansana*	Kansan leafhopper	SC; S1S2
	Prosapia ignipectus	red-legged spittlebug	SC; S2S3
Whitefish Bay	coastal fen		S2
	northern fen		S2
	Flexamia delongi	leafhopper	SC; S1S2
Dudley Bay East	coastal fen		S2
St. Martin Point	coastal fen		S2
	limestone cobble shore		S3
	Flexamia delongi	leafhopper	SC; S1S2

EL CAJON BAY
T31N R09E S27, 15, 14, 22, 23, 26
Alpena County

El Cajon Bay supports an extensive coastal fen developed in a series of protected embayments. The community grades to Great Lakes marsh lakeward and rich conifer swamp landward. The coastal fen at this site occurs on fine lacustrine sands which are overlain in much of the area by moderately to strongly alkaline marl of variable depth. Limestone bedrock occurs at a shallow depth. Several vegetation zones are present, including marl flats and extensive alkaline sand flats.

Vegetation and Environmental Data

A total of 48 vascular plant species were encountered in plots along a 200-meter belt transect (Figure 2), comprising 62% of the 78 species identified in a meander survey of the site (Appendix 3a). Six species (13%) were encountered in 50% or more of the plots (Table 11). No species averaged greater than 10% cover; eight species averaged 1% or greater cover (Table 12). Beak-rush (*Rhynchospora capillacea*) and spike-rush (*Eleocharis rostellata*) are the most important species, closely followed by twig-rush (*Cladium mariscoides*) and shrubby cinquefoil (*Potentilla fruticosa*) (Table 13).

Figure 2. El Cajon Bay coastal fen and transect line.

Table 11. Ten most frequently encountered vascular plant species, El Cajon Bay.

Species	Common name	Frequency (%)
Cladium mariscoides	twig-rush	97.1
Solidago ohioensis	Ohio goldenrod	82.9
Rhynchospora capillacea	beak-rush	74.3
Potentilla fruticosa <0.5m	shrubby cinquefoil	71.4
Eleocharis rostellata	spike-rush	68.6
Juncus brachycephalus	rush	62.9
Thuja occidentalis <0.5m	northern white-cedar	48.6
Sarracenia purpurea	pitcher-plant	42.9
Parnassia glauca	grass-of-Parnassus	42.9
Hypericum kalmianum <0.5m	Kalm's St. John's-wort	42.9

Table 12. Ten vascular plant species with highest average cover, El Cajon Bay.

Species	Common name	Average cover (%)
Rhynchospora capillacea	beak-rush	6.7
Eleocharis rostellata	spike-rush	5.7
Potentilla fruticosa <0.5m	shrubby cinquefoil	3.6
Cladium mariscoides	twig-rush	3.2
Juncus balticus	Baltic rush	2.6
Sarracenia purpurea	pitcher-plant	2.1

Species	Common name	Average cover (%)
Solidago ohioensis	Ohio goldenrod	1.4
Calamagrostis canadensis	bluejoint grass	1.0
Thuja occidentalis 1-3m	northern white-cedar	0.9
Thuja occidentalis <0.5m	northern white-cedar	0.6

Table 13. Ten most important vascular plant species, El Cajon Bay.

Species	Common name	Relative Cover (%)	Relative Frequency (%)	Importance Value
Rhynchospora capillacea	beak-rush	22.1	6.4	14.2
Eleocharis rostellata	spike-rush	18.9	5.9	12.4
Cladium mariscoides	twig-rush	10.6	8.3	9.4
Potentilla fruticosa <0.5m	shrubby cinquefoil	11.7	6.1	8.9
Juncus balticus	Baltic rush	8.7	4.6	6.7
Solidago ohioensis	Ohio goldenrod	4.7	7.1	5.9
Sarracenia purpurea	pitcher-plant	6.7	3.7	5.2
Juncus brachycephalus	rush	1.1	5.4	3.2
Thuja occidentalis <0.5m	northern white-cedar	1.9	4.2	3.0
Calamagrostis canadensis	bluejoint grass	3.4	1.0	2.2

Among environmental variables, El Cajon Bay was characterized by widespread bare marl, though it comprised low average coverage (Table 14). Fifty crayfish burrows were documented from plots in this site, by far the most burrows observed during 2010 surveys.

Table 14. Environmental variables, frequency and average value per plot, El Cajon Bay.

Environmental variable	Frequency (%)	Average % cover
Moss cover	42.9	3.8
Unvegetated mineral soil	22.9	6.3
Unvegetated marl	62.9	3.3
Unvegetated peat	0	0
Unvegetated cobble	14.3	0.2
Unvegetated wood	0	0
Open water	2.9	0.1
Water depth	2.9	0.0 cm
Crayfish burrows	54.3	1.4 burrows

Element Occurrences

The known occurrences for coastal fen and dwarf lake iris were updated in 2010. In addition, two new occurrences for rare insects were documented at El Cajon Bay (Table 15).

Table 15. Known and newly documented element occurrences, El Cajon Bay.

Community/species	Common name	State Status	Year First Observed	Year Last Observed
Coastal fen		S2	1989	2010
Iris lacustris	dwarf lake iris	T/LT	1981	2010
Dorydiella kansana	Kansan leafhopper	SC	2010	2010
Prosapia ignipectus	red-legged spittlebug	SC	2010	2010

WHITEFISH BAY
T31N R09E S29, 20, 17, 19
Alpena County

Whitefish Bay supports extensive development of coastal fen on moderately alkaline marl and sandy marl over lacustrine sands. This site is notable for the high percentage of standing water over much of the fen surface. In addition, portions of the fen are impacted by dumped and/or lake-deposited logs and stumps, which provide substrate for plant species that are otherwise restricted to relatively dry sedge hummocks within the marl flats. Although marl flats are the most important vegetation zone, open and forested low cobble rises within the fen provide substrate for a significant number of plant species not found elsewhere in the fen. This site is at least partly protected from wind, wave, and ice action by a low open dune ridge near the shoreline.

Vegetation and Environmental Data

A total of 60 vascular plant species were encountered in plots along the 230-meter belt transect (Figure 3), comprising 78% of the 77 species identified in a meander survey of the site (Appendix 3b). Six species (10%) were encountered in 50% or more of the plots (Table 16). One species averaged greater than 10% cover; eight species averaged 1% or greater cover (Table 17). Spike-rush (*Eleocharis rostellata*) was by far the most important species, due largely to its high relative cover (Table 18).

Figure 3. Whitefish Bay coastal fen and transect line.

Table 16. Ten most frequently encountered vascular plant species, Whitefish Bay.

Species	Common name	Frequency (%)
Eleocharis rostellata	spike-rush	85.2
Potentilla fruticosa <0.5m	shrubby cinquefoil	70.4
Schoenoplectus pungens	three-square	63.0
Parnassia glauca	grass-of-Parnassus	59.3
Sarracenia purpurea	pitcher-plant	55.6
Solidago ohioensis	Ohio goldenrod	51.9
Thuja occidentalis <0.5m	northern white-cedar	48.2
Cladium mariscoides	twig-rush	44.4
Rhynchospora alba	white beak-rush	44.4
Juncus balticus	Baltic rush	40.7

Table 17. Ten vascular plant species with highest average cover, Whitefish Bay.

Species	Common name	Average cover (%)
Eleocharis rostellata	spike-rush	20.6
Larix laricina 1-3m	tamarack	2.4
Thuja occidentalis 1-3m	northern white-cedar	2.1
Schoenoplectus pungens	three-square	1.8
Juncus balticus	Baltic rush	1.6
Trichophorum cespitosum	tufted bulrush	1.4
Sarracenia purpurea	pitcher-plant	1.2

Species	Common name	Average cover (%)
Potentilla fruticosa <0.5m	shrubby cinquefoil	1.0
Carex stricta	tussock sedge	0.9
Rhynchospora capillacea	beak-rush	0.9

Table 18. Ten most important vascular plant species, Whitefish Bay.

Species	Common name	Relative Cover (%)	Relative Frequency (%)	Importance Value
Eleocharis rostellata	spike-rush	53.2	6.8	30.0
Schoenoplectus pungens	three-square	4.7	5.0	4.9
Potentilla fruticosa <0.5m	shrubby cinquefoil	2.7	5.6	4.2
Sarracenia purpurea	pitcher-plant	3.1	4.5	3.8
Juncus balticus	Baltic rush	4.1	3.3	3.7
Larix laricina 1-3m	tamarack	6.2	0.6	3.4
Trichophorum cespitosum	tufted bulrush	3.7	2.7	3.2
Thuja occidentalis 1-3m	northern white-cedar	5.4	0.9	3.1
Rhynchospora alba	white beak-rush	1.6	3.6	2.6
Parnassia glauca	grass-of-Parnassus	0.3	4.8	2.5

Among environmental variables, Whitefish Bay was characterized by significant areas of woody substrate (mostly artificial) and open water (Table 19). Only one crayfish burrow was observed in the sample plots.

Table 19. Environmental variables, frequency and average value per plot, Whitefish Bay.

Environmental variable	Frequency (%)	Average % cover
Moss cover	51.9	3.7
Unvegetated mineral soil	7.4	2.3
Unvegetated marl	18.5	0.4
Unvegetated peat	7.4	0.1
Unvegetated cobble	0	0
Unvegetated wood	44.4	7.2
Open water	77.8	42.5
Water depth	77.8	3.1 cm
Crayfish burrows	3.7	0.1 burrows

Element Occurrences

The previously documented Great Lakes marsh at this site was remapped and reclassified as coastal fen based on the 2010 survey. In addition, a small area of the previously mapped Great Lakes marsh was reclassified as northern fen. The previously documented population of dwarf lake iris was observed in 2010, and a population of a rare leafhopper was discovered (Table 20).

Table 20. Known and newly documented element occurrences, Whitefish Bay.

Community/species	Common name	State Status	Year First Observed	Year Last Observed
Great Lakes marsh		S3	1989	2010*
Coastal fen		S2	2010	2010
Northern fen		S3	2010	2010
Iris lacustris	dwarf lake iris	T/LT	1895	2010

Community/species	Common name	State Status	Year First Observed	Year Last Observed
Flexamia delongi	leafhopper	SC	2010	2010

*Great Lakes marsh reclassified as coastal fen and northern fen based on 2010 survey.

Extensive marl flats with interspersed peat hummocks characterize much of the coastal fen at Whitefish Bay.

SQUAW BAY
T30N R08E S15, 9, 16
Alpena County

Squaw Bay supports an extensive coastal fen developed in a large protected embayment. The community grades to Great Lakes marsh lakeward and rich conifer swamp and boreal forest landward. US-23 bisects the wetland and has significantly disrupted the natural hydrologic regime. The coastal fen at this site occurs on mildly to moderately alkaline fine lacustrine sands that are overlain in places by a thin layer of sapric peat. The fen is primarily characterized by open, low diversity alkaline sand flats, with hummock development concentrated in areas of groundwater seepage near the inland margin.

Vegetation and Environmental Data

A total of 37 vascular plant species were encountered in plots along the 300-meter belt transect (Figure 4), comprising 57% of the 65 species identified in a meander survey of the site (Appendix 3c). Five species (14%) were encountered in 50% or more of the plots (Table 21). Two species averaged greater than 10% cover; five species averaged 1% or greater cover (Table 22). Twig-rush (*Cladium mariscoides*) and beak-rush (*Rhynchospora capillacea*) were the most important species, comprising nearly 80% of total vascular plant cover (Table 23).

Figure 4. Squaw Bay coastal fen and transect.

Table 21. Ten most frequently encountered vascular plant species, Squaw Bay.

Species	Common name	Frequency (%)
Cladium mariscoides	twig-rush	100.0
Lycopus uniflorus	northern bugleweed	68.0
Rhynchospora capillacea	beak-rush	64.0
Panicum lindheimeri	panic grass	56.0
Solidago ohioensis	Ohio goldenrod	56.0
Calamagrostis canadensis	bluejoint grass	48.0
Carex livida	livid sedge	48.0
Hypericum kalmianum <0.5m	Kalm's St. John's-wort	48.0
Equisetum variegatum	variegated scouring rush	40.0
Potentilla fruticosa <0.5m	shrubby cinquefoil	40.0

Table 22. Ten vascular plant species with highest average cover, Squaw Bay.

Species	Common name	Average cover (%)
Cladium mariscoides	twig-rush	19.3
Rhynchospora capillacea	beak-rush	10.9
Myrica gale <0.5m	sweet gale	2.0
Alnus rugosa 1-3m	tag alder	1.6
Carex livida	livid sedge	1.5
Potentilla fruticosa <0.5m	shrubby cinquefoil	0.9
Sarracenia purpurea	pitcher-plant	0.6

Species	Common name	Average cover (%)
Rhynchospora alba	white beak-rush	0.3
Solidago ohioensis	Ohio goldenrod	0.2
Thuja occidentalis <0.5m	northern white-cedar	0.2

Table 23. Ten most important vascular plant species, Squaw Bay.

Species	Common name	Relative Cover (%)	Relative Frequency (%)	Importance Value
Cladium mariscoides	twig-rush	50.6	11.2	30.9
Rhynchospora capillacea	beak-rush	28.7	7.1	17.9
Carex livida	livid sedge	4.0	5.4	4.7
Myrica gale <0.5m	sweet gale	5.3	4.0	4.7
Lycopus uniflorus	northern bugleweed	0.1	7.6	3.8
Potentilla fruticosa <0.5m	shrubby cinquefoil	2.4	4.5	3.4
Solidago ohioensis	Ohio goldenrod	0.6	6.3	3.4
Panicum lindheimeri	panic grass	0.0	6.3	3.1
Calamagrostis canadensis	bluejoint grass	0.4	5.4	2.9
Hypericum kalmianum <0.5m	Kalm's St. John's-wort	0.2	5.4	2.8

Among environmental variables, only unvegetated marl was observed in greater than 50% of plots, and it comprised low coverage (Table 24). No crayfish burrows were observed in the sample plots.

Table 24. Environmental variables, frequency and average value per plot, Squaw Bay.

Environmental variable	Frequency (%)	Average % cover
Moss cover	20.0	1.2
Unvegetated mineral soil	24.0	0.6
Unvegetated marl	56.0	1.7
Unvegetated peat	0	0
Unvegetated cobble	0	0
Unvegetated wood	8.0	0.1
Open water	28.0	12.5
Water depth	28.0	0.4 cm
Crayfish burrows	0	0.0 burrows

Element Occurrences

The previously documented occurrences of coastal fen and Great Lakes marsh at this location were updated in 2010 (Table 25). In addition, eastern massasauga (*Sistrurus catenatus catenatus*) was documented within or near the coastal fen in a separate site visit in 2010.

Table 25. Known and newly documented element occurrences, Squaw Bay.

Community/species	Common name	State Status	Year First Observed	Year Last Observed
Coastal fen		S2	1996	2010
Great Lakes marsh		S3	1981	2010
Iris lacustris	dwarf lake iris	T/LT	1981	1987
Sistrurus c. catenatus	eastern massasauga	SC	2010	2010
Sterna hirundo	common tern	T	1962	1962

THOMPSON'S HARBOR
T34N R07E S15, 9, 16
Presque Isle County

Thompson's Harbor supports a species-rich, well-zoned coastal fen in a narrow protected embayment, where it is associated with Great Lakes marsh, limestone cobble shore, and boreal forest. The coastal fen has developed on moderately alkaline lacustrine deposits, with areas of marl concentrated near the inland margin of the embayment, and patchy zones of sapric peats, often associated with underlying limestone cobble. Vegetative zones include marl flats with sedge-dominated hummocks, broad, low peat mounds, and shallowly inundated sandy flats with emergent vegetation.

Vegetation and Environmental Data

A total of 76 vascular plant species were encountered in plots along the 200-meter belt transect (Figure 5), comprising 69% of the 110 species identified in a meander survey of the site (Appendix 3d). Eight species (11%) were encountered in 50% or more of the plots (Table 26). One species averaged greater than 10% cover; 12 species averaged 1% or greater cover (Table 27). Beak-rush (*Rhynchospora capillacea*) was the most important species, due largely to its high relative cover (Table 28).

Figure 5. Thompson's Harbor coastal fen and transect.

Table 26. Ten most frequently encountered vascular plant species, Thompson's Harbor.

Species	Common name	Frequency (%)
Solidago ohioensis	Ohio goldenrod	81.0
Potentilla fruticosa <0.5m	shrubby cinquefoil	71.4
Schoenoplectus pungens	three-square	66.7
Hypericum kalmianum <0.5m	Kalm's St. John's-wort	61.9
Parnassia glauca	grass-of-Parnassus	61.9
Rhynchospora capillacea	beak-rush	57.1
Muhlenbergia glomerata	marsh wild-timothy	57.1
Lobelia kalmii	Kalm's lobelia	52.4
Thuja occidentalis <0.5m	northern white-cedar	47.6
Sarracenia purpurea	pitcher-plant	42.9

Table 27. Ten vascular plant species with highest average cover, Thompson's Harbor.

Species	Common name	Average cover (%)
Rhynchospora capillacea	beak-rush	20.1
Calamagrostis canadensis	bluejoint grass	9.9
Juncus balticus	Baltic rush	5.8
Solidago ohioensis	Ohio goldenrod	3.0
Sarracenia purpurea	pitcher-plant	2.4
Potentilla fruticosa <0.5m	shrubby cinquefoil	2.1

Species	Common name	Average cover (%)
Hypericum kalmianum 0.5-1m	Kalm's St. John's-wort	2.0
Eleocharis rostellata	spike-rush	1.5
Rhynchospora alba	white beak-rush	1.4
Carex flava	yellow sedge	1.3

Table 28. Ten most important vascular plant species, Thompson's Harbor.

Species	Common name	Relative Cover (%)	Relative Frequency (%)	Importance Value
Rhynchospora capillacea	beak-rush	33.3	3.7	18.5
Calamagrostis canadensis	bluejoint grass	16.4	1.8	9.1
Juncus balticus	Baltic rush	9.6	2.4	6.0
Solidago ohioensis	Ohio goldenrod	5.0	5.2	5.1
Potentilla fruticosa <0.5m	shrubby cinquefoil	3.5	4.6	4.0
Sarracenia purpurea	pitcher-plant	3.9	2.7	3.3
Schoenoplectus pungens	three-square	1.0	4.3	2.6
Hypericum kalmianum <0.5m	Kalm's St. John's-wort	0.6	4.0	2.3
Carex flava	yellow sedge	2.2	2.1	2.2
Parnassia glauca	grass-of-Parnassus	0.4	4.0	2.2

Among environmental variables, Thompson's Harbor was characterized by significant areas of moss cover (Table 29). Only one crayfish burrow was observed in the sample plots.

Table 29. Environmental variables, frequency and average value per plot, Thompson's Harbor.

Environmental variable	Frequency (%)	Average % cover
Moss cover	61.9	23.2
Unvegetated mineral soil	23.8	0.7
Unvegetated marl	9.5	0.1
Unvegetated peat	9.5	0.1
Unvegetated cobble	0	0
Unvegetated wood	0	0
Open water	19.1	9.0
Water depth	19.1	0.5 cm
Crayfish burrows	4.8	0.0 burrows

Element Occurrences

Four previously documented element occurrences at this location were redocumented during 2010 surveys (Table 30). A fifth rare element known from this site, bulrush sedge (*Carex scirpoidea*), was not documented in 2010.

Table 30. Known and newly documented element occurrences, Thompson's Harbor (coastal fen area only).

Community/species	Common name	State Status	Year First Observed	Year Last Observed
Coastal fen		S2	1987	2010
Cacalia plantaginea	prairie Indian-plantain	SC	1987	2010
Iris lacustris	dwarf lake iris	T/LT	1977	2010
Pinguicula vulgaris	butterwort	SC	1987	2010

WAUGOSHANCE POINT
T39N R06W S25, 23, 24; T39N R05W S19, 30
Emmet County

Waugoshance Point is an extensive complex of several natural communities developed on a headland at the western margin of Wilderness State Park. Here, coastal fen is interspersed within a broad area of limestone cobble shore and Great Lakes marsh, and abuts open dunes, interdunal wetland, and boreal forest. Significant substrate heterogeneity characterizes the coastal fen, which has developed on moderately alkaline lacustrine sands, gravels, and cobble, with local marl accumulation in areas protected from frequent wind, wave, and ice action. The vegetative communities here exhibit broad, patchy zonation, with coastal fen best developed where layers of fine sediments overlie cobble.

Vegetation and Environmental Data

A total of 32 vascular plant species were encountered in plots along the 200-meter belt transect (Figure 6), comprising 57% of the 58 species identified in a meander survey of the site (Appendix 3e). Four species (13%) were encountered in 50% or more of the plots (Table 31). One species averaged greater than 10% cover; four species averaged 1% or greater cover (Table 32). Twig-rush (*Cladium mariscoides*) was by far the most important species, followed by Ohio goldenrod (*Solidago ohioensis*), beak-rush (*Rhynchospora capillacea*), and shrubby cinquefoil (*Potentilla fruticosa*) (Table 33).

Figure 6. Waugoshance Point coastal fen and transect.

Table 31. Ten most frequently encountered vascular plant species, Waugoshance Point.

Species	Common name	Frequency (%)
Cladium mariscoides	twig-rush	68.4
Schoenoplectus pungens	three-square	57.9
Potentilla fruticosa <0.5m	shrubby cinquefoil	52.6
Solidago ohioensis	Ohio goldenrod	52.6
Calamintha arkansana	low calamint	47.4
Panicum lindheimeri	panic grass	42.1
Primula mistassinica	dwarf Canadian primrose	42.1
Rhynchospora capillacea	beak-rush	42.1
Hypericum kalmianum <0.5m	Kalm's St. John's-wort	31.6
Thuja occidentalis <0.5m	northern white-cedar	31.6

Table 32. Ten vascular plant species with highest average cover, Waugoshance Point.

Species	Common name	Average cover (%)
Cladium mariscoides	twig-rush	19.4
Solidago ohioensis	Ohio goldenrod	6.9
Rhynchospora capillacea	beak-rush	5.1
Potentilla fruticosa <0.5m	shrubby cinquefoil	2.3
Solidago houghtonii	Houghton's goldenrod	0.7
Potentilla fruticosa 0.5-1m	shrubby cinquefoil	0.6

Species	Common name	Average cover (%)
Eleocharis quinqueflora	few-flower spike-rush	0.5
Juncus balticus	Baltic rush	0.5
Panicum lindheimeri	panic grass	0.4
Primula mistassinica	dwarf Canadian primrose	0.2

Table 33. Ten most important vascular plant species, Waugoshance Point.

Species	Common name	Relative Cover (%)	Relative Frequency (%)	Importance Value
Cladium mariscoides	twig-rush	51.7	8.7	30.2
Solidago ohioensis	Ohio goldenrod	18.4	6.7	12.5
Rhynchospora capillacea	beak-rush	13.6	5.4	9.5
Potentilla fruticosa <0.5m	shrubby cinquefoil	6.2	6.7	6.5
Schoenoplectus pungens	three-square	0.3	7.4	3.8
Calamintha arkansana	low calamint	0.5	6.0	3.3
Panicum lindheimeri	panic grass	1.1	5.4	3.2
Primula mistassinica	dwarf Canadian primrose	0.5	5.4	3.0
Juncus balticus	Baltic rush	1.3	3.4	2.3
Solidago houghtonii	Houghton's goldenrod	1.8	2.7	2.3

Among environmental variables, Waugoshance Point was characterized by scattered moss cover and bare mineral soil and large areas of unvegetated cobble and standing water (Table 34). No crayfish burrows were observed in the sample plots.

Table 34. Environmental variables, frequency and average value per plot, Waugoshance Point.

Environmental variable	Frequency (%)	Average % cover
Moss cover	42.1	2.0
Unvegetated mineral soil	31.6	1.0
Unvegetated marl	10.5	4.9
Unvegetated peat	0	0
Unvegetated cobble	47.4	31.2
Unvegetated wood	5.3	0.4
Open water	47.4	33.3
Water depth	47.4	3.9 cm
Crayfish burrows	0	0.0 burrows

Element Occurrences

The coastal fen and Great Lakes marsh occurrences were updated during 2010 surveys. In addition, previously documented populations of butterwort and Houghton's goldenrod were encountered in 2010 (Table 35).

Table 35. Known and newly documented element occurrences, Waugoshance Point (listed rare species known from coastal fen or associated wetlands).

Community/species	Common name	State Status	Year First Observed	Year Last Observed
Coastal fen		S2	2009	2010
Great Lakes marsh		S3	1985	2010

Community/species	Common name	State Status	Year First Observed	Year Last Observed
Pinguicula vulgaris	butterwort	SC	1948	2010
Solidago houghtonii	Houghton's goldenrod	T/LT	1952	2010

A large population of the state and federally threatened Houghton's goldenrod (*Solidago houghtonii*) occurs in the coastal fen, limestone cobble shore, and Great Lakes marsh at Waugoshance Point.

DUDLEY BAY WEST
T41N R02E S3
Mackinac County

This small area of coastal fen occurs at the mouth of a small stream in the western portion of Dudley Bay, and is associated with limestone bedrock lakeshore and limestone cobble shore along Lake Huron. The fen occurs on a patchy, heterogeneous substrate of circumneutral to moderately alkaline lacustrine sand, gravel, cobble, and clay, overlain in places by shallow sapric peat. Vegetation zones range from peaty sand flats with sedge hummocks to low-shrub dominated zones on shallow peat over cobble to a relatively narrow emergent zone in shallow standing water.

Vegetation and Environmental Data

A total of 42 vascular plant species were encountered in plots along the 110-meter belt transect (Figure 7), comprising 51% of the 83 species identified in a meander survey of the site[1] (Appendix 3f). Eight species (19%) were encountered in 50% or more of the plots (Table 36). One species averaged greater than 10% cover; 12 species averaged 1% or greater cover (Table 37). The most important plant species were shrubby cinquefoil (*Potentilla fruticosa*), beak-rush (*Rhynchospora capillacea*), and northern white-cedar (*Thuja occidentalis*) (Table 38).

[1] The overall species list for Dudley Bay includes the coastal fens at Dudley Bay East and Dudley Bay West.

Figure 7. Dudley Bay West coastal fen and transect.

Table 36. Thirteen most frequently encountered vascular plant species, Dudley Bay West.

Species	Common name	Frequency (%)
Potentilla fruticosa <0.5m	shrubby cinquefoil	81.8
Cladium mariscoides	twig-rush	72.7
Schoenoplectus pungens	three-square	72.7
Thuja occidentalis <0.5m	northern white-cedar	72.7
Myrica gale <0.5m	sweet gale	54.6
Rhynchospora capillacea	beak-rush	54.6
Solidago ohioensis	Ohio goldenrod	54.6
Tofieldia glutinosa	false asphodel	54.6
Lobelia kalmii	Kalm's lobelia	45.5
Aster umbellatus	tall flat-top white aster	36.4
Carex stricta	tussock sedge	36.4
Hypericum kalmianum <0.5m	Kalm's St. John's-wort	36.4
Juncus balticus	Baltic rush	36.4

Table 37. Ten vascular plant species with highest average cover, Dudley Bay West.

Species	Common name	Average cover (%)
Potentilla fruticosa <0.5m	shrubby cinquefoil	11.1
Thuja occidentalis 1-3m	northern white-cedar	8.6
Rhynchospora capillacea	beak-rush	8.4
Juncus balticus	Baltic rush	4.9

Cladium mariscoides	twig-rush	3.6
Myrica gale 0.5-1m	sweet gale	3.5
Myrica gale <0.5m	sweet gale	2.7
Potentilla fruticosa 0.5-1m	shrubby cinquefoil	2.0
Alnus rugosa 3-10m	tag alder	2.0
Carex stricta	tussock sedge	1.7

Table 38. Ten most important vascular plant species, Dudley Bay West.

Species	Common name	Relative Cover (%)	Relative Frequency (%)	Importance Value
Potentilla fruticosa <0.5m	shrubby cinquefoil	19.9	6.7	13.3
Rhynchospora capillacea	beak-rush	15.0	4.4	9.7
Thuja occidentalis 1-3m	northern white-cedar	15.5	0.7	8.1
Cladium mariscoides	twig-rush	6.5	5.9	6.2
Juncus balticus	Baltic rush	8.8	3.0	5.9
Myrica gale <0.5m	sweet gale	4.9	4.4	4.7
Schoenoplectus pungens	three-square	1.8	5.9	3.9
Myrica gale 0.5-1m	sweet gale	6.2	1.5	3.8
Thuja occidentalis <0.5m	northern white-cedar	0.2	5.9	3.1
Carex stricta	tussock sedge	3.1	3.0	3.0

Among environmental variables, Dudley Bay West was characterized by significant areas of moss cover and unvegetated mineral soil (Table 39). No crayfish burrows were documented in the sample plots.

Table 39. Environmental variables, frequency and average value per plot, Dudley Bay West.

Environmental variable	Frequency (%)	Average % cover
Moss cover	63.6	24.5
Unvegetated mineral soil	54.6	10.0
Unvegetated marl	0	0
Unvegetated peat	0	0
Unvegetated cobble	0	0
Unvegetated wood	0	0
Open water	18.2	2.5
Water depth	18.2	0.7 cm
Crayfish burrows	0	0.0 burrows

Element Occurrences

This coastal fen was previously surveyed in 1992 (Table 40). The previously documented population of dwarf lake iris (*Iris lacustris*) was redocumented in 2010.

Table 40. Known and newly documented element occurrences, Dudley Bay West.

Community/species	Common name	State Status	Year First Observed	Year Last Observed
Coastal fen		S2	1991	2010
Iris lacustris	dwarf lake iris	T/LT		2010

DUDLEY BAY EAST
T41N R02E S2
Mackinac County

This relatively small coastal fen occurs in a protected embayment in the eastern portion of Dudley Bay, where it is associated with limestone cobble shore and limestone bedrock lakeshore along Lake Huron. The coastal fen has developed on circumneutral to moderately alkaline fine lacustrine sands, overlain in places by a thin veneer of organic matter. Large cobble and boulders occur primarily along the shoreline. Vegetation zones range from infrequently disturbed alkaline sand flats with clumps of trees and shrubs to shallowly inundated emergent zones on the Lake Huron shoreline.

Vegetation and Environmental Data

A total of 50 vascular plant species were encountered in plots along the 180-meter belt transect (Figure 8), comprising 60% of the 83 species identified in a meander survey of the site[2] (Appendix 3f). Ten species (20%) were encountered in 50% or more of the plots (Table 41). No species averaged greater than 10% cover; nine species averaged 1% or greater cover (Table 42). The most important plant species were beak-rush (*Rhynchospora capillacea*), twig-rush (*Cladium mariscoides*), and shrubby cinquefoil (*Potentilla fruticosa*) (*Thuja occidentalis*) (Table 43).

[2] The overall species list for Dudley Bay includes the coastal fens at Dudley Bay East and Dudley Bay West.

Figure 8. Dudley Bay East coastal fen and transect.

Table 41. Ten most frequently encountered vascular plant species, Dudley Bay East.

Species	Common name	Frequency (%)
Cladium mariscoides	twig-rush	75.0
Solidago ohioensis	Ohio goldenrod	75.0
Potentilla fruticosa <0.5m	shrubby cinquefoil	68.8
Hypericum kalmianum <0.5m	Kalm's St. John's-wort	56.3
Parnassia glauca	grass-of-Parnassus	56.3
Primula mistassinica	dwarf Canadian primrose	56.3
Rhynchospora capillacea	beak-rush	56.3
Thuja occidentalis <0.5m	northern white-cedar	56.3
Calamintha arkansana	low calamint	50.0
Juncus balticus	Baltic rush	50.0

Table 42. Ten vascular plant species with highest average cover, Dudley Bay East.

Species	Common name	Average cover (%)
Rhynchospora capillacea	beak-rush	8.8
Cladium mariscoides	twig-rush	7.2
Potentilla fruticosa 0.5-1m	shrubby cinquefoil	6.6
Carex stricta	tussock sedge	3.0
Solidago ohioensis	Ohio goldenrod	2.7
Potentilla fruticosa <0.5m	shrubby cinquefoil	2.2
Myrica gale <0.5m	sweet gale	1.8

Species	Common name	Average cover (%)
Calamintha arkansana	low calamint	1.4
Thuja occidentalis 1-3m	northern white-cedar	1.1
Juncus balticus	Baltic rush	0.8

Table 43. Ten most important vascular plant species, Dudley Bay East.

Species	Common name	Relative Cover (%)	Relative Frequency (%)	Importance Value
Rhynchospora capillacea	beak-rush	21.4	4.2	12.8
Cladium mariscoides	twig-rush	17.5	5.5	11.5
Potentilla fruticosa 0.5-1m	shrubby cinquefoil	16.1	1.8	9.0
Solidago ohioensis	Ohio goldenrod	6.6	5.5	6.1
Potentilla fruticosa <0.5m	shrubby cinquefoil	5.4	5.1	5.2
Carex stricta	tussock sedge	7.4	1.8	4.6
Calamintha arkansana	low calamint	3.5	3.7	3.6
Myrica gale <0.5m	sweet gale	4.4	2.8	3.6
Thuja occidentalis <0.5m	northern white-cedar	1.6	4.2	2.9
Juncus balticus	Baltic rush	2.0	3.7	2.8

Among environmental variables, Dudley Bay East was characterized by significant areas of unvegetated mineral soil (Table 44). No crayfish burrows were documented in the sample plots.

Table 44. Environmental variables, frequency and average value per plot, Dudley Bay East.

Environmental variable	Frequency (%)	Average % cover
Moss cover	50.0	2.7
Unvegetated mineral soil	50.0	12.2
Unvegetated marl	0	0
Unvegetated peat	12.5	0.3
Unvegetated cobble	12.5	0.6
Unvegetated wood	0	0
Open water	12.5	12.5
Water depth	12.5	1.5 cm
Crayfish burrows	0	0.0 burrows

Element Occurrences

The coastal fen surveyed at this site in 2010 was previously undocumented, and will be incorporated into the previously documented occurrence at Dudley Bay West (Table 45). No state-listed plant or animal species were documented from this site.

Table 45. Known and newly documented element occurrences, Dudley Bay East.

Community/species	State Status	Year First Observed	Year Last Observed
Coastal fen	S2	2010	2010

ST. MARTIN POINT
T41N R02W S2
Mackinac County

St. Martin Point, at the western edge of the Les Cheneaux region of Mackinac County, supports relatively small areas of coastal marsh that have developed in protected embayments that are partially buffered from Lake Huron by bands of limestone cobble shore. Areas of limestone cobble are frequent within the coastal fen, creating a patchy matrix of the two communities. Soils in the coastal fen zones range from mildly to moderately alkaline, shallow sapric peat over gravel and clay to mildly alkaline peaty sands in the crevices of moderate to large-sized cobble. Large limestone cobble underlies the fen at shallow depths. Several vegetation zones are present, including seepage zones with shallow peat, low shrub-dominated meadow on limestone cobble, and an emergent zone in shallow water.

Vegetation and Environmental Data

A total of 50 vascular plant species were encountered in plots along the 150-meter belt transect (Figure 9), comprising 62% of the 81 species identified in a meander survey of the site (Appendix 3g). Eight species (16%) were encountered in 50% or more of the plots (Table 46). Two species averaged greater than 10% cover; ten species averaged 1% or greater cover (Table 47). Shrubby cinquefoil (*Potentilla fruticosa*) and twig-rush (*Cladium mariscoides*) were the most important species (Table 48).

Figure 9. St. Martin Point coastal fen and transect.

Table 46. Twelve most frequently encountered vascular plant species, St. Martin Point.

Species	Common name	Frequency (%)
Cladium mariscoides	twig-rush	80.0
Potentilla fruticosa <0.5m	shrubby cinquefoil	73.3
Hypericum kalmianum <0.5m	Kalm's St. John's-wort	73.3
Thuja occidentalis <0.5m	northern white-cedar	60.0
Panicum lindheimeri	panic grass	60.0
Parnassia glauca	grass-of-Parnassus	53.3
Viola sp.	violet sp.	53.3
Calamintha arkansana	low calamint	53.3
Solidago ohioensis	Ohio goldenrod	46.7
Danthonia spicata	poverty oats	46.7
Eleocharis rostellata	spike-rush	46.7
Tofieldia glutinosa	false asphodel	46.7

Table 47. Ten vascular plant species with highest average cover, St. Martin Point.

Species	Common name	Average cover (%)
Potentilla fruticosa <0.5m	shrubby cinquefoil	15.1
Cladium mariscoides	twig-rush	10.6
Myrica gale <0.5m	sweet gale	5.0
Solidago ohioensis	Ohio goldenrod	3.7
Schizachyrium scoparium	little bluestem	3.5

Species	Common name	Average cover (%)
Danthonia spicata	poverty oats	3.2
Eleocharis rostellata	spike-rush	2.7
Potentilla fruticosa 0.5-1m	shrubby cinquefoil	2.6
Eleocharis elliptica	golden-seeded spike-rush	1.6
Juncus balticus	Baltic rush	1.1

Table 48. Ten most important vascular plant species, St. Martin Point.

Species	Common name	Relative Cover (%)	Relative Frequency (%)	Importance Value
Potentilla fruticosa <0.5m	shrubby cinquefoil	26.6	4.9	15.8
Cladium mariscoides	twig-rush	18.6	5.4	12.0
Myrica gale <0.5m	sweet gale	8.8	2.2	5.5
Solidago ohioensis	Ohio goldenrod	6.6	3.1	4.9
Danthonia spicata	poverty oats	5.6	3.1	4.4
Schizachyrium scoparium	little bluestem	6.2	1.8	4.0
Eleocharis rostellata	spike-rush	4.8	3.1	4.0
Potentilla fruticosa 0.5-1m	shrubby cinquefoil	4.6	1.8	3.2
Hypericum kalmianum <0.5m	Kalm's St. John's-wort	0.5	4.9	2.7
Parnassia glauca	grass-of-Parnassus	1.7	3.6	2.6

Among environmental variables, St. Martin Point was characterized by significant areas of moss cover, unvegetated cobble, and open water (Table 49). No crayfish burrows were documented in the sample plots.

Table 49. Environmental variables, frequency and average value per plot, St. Martin Point.

Environmental variable	Frequency (%)	Average % cover
Moss cover	73.3	25.3
Unvegetated mineral soil	6.7	0.0
Unvegetated marl	0	0
Unvegetated peat	0	0
Unvegetated cobble	40.0	11.7
Unvegetated wood	0	0
Open water	26.7	26.7
Water depth	26.7	1.5 cm
Crayfish burrows	0	0.0 burrows

Element Occurrences

New occurrences for coastal fen, limestone cobble shore, and a rare leafhopper were documented at St. Martin Point in 2010. The previously identified occurrence of Houghton's goldenrod was redocumented in the 2010 survey (Table 50).

Table 50. Known and newly documented element occurrences, St. Martin Point.

Community/species	Common name	State Status	Year First Observed	Year Last Observed
Coastal fen		S2	2010	2010
Limestone cobble shore		S3	2010	2010
Solidago houghtonii	Houghton's goldenrod	T/LT	1984	2010

Community/species	Common name	State Status	Year First Observed	Year Last Observed
Flexamia delongi	leafhopper	SC	2010	2010

The coastal fen at St. Martin Point grades into bands of limestone cobble shore along Lake Huron.

DISCUSSION

Vegetation and Environmental Sampling

Within each site, there was significant variation in number of vascular plant taxa per plot, indicative of the presence of different vegetative zones. In general, those portions of the coastal fens least frequently and/or severely affected by wave and ice action appeared to exhibit the highest number of species per plot and the highest overall species richness. Plots were dominated by herbs and shrubs <0.5 m in height, although placement of the transect lines was biased towards characterizing open fen. The coastal fen at Squaw Bay West had the highest importance of shrubs >0.5 m in height; these shrubs were concentrated on shallow rises of peat- and silt-covered cobble within the wetland. Following collection of additional data in 2011, data analyses will be conducted to assess the nature of differences in overall vascular plant cover and shrub/tree cover among sites.

The most important plant species had the tendency to occur in most or all vegetative zones. Among these species, twig-rush (*Cladium mariscoides*) and beak-rush (*Rhynchospora capillacea*) were most important, largely due to their high relative cover and tendency to dominate certain zones of the coastal fen, particularly saturated to shallowly inundated alkaline sand flats exposed by summer recession of Great Lakes water levels. Shrubby cinquefoil (*Potentilla fruticosa*), the third-most important species, occurred in all coastal fen zones, although it was present almost exclusively as first-year seedlings in the sand flat zones. Ohio goldenrod (*Solidago ohioensis*) and northern white-cedar (*Thuja occidentalis*) were most important in the least frequently disturbed zones, but were also present as seedlings in the sand flat zones. Beaked spike-rush was locally important, and appeared to display a high fidelity to marl substrates.

Although relative cover values were used in conjunction with relative frequency to determine the most important species across coastal fen sites, the tendency of some species to occur densely in particular vegetative zones and sparsely in other zones limits the utility of average and relative cover values. After vegetation and substrate data are collected from additional coastal fen sites in 2011, data analyses will be conducted to elucidate the relationship of vegetation structure and composition to abiotic variables (e.g., moss cover, surface soil type), and to better characterize and compare individual vegetation zones within each fen and across all sites.

The Floristic Quality Assessments provide a baseline for the assessment of floristic integrity in coastal fens, and the addition of new survey sites in 2011 will allow a range-wide assessment of floristic quality associated with this natural community. All of the sites surveyed in 2010 exhibited significant floristic quality, as assessed through the mean *C* (coefficient of conservatism) and Floristic Quality Index (FQI) measures (Table 9, Herman et al. 2001). Coastal fens, due to their highly alkaline substrate, support a number of specialized plant species that occur predominantly in areas affected minimally by anthropogenic disturbance (Herman et al. 2001, Cohen et al. 2010). Native mean *C* values, which ranged from 6.0 to 6.9 in this study, are similar to those found in undisturbed northern Michigan peatlands and limestone habitats (MNFI, unpublished data).

Rare Element Surveys

The 2010 surveys yielded two new occurrences of coastal fen, and a third area of coastal fen that will be added to an existing coastal fen (Table 10). Following the 2010 field season, MNFI has documented 21 coastal fens in Michigan (MNFI 2010). In addition, an occurrence of northern fen was split off a previously documented Great Lakes marsh, and a new occurrence of limestone

cobble shore was surveyed. In several areas that support coastal fen, small areas of northern fen isolated from the direct impacts of Great Lakes water level fluctuations occur behind forested beach ridges. These fens accumulate deeper deposits of peat and marl than the coastal fens, which are disturbed by wave and ice action (Cohen et al. 2010).

Eight previously documented occurrences of rare plant species were observed in 2010, including three occurrences of dwarf lake iris (*Iris lacustris*, state/federal threatened), two occurrences of butterwort (*Pinguicula vulgaris*, state special concern), two occurrences of Houghton's goldenrod (*Solidago houghtonii*, state/federal threatened), and one occurrence of prairie Indian plantain (*Cacalia plantaginea*, state special concern). No new occurrences of state-listed plant species were identified at the eight sample sites. Rare species surveys in 2011 will continue to focus on those species and others identified as potentially occurring in coastal fen by Cohen et al. (2010).

The most significant results of the rare element surveys were the new element occurrence records for three insects. The red-legged spittlebug (*Prosapia ignipectus*) was previously known to occur in alvar, pine barrens, lakeplain prairies, and prairie fen (Cuthrell 1999), and the 2010 surveys revealed the species also occurs in at least one coastal fen (El Cajon Bay). Nymphs (sub-adult life stages) are believed to feed on the subterranean parts of little bluestem (*Schizachyrium scoparium*), a species that is concentrated in the drier zones of coastal fens. Further intensive sampling at the other four sites which contained little bluestem (Appendix 4) may turn up additional records for this species as 5 of the 7 sites sampled contained the host plant.

The leafhopper (*Flexamia delongi*) was known from only 6 locations in Michigan prior to 2010, and the two new records from this study are both new county records (Mackinac, Alpena). This is another species associated with little bluestem, and was previously known from alvar and lakeplain prairies before its discovery in coastal fens in 2010. Prior to 2010, *F. delongi* had been recorded in Michigan from Allegan, Barry, Chippewa, Kalamazoo, and St. Clair counties. Further intensive sampling at the other four sites which contained little bluestem (Appendix 4) may turn up additional records for this species.

The Kansan leafhopper (*Dorydiella kansana*) was first discovered in Michigan in 1994 at a lakeplain prairie site in St. Clair County (Comer et al. 1995). Since its initial discovery, Kansan leafhopper has been found in additional lakeplain prairies in Huron and Tuscola counties and from prairie fens in Washtenaw, Jackson, Hillsdale, and Kalamazoo counties. It has been reported to occur on spike-rushes (*Eleocharis* spp.), beak-rushes (*Rhynchospora* spp.), and nut-rush (*Scleria verticillata*) (Bess 2005). We believe that the species feeds on nut-rush in Michigan, as this was one of the important plant species in the zone in which it was swept from at El Cajon Bay. In addition, several coastal fen sites containing large stands of beak-rush (*Rhynchospora capillacea*) and spike-rushes (*Eleocharis* spp.) failed to produce this leafhopper after numerous sweeps. The only other coastal fen identified thus far by our study that contained nut-rush was Thompson's Harbor (Appendix 4,) and additional sampling may reveal the presence of Kansan leafhopper at that site.

Management and Protection

As noted by Cohen et al. (2010), coastal fens are threatened by hydrologic alteration, the construction of roads and trails, off-road vehicle use, and invasive plant species. Several of the coastal fens surveyed in 2010 have experienced at least modest disturbance associated with recreational use of the Great Lakes shoreline, primarily in the form of off-road vehicle use. In particular, portions of the coastal fens at Squaw Bay, Waugoshance Point, and Dudley Bay East are affected by well-worn two-tracks that are used to access shoreline areas. Foot trails enter fen

areas at Waugoshance Point and Thompson's Harbor, and locally alter surface water flow and species composition in these sites. However, damage to both sites appears minimal, and the foot trails provide people with the opportunity to explore and gain appreciation for these sensitive habitats. The coastal fen at Squaw Bay has been significantly disturbed by the construction of US-23, which bisects the wetland, and, in conjunction with the adjacent drainage ditch, has severely disrupted the hydrologic regime of the entire wetland.

Invasive species threaten even the least-disturbed coastal fens. Although all sites were dominated by native species in terms of numbers of species and abundance, 12 non-native taxa were documented, including several species identified by Cohen et al. (2010) as particularly aggressive threats. Of particular concern is an infestation of glossy buckthorn (*Rhamnus frangula*) in the Alpena area. Glossy buckthorn was observed in all three Alpena County coastal fens, and was especially abundant in the disturbed Squaw Bay site, where it was concentrated around forested "islands" and in the best-developed fen areas at the margin of the inland forest. Despite invasive species removal efforts conducted by The Nature Conservancy at Squaw Bay, glossy buckthorn remains abundant and widespread, likely due to the presence of dense colonies on adjacent lands not being managed for conservation of biodiversity. Monitoring and removal efforts should focus on the less disturbed El Cajon Bay and Whitefish Bay sites to ensure glossy buckthorn does not attain population levels that require costly, time-consuming control efforts. Glossy buckthorn was not detected at Thompson's Harbor, Waugoshance Point, or in the Upper Peninsula sites.

The non-native variety of common reed (*Phragmites australis*) is another significant threat to coastal fen. Although only the native variety of common reed was documented in 2010 coastal fen surveys, the non-native variety has been previously documented in El Cajon Bay and Squaw Bay (MNFI 2010), where the species is likely concentrated in the emergent marsh zones. The non-native variety of common reed was observed forming vigorous colonies in ditches and degraded wetlands near the City of Alpena in 2010, and the species appears to pose a particular threat to coastal wetlands in this region. Monitoring and removal of nascent populations of common reed is of critical importance to preserving the ecological integrity and biodiversity of coastal fens.

Among the remaining non-native species observed in the coastal fen study sites, purple loosestrife (*Lythrum salicaria*) and dog mustard (*Erucastrum gallicum*) were locally important in shallow emergent and sand flat zones, respectively. Purple loosestrife populations were generally small and/or consisted of widely dispersed individuals, and may be controlled by hand-pulling and/or careful use of herbicides. Dog mustard colonizes bare substrates and may occur in large numbers, but its impacts on native species are unclear. Remaining non-native species observed in coastal fen occurred in small numbers or in association with adjacent more suitable habitats (e.g., spotted knapweed [*Centaurea maculosa*] at the base of dune ridges).

Following additional surveys in 2011, management and protection strategies for all sampled coastal fen sites will be outlined and prioritized.

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Appendix 1. Global and state element ranking criteria.

GLOBAL RANKS

G1 = critically imperiled: at very high risk of extinction due to extreme rarity (often 5 or fewer occurrences), very steep declines, or other factors.

G2 = imperiled: at high risk of extinction due to very restricted range, very few occurrences (often 20 or fewer), steep declines, or other factors.

G3 = vulnerable: at moderate risk of extinction due to a restricted range, relatively few occurrences (often 80 or fewer), recent and widespread declines, or other factors.

G4 = apparently secure: uncommon but not rare; some cause for long-term concern due to declines or other factors.

G5 = secure: common; widespread.

GU = currently unrankable due to lack of information or due to substantially conflicting information about status or trends.

GX = eliminated: eliminated throughout its range, with no restoration potential due to extinction of dominant or characteristic species.

G? = incomplete data.

STATE RANKS

S1 = critically imperiled in the state because of extreme rarity (often 5 or fewer occurrences) or because of some factor(s) such as very steep declines making it especially vulnerable to extirpation from the state.

S2 = imperiled in the state because of rarity due to very restricted range, very few occurrences (often 20 or fewer), steep declines, or other factors making it very vulnerable to extirpation from the state.

S3 = vulnerable in the state due to a restricted range, relatively few occurrences (often 80 or fewer), recent and widespread declines, or other factors making it vulnerable to extirpation.

S4 = uncommon but not rare; some cause for long-term concern due to declines or other factors.

S5 = common and widespread in the state.

SX = community is presumed to be extirpated from the state. Not located despite intensive searches of historical sites and other appropriate habitat, and virtually no likelihood that it will be rediscovered.

S? = incomplete data.

Appendix 2. Summary list of vascular plant taxa documented in coastal fen sample plots, ranked by importance value. CAPITALIZED names indicate non-native species.

Species	Common name	Relative Cover (%)	Relative Frequency (%)	Importance Value
Cladium mariscoides	twig-rush	18.21%	6.09%	12.15
Rhynchospora capillacea	beak-rush	18.07%	4.41%	11.24
Potentilla fruticosa <0.5m	shrubby cinquefoil	9.06%	5.45%	7.25
Eleocharis rostellata	beaked spike-rush	11.57%	2.92%	7.25
Solidago ohioensis	Ohio goldenrod	4.90%	5.40%	5.15
Juncus balticus	Baltic rush	4.88%	3.07%	3.98
Calamagrostis canadensis	bluejoint grass	3.50%	1.73%	2.61
Thuja occidentalis <0.5m	northern white-cedar	0.90%	3.86%	2.38
Sarracenia purpurea	pitcher-plant	2.36%	2.13%	2.25
Hypericum kalmianum <0.5m	Kalm's St. John's-wort	0.29%	3.81%	2.05
Schoenoplectus pungens	three-square	1.06%	2.92%	1.99
Myrica gale <0.5m	bayberry	2.59%	1.29%	1.94
Parnassia glauca	grass-of-Parnassus	0.40%	3.12%	1.76
Panicum lindheimeri	panic grass	0.37%	3.12%	1.75
Thuja occidentalis 1-3m	northern white-cedar	2.78%	0.35%	1.56
Potentilla fruticosa 0.5-1m	shrubby cinquefoil	2.49%	0.54%	1.52
Lobelia kalmii	Kalm's lobelia	0.03%	2.87%	1.45
Primula mistassinica	dwarf Canadian primrose	0.41%	2.33%	1.37
Calamintha arkansana	low calamint	0.43%	2.23%	1.33
Equisetum variegatum	variegated scouring rush	0.04%	2.43%	1.23
Juncus brachycephalus	rush	0.32%	2.03%	1.18
Tofieldia glutinosa	false asphodel	0.04%	2.28%	1.16
Muhlenbergia glomerata	marsh wild timothy	0.06%	2.23%	1.15
Lycopus uniflorus	northern bugleweed	0.09%	2.18%	1.13
Carex stricta	tussock sedge	1.30%	0.84%	1.07
Carex flava	yellow sedge	0.55%	1.24%	0.89
Rhynchospora alba	white beak-rush	0.75%	0.99%	0.87
Senecio pauperculus	balsam ragwort	0.13%	1.58%	0.86
Carex livida	livid sedge	0.61%	1.09%	0.85
Schizachyrium scoparium	little bluestem	0.90%	0.54%	0.72
Trichophorum cespitosum	tufted bulrush	0.88%	0.54%	0.71
Selaginella eclipes	selaginella	0.07%	1.34%	0.70
Gentianopsis procera	small-fringed gentian	0.03%	1.24%	0.63
Danthonia spicata	poverty grass	0.69%	0.54%	0.62
Carex sterilis	dioecious sedge	0.40%	0.79%	0.60
Myrica gale 0.5-1m	bayberry	0.73%	0.30%	0.51
Larix laricina 1-3m	tamarack	0.91%	0.10%	0.50
Triglochin maritimum	common bog arrow-grass	0.03%	0.94%	0.49
Deschampsia cespitosa	tufted hair grass	0.12%	0.84%	0.48
Scleria verticillata	nut-rush	0.41%	0.50%	0.45
Viola sp.	violet sp.	0.06%	0.84%	0.45
Solidago uliginosa	bog goldenrod	0.24%	0.64%	0.44
Thuja occidentalis 0.5-1m	northern white-cedar	0.45%	0.40%	0.43
Utricularia cornuta	horned bladderwort	0.01%	0.79%	0.40
Alnus rugosa 1-3m	tag alder	0.63%	0.15%	0.39

Species	Common name	Relative Cover (%)	Relative Frequency (%)	Importance Value
Hypericum kalmianum 0.5-1m	Kalm's St. John's-wort	0.57%	0.10%	0.34
Solidago altissima	tall goldenrod	0.32%	0.35%	0.34
Potentilla anserina	silverweed	0.27%	0.40%	0.34
Solidago houghtonii	Houghton's goldenrod	0.27%	0.40%	0.33
Drosera rotundifolia	round-leaved sundew	0.01%	0.59%	0.30
Aster umbellatus	tall flat-top white aster	0.15%	0.45%	0.30
Carex eburnea	ebony sedge	0.29%	0.25%	0.27
Eleocharis elliptica	golden-seeded spike-rush	0.34%	0.20%	0.27
Euthamia graminifolia	grass-leaved goldenrod	0.08%	0.45%	0.26
Aster borealis	northern bog aster	0.02%	0.50%	0.26
Acer rubrum	red maple	0.00%	0.50%	0.25
Aster lanceolatus	eastern lined aster	0.09%	0.40%	0.24
Larix laricina <0.5m	tamarack	0.01%	0.45%	0.23
Solidago canadensis	Canada goldenrod	0.18%	0.25%	0.21
Eleocharis quinqueflora	few-flower spike-rush	0.18%	0.25%	0.21
Proserpinaca palustris	mermaid-weed	0.02%	0.40%	0.21
Alnus rugosa 3-10m	tag alder	0.31%	0.10%	0.21
Pogonia ophioglossoides	rose pogonia	0.01%	0.40%	0.20
Triglochin palustris	slender bog arrow-grass	0.00%	0.40%	0.20
Schoenoplectus acutus	hardstem bulrush	0.02%	0.35%	0.18
Juncus brevicaudatus	rush	0.16%	0.20%	0.18
Calamagrostis inexpansa	bog reedgrass	0.00%	0.35%	0.18
CIRSIUM PALUSTRE	MARSH THISTLE	0.15%	0.20%	0.17
Eupatorium perfoliatum	common boneset	0.04%	0.30%	0.17
Lysimachia quadriflora	whorled loosestrife	0.03%	0.30%	0.16
Spiranthes cernua	nodding ladies' tresses	0.01%	0.30%	0.15
Utricularia sp.	bladderwort	0.00%	0.30%	0.15
Solidago rugosa	rough goldenrod	0.20%	0.10%	0.15
Agalinis purpurea	purple gerardia	0.04%	0.25%	0.14
Comandra umbellata	bastard toadflax	0.04%	0.25%	0.14
Juniperus horizontalis	creeping juniper	0.13%	0.15%	0.14
Juniperus communis	common juniper	0.15%	0.10%	0.13
RHAMNUS FRANGULA <0.5m	GLOSSY BUCKTHORN	0.03%	0.20%	0.11
Castilleja coccinea	Indian paintbrush	0.00%	0.20%	0.10
Aronia prunifolia	black chokeberry	0.00%	0.20%	0.10
unknown forb		0.00%	0.20%	0.10
Juncus nodosus	rush	0.04%	0.15%	0.10
ERUCASTRUM GALLICUM	DOG MUSTARD	0.03%	0.15%	0.09
PRUNELLA VULGARIS	LAWN PRUNELLA	0.03%	0.15%	0.09
Aster puniceus	swamp aster	0.08%	0.10%	0.09
Lathyrus palustris	marsh pea	0.13%	0.05%	0.09
Carex capillaris	hair-like sedge	0.01%	0.15%	0.08
Carex viridula	little green sedge	0.01%	0.15%	0.08
Drosera linearis	linear-leaved sundew	0.00%	0.15%	0.07
Picea mariana <0.5m	black spruce	0.00%	0.15%	0.07
Larix laricina 3-10m	tamarack	0.05%	0.10%	0.07
Cornus sericea <0.5m	red-osier dogwood	0.08%	0.05%	0.07
Aster firmus	smooth swamp aster	0.03%	0.10%	0.06

Species	Common name	Relative Cover (%)	Relative Frequency (%)	Importance Value
Rudbeckia hirta	black-eyed Susan	0.03%	0.10%	0.06
Cornus sericea 0.5-1m	red-osier dogwood	0.07%	0.05%	0.06
Aster indet. 1	aster sp.	0.02%	0.10%	0.06
Carex indet. 4	sedge sp.	0.01%	0.10%	0.06
Iris lacustris	dwarf lake iris	0.01%	0.10%	0.05
Alnus rugosa 0.5-1m	tag alder	0.06%	0.05%	0.05
Anemone canadensis	Canada anemone	0.06%	0.05%	0.05
Populus balsamifera 0.5-1m	balsam poplar	0.06%	0.05%	0.05
Campanula aparinoides	marsh bellflower	0.00%	0.10%	0.05
Populus tremuloides <0.5m	quaking aspen	0.00%	0.10%	0.05
Stachys sp.	hedge nettle	0.00%	0.10%	0.05
Fraxinus pennsylvanicus	green ash	0.00%	0.10%	0.05
Lycopus americanus	common water horehound	0.00%	0.10%	0.05
unknown woody seedling		0.00%	0.10%	0.05
Cirsium muticum	swamp thistle	0.04%	0.05%	0.05
Thuja occidentalis 3-10m	northern white-cedar	0.04%	0.05%	0.05
Fragaria virginiana	wild strawberry	0.03%	0.05%	0.04
Lysimachia terrestris	swamp candles	0.03%	0.05%	0.04
Arctostaphylos uva-ursi	bearberry	0.01%	0.05%	0.03
Betula papyrifera	paper birch	0.01%	0.05%	0.03
Carex indet. 1	sedge	0.01%	0.05%	0.03
Carex lasiocarpa	wiregrass sedge	0.01%	0.05%	0.03
HIERACIUM CAESPITOSUM	KING DEVIL	0.01%	0.05%	0.03
Larix laricina 0.5-1m	tamarack	0.01%	0.05%	0.03
Salix petiolaris 1-3m	slender willow	0.01%	0.05%	0.03
Bromus ciliatus	fringed brome	0.01%	0.05%	0.03
Eleocharis smallii	spike-rush	0.01%	0.05%	0.03
Mentha spicata	wild mint	0.01%	0.05%	0.03
Prenanthes racemosa	glaucous white lettuce	0.01%	0.05%	0.03
Salix candida 0.5-1m	sage willow	0.01%	0.05%	0.03
SONCHUS sp.	SOW THISTLE	0.01%	0.05%	0.03
Carex crawei	Crawe’s sedge	0.00%	0.05%	0.03
Carex indet. 3	sedge	0.00%	0.05%	0.03
Lilium philadelphicum	wood lily	0.00%	0.05%	0.03
Polygonum sp.	smartweed	0.00%	0.05%	0.03
Salix indet. 2 (narrow lf)	willow	0.00%	0.05%	0.03
Salix indet. 3	willow	0.00%	0.05%	0.03
Senecio aureus	golden ragwort	0.00%	0.05%	0.03
Aster indet. 2	aster	0.00%	0.05%	0.02
Carex indet. 2	sedge	0.00%	0.05%	0.02
Liparis loeselii	Loesel’s twayblade	0.00%	0.05%	0.02
Lobelia spicata	pale spiked lobelia	0.00%	0.05%	0.02
Poa compressa	Canada bluegrass	0.00%	0.05%	0.02
Polygala paucifolia	gaywings	0.00%	0.05%	0.02
Salix indet. 1.	willow	0.00%	0.05%	0.02
Trientalis borealis	starflower	0.00%	0.05%	0.02
unknown grass		0.00%	0.05%	0.02

Species	Common name	Relative Cover (%)	Relative Frequency (%)	Importance Value
unknown sterile graminoid		0.00%	0.05%	0.02
Utricularia intermedia	flat-leaved bladderwort	0.00%	0.00%	0.00

Appendix 3a. Floristic Quality Assessment of El Cajon Bay.

Site: El Cajon Bay Coastal Fen EO-57-1936
Locale: Alpena Co., MI
Date: August 9, 10, 2010 - hours
By: Brad Slaughter, Dave Cuthrell
File: c:\Active Projects\Coastal fen CZM grant\FQA\El Cajon Bay Coastal Fen EO-57-1936.inv
Notes: Also: Viola sp., Carex sp. **(78 spp. total)**

FLORISTIC QUALITY DATA		Native		Adventive	
73	NATIVE SPECIES	Tree	5	Tree	0
76	Total Species	Shrub	8	Shrub	1
6.5	NATIVE MEAN C	W-Vine	0	W-Vine	0
6.3	W/Adventives	H-Vine	0	H-Vine	0
55.9	NATIVE FQI	P-Forb	30	P-Forb	1
54.8	W/Adventives	B-Forb	1	B-Forb	1
-3.2	NATIVE MEAN W	A-Forb	3	A-Forb	0
-3.1	W/Adventives	P-Grass	7	P-Grass	0
AVG:	Fac. Wetland	A-Grass	0	A-Grass	0
		P-Sedge	15	P-Sedge	0
		A-Sedge	1	A-Sedge	0
		Fern	3		

ACRONYM	C	SCIENTIFIC NAME	W	WETNESS	PHYSIOGNOMY	COMMON NAME
ACERUB	1	Acer rubrum	0	FAC	Nt Tree	RED MAPLE
ALNRUG	5	Alnus rugosa	-5	OBL	Nt Shrub	TAG ALDER
ANDSCO	5	Andropogon scoparius	3	FACU	Nt P-Grass	LITTLE BLUESTEM GRASS
ARCUVA	8	Arctostaphylos uva-ursi	5	UPL	Nt Shrub	BEARBERRY
ASTBOR	9	Aster borealis	-5	OBL	Nt P-Forb	NORTHERN BOG ASTER
CALCAN	3	Calamagrostis canadensis	-5	OBL	Nt P-Grass	BLUE JOINT GRASS
CALARK	10	Calamintha arkansana	-3	FACW	Nt P-Forb	LOW CALAMINT
CXBUXB	10	Carex buxbaumii	-5	OBL	Nt P-Sedge	SEDGE
CXEBUR	7	Carex eburnea	4	FACU-	Nt P-Sedge	SEDGE
CXFLAV	4	Carex flava	-5	OBL	Nt P-Sedge	SEDGE
CXLIVI	10	Carex livida	-5	OBL	Nt P-Sedge	SEDGE
CXSTER	10	Carex sterilis	-5	OBL	Nt P-Sedge	SEDGE
CXSTRI	4	Carex stricta	-5	OBL	Nt P-Sedge	SEDGE

CXVIRI	4	Carex viridula	-5	OBL	Nt	P-Sedge	SEDGE
CASCOC	8	Castilleja coccinea	0	FAC	Nt	A-Forb	INDIAN PAINTBRUSH
CICBUL	5	Cicuta bulbifera	-5	OBL	Nt	P-Forb	WATER HEMLOCK
CIRMUT	6	Cirsium muticum	-5	OBL	Nt	B-Forb	SWAMP THISTLE
CIRVUL	0	CIRSIUM VULGARE	4	FACU-	Ad	B-Forb	BULL THISTLE
CLAMAR	10	Cladium mariscoides	-5	OBL	Nt	P-Sedge	TWIG RUSH
COMUMB	5	Comandra umbellata	3	FACU	Nt	P-Forb	BASTARD TOADFLAX
CORSTO	2	Cornus stolonifera	-3	FACW	Nt	Shrub	RED OSIER DOGWOOD
DANSPI	4	Danthonia spicata	5	UPL	Nt	P-Grass	POVERTY GRASS; OATGRASS
DESCES	9	Deschampsia cespitosa	-4	FACW+	Nt	P-Grass	HAIR GRASS
DROLIN	10	Drosera linearis	-5	OBL	Nt	P-Forb	LINEAR LEAVED SUNDEW
ELEQUI	10	Eleocharis quinqueflora	-5	OBL	Nt	P-Sedge	SPIKE RUSH
ELEROS	10	Eleocharis rostellata	-5	OBL	Nt	P-Sedge	SPIKE RUSH
ELESMA	5	Eleocharis smallii	-5	OBL	Nt	P-Sedge	SPIKE RUSH
EQUVAR	8	Equisetum variegatum	-3	FACW	Nt	F...Ally	VARIEGATED SCOURING RUSH
EUPPER	4	Eupatorium perfoliatum	-4	FACW+	Nt	P-Forb	COMMON BONESET
FRAPEN	2	Fraxinus pennsylvanica	-3	FACW	Nt	Tree	RED ASH
GENPRO	8	Gentianopsis procera	-5	OBL	Nt	A-Forb	SMALL FRINGED GENTIAN
HYPKAL	10	Hypericum kalmianum	-2	FACW-	Nt	Shrub	KALM'S ST. JOHN'S WORT
IRILAC	9	Iris lacustris	0	FAC	Nt	P-Forb	DWARF LAKE IRIS
JUNBAL	4	Juncus balticus	-5	OBL	Nt	P-Forb	RUSH
JUNBRP	7	Juncus brachycephalus	-5	OBL	Nt	P-Forb	RUSH
JUNBRE	8	Juncus brevicaudatus	-5	OBL	Nt	P-Forb	RUSH
JUNHOR	10	Juniperus horizontalis	1	FAC-	Nt	Shrub	CREEPING JUNIPER
LARLAR	5	Larix laricina	-3	FACW	Nt	Tree	TAMARACK
LOBKAL	10	Lobelia kalmii	-5	OBL	Nt	P-Forb	BOG LOBELIA
LONOBL	8	Lonicera oblongifolia	-5	OBL	Nt	Shrub	SWAMP FLY HONEYSUCKLE
LYCAME	2	Lycopus americanus	-5	OBL	Nt	P-Forb	COMMON WATER HOREHOUND
LYCUNI	2	Lycopus uniflorus	-5	OBL	Nt	P-Forb	NORTHERN BUGLE WEED
LYTSAL	0	LYTHRUM SALICARIA	-5	OBL	Ad	P-Forb	PURPLE LOOSESTRIFE
MUHGLO	10	Muhlenbergia glomerata	-4	FACW+	Nt	P-Grass	MARSH WILD TIMOTHY
PANLID	8	Panicum lindheimeri	-5	OBL	Nt	P-Grass	PANIC GRASS
PARGLA	8	Parnassia glauca	-5	OBL	Nt	P-Forb	GRASS OF PARNASSUS
PHRAUS	0	Phragmites australis	-4	FACW+	Nt	P-Grass	REED
PICMAR	6	Picea mariana	-3	FACW	Nt	Tree	BLACK SPRUCE
POGOPH	10	Pogonia ophioglossoides	-5	OBL	Nt	P-Forb	ROSE POGONIA
POTANS	5	Potentilla anserina	-4	FACW+	Nt	P-Forb	SILVERWEED
POTFRU	10	Potentilla fruticosa	-3	FACW	Nt	Shrub	SHRUBBY CINQUEFOIL

PRIMIS	10	Primula mistassinica	-3	FACW	Nt P-Forb	DWARF CANADIAN PRIMROSE
PRUVUL	0	PRUNELLA VULGARIS	0	FAC	Nt P-Forb	LAWN PRUNELLA
RHAFRA	0	RHAMNUS FRANGULA	-1	FAC+	Ad Shrub	GLOSSY BUCKTHORN
RHYALB	6	Rhynchospora alba	-5	OBL	Nt P-Sedge	BEAK RUSH
RHYCAL	10	Rhynchospora capillacea	-5	OBL	Nt P-Sedge	BEAK RUSH
RUDHIR	1	Rudbeckia hirta	3	FACU	Nt P-Forb	BLACK EYED SUSAN
SALCAN	9	Salix candida	-5	OBL	Nt Shrub	HOARY WILLOW
SARPUP	10	Sarracenia purpurea	-5	OBL	Nt P-Forb	PITCHER PLANT
SCHPUN	5	Schoenoplectus pungens	-5	OBL	Nt P-Sedge	THREE SQUARE
SCLVER	10	Scleria verticillata	-5	OBL	Nt A-Sedge	NUT RUSH
SELECL	5	Selaginella eclipes	-4	FACW+	Nt F...Ally	SELAGINELLA
SENPAU	3	Senecio pauperculus	-1	FAC+	Nt P-Forb	BALSAM RAGWORT
SOLALT	1	Solidago altissima	3	FACU	Nt P-Forb	TALL GOLDENROD
SOLOHI	8	Solidago ohioensis	-5	OBL	Nt P-Forb	OHIO GOLDENROD
SOLPTA	6	Solidago ptarmicoides	5	UPL	Nt P-Forb	UPLAND WHITE GOLDENROD
SOLULI	4	Solidago uliginosa	-5	OBL	Nt P-Forb	BOG GOLDENROD
SPICER	4	Spiranthes cernua	-2	FACW-	Nt P-Forb	NODDING LADIES' TRESSES
THEPAL	2	Thelypteris palustris	-4	FACW+	Nt Fern	MARSH FERN
THUOCC	4	Thuja occidentalis	-3	FACW	Nt Tree	ARBOR VITAE
TOFGLU	10	Tofieldia glutinosa	-5	OBL	Nt P-Forb	FALSE ASPHODEL
TRIFRA	6	Triadenum fraseri	-5	OBL	Nt P-Forb	MARSH ST. JOHN'S WORT
TRICES	10	Trichophorum cespitosum	-5	OBL	Nt P-Sedge	BULRUSH
TRIMAR	8	Triglochin maritimum	-5	OBL	Nt P-Forb	COMMON BOG ARROW GRASS
TRIPAL	8	Triglochin palustris	-5	OBL	Nt P-Forb	SLENDER BOG ARROW GRASS
UTRCOR	10	Utricularia cornuta	-5	OBL	Nt A-Forb	HORNED BLADDERWORT

Appendix 3b. Floristic Quality Assessment for Whitefish Bay.

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Site:     Whitefish Bay Coastal Fen EO-56-24
Locale:   Alpena Co., MI
Date:     August 11, 2010   - hours
By:       Brad Slaughter, Dave Cuthrell
File:     c:\FQA\studies\Whitefish Bay.inv
Notes:    Also: Carex sp., Viola sp., Salix sp., Platanthera hyperborea = P. huronensis. (77 total spp.)
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FLORISTIC QUALITY DATA		Native		Adventive	
70	NATIVE SPECIES				
74	Total Species				
6.9	NATIVE MEAN C				
6.5	W/Adventives				
57.8	NATIVE FQI				
56.3	W/Adventives				
-2.9	NATIVE MEAN W				
-2.6	W/Adventives				
AVG:	Fac. Wetland				
		Native	70	Adventive	4
		Tree	4	Tree	0
		Shrub	9	Shrub	1
		W-Vine	1	W-Vine	0
		H-Vine	0	H-Vine	0
		P-Forb	33	P-Forb	2
		B-Forb	0	B-Forb	1
		A-Forb	3	A-Forb	0
		P-Grass	7	P-Grass	0
		A-Grass	0	A-Grass	0
		P-Sedge	12	P-Sedge	0
		A-Sedge	0	A-Sedge	0
		Fern	1		

ACRONYM	C	SCIENTIFIC NAME	W	WETNESS	PHYSIOGNOMY	COMMON NAME
ANDGLA	10	Andromeda glaucophylla	-5	OBL	Nt Shrub	BOG ROSEMARY
ANDSCO	5	Andropogon scoparius	3	FACU	Nt P-Grass	LITTLE BLUESTEM GRASS
ARCUVA	8	Arctostaphylos uva-ursi	5	UPL	Nt Shrub	BEARBERRY
ASCINC	6	Asclepias incarnata	-5	OBL	Nt P-Forb	SWAMP MILKWEED
ASTBOR	9	Aster borealis	-5	OBL	Nt P-Forb	NORTHERN BOG ASTER
BETALL	7	Betula alleghaniensis	0	FAC	Nt Tree	YELLOW BIRCH
CALCAN	3	Calamagrostis canadensis	-5	OBL	Nt P-Grass	BLUE JOINT GRASS
CALARK	10	Calamintha arkansana	-3	FACW	Nt P-Forb	LOW CALAMINT
CALTUB	9	Calopogon tuberosus	-5	OBL	Nt P-Forb	GRASS PINK
CXCAPI	9	Carex capillaris	-3	FACW	Nt P-Sedge	SEDGE
CXEBUR	7	Carex eburnea	4	FACU-	Nt P-Sedge	SEDGE
CXFLAV	4	Carex flava	-5	OBL	Nt P-Sedge	SEDGE
CXSTER	10	Carex sterilis	-5	OBL	Nt P-Sedge	SEDGE

CXSTRI	4	Carex stricta	-5	OBL	Nt P-Sedge	SEDGE
CASCOC	8	Castilleja coccinea	0	FAC	Nt A-Forb	INDIAN PAINTBRUSH
CENMAU	0	CENTAUREA MACULOSA	5	UPL	Ad B-Forb	SPOTTED BLUET
CLAMAR	10	Cladium mariscoides	-5	OBL	Nt P-Sedge	TWIG RUSH
COMUMB	5	Comandra umbellata	3	FACU	Nt P-Forb	BASTARD TOADFLAX
DANSPI	4	Danthonia spicata	5	UPL	Nt P-Grass	POVERTY GRASS; OATGRASS
DESCES	9	Deschampsia cespitosa	-4	FACW+	Nt P-Grass	HAIR GRASS
DROLIN	10	Drosera linearis	-5	OBL	Nt P-Forb	LINEAR LEAVED SUNDEW
DROROT	6	Drosera rotundifolia	-5	OBL	Nt P-Forb	ROUND LEAVED SUNDEW
ELEROS	10	Eleocharis rostellata	-5	OBL	Nt P-Sedge	SPIKE RUSH
EQUVAR	8	Equisetum variegatum	-3	FACW	Nt F...Ally	VARIEGATED SCOURING RUSH
EUPPER	4	Eupatorium perfoliatum	-4	FACW+	Nt P-Forb	COMMON BONESET
GENPRO	8	Gentianopsis procera	-5	OBL	Nt A-Forb	SMALL FRINGED GENTIAN
HIECAE	0	HIERACIUM CAESPITOSUM	5	UPL	Ad P-Forb	KING DEVIL
HYPKAL	10	Hypericum kalmianum	-2	FACW-	Nt Shrub	KALM'S ST. JOHN'S WORT
IRILAC	9	Iris lacustris	0	FAC	Nt P-Forb	DWARF LAKE IRIS
JUNBAL	4	Juncus balticus	-5	OBL	Nt P-Forb	RUSH
JUNCOI	4	Juniperus communis	3	FACU	Nt Shrub	COMMON or GROUND JUNIPER
JUNHOR	10	Juniperus horizontalis	1	FAC-	Nt Shrub	CREEPING JUNIPER
LARLAR	5	Larix laricina	-3	FACW	Nt Tree	TAMARACK
LILPHI	10	Lilium philadelphicum	1	FAC-	Nt P-Forb	WOOD LILY
LOBKAL	10	Lobelia kalmii	-5	OBL	Nt P-Forb	BOG LOBELIA
LOBSPI	4	Lobelia spicata	0	FAC	Nt P-Forb	PALE SPIKED LOBELIA
LONOBL	8	Lonicera oblongifolia	-5	OBL	Nt Shrub	SWAMP FLY HONEYSUCKLE
LYCUNI	2	Lycopus uniflorus	-5	OBL	Nt P-Forb	NORTHERN BUGLE WEED
LYTSAL	0	LYTHRUM SALICARIA	-5	OBL	Ad P-Forb	PURPLE LOOSESTRIFE
MUHGLO	10	Muhlenbergia glomerata	-4	FACW+	Nt P-Grass	MARSH WILD TIMOTHY
MYRGAL	6	Myrica gale	-5	OBL	Nt Shrub	SWEET GALE
PANLID	8	Panicum lindheimeri	-5	OBL	Nt P-Grass	PANIC GRASS
PARGLA	8	Parnassia glauca	-5	OBL	Nt P-Forb	GRASS OF PARNASSUS
PEDLAN	8	Pedicularis lanceolata	-4	FACW+	Nt P-Forb	SWAMP BETONY
PHRAUS	0	Phragmites australis	-4	FACW+	Nt P-Grass	REED
PICMAR	6	Picea mariana	-3	FACW	Nt Tree	BLACK SPRUCE
PLAHYP	5	Platanthera hyperborea	-4	FACW+	Nt P-Forb	TALL NORTHERN BOG ORCHID
POGOPH	10	Pogonia ophioglossoides	-5	OBL	Nt P-Forb	ROSE POGONIA
POTANS	5	Potentilla anserina	-4	FACW+	Nt P-Forb	SILVERWEED
POTFRU	10	Potentilla fruticosa	-3	FACW	Nt Shrub	SHRUBBY CINQUEFOIL
PRIMIS	10	Primula mistassinica	-3	FACW	Nt P-Forb	DWARF CANADIAN PRIMROSE

PRUVUL	0	PRUNELLA VULGARIS	0	FAC	Nt P-Forb	LAWN PRUNELLA
RHAFRA	0	RHAMNUS FRANGULA	-1	FAC+	Ad Shrub	GLOSSY BUCKTHORN
RHYALB	6	Rhynchospora alba	-5	OBL	Nt P-Sedge	BEAK RUSH
RHYCAL	10	Rhynchospora capillacea	-5	OBL	Nt P-Sedge	BEAK RUSH
RUDHIR	1	Rudbeckia hirta	3	FACU	Nt P-Forb	BLACK EYED SUSAN
SARPUP	10	Sarracenia purpurea	-5	OBL	Nt P-Forb	PITCHER PLANT
SCHACU	5	Schoenoplectus acutus	-5	OBL	Nt P-Sedge	HARDSTEM BULRUSH
SCHPUN	5	Schoenoplectus pungens	-5	OBL	Nt P-Sedge	THREE SQUARE
SENPAU	3	Senecio pauperculus	-1	FAC+	Nt P-Forb	BALSAM RAGWORT
SHECAN	7	Shepherdia canadensis	5	UPL	Nt Shrub	SOAPBERRY
SOLOHI	8	Solidago ohioensis	-5	OBL	Nt P-Forb	OHIO GOLDENROD
SOLRUG	3	Solidago rugosa	-1	FAC+	Nt P-Forb	ROUGH GOLDENROD
SOLULI	4	Solidago uliginosa	-5	OBL	Nt P-Forb	BOG GOLDENROD
SPICER	4	Spiranthes cernua	-2	FACW-	Nt P-Forb	NODDING LADIES' TRESSES
THUOCC	4	Thuja occidentalis	-3	FACW	Nt Tree	ARBOR VITAE
TOFGLU	10	Tofieldia glutinosa	-5	OBL	Nt P-Forb	FALSE ASPHODEL
TRICES	10	Trichophorum cespitosum	-5	OBL	Nt P-Sedge	BULRUSH
TRIMAR	8	Triglochin maritimum	-5	OBL	Nt P-Forb	COMMON BOG ARROW GRASS
TRIPAL	8	Triglochin palustris	-5	OBL	Nt P-Forb	SLENDER BOG ARROW GRASS
UTRCOR	10	Utricularia cornuta	-5	OBL	Nt A-Forb	HORNED BLADDERWORT
UTRINT	10	Utricularia intermedia	-5	OBL	Nt P-Forb	FLAT LEAVED BLADDERWORT
VITRIP	3	Vitis riparia	-2	FACW-	Nt W-Vine	RIVERBANK GRAPE
ZIGGLA	10	Zigadenus glaucus	-3	FACW	Nt P-Forb	WHITE CAMAS

Appendix 3c. Floristic Quality Assessment of Squaw Bay.

Site: Thunder Bay/Squaw Bay EO-25-13250
Locale: Alpena Co.
Date: August 12, 2010 - hours
By: Brad Slaughter, Dave Cuthrell
File: c:\Active Projects\Coastal fen CZM grant\FQA\Thunder Bay, Squaw Bay EO-25-13250.inv
Notes: Also: Polygonum sp., Aster ?lanceolatus, Viola sp. **(65 total spp.)**

FLORISTIC QUALITY DATA	Native	61	98.4%	Adventive	1	1.6%
61 NATIVE SPECIES	Tree	6	9.7%	Tree	0	0.0%
62 Total Species	Shrub	8	12.9%	Shrub	1	1.6%
6.2 NATIVE MEAN C	W-Vine	0	0.0%	W-Vine	0	0.0%
6.1 W/Adventives	H-Vine	0	0.0%	H-Vine	0	0.0%
48.8 NATIVE FQI	P-Forb	24	38.7%	P-Forb	0	0.0%
48.4 W/Adventives	B-Forb	0	0.0%	B-Forb	0	0.0%
-3.5 NATIVE MEAN W	A-Forb	2	3.2%	A-Forb	0	0.0%
-3.5 W/Adventives	P-Grass	6	9.7%	P-Grass	0	0.0%
AVG: Fac. Wetland (+)	A-Grass	0	0.0%	A-Grass	0	0.0%
	P-Sedge	12	19.4%	P-Sedge	0	0.0%
	A-Sedge	0	0.0%	A-Sedge	0	0.0%
	Fern	3	4.8%			

ACRONYM	C	SCIENTIFIC NAME	W	WETNESS	PHYSIOGNOMY	COMMON NAME
ACERUB	1	Acer rubrum	0	FAC	Nt Tree	RED MAPLE
ALNRUG	5	Alnus rugosa	-5	OBL	Nt Shrub	TAG ALDER
AROPRU	5	Aronia prunifolia	-3	FACW	Nt Shrub	BLACK CHOKEBERRY
ASCINC	6	Asclepias incarnata	-5	OBL	Nt P-Forb	SWAMP MILKWEED
ASTUMB	5	Aster umbellatus	-3	FACW	Nt P-Forb	TALL FLAT TOP WHITE ASTER
CALCAN	3	Calamagrostis canadensis	-5	OBL	Nt P-Grass	BLUE JOINT GRASS
CALINE	8	Calamagrostis inexpansa	-4	FACW+	Nt P-Grass	BOG REEDGRASS
CXEBUR	7	Carex eburnea	4	FACU-	Nt P-Sedge	SEDGE
CXFLAV	4	Carex flava	-5	OBL	Nt P-Sedge	SEDGE
CXLIVI	10	Carex livida	-5	OBL	Nt P-Sedge	SEDGE
CXSTER	10	Carex sterilis	-5	OBL	Nt P-Sedge	SEDGE
CXSTRI	4	Carex stricta	-5	OBL	Nt P-Sedge	SEDGE
CXVIRI	4	Carex viridula	-5	OBL	Nt P-Sedge	SEDGE

CLAMAR	10	Cladium mariscoides	-5	OBL	Nt P-Sedge	TWIG RUSH
CYCAPU	5	Cypripedium calceolus var. pubescens	-1	FAC+	Nt P-Forb	LARGE YELLOW LADY'S SLIPPER
DESCES	9	Deschampsia cespitosa	-4	FACW+	Nt P-Grass	HAIR GRASS
DROROT	6	Drosera rotundifolia	-5	OBL	Nt P-Forb	ROUND LEAVED SUNDEW
EQUVAR	8	Equisetum variegatum	-3	FACW	Nt F...Ally	VARIEGATED SCOURING RUSH
ERIVID	8	Eriophorum viridi-carinatum	-5	OBL	Nt P-Sedge	GREEN KEELED COTTON GRASS
EUTGRA	3	Euthamia graminifolia	-2	FACW-	Nt P-Forb	GRASS LEAVED GOLDENROD
FRAVIR	2	Fragaria virginiana	1	FAC-	Nt P-Forb	WILD STRAWBERRY
FRAPEN	2	Fraxinus pennsylvanica	-3	FACW	Nt Tree	RED ASH
GENPRO	8	Gentianopsis procera	-5	OBL	Nt A-Forb	SMALL FRINGED GENTIAN
HYPKAL	10	Hypericum kalmianum	-2	FACW-	Nt Shrub	KALM'S ST. JOHN'S WORT
JUNBAL	4	Juncus balticus	-5	OBL	Nt P-Forb	RUSH
JUNBRP	7	Juncus brachycephalus	-5	OBL	Nt P-Forb	RUSH
JUNBRE	8	Juncus brevicaudatus	-5	OBL	Nt P-Forb	RUSH
JUNCOI	4	Juniperus communis	3	FACU	Nt Shrub	COMMON or GROUND JUNIPER
LARLAR	5	Larix laricina	-3	FACW	Nt Tree	TAMARACK
LOBKAL	10	Lobelia kalmii	-5	OBL	Nt P-Forb	BOG LOBELIA
LYCUNI	2	Lycopus uniflorus	-5	OBL	Nt P-Forb	NORTHERN BUGLE WEED
MUHGLO	10	Muhlenbergia glomerata	-4	FACW+	Nt P-Grass	MARSH WILD TIMOTHY
MYRGAL	6	Myrica gale	-5	OBL	Nt Shrub	SWEET GALE
OSMREG	5	Osmunda regalis	-5	OBL	Nt Fern	ROYAL FERN
PANLID	8	Panicum lindheimeri	-5	OBL	Nt P-Grass	PANIC GRASS
PHRAUS	0	Phragmites australis	-4	FACW+	Nt P-Grass	REED
PINSTR	3	Pinus strobus	3	FACU	Nt Tree	WHITE PINE
POTFRU	10	Potentilla fruticosa	-3	FACW	Nt Shrub	SHRUBBY CINQUEFOIL
PRIMIS	10	Primula mistassinica	-3	FACW	Nt P-Forb	DWARF CANADIAN PRIMROSE
PROPAL	6	Proserpinaca palustris	-5	OBL	Nt P-Forb	MERMAID WEED
QUERUB	5	Quercus rubra	3	FACU	Nt Tree	RED OAK
RHAFRA	0	RHAMNUS FRANGULA	-1	FAC+	Ad Shrub	GLOSSY BUCKTHORN
RHYALB	6	Rhynchospora alba	-5	OBL	Nt P-Sedge	BEAK RUSH
RHYCAL	10	Rhynchospora capillacea	-5	OBL	Nt P-Sedge	BEAK RUSH
SARPUP	10	Sarracenia purpurea	-5	OBL	Nt P-Forb	PITCHER PLANT
SCHPUN	5	Schoenoplectus pungens	-5	OBL	Nt P-Sedge	THREE SQUARE
SOLOHI	8	Solidago ohioensis	-5	OBL	Nt P-Forb	OHIO GOLDENROD
SOLRUG	3	Solidago rugosa	-1	FAC+	Nt P-Forb	ROUGH GOLDENROD
SOLULI	4	Solidago uliginosa	-5	OBL	Nt P-Forb	BOG GOLDENROD
SPICER	4	Spiranthes cernua	-2	FACW-	Nt P-Forb	NODDING LADIES' TRESSES
THEPAL	2	Thelypteris palustris	-4	FACW+	Nt Fern	MARSH FERN

THUOCC	4	Thuja occidentalis	-3	FACW	Nt Tree	ARBOR VITAE
TOFGLU	10	Tofieldia glutinosa	-5	OBL	Nt P-Forb	FALSE ASPHODEL
TRIFRA	6	Triadenum fraseri	-5	OBL	Nt P-Forb	MARSH ST. JOHN'S WORT
TRIALP	10	Trichophorum alpinum	-5	OBL	Nt P-Sedge	BULRUSH
TRIBOR	5	Trientalis borealis	-1	FAC+	Nt P-Forb	STARFLOWER
TRIMAR	8	Triglochin maritimum	-5	OBL	Nt P-Forb	COMMON BOG ARROW GRASS
TRIPAL	8	Triglochin palustris	-5	OBL	Nt P-Forb	SLENDER BOG ARROW GRASS
UTRCOR	10	Utricularia cornuta	-5	OBL	Nt A-Forb	HORNED BLADDERWORT
UTRINT	10	Utricularia intermedia	-5	OBL	Nt P-Forb	FLAT LEAVED BLADDERWORT
VACMYR	4	Vaccinium myrtilloides	-2	FACW-	Nt Shrub	CANADA BLUEBERRY
VACOXY	8	Vaccinium oxycoccos	-5	OBL	Nt Shrub	SMALL CRANBERRY

Appendix 3d. Floristic Quality Assessment for Thompson's Harbor Coastal Fen.

Site: Thompson's Harbor State Park
Locale: Presque Isle Co., MI
Date: August 13, 2010 - hours
By: Brad Slaughter, Dave Cuthrell
File: c:\Active Projects\Coastal fen CZM grant\FQA\Thompson's Harbor Coastal Fen EO-3-11086.inv
Notes: Also: indet. Salix spp. (2), Polygonum sp., Stachys sp., Aster sp., Sonchus sp., Viola sp. **(110 total spp.)**

FLORISTIC QUALITY DATA		Native		Adventive	
99	NATIVE SPECIES	Tree	8	Tree	0
103	Total Species	Shrub	12	Shrub	0
6.3	NATIVE MEAN C	W-Vine	0	W-Vine	0
6.1	W/Adventives	H-Vine	0	H-Vine	0
62.8	NATIVE FQI	P-Forb	45	P-Forb	3
61.6	W/Adventives	B-Forb	1	B-Forb	0
-2.9	NATIVE MEAN W	A-Forb	4	A-Forb	0
-2.8	W/Adventives	P-Grass	8	P-Grass	1
AVG:	Fac. Wetland	A-Grass	0	A-Grass	0
		P-Sedge	16	P-Sedge	0
		A-Sedge	1	A-Sedge	0
		Fern	4		

ACRONYM	C	SCIENTIFIC NAME	W	WETNESS	PHYSIOGNOMY	COMMON NAME
ACERUB	1	Acer rubrum	0	FAC	Nt Tree	RED MAPLE
AGAPUR	7	Agalinis purpurea	-3	FACW	Nt A-Forb	PURPLE GERARDIA
ANDSCO	5	Andropogon scoparius	3	FACU	Nt P-Grass	LITTLE BLUESTEM GRASS
ARCUVA	8	Arctostaphylos uva-ursi	5	UPL	Nt Shrub	BEARBERRY
ASTBOR	9	Aster borealis	-5	OBL	Nt P-Forb	NORTHERN BOG ASTER
ASTFIR	4	Aster firmus	-5	OBL	Nt P-Forb	SMOOTH SWAMP ASTER
ASTLAN	2	Aster lanceolatus	-3	FACW	Nt P-Forb	EASTERN LINED ASTER
ASTMAC	4	Aster macrophyllus	5	UPL	Nt P-Forb	BIG LEAVED ASTER
ASTPUN	5	Aster puniceus	-5	OBL	Nt P-Forb	SWAMP ASTER
ASTUMB	5	Aster umbellatus	-3	FACW	Nt P-Forb	TALL FLAT TOP WHITE ASTER
BETPAP	2	Betula papyrifera	2	FACU+	Nt Tree	PAPER BIRCH
CACPLA	10	Cacalia plantaginea	0	FAC	Nt P-Forb	TUBEROUS INDIAN PLANTAIN

CALCAN	3	Calamagrostis canadensis	-5	OBL	Nt	P-Grass	BLUE JOINT GRASS
CALINE	8	Calamagrostis inexpansa	-4	FACW+	Nt	P-Grass	BOG REEDGRASS
CALARK	10	Calamintha arkansana	-3	FACW	Nt	P-Forb	LOW CALAMINT
CALTUB	9	Calopogon tuberosus	-5	OBL	Nt	P-Forb	GRASS PINK
CXBUXB	10	Carex buxbaumii	-5	OBL	Nt	P-Sedge	SEDGE
CXCAPI	9	Carex capillaris	-3	FACW	Nt	P-Sedge	SEDGE
CXCRAE	10	Carex crawei	-3	FACW	Nt	P-Sedge	SEDGE
CXFLAV	4	Carex flava	-5	OBL	Nt	P-Sedge	SEDGE
CXLASI	8	Carex lasiocarpa	-5	OBL	Nt	P-Sedge	SEDGE
CXSTER	10	Carex sterilis	-5	OBL	Nt	P-Sedge	SEDGE
CXSTRI	4	Carex stricta	-5	OBL	Nt	P-Sedge	SEDGE
CXVIRI	4	Carex viridula	-5	OBL	Nt	P-Sedge	SEDGE
CASCOC	8	Castilleja coccinea	0	FAC	Nt	A-Forb	INDIAN PAINTBRUSH
CIRMUT	6	Cirsium muticum	-5	OBL	Nt	B-Forb	SWAMP THISTLE
CLAMAR	10	Cladium mariscoides	-5	OBL	Nt	P-Sedge	TWIG RUSH
COMUMB	5	Comandra umbellata	3	FACU	Nt	P-Forb	BASTARD TOADFLAX
CORSTO	2	Cornus stolonifera	-3	FACW	Nt	Shrub	RED OSIER DOGWOOD
CYCAPU	5	Cypripedium calceolus var. pubescens	-1	FAC+	Nt	P-Forb	LARGE YELLOW LADY'S SLIPPER
DANSPI	4	Danthonia spicata	5	UPL	Nt	P-Grass	POVERTY GRASS; OATGRASS
DESCES	9	Deschampsia cespitosa	-4	FACW+	Nt	P-Grass	HAIR GRASS
DROLIN	10	Drosera linearis	-5	OBL	Nt	P-Forb	LINEAR LEAVED SUNDEW
DROROT	6	Drosera rotundifolia	-5	OBL	Nt	P-Forb	ROUND LEAVED SUNDEW
ELEROS	10	Eleocharis rostellata	-5	OBL	Nt	P-Sedge	SPIKE RUSH
EQUFLU	7	Equisetum fluviatile	-5	OBL	Nt	F...Ally	WATER HORSETAIL
EQUVAR	8	Equisetum variegatum	-3	FACW	Nt	F...Ally	VARIEGATED SCOURING RUSH
ERIVID	8	Eriophorum viridi-carinatum	-5	OBL	Nt	P-Sedge	GREEN KEELED COTTON GRASS
EUPMAM	4	Eupatorium maculatum	-5	OBL	Nt	P-Forb	JOE PYE WEED
EUPPER	4	Eupatorium perfoliatum	-4	FACW+	Nt	P-Forb	COMMON BONESET
EUTGRA	3	Euthamia graminifolia	-2	FACW-	Nt	P-Forb	GRASS LEAVED GOLDENROD
FRAPEN	2	Fraxinus pennsylvanica	-3	FACW	Nt	Tree	RED ASH
GENPRO	8	Gentianopsis procera	-5	OBL	Nt	A-Forb	SMALL FRINGED GENTIAN
HIECAE	0	HIERACIUM CAESPITOSUM	5	UPL	Ad	P-Forb	KING DEVIL
HYPKAL	10	Hypericum kalmianum	-2	FACW-	Nt	Shrub	KALM'S ST. JOHN'S WORT
IRILAC	9	Iris lacustris	0	FAC	Nt	P-Forb	DWARF LAKE IRIS
JUNBAL	4	Juncus balticus	-5	OBL	Nt	P-Forb	RUSH
JUNBRP	7	Juncus brachycephalus	-5	OBL	Nt	P-Forb	RUSH
JUNCOI	4	Juniperus communis	3	FACU	Nt	Shrub	COMMON or GROUND JUNIPER
JUNHOR	10	Juniperus horizontalis	1	FAC-	Nt	Shrub	CREEPING JUNIPER

LARLAR	5	Larix laricina	-3	FACW	Nt Tree	TAMARACK
LATPAL	7	Lathyrus palustris	-3	FACW	Nt P-Forb	MARSH PEA
LEDGRO	8	Ledum groenlandicum	-5	OBL	Nt Shrub	LABRADOR TEA
LIPLOE	5	Liparis loeselii	-4	FACW+	Nt P-Forb	LOESEL'S TWAYBLADE
LOBKAL	10	Lobelia kalmii	-5	OBL	Nt P-Forb	BOG LOBELIA
LONOBL	8	Lonicera oblongifolia	-5	OBL	Nt Shrub	SWAMP FLY HONEYSUCKLE
LYCUNI	2	Lycopus uniflorus	-5	OBL	Nt P-Forb	NORTHERN BUGLE WEED
LYSQUR	10	Lysimachia quadriflora	-5	OBL	Nt P-Forb	WHORLED LOOSESTRIFE
MENPIP	0	MENTHA PIPERITA	-5	OBL	Ad P-Forb	PEPPERMINT
MUHGLO	10	Muhlenbergia glomerata	-4	FACW+	Nt P-Grass	MARSH WILD TIMOTHY
ONOSEN	2	Onoclea sensibilis	-3	FACW	Nt Fern	SENSITIVE FERN
PANLID	8	Panicum lindheimeri	-5	OBL	Nt P-Grass	PANIC GRASS
PARGLA	8	Parnassia glauca	-5	OBL	Nt P-Forb	GRASS OF PARNASSUS
PHRAUS	0	Phragmites australis	-4	FACW+	Nt P-Grass	REED
PICMAR	6	Picea mariana	-3	FACW	Nt Tree	BLACK SPRUCE
PINVUL	10	Pinguicula vulgaris	-5	OBL	Nt P-Forb	BUTTERWORT
PLAHYP	5	Platanthera hyperborea	-4	FACW+	Nt P-Forb	TALL NORTHERN BOG ORCHID
POACOM	0	POA COMPRESSA	2	FACU+	Ad P-Grass	CANADA BLUEGRASS
POPBAL	2	Populus balsamifera	-3	FACW	Nt Tree	BALSAM POPLAR
POPTRE	1	Populus tremuloides	0	FAC	Nt Tree	QUAKING ASPEN
POTANS	5	Potentilla anserina	-4	FACW+	Nt P-Forb	SILVERWEED
POTFRU	10	Potentilla fruticosa	-3	FACW	Nt Shrub	SHRUBBY CINQUEFOIL
PRIMIS	10	Primula mistassinica	-3	FACW	Nt P-Forb	DWARF CANADIAN PRIMROSE
PRUVUL	0	PRUNELLA VULGARIS	0	FAC	Nt P-Forb	LAWN PRUNELLA
RHAALN	8	Rhamnus alnifolia	-5	OBL	Nt Shrub	ALDER LEAVED BUCKTHORN
RHYALB	6	Rhynchospora alba	-5	OBL	Nt P-Sedge	BEAK RUSH
RHYCAL	10	Rhynchospora capillacea	-5	OBL	Nt P-Sedge	BEAK RUSH
RUDHIR	1	Rudbeckia hirta	3	FACU	Nt P-Forb	BLACK EYED SUSAN
SALCAN	9	Salix candida	-5	OBL	Nt Shrub	HOARY WILLOW
SARPUP	10	Sarracenia purpurea	-5	OBL	Nt P-Forb	PITCHER PLANT
SCHACU	5	Schoenoplectus acutus	-5	OBL	Nt P-Sedge	HARDSTEM BULRUSH
SCHPUN	5	Schoenoplectus pungens	-5	OBL	Nt P-Sedge	THREE SQUARE
SCLVER	10	Scleria verticillata	-5	OBL	Nt A-Sedge	NUT RUSH
SELECL	5	Selaginella eclipes	-4	FACW+	Nt F...Ally	SELAGINELLA
SENAUR	5	Senecio aureus	-3	FACW	Nt P-Forb	GOLDEN RAGWORT
SENPAU	3	Senecio pauperculus	-1	FAC+	Nt P-Forb	BALSAM RAGWORT
SHECAN	7	Shepherdia canadensis	5	UPL	Nt Shrub	SOAPBERRY
SMISTE	5	Smilacina stellata	1	FAC-	Nt P-Forb	STARRY FALSE SOLOMON SEAL

SOLCAN	1	Solidago canadensis	3	FACU	Nt P-Forb	CANADA GOLDENROD
SOLOHI	8	Solidago ohioensis	-5	OBL	Nt P-Forb	OHIO GOLDENROD
SOLPTA	6	Solidago ptarmicoides	5	UPL	Nt P-Forb	UPLAND WHITE GOLDENROD
SOLRUG	3	Solidago rugosa	-1	FAC+	Nt P-Forb	ROUGH GOLDENROD
SOLULI	4	Solidago uliginosa	-5	OBL	Nt P-Forb	BOG GOLDENROD
SPICER	4	Spiranthes cernua	-2	FACW-	Nt P-Forb	NODDING LADIES' TRESSES
THUOCC	4	Thuja occidentalis	-3	FACW	Nt Tree	ARBOR VITAE
TOFGLU	10	Tofieldia glutinosa	-5	OBL	Nt P-Forb	FALSE ASPHODEL
TRIFRA	6	Triadenum fraseri	-5	OBL	Nt P-Forb	MARSH ST. JOHN'S WORT
TRICES	10	Trichophorum cespitosum	-5	OBL	Nt P-Sedge	BULRUSH
TRIMAR	8	Triglochin maritimum	-5	OBL	Nt P-Forb	COMMON BOG ARROW GRASS
TRIPAL	8	Triglochin palustris	-5	OBL	Nt P-Forb	SLENDER BOG ARROW GRASS
TYPANG	0	TYPHA ANGUSTIFOLIA	-5	OBL	Ad P-Forb	NARROW LEAVED CATTAIL
UTRCOR	10	Utricularia cornuta	-5	OBL	Nt A-Forb	HORNED BLADDERWORT
VACOXY	8	Vaccinium oxycoccos	-5	OBL	Nt Shrub	SMALL CRANBERRY

Appendix 3e. Floristic Quality Assessment for Waugoshance Point.

Site: Waugoshance Point Coastal Fen EO-1-17336
Locale: Emmet Co., MI
Date: August 14, 2010 - hours
By: Brad Slaughter, Dave Cuthrell
File: c:\Active Projects\Coastal fen CZM grant\FQA\Waugoshance Point Coastal Fen EO-1-17336.inv
Notes: Also: Salix sp., Aster lanceolatus/borealis, Potamogeton sp., Carex sp. **(58 total spp.)**

FLORISTIC QUALITY DATA						
54 NATIVE SPECIES	Native	54	100.0%	Adventive	0	0.0%
54 Total Species	Tree	3	5.6%	Tree	0	0.0%
6.4 NATIVE MEAN C	Shrub	4	7.4%	Shrub	0	0.0%
6.4 W/Adventives	W-Vine	0	0.0%	W-Vine	0	0.0%
47.2 NATIVE FQI	H-Vine	0	0.0%	H-Vine	0	0.0%
47.2 W/Adventives	P-Forb	25	46.3%	P-Forb	0	0.0%
-3.7 NATIVE MEAN W	B-Forb	1	1.9%	B-Forb	0	0.0%
-3.7 W/Adventives	A-Forb	4	7.4%	A-Forb	0	0.0%
AVG: Fac. Wetland (+)	P-Grass	8	14.8%	P-Grass	0	0.0%
	A-Grass	0	0.0%	A-Grass	0	0.0%
	P-Sedge	7	13.0%	P-Sedge	0	0.0%
	A-Sedge	0	0.0%	A-Sedge	0	0.0%
	Fern	2	3.7%			

ACRONYM	C	SCIENTIFIC NAME	W	WETNESS	PHYSIOGNOMY	COMMON NAME
AGAPUR	7	Agalinis purpurea	-3	FACW	Nt A-Forb	PURPLE GERARDIA
ANDSCO	5	Andropogon scoparius	3	FACU	Nt P-Grass	LITTLE BLUESTEM GRASS
ARTCAM	5	Artemisia campestris	0	FAC	Nt B-Forb	WORMWOOD
ASCINC	6	Asclepias incarnata	-5	OBL	Nt P-Forb	SWAMP MILKWEED
CALCAN	3	Calamagrostis canadensis	-5	OBL	Nt P-Grass	BLUE JOINT GRASS
CALINE	8	Calamagrostis inexpansa	-4	FACW+	Nt P-Grass	BOG REEDGRASS
CALARK	10	Calamintha arkansana	-3	FACW	Nt P-Forb	LOW CALAMINT
CAMAPR	7	Campanula aparinoides	-5	OBL	Nt P-Forb	MARSH BELLFLOWER
CXLASI	8	Carex lasiocarpa	-5	OBL	Nt P-Sedge	SEDGE
CXVIRI	4	Carex viridula	-5	OBL	Nt P-Sedge	SEDGE
CASCOC	8	Castilleja coccinea	0	FAC	Nt A-Forb	INDIAN PAINTBRUSH
CLAMAR	10	Cladium mariscoides	-5	OBL	Nt P-Sedge	TWIG RUSH
DANSPI	4	Danthonia spicata	5	UPL	Nt P-Grass	POVERTY GRASS; OATGRASS

DESCES	9	Deschampsia cespitosa	-4	FACW+	Nt P-Grass	HAIR GRASS
ELEQUI	10	Eleocharis quinqueflora	-5	OBL	Nt P-Sedge	SPIKE RUSH
EQUVAR	8	Equisetum variegatum	-3	FACW	Nt F...Ally	VARIEGATED SCOURING RUSH
EUPMAM	4	Eupatorium maculatum	-5	OBL	Nt P-Forb	JOE PYE WEED
EUPPER	4	Eupatorium perfoliatum	-4	FACW+	Nt P-Forb	COMMON BONESET
EUTGRA	3	Euthamia graminifolia	-2	FACW-	Nt P-Forb	GRASS LEAVED GOLDENROD
FRAPEN	2	Fraxinus pennsylvanica	-3	FACW	Nt Tree	RED ASH
GENPRO	8	Gentianopsis procera	-5	OBL	Nt A-Forb	SMALL FRINGED GENTIAN
HYPKAL	10	Hypericum kalmianum	-2	FACW-	Nt Shrub	KALM'S ST. JOHN'S WORT
IRIVER	5	Iris versicolor	-5	OBL	Nt P-Forb	WILD BLUE FLAG
JUNBAL	4	Juncus balticus	-5	OBL	Nt P-Forb	RUSH
JUNBRP	7	Juncus brachycephalus	-5	OBL	Nt P-Forb	RUSH
LARLAR	5	Larix laricina	-3	FACW	Nt Tree	TAMARACK
LOBKAL	10	Lobelia kalmii	-5	OBL	Nt P-Forb	BOG LOBELIA
LYCAME	2	Lycopus americanus	-5	OBL	Nt P-Forb	COMMON WATER HOREHOUND
LYCUNI	2	Lycopus uniflorus	-5	OBL	Nt P-Forb	NORTHERN BUGLE WEED
MUHGLO	10	Muhlenbergia glomerata	-4	FACW+	Nt P-Grass	MARSH WILD TIMOTHY
MYRGAL	6	Myrica gale	-5	OBL	Nt Shrub	SWEET GALE
PANLID	8	Panicum lindheimeri	-5	OBL	Nt P-Grass	PANIC GRASS
PARGLA	8	Parnassia glauca	-5	OBL	Nt P-Forb	GRASS OF PARNASSUS
PHRAUS	0	Phragmites australis	-4	FACW+	Nt P-Grass	REED
PINVUL	10	Pinguicula vulgaris	-5	OBL	Nt P-Forb	BUTTERWORT
POTFRU	10	Potentilla fruticosa	-3	FACW	Nt Shrub	SHRUBBY CINQUEFOIL
PRIMIS	10	Primula mistassinica	-3	FACW	Nt P-Forb	DWARF CANADIAN PRIMROSE
PROPAL	6	Proserpinaca palustris	-5	OBL	Nt P-Forb	MERMAID WEED
PRUVUL	0	PRUNELLA VULGARIS	0	FAC	Nt P-Forb	LAWN PRUNELLA
RHYCAL	10	Rhynchospora capillacea	-5	OBL	Nt P-Sedge	BEAK RUSH
SALCAN	9	Salix candida	-5	OBL	Nt Shrub	HOARY WILLOW
SCHACU	5	Schoenoplectus acutus	-5	OBL	Nt P-Sedge	HARDSTEM BULRUSH
SCHPUN	5	Schoenoplectus pungens	-5	OBL	Nt P-Sedge	THREE SQUARE
SELECL	5	Selaginella eclipes	-4	FACW+	Nt F...Ally	SELAGINELLA
SENPAU	3	Senecio pauperculus	-1	FAC+	Nt P-Forb	BALSAM RAGWORT
SOLHOU	10	Solidago houghtonii	-5	OBL	Nt P-Forb	HOUGHTON'S GOLDENROD
SOLOHI	8	Solidago ohioensis	-5	OBL	Nt P-Forb	OHIO GOLDENROD
SOLULI	4	Solidago uliginosa	-5	OBL	Nt P-Forb	BOG GOLDENROD
SPICER	4	Spiranthes cernua	-2	FACW-	Nt P-Forb	NODDING LADIES' TRESSES
THUOCC	4	Thuja occidentalis	-3	FACW	Nt Tree	ARBOR VITAE
TOFGLU	10	Tofieldia glutinosa	-5	OBL	Nt P-Forb	FALSE ASPHODEL

TRIFRA	6	Triadenum fraseri	-5 OBL	Nt P-Forb	MARSH ST. JOHN'S WORT
TRIMAR	8	Triglochin maritimum	-5 OBL	Nt P-Forb	COMMON BOG ARROW GRASS
UTRCOR	10	Utricularia cornuta	-5 OBL	Nt A-Forb	HORNED BLADDERWORT

Appendix 3f. Floristic Quality Assessment for Dudley Bay (West and East).

Site: Dudley Bay Coastal Fen
Locale: Mackinac Co., MI
Date: August 15, 2010 - hours
By: Brad Slaughter, Dave Cuthrell
File: c:\Active Projects\Coastal fen CZM grant\FQA\Dudley Bay Coastal Fen EO-26-13470.inv
Notes: Also: Salix sp. with red petioles, Rubus sp., Aster sp., Viola sp. **(83 total spp.)**

FLORISTIC QUALITY DATA		Native		Adventive	
77	NATIVE SPECIES	Tree	7	Tree	0
79	Total Species	Shrub	8	Shrub	0
6.0	NATIVE MEAN C	W-Vine	0	W-Vine	0
5.8	W/Adventives	H-Vine	0	H-Vine	0
52.3	NATIVE FQI	P-Forb	37	P-Forb	0
51.6	W/Adventives	B-Forb	0	B-Forb	1
-2.9	NATIVE MEAN W	A-Forb	3	A-Forb	1
-2.8	W/Adventives	P-Grass	8	P-Grass	0
AVG:	Fac. Wetland	A-Grass	0	A-Grass	0
		P-Sedge	12	P-Sedge	0
		A-Sedge	0	A-Sedge	0
		Fern	2		

ACRONYM	C	SCIENTIFIC NAME	W	WETNESS	PHYSIOGNOMY	COMMON NAME
AGAPUR	7	Agalinis purpurea	-3	FACW	Nt A-Forb	PURPLE GERARDIA
AGRTRA	8	Agropyron trachycaulum	0	FAC	Nt P-Grass	SLENDER WHEAT GRASS
ALNRUG	5	Alnus rugosa	-5	OBL	Nt Shrub	TAG ALDER
ANECAN	4	Anemone canadensis	-3	FACW	Nt P-Forb	CANADA ANEMONE
ASTLAN	2	Aster lanceolatus	-3	FACW	Nt P-Forb	EASTERN LINED ASTER
ASTPUN	5	Aster puniceus	-5	OBL	Nt P-Forb	SWAMP ASTER
ASTUMB	5	Aster umbellatus	-3	FACW	Nt P-Forb	TALL FLAT TOP WHITE ASTER
BETPAP	2	Betula papyrifera	2	FACU+	Nt Tree	PAPER BIRCH
BROCIL	6	Bromus ciliatus	-3	FACW	Nt P-Grass	FRINGED BROME
CALCAN	3	Calamagrostis canadensis	-5	OBL	Nt P-Grass	BLUE JOINT GRASS
CALARK	10	Calamintha arkansana	-3	FACW	Nt P-Forb	LOW CALAMINT
CAMAPR	7	Campanula aparinoides	-5	OBL	Nt P-Forb	MARSH BELLFLOWER
CXCAPI	9	Carex capillaris	-3	FACW	Nt P-Sedge	SEDGE

CXEBUR	7	Carex eburnea	4	FACU-	Nt	P-Sedge	SEDGE
CXFLAV	4	Carex flava	-5	OBL	Nt	P-Sedge	SEDGE
CXSTRI	4	Carex stricta	-5	OBL	Nt	P-Sedge	SEDGE
CIRPAL	0	CIRSIUM PALUSTRE	-4	FACW+	Ad	B-Forb	MARSH THISTLE
CLAMAR	10	Cladium mariscoides	-5	OBL	Nt	P-Sedge	TWIG RUSH
COMUMB	5	Comandra umbellata	3	FACU	Nt	P-Forb	BASTARD TOADFLAX
CYCAPU	5	Cypripedium calceolus var. pubescens	-1	FAC+	Nt	P-Forb	LARGE YELLOW LADY'S SLIPPER
DANSPI	4	Danthonia spicata	5	UPL	Nt	P-Grass	POVERTY GRASS; OATGRASS
DESCES	9	Deschampsia cespitosa	-4	FACW+	Nt	P-Grass	HAIR GRASS
ELEELL	6	Eleocharis elliptica	-3	FACW	Nt	P-Sedge	GOLDEN SEEDED SPIKE RUSH
ELEQUI	10	Eleocharis quinqueflora	-5	OBL	Nt	P-Sedge	SPIKE RUSH
ELESMA	5	Eleocharis smallii	-5	OBL	Nt	P-Sedge	SPIKE RUSH
EQUVAR	8	Equisetum variegatum	-3	FACW	Nt	F...Ally	VARIEGATED SCOURING RUSH
ERUGAL	0	ERUCASTRUM GALLICUM	5	UPL	Ad	A-Forb	DOG MUSTARD
EUPPER	4	Eupatorium perfoliatum	-4	FACW+	Nt	P-Forb	COMMON BONESET
EUTGRA	3	Euthamia graminifolia	-2	FACW-	Nt	P-Forb	GRASS LEAVED GOLDENROD
GENPRO	8	Gentianopsis procera	-5	OBL	Nt	A-Forb	SMALL FRINGED GENTIAN
HYPKAL	10	Hypericum kalmianum	-2	FACW-	Nt	Shrub	KALM'S ST. JOHN'S WORT
IRILAC	9	Iris lacustris	0	FAC	Nt	P-Forb	DWARF LAKE IRIS
JUNBAL	4	Juncus balticus	-5	OBL	Nt	P-Forb	RUSH
JUNBRP	7	Juncus brachycephalus	-5	OBL	Nt	P-Forb	RUSH
JUNNOD	5	Juncus nodosus	-5	OBL	Nt	P-Forb	JOINT RUSH
LARLAR	5	Larix laricina	-3	FACW	Nt	Tree	TAMARACK
LOBKAL	10	Lobelia kalmii	-5	OBL	Nt	P-Forb	BOG LOBELIA
LYCUNI	2	Lycopus uniflorus	-5	OBL	Nt	P-Forb	NORTHERN BUGLE WEED
LYSTER	6	Lysimachia terrestris	-5	OBL	Nt	P-Forb	SWAMP CANDLES
MENARV	3	Mentha arvensis	-3	FACW	Nt	P-Forb	WILD MINT
MUHGLO	10	Muhlenbergia glomerata	-4	FACW+	Nt	P-Grass	MARSH WILD TIMOTHY
MYRGAL	6	Myrica gale	-5	OBL	Nt	Shrub	SWEET GALE
PANLID	8	Panicum lindheimeri	-5	OBL	Nt	P-Grass	PANIC GRASS
PARGLA	8	Parnassia glauca	-5	OBL	Nt	P-Forb	GRASS OF PARNASSUS
PHAARU	0	Phalaris arundinacea	-4	FACW+	Nt	P-Grass	REED CANARY GRASS
PICMAR	6	Picea mariana	-3	FACW	Nt	Tree	BLACK SPRUCE
PINSTR	3	Pinus strobus	3	FACU	Nt	Tree	WHITE PINE
POLPAU	7	Polygala paucifolia	3	FACU	Nt	P-Forb	GAY WINGS
POPBAL	2	Populus balsamifera	-3	FACW	Nt	Tree	BALSAM POPLAR
POPTRE	1	Populus tremuloides	0	FAC	Nt	Tree	QUAKING ASPEN
POTANS	5	Potentilla anserina	-4	FACW+	Nt	P-Forb	SILVERWEED

POTFRU	10	Potentilla fruticosa	-3	FACW	Nt Shrub	SHRUBBY CINQUEFOIL
PRERAC	8	Prenanthes racemosa	-3	FACW	Nt P-Forb	GLAUCOUS WHITE LETTUCE
PRIMIS	10	Primula mistassinica	-3	FACW	Nt P-Forb	DWARF CANADIAN PRIMROSE
PRUVUL	0	PRUNELLA VULGARIS	0	FAC	Nt P-Forb	LAWN PRUNELLA
RHAALN	8	Rhamnus alnifolia	-5	OBL	Nt Shrub	ALDER LEAVED BUCKTHORN
RHYCAL	10	Rhynchospora capillacea	-5	OBL	Nt P-Sedge	BEAK RUSH
SALCAN	9	Salix candida	-5	OBL	Nt Shrub	HOARY WILLOW
SALPET	1	Salix petiolaris	-4	FACW+	Nt Shrub	SLENDER WILLOW
SARPUP	10	Sarracenia purpurea	-5	OBL	Nt P-Forb	PITCHER PLANT
SCHACU	5	Schoenoplectus acutus	-5	OBL	Nt P-Sedge	HARDSTEM BULRUSH
SCHPUN	5	Schoenoplectus pungens	-5	OBL	Nt P-Sedge	THREE SQUARE
SELECL	5	Selaginella eclipes	-4	FACW+	Nt F...Ally	SELAGINELLA
SENPAU	3	Senecio pauperculus	-1	FAC+	Nt P-Forb	BALSAM RAGWORT
SHECAN	7	Shepherdia canadensis	5	UPL	Nt Shrub	SOAPBERRY
SOLALT	1	Solidago altissima	3	FACU	Nt P-Forb	TALL GOLDENROD
SOLCAN	1	Solidago canadensis	3	FACU	Nt P-Forb	CANADA GOLDENROD
SOLOHI	8	Solidago ohioensis	-5	OBL	Nt P-Forb	OHIO GOLDENROD
SOLRUG	3	Solidago rugosa	-1	FAC+	Nt P-Forb	ROUGH GOLDENROD
SOLULI	4	Solidago uliginosa	-5	OBL	Nt P-Forb	BOG GOLDENROD
SPICER	4	Spiranthes cernua	-2	FACW-	Nt P-Forb	NODDING LADIES' TRESSES
THUOCC	4	Thuja occidentalis	-3	FACW	Nt Tree	ARBOR VITAE
TOFGLU	10	Tofieldia glutinosa	-5	OBL	Nt P-Forb	FALSE ASPHODEL
TRICES	10	Trichophorum cespitosum	-5	OBL	Nt P-Sedge	BULRUSH
TRIBOR	5	Trientalis borealis	-1	FAC+	Nt P-Forb	STARFLOWER
TRIMAR	8	Triglochin maritimum	-5	OBL	Nt P-Forb	COMMON BOG ARROW GRASS
TRIPAL	8	Triglochin palustris	-5	OBL	Nt P-Forb	SLENDER BOG ARROW GRASS
UTRCOR	10	Utricularia cornuta	-5	OBL	Nt A-Forb	HORNED BLADDERWORT
ZIGGLA	10	Zigadenus glaucus	-3	FACW	Nt P-Forb	WHITE CAMAS

Appendix 3g. Floristic Quality Assessment for St. Martin Point.

Site: St. Martin Point coastal fen
Locale: Mackinac Co., MI
Date: August 16, 2010 - hours
By: Brad Slaughter, Dave Cuthrell
File: c:\FQA\studies\St. Martin Point.inv
Notes: Also: Salix spp., Rubus sp., Ribes sp., Viola sp., Carex sp. **(81 total spp.)**

FLORISTIC QUALITY DATA		Native		Adventive	
75	NATIVE SPECIES	Tree	4	Tree	0
76	Total Species	Shrub	12	Shrub	0
6.1	NATIVE MEAN C	W-Vine	0	W-Vine	0
6.1	W/Adventives	H-Vine	0	H-Vine	0
53.2	NATIVE FQI	P-Forb	35	P-Forb	0
52.9	W/Adventives	B-Forb	0	B-Forb	1
-2.9	NATIVE MEAN W	A-Forb	3	A-Forb	0
-3.0	W/Adventives	P-Grass	10	P-Grass	0
AVG:	Fac. Wetland	A-Grass	0	A-Grass	0
		P-Sedge	9	P-Sedge	0
		A-Sedge	0	A-Sedge	0
		Fern	2		

ACRONYM	C	SCIENTIFIC NAME	W	WETNESS	PHYSIOGNOMY	COMMON NAME
ACHMIL	1	Achillea millefolium	3	FACU	Nt P-Forb	YARROW
AGAPUR	7	Agalinis purpurea	-3	FACW	Nt A-Forb	PURPLE GERARDIA
AGRTRA	8	Agropyron trachycaulum	0	FAC	Nt P-Grass	SLENDER WHEAT GRASS
ALNRUG	5	Alnus rugosa	-5	OBL	Nt Shrub	TAG ALDER
ANDSCO	5	Andropogon scoparius	3	FACU	Nt P-Grass	LITTLE BLUESTEM GRASS
ARCUVA	8	Arctostaphylos uva-ursi	5	UPL	Nt Shrub	BEARBERRY
ASTBOR	9	Aster borealis	-5	OBL	Nt P-Forb	NORTHERN BOG ASTER
ASTLAN	2	Aster lanceolatus	-3	FACW	Nt P-Forb	EASTERN LINED ASTER
ASTPUN	5	Aster puniceus	-5	OBL	Nt P-Forb	SWAMP ASTER
BROCIL	6	Bromus ciliatus	-3	FACW	Nt P-Grass	FRINGED BROME
CALCAN	3	Calamagrostis canadensis	-5	OBL	Nt P-Grass	BLUE JOINT GRASS
CALINE	8	Calamagrostis inexpansa	-4	FACW+	Nt P-Grass	BOG REEDGRASS
CALARK	10	Calamintha arkansana	-3	FACW	Nt P-Forb	LOW CALAMINT

CXCAPI	9	Carex capillaris	-3	FACW	Nt	P-Sedge	SEDGE
CXFLAV	4	Carex flava	-5	OBL	Nt	P-Sedge	SEDGE
CXLASI	8	Carex lasiocarpa	-5	OBL	Nt	P-Sedge	SEDGE
CASCOC	8	Castilleja coccinea	0	FAC	Nt	A-Forb	INDIAN PAINTBRUSH
CHEGLB	7	Chelone glabra	-5	OBL	Nt	P-Forb	TURTLEHEAD
CIRPAL	0	CIRSIUM PALUSTRE	-4	FACW+	Ad	B-Forb	MARSH THISTLE
CLAMAR	10	Cladium mariscoides	-5	OBL	Nt	P-Sedge	TWIG RUSH
COMUMB	5	Comandra umbellata	3	FACU	Nt	P-Forb	BASTARD TOADFLAX
CORSTO	2	Cornus stolonifera	-3	FACW	Nt	Shrub	RED OSIER DOGWOOD
CYCAPU	5	Cypripedium calceolus var. pubescens	-1	FAC+	Nt	P-Forb	LARGE YELLOW LADY'S SLIPPER
DANSPI	4	Danthonia spicata	5	UPL	Nt	P-Grass	POVERTY GRASS; OATGRASS
DESCES	9	Deschampsia cespitosa	-4	FACW+	Nt	P-Grass	HAIR GRASS
ELEELL	6	Eleocharis elliptica	-3	FACW	Nt	P-Sedge	GOLDEN SEEDED SPIKE RUSH
ELEROS	10	Eleocharis rostellata	-5	OBL	Nt	P-Sedge	SPIKE RUSH
EQUVAR	8	Equisetum variegatum	-3	FACW	Nt	F...Ally	VARIEGATED SCOURING RUSH
EUPPER	4	Eupatorium perfoliatum	-4	FACW+	Nt	P-Forb	COMMON BONESET
EUTGRA	3	Euthamia graminifolia	-2	FACW-	Nt	P-Forb	GRASS LEAVED GOLDENROD
FRAVIR	2	Fragaria virginiana	1	FAC-	Nt	P-Forb	WILD STRAWBERRY
FRAPEN	2	Fraxinus pennsylvanica	-3	FACW	Nt	Tree	RED ASH
GAUHIS	8	Gaultheria hispidula	-3	FACW	Nt	Shrub	CREEPING SNOWBERRY
GENPRO	8	Gentianopsis procera	-5	OBL	Nt	A-Forb	SMALL FRINGED GENTIAN
HYPKAL	10	Hypericum kalmianum	-2	FACW-	Nt	Shrub	KALM'S ST. JOHN'S WORT
IRIVER	5	Iris versicolor	-5	OBL	Nt	P-Forb	WILD BLUE FLAG
JUNBAL	4	Juncus balticus	-5	OBL	Nt	P-Forb	RUSH
JUNBRP	7	Juncus brachycephalus	-5	OBL	Nt	P-Forb	RUSH
JUNNOD	5	Juncus nodosus	-5	OBL	Nt	P-Forb	JOINT RUSH
JUNHOR	10	Juniperus horizontalis	1	FAC-	Nt	Shrub	CREEPING JUNIPER
LARLAR	5	Larix laricina	-3	FACW	Nt	Tree	TAMARACK
LOBKAL	10	Lobelia kalmii	-5	OBL	Nt	P-Forb	BOG LOBELIA
LYCAME	2	Lycopus americanus	-5	OBL	Nt	P-Forb	COMMON WATER HOREHOUND
LYCUNI	2	Lycopus uniflorus	-5	OBL	Nt	P-Forb	NORTHERN BUGLE WEED
MUHGLO	10	Muhlenbergia glomerata	-4	FACW+	Nt	P-Grass	MARSH WILD TIMOTHY
MYRGAL	6	Myrica gale	-5	OBL	Nt	Shrub	SWEET GALE
PANLID	8	Panicum lindheimeri	-5	OBL	Nt	P-Grass	PANIC GRASS
PARGLA	8	Parnassia glauca	-5	OBL	Nt	P-Forb	GRASS OF PARNASSUS
PHAARU	0	Phalaris arundinacea	-4	FACW+	Nt	P-Grass	REED CANARY GRASS
PICMAR	6	Picea mariana	-3	FACW	Nt	Tree	BLACK SPRUCE
POLAMP	6	Polygonum amphibium	-5	OBL	Nt	P-Forb	WATER SMARTWEED

POTANS	5	Potentilla anserina	-4	FACW+	Nt P-Forb	SILVERWEED
POTFRU	10	Potentilla fruticosa	-3	FACW	Nt Shrub	SHRUBBY CINQUEFOIL
PRERAC	8	Prenanthes racemosa	-3	FACW	Nt P-Forb	GLAUCOUS WHITE LETTUCE
PRIMIS	10	Primula mistassinica	-3	FACW	Nt P-Forb	DWARF CANADIAN PRIMROSE
PROPAL	6	Proserpinaca palustris	-5	OBL	Nt P-Forb	MERMAID WEED
PRUVUL	0	PRUNELLA VULGARIS	0	FAC	Nt P-Forb	LAWN PRUNELLA
RHAALN	8	Rhamnus alnifolia	-5	OBL	Nt Shrub	ALDER LEAVED BUCKTHORN
RHYCAL	10	Rhynchospora capillacea	-5	OBL	Nt P-Sedge	BEAK RUSH
SALCAN	9	Salix candida	-5	OBL	Nt Shrub	HOARY WILLOW
SARPUP	10	Sarracenia purpurea	-5	OBL	Nt P-Forb	PITCHER PLANT
SCHACU	5	Schoenoplectus acutus	-5	OBL	Nt P-Sedge	HARDSTEM BULRUSH
SELECL	5	Selaginella eclipes	-4	FACW+	Nt F...Ally	SELAGINELLA
SENPAU	3	Senecio pauperculus	-1	FAC+	Nt P-Forb	BALSAM RAGWORT
SMISTE	5	Smilacina stellata	1	FAC-	Nt P-Forb	STARRY FALSE SOLOMON SEAL
SOLALT	1	Solidago altissima	3	FACU	Nt P-Forb	TALL GOLDENROD
SOLHOU	10	Solidago houghtonii	-5	OBL	Nt P-Forb	HOUGHTON'S GOLDENROD
SOLOHI	8	Solidago ohioensis	-5	OBL	Nt P-Forb	OHIO GOLDENROD
SOLULI	4	Solidago uliginosa	-5	OBL	Nt P-Forb	BOG GOLDENROD
SPIALB	4	Spiraea alba	-4	FACW+	Nt Shrub	MEADOWSWEET
SPICER	4	Spiranthes cernua	-2	FACW-	Nt P-Forb	NODDING LADIES' TRESSES
THUOCC	4	Thuja occidentalis	-3	FACW	Nt Tree	ARBOR VITAE
TOFGLU	10	Tofieldia glutinosa	-5	OBL	Nt P-Forb	FALSE ASPHODEL
TRICES	10	Trichophorum cespitosum	-5	OBL	Nt P-Sedge	BULRUSH
TRIBOR	5	Trientalis borealis	-1	FAC+	Nt P-Forb	STARFLOWER
VACANG	4	Vaccinium angustifolium	3	FACU	Nt Shrub	BLUEBERRY

Appendix 4. Summary list of vascular plant taxa documented in coastal fen sample sites. Capitalized scientific names indicate non-native species. Yellow highlighting indicates that the species was present in a sample plot(s).

Scientific Name	Common Name	El Cajon Bay	Whitefish Bay	Squaw Bay	Thompson's Harbor	Waugoshance Point	Dudley Bay West and East*	St. Martin Point
Acer rubrum	red maple	x		x	x			
Achillea millefolium	yarrow							x
Agalinis purpurea	purple gerardia				x	x	x	x
Agropyron trachycaulum	slender wheat grass							x
Alnus rugosa	tag alder	x		x			x	x
Andromeda glaucophylla	bog rosemary		x					
Anemone canadensis	Canada anemone						x	
Arctostaphylos uva-ursi	bearberry	x	x		x			x
Aronia prunifolia	black chokeberry			x				
Artemisia campestris	wormwood					x		
Asclepias incarnata	swamp milkweed		x	x		x		
Aster borealis	northern bog aster	x	x		x			x
Aster firmus	smooth swamp aster				x			
Aster lanceolatus	eastern lined aster			x	x	x	x	x
Aster macrophyllus	big leaved aster				x			
Aster puniceus	swamp aster				x		x	x
Aster spp.	aster spp.				x		x	
Aster umbellatus	tall flat-top white aster			x	x		x	
Betula alleghaniensis	yellow birch		x					
Betula papyrifera	paper birch				x		x	
Bromus ciliatus	fringed brome						x	
Cacalia plantaginea	prairie Indian-plantain				x			
Calamagrostis canadensis	bluejoint grass	x	x	x	x	x	x	x
Calamagrostis inexpansa	bog reedgrass			x	x	x		x
Calamintha arkansana	low calamint	x	x		x	x	x	x
Calopogon tuberosus	grass pink		x		x			
Campanula aparinoides	marsh bellflower					x	x	
Carex buxbaumii	Buxbaum's sedge	x			x			
Carex capillaris	hair-like sedge		x		x		x	x
Carex crawei	Crawe's sedge				x			
Carex eburnea	ebony sedge	x	x	x			x	
Carex flava	yellow sedge	x	x	x	x		x	x
Carex lasiocarpa	wiregrass sedge				x	x		x
Carex livida	livid sedge	x		x				
Carex spp.	sedges	x	x			x		x
Carex sterilis	dioecious sedge	x	x	x	x			

Scientific Name	Common Name	El Cajon Bay	Whitefish Bay	Squaw Bay	Thompson's Harbor	Waugoshance Point	Dudley Bay West and East*	St. Martin Point
Carex stricta	tussock sedge	x	x	x	x		x	
Carex viridula	little green sedge	x		x	x	x		
Castilleja coccinea	Indian paintbrush	x	x		x	x		x
CENTAUREA MACULOSA	SPOTTED BLUET		x					
Chelone glabra	turtlehead							x
Cicuta bulbifera	water hemlock	x						
Cirsium muticum	swamp thistle	x			x			
CIRSIUM PALUSTRE	MARSH THISTLE						x	x
CIRSIUM VULGARE	BULL THISTLE	x						
Cladium mariscoides	twig-rush	x	x	x	x	x	x	x
Comandra umbellata	bastard toadflax	x	x		x		x	x
Cornus stolonifera	red-osier dogwood	x			x			x
Cypripedium calceolus var. *pubescens*	large yellow lady's-slipper			x	x		x	x
Danthonia spicata	poverty grass	x	x		x	x	x	x
Deschampsia cespitosa	hair grass	x	x	x	x	x	x	x
Drosera linearis	linear-leaved sundew	x	x		x			
Drosera rotundifolia	round-leaved sundew		x	x	x			
Eleocharis elliptica	golden-seeded spike-rush							x
Eleocharis quinqueflora	few-flower spike-rush	x				x	x	
Eleocharis rostellata	beaked spike-rush	x	x		x			x
Eleocharis smallii	spike-rush	x					x	
Equisetum fluviatile	water horsetail							
Equisetum variegatum	variegated scouring rush	x	x	x	x	x	x	x
Eriophorum viridi-carinatum	green-keeled cotton-grass			x	x			
ERUCASTRUM GALLICUM	DOG MUSTARD						x	
Eupatorium maculatum	joe-pye-weed				x	x		
Eupatorium perfoliatum	common boneset	x	x		x	x	x	x
Euthamia graminifolia	grass-leaved goldenrod			x	x	x	x	x
Fragaria virginiana	wild strawberry			x				x
Fraxinus pennsylvanica	green ash	x		x	x	x		x
Gaultheria hispidula	creeping snowberry							x
Gentianopsis procera	small-fringed gentian	x	x	x	x	x	x	x
HIERACIUM CAESPITOSUM	KING DEVIL		x		x			
Hypericum kalmianum	Kalm's St. John's-wort	x	x	x	x	x	x	x
Iris lacustris	dwarf lake iris	x	x		x		x	
Iris versicolor	wild blue flag					x		x
Juncus balticus	Baltic rush	x	x	x	x	x	x	x
Juncus brachycephalus	rush	x	x	x	x	x	x	x
Juncus brevicaudatus	rush	x		x				

Scientific Name	Common Name	El Cajon Bay	Whitefish Bay	Squaw Bay	Thompson's Harbor	Waugoshance Point	Dudley Bay West and East*	St. Martin Point
Juncus nodosus	rush						x	x
Juniperus communis	common juniper		x	x	x			
Juniperus horizontalis	creeping juniper	x	x		x			x
Larix laricina	tamarack	x	x	x	x	x	x	x
Lathyrus palustris	marsh pea				x			
Ledum groenlandicum	Labrador tea				x			
Lilium philadelphicum	wood lily		x					
Liparis loeselii	Loesel's twayblade				x			
Lobelia kalmii	Kalm's lobelia	x	x	x	x	x	x	x
Lobelia spicata	pale spiked lobelia		x					
Lonicera oblongifolia	swamp fly honeysuckle	x	x		x			
Lycopus americanus	common water horehound	x				x		x
Lycopus uniflorus	northern bugleweed	x	x	x	x	x	x	x
Lysimachia quadriflora	whorled loosestrife				x			
Lysimachia terrestris	swamp candles						x	
LYTHRUM SALICARIA	PURPLE LOOSESTRIFE	x	x					
Mentha arvensis	wild mint						x	
MENTHA PIPERITA	peppermint				x			
Muhlenbergia glomerata	marsh wild timothy	x	x	x	x	x	x	x
Myrica gale	sweet gale		x	x		x	x	x
Onoclea sensibilis	sensitive fern				x			
Osmunda regalis	royal fern			x				
Panicum lindheimeri	panic grass	x	x	x	x	x	x	x
Parnassia glauca	grass-of-Parnassus	x	x		x	x	x	x
PHALARIS ARUNDINACEA	REED CANARY GRASS						x	x
Phragmites australis	common reed	x	x	x	x	x		
Picea mariana	black spruce	x	x		x		x	x
Pinguicula vulgaris	butterwort				x	x		
Pinus strobus	white pine			x			x	
Platanthera hyperborea	tall northern bog orchid		x		x			
POA COMPRESSA	Canada bluegrass				x			
Pogonia ophioglossoides	rose pogonia	x	x					
Polygala paucifolia	gay wings						x	
Polygonum amphibium	water smartweed							x
Polygonum sp.	smartweed				x			
Populus balsamifera	balsam poplar				x		x	
Populus tremuloides	quaking aspen				x		x	
Potentilla anserina	silverweed	x	x		x		x	x
Potentilla fruticosa	shrubby cinquefoil	x	x	x	x	x	x	x
Prenanthes racemosa	glaucous white lettuce						x	x

Scientific Name	Common Name	El Cajon Bay	Whitefish Bay	Squaw Bay	Thompson's Harbor	Waugoshance Point	Dudley Bay West and East*	St. Martin Point
Primula mistassinica	dwarf Canadian primrose	x	x	x	x	x	x	x
Proserpinaca palustris	mermaid-weed			x		x		x
PRUNELLA VULGARIS	lawn prunella	x	x		x	x	x	x
Quercus rubra	red oak			x				
Rhamnus alnifolia	alder-leaved buckthorn				x		x	x
RHAMNUS FRANGULA	glossy buckthorn	x	x	x				
Rhynchospora alba	white beak-rush	x	x	x	x			
Rhynchospora capillacea	beak-rush	x	x	x	x	x	x	x
Rudbeckia hirta	black-eyed Susan	x	x		x			
Salix candida	sage willow	x			x	x	x	x
Salix petiolaris	slender willow						x	
Salix spp.	willows		x		x	x	x	x
Sarracenia purpurea	pitcher-plant	x	x	x	x		x	x
Schizachyrium scoparium	little bluestem	x	x		x	x		x
Schoenoplectus acutus	hardstem bulrush		x		x	x	x	x
Schoenoplectus pungens	three-square	x	x	x	x	x	x	
Scleria verticillata	nut-rush	x			x			
Selaginella eclipes	selaginella	x			x	x	x	x
Senecio aureus	golden ragwort				x			
Senecio pauperculus	balsam ragwort	x	x		x	x	x	x
Shepherdia canadensis	soapberry		x		x		x	
Smilacina stellata	starry false Solomon's seal				x		x	
Solidago altissima	tall goldenrod	x					x	x
Solidago canadensis	Canada goldenrod				x		x	
Solidago houghtonii	Houghton's goldenrod					x		x
Solidago ohioensis	Ohio goldenrod	x	x	x	x	x	x	x
Solidago ptarmicoides	upland white goldenrod	x			x			
Solidago rugosa	rough goldenrod		x	x	x		x	
Solidago uliginosa	bog goldenrod	x	x	x	x	x	x	x
SONCHUS sp.	SOW THISTLE				x			
Spiraea alba	meadowsweet							x
Spiranthes cernua	nodding ladies' tresses	x	x	x	x	x	x	x
Stachys sp.	hedge nettle				x			
Thelypteris palustris	marsh fern	x		x				
Thuja occidentalis	northern white-cedar	x	x	x	x	x	x	x
Tofieldia glutinosa	false asphodel	x	x	x	x	x	x	x
Triadenum fraseri	marsh St. John's-wort	x		x	x	x		
Trichophorum alpinum	Alpine bulrush			x				
Trichophorum cespitosum	tufted bulrush	x	x		x		x	x
Trientalis borealis	starflower			x			x	x

Scientific Name	Common Name	El Cajon Bay	Whitefish Bay	Squaw Bay	Thompson's Harbor	Waugoshance Point	Dudley Bay West and East*	St. Martin Point
Triglochin maritimum	common bog arrow-grass	x	x	x	x	x	x	
Triglochin palustris	slender bog arrow-grass	x	x	x	x		x	
Utricularia cornuta	horned bladderwort	x	x	x	x	x	x	
Utricularia intermedia	flat-leaved bladderwort		x	x				
Vaccinium angustifolium	low sweet blueberry							x
Vaccinium myrtilloides	Canada blueberry			x				
Vaccinium oxycoccos	small cranberry			x	x			
Viola spp.	violets	x	x	x	x		x	x
Vitis riparia	riverbank grape		x					
Zigadenus glaucus	white camas		x				x	

* Yellow highlighting indicates the taxon occurred in plots in Dudley Bay West, Dudley Bay East, or both sites.

Appendix 5. Summary list of animals documented in coastal fen sample sites, August 2010.

Scientific Name	Common Name	El Cajon Bay	Whitefish Bay	Squaw Bay	Thompson's Harbor	Waugoshance Point	Dudley Bay West and East*	St. Martin Point
Dragonflies (9)								
Libellula pulchella	Twelve-Spotted Skimmer	x	x	x	x	x	x	x
Libellula quadrimaculata	Four-Spotted Skimmer	x	x		x			
Sympetrum spp.	Meadowhawk	x	x	x	x	x	x	x
Celithemis elisa	Calico Pennant	x	x		x			
Celithemis eponina	Halloween Pennant					x		
Aeshna canadensis	Canada Darner	x	x	x	x	x	x	
Aeshna verticalis	Green-Striped Darner	x						
Anax junius	Common Green Darner			x		x	x	x
Somatochlora walshii	Brush-Tipped Emerald				x			
Butterflies (17)								
Pieris rapae	Cabbage White			x				
Colias eurytheme	Orange Sulphur			x	x			
Colias interior	Pink-edged Sulphur	x		x	x			
Cercyonis pegala nephele	Wood Nymph	x			x	x	x	x
Beloria bellona	Meadow Fritillary	x		x	x			
Boloria selene myrina	Silver-bordered Fritillary					x	x	x
Speyeria cybele cybele	Great-spangled Fritillary					x	x	
Euptoieta claudia	Variegated Fritillary	x						
Phyciodes selenis	Northern Pearl Crescent		x		x	x	x	x
Euphydryas phaeton	Baltimore	x						
Vanessa cardui	Painted Lady						x	
Junonia coenia	Buckeye					x		x
Limenitis archippus	Viceroy	x		x	x	x	x	x
Limenitis arthemis astyanax	Red-spotted Purple					x	x	
Limenitis arthemis arthemis	White Admiral						x	
Danaus plexippus	Monarch	x				x		
Hesperia comma laurentina	Common Branded Skipper	x					x	
Other State-Listed Insects (3)								
Flexamia delongi	A leafhopper		x					x
Dorydiella kansana	Kansan Leafhopper	x						
Prosapia ignipectus	Red-legged Spittlebug	x						
Birds (14)								
Ardea alba	Great Egret		x					
Ardea herodias	Great Blue Heron			x	x		x	
Cygnus olor	Mute Swan	x						
Cathartes aura	Turkey vulture	x						
Haliaeetus leucocephalus	Bald Eagle		x			x		

Scientific Name	Common Name	El Cajon Bay	Whitefish Bay	Squaw Bay	Thompson's Harbor	Waugoshance Point	Dudley Bay West and East*	St. Martin Point
Accipiter cooperii	Cooper's Hawk	x		x		x		
Buteo lineatus	Red-shouldered Hawk	x					x	
Buteo jamaciensis	Red-tailed Hawk			x		x		
Falco columbarius	Merlin					x	x	
Tringa melanoleuca	Greater Yellowlegs	x	x					
Larus delawarensis	Ring-billed Gull	x			x			
Sterna hirundo	Common Tern			x				
Zenaida macroura	Mourning Dove	x						x
Tyrannus tyrannus	Eastern Kingbird	x						
Reptiles and Amphibians (3)								
Thamnophis sirtalis sirtalis	Eastern Garter Snake		x					
Bufo americanus americanus	Eastern American Toad		x					
Rana pipiens	Northern Leopard Frog	x	x	x	x	x		x