

Appendix 9.13: Point Sable

Written by Erin Giese, Dr. James Horn, and Bobbie Webster

Location (centroid)	Lat. 44.579726°, Lon. -87.901034° ¹ (NAD 1983, UTM Zone 16N)																																				
Total Area (ha)	118.47 ha																																				
Area Public Land (ha)	77.2 ha																																				
Area of Habitat Types Present (ha) and Percent of Each Habitat Type	<p>Dominant Habitat Types: These habitat types were documented during a July 2015 habitat mapping effort led by the University of Wisconsin-Green Bay Cofrin Center for Biodiversity (CCB) across the Lower Green Bay and Fox River Area of Concern (LGB&FR AOC)². Habitat types within Point Sable are displayed as a static map at the bottom of this document. Note that the extent of submergent marsh was refined by the CCB's 2017 submerged aquatic vegetation field surveys. There is a total of 116.84 ha of natural habitat within Point Sable.</p> <table border="1"> <thead> <tr> <th>Habitat Type</th> <th>Area (ha)</th> <th>Percent</th> </tr> </thead> <tbody> <tr> <td>Emergent Marsh (High Energy Coastal)</td> <td>1.61</td> <td>1.37</td> </tr> <tr> <td>Emergent Marsh (Inland)</td> <td>39.63</td> <td>33.92</td> </tr> <tr> <td>Great Lakes Beach</td> <td>5.91</td> <td>5.06</td> </tr> <tr> <td>Hardwood Swamp</td> <td>45.21</td> <td>38.69</td> </tr> <tr> <td>Northern Mesic Forest</td> <td>0.66</td> <td>0.57</td> </tr> <tr> <td>Open Water Inland</td> <td>0.06</td> <td>0.05</td> </tr> <tr> <td>Other Forest</td> <td>11.53</td> <td>9.87</td> </tr> <tr> <td>Southern Sedge Meadow</td> <td>0.10</td> <td>0.08</td> </tr> <tr> <td>Submergent Marsh</td> <td>9.48</td> <td>8.11</td> </tr> <tr> <td>Surrogate Grassland (Old Field)</td> <td>2.46</td> <td>2.11</td> </tr> <tr> <td>Tributary Open Water</td> <td>0.19</td> <td>0.16</td> </tr> </tbody> </table> <p><i>Disclaimer!</i> Because this priority area is located within the Great Lakes coastal zone, the amount of habitat types can vary drastically across years and even within years (or months) due to changing Great Lakes water levels, precipitation, and seiche. Within this priority area specifically, the amounts of emergent and submergent marsh and Great Lakes beach are known to fluctuate significantly from year to year and within years. The habitat types listed above and mapped below are based on a field effort conducted in July 2015. Plants recorded in the "Natural Habitat Communities and Significant Plants" section were primarily documented in July 2015, late summer/fall 2016 and 2017. Great Lakes water levels were much higher in 2016 and 2017 than in July 2015.</p>	Habitat Type	Area (ha)	Percent	Emergent Marsh (High Energy Coastal)	1.61	1.37	Emergent Marsh (Inland)	39.63	33.92	Great Lakes Beach	5.91	5.06	Hardwood Swamp	45.21	38.69	Northern Mesic Forest	0.66	0.57	Open Water Inland	0.06	0.05	Other Forest	11.53	9.87	Southern Sedge Meadow	0.10	0.08	Submergent Marsh	9.48	8.11	Surrogate Grassland (Old Field)	2.46	2.11	Tributary Open Water	0.19	0.16
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General Description	Point au Sable is a peninsula located along the eastern shore of the bay of Green Bay, approximately 10 km northeast of the city of Green Bay (in the town of Scott), and constitutes the LGB&FR AOC northeastern-most boundary. It consists of a wide variety of habitats including emergent marsh, hardwood swamp, Great Lakes beach, and a small patch of southern sedge meadow ² . In fact, the Point contains one of the largest remaining Great Lakes coastal wetlands along the bay of Green Bay's eastern shore ⁴ . It primarily consists of Tedrow loamy fine sand, ruse silt loam, and Markey																																				

¹ File "AOC_PriorityAreas.v09_20171212.shp"

² LGB&FR AOC 2015 habitat field mapping effort

	<p>muck soils³. Today, Pt. au Sable is primarily owned and managed by the Cofrin Center for Biodiversity (CCB) at the University of Wisconsin-Green Bay though some of it is privately owned; the university portion is officially called the “Point au Sable Nature Preserve.” Even though several aggressively invasive plant species are frequent to dominant in parts of the Point, it still supports over 200 bird species annually and is an extremely important migratory bird stopover location^{4,5} for many waterfowl, Neotropical migrant songbirds, and shorebirds. It is also an important nursery for yellow perch (<i>Perca flavescens</i>)⁶, provides spawning habitat for northern pike (<i>Esox lucius</i>)⁶, and is home to over 40 species of fish in Wequiock Creek and offshore areas. Because UW-Green Bay owns most of the Point, it is extremely well-studied by university and agency scientists. CCB staff have been heavily treating and managing invasive plant species, especially the common reed (<i>Phragmites australis</i>; hereafter referred to as “<i>Phragmites</i>”) and understory woody plants (e.g., showy bush honeysuckle [<i>Lonicera × bella</i>]).</p>
<p>Special Features</p>	<ul style="list-style-type: none"> • One of the largest remaining Great Lakes coastal wetlands along the eastern shore of lower Green Bay⁴, which makes Pt. au Sable extremely dynamic due to changing water levels and seiche; located on a peninsula that extends into lower Green Bay. • Significant migratory bird stopover site, particularly for waterfowl, songbirds, and waterbirds^{4,5}. • Nursery for yellow perch and others as well as spawning habitat for predatory fish, including northern pike, bowfin (<i>Amia calva</i>), and shortnose gar (<i>Lepisosteus platostomus</i>)^{6,17}. • Contains habitats rare to both the state of WI and the LGB&FR AOC, namely Great Lakes beach and a small patch of southern sedge meadow². • Contains one of the highest quality hardwood swamps in the LGB&FR AOC (located south of Point Lane; canopy dominated by green ash [<i>Fraxinus pennsylvanica</i>] and swamp white oak [<i>Quercus bicolor</i>]) because there is a very low abundance of invasive species and a high diversity of native plant species (high native graminoid diversity [50+ species]), including at least three considered to be relatively uncommon or rare in WI and >90 bryophyte species. There are also over a dozen small creeks that traverse through this hardwood swamp. • Contains two of the highest-quality submergent marsh communities in the LGB&FR AOC. • Provides breeding bird habitat for Bald Eagles (<i>Haliaeetus leucocephalus</i>), woodpeckers, marsh-nesting birds, and many Neotropical migrant songbirds (e.g., warblers, flycatchers). • Important habitat for muskrats in open water lagoon/emergent marsh. • Breeding habitat for many anuran species.
<p>Natural Habitat Communities and Significant Plants (ordered in terms of ecological importance and size/amount)</p>	<p>Over half of Pt. au Sable consists of emergent marsh; the western half of the Point within the open water lagoon is inland emergent marsh while the vegetation alongside Wequiock Creek and in the center of Pt. au Sable makes up a riparian emergent marsh. In both areas, the marshes are largely dominated by <i>Phragmites</i> and hybrid cattail (<i>Typha × glauca</i>) though there are a few native species²:</p> <ul style="list-style-type: none"> • Sedges (<i>Carex</i> spp.), occasional • Jewelweed (<i>Impatiens capensis</i>), rare • Giant bur-reed (<i>Sparganium eurycarpum</i>), rare

³ Soil Survey Geographic (SSURGO) by the United States Department of Agriculture’s Natural Resources Conservation Service. Published Dec 2010. Available: <http://uwgb.maps.arcgis.com/home/item.html?id=204d94c9b1374de9a21574c9efa31164>; accessed 14 October 2016.

⁴ Epstein et al. 2002

⁵ eBird 2016: <http://ebird.org/ebird/hotspot/L159724>

⁶ David Lawrence Cofrin Student Research Grant and UW-Green Bay Senior Thesis 2010-12; Lawrence’s sampling took place at Wequiock Creek.

- Soft-stem bulrush (*Schoenoplectus tabernaemontani*), rare
- Broadleaf arrowhead (*Sagittaria latifolia*), rare
- Broadleaf cattail (*Typha latifolia*), rare

The second most common habitat at the Point is **hardwood swamp**^{2,7}. One of the highest quality hardwood swamps in the entire LGB&FR AOC, in terms of native plant diversity, is located to the south of Point Lane on the north side of the peninsula^{2,7}. Swamp white oak and green ash dominate the tree canopy. The extremely diverse herbaceous layer, with over 40 species of graminoids, includes⁷:

- Fowl manna grass (*Glyceria striata*), common
- Crested sedge (*Carex cristatella*), common
- Woolly sedge (*Carex pellita*), moderately common
- Common lake sedge (*Carex lacustris*), moderately common
- Blue flag iris (*Iris versicolor* & *I. virginica* var. *shrevei*), moderately common
- Small forget-me-not (*Myosotis laxa*), a state special concern species, rare
- Awnless wild-rye (*Elymus curvatus*), rare
- Crested wood fern (*Dryopteris cristata*), rare
- Spinulose wood fern (*Dryopteris carthusiana*), rare
- Great blue lobelia (*Lobelia siphilitica*), rare
- Common hop sedge (*Carex lupulina*), rare
- Common beggar-ticks (*Bidens frondosa*), rare
- Blunt-leaf bedstraw (*Galium obtusum*), rare
- Common water-hemlock (*Cicuta maculata*), rare

Shrubs and woody vines are infrequent here, but when present include red-osier dogwood (*Cornus sericea*), nannyberry (*Viburnum lentago*), thicket creeper (*Parthenocissus inserta*), riverbank grape (*Vitis riparia*), and blackberry/raspberry (*Rubus* spp.)².

The remaining hardwood swamp at the Point also contains swamp white oak and green ash but also cottonwood (*Populus deltoides*), box elder (*Acer negundo*), and American elm (*Ulmus americana*). In the understory, which differs from the above in having a much denser shrub layer, there is black cherry (*Prunus serotina*), thicket creeper (*Parthenocissus inserta*), riverbank grape (*Vitis riparia*), gooseberry/currant (*Ribes* spp.), and blackberry/raspberry (*Rubus* spp.)².

Great Lakes beach habitat encircles most of the Point and primarily consists of zebra and quagga mussel shells with some sand and matted dead *Phragmites* stems². However, there are a number of important native plants that inhabit these shorelines⁷:

- Cocklebur (*Xanthium strumarium*), common
- American red raspberry (*Rubus idaeus* subsp. *strigosus*), common
- Beach rocket (*Cakile edentula* ssp. *edentula* var. *lacustris*), a state special concern species, moderately common
- Late goldenrod (*Solidago gigantea*), moderately common
- Seaside spurge (*Euphorbia polygonifolia*), a state special concern species, rare
- Sandbar willow (*Salix interior*), rare
- Field horsetail (*Equisetum arvense*), rare
- Threepetal bedstraw (*Galium trifidum*), rare
- Smartweed (*Persicaria* spp.), rare
- Canada wild-rye (*Elymus canadensis*), rare
- Eastern red cedar (*Juniperus virginiana*), rare
- Canadian horseweed (*Conyza canadensis*), rare

⁷ LGB&FR AOC 2016 botanical surveys

One small patch of **southern sedge meadow** still remains and is present east of the central part of the Point, close to Wequiock Creek². Historically, sedge meadows covered a much larger area of the Point. Common tussock sedge (*Carex stricta*) and grasses (Poaceae spp., especially *Calamagrostis canadensis*) are dominants in the meadow, but additionally present are swamp milkweed (*Asclepias incarnata*), spotted joe-pye-weed (*Eutrochium maculatum*), blue vervain (*Verbena hastata*), hedge-nettle (*Stachys palustris*), and sweet-flag (*Acorus americanus*), among others².

Southwest of the end of Point Lane, there is a small patch of **northern mesic forest** along the higher, drier stretch of forest that parallels the shoreline. Overall, this habitat is relatively uncommon throughout the LGB&FR AOC. It is dominated by²:

- Sugar maple (*Acer saccharum*)
- Basswood (*Tilia americana*)
- Green ash (*Fraxinus pennsylvanica*)
- Box elder (*Acer negundo*)
- Riverbank grape (*Vitis riparia*)
- Zig-zag goldenrod (*Solidago flexicaulis*)

Pt. au Sable contains two, distinct **submergent marsh**² communities, each among the most plant species-rich in LGB&FR AOC. The first is the **lagoon**, located within the center of the peninsula. The second is **Wequiock Creek** and its sloughs in the southeastern part of the Point Sable priority area. These two communities have somewhat contrasting species composition, likely because they are each part of different hydrologic systems.

The **lagoon** is without any invasive aquatic macrophytes and contains 17 native species, including:

- Coontail (*Ceratophyllum demersum*), common
- Common bladderwort (*Utricularia vulgaris*), common
- Small duckweed (*Lemna minor*), common
- Flatstem pondweed (*Potamogeton zosteriformis*), moderately common
- Common water-meal (*Wolffia columbiana*), moderately common
- Forked duckweed (*Lemna trisulca*), moderately common
- Slender riccia (*Riccia fluitans*, a thallose liverwort), rare
- Hook moss (*Drepanocladus* sp., a pleurocarpous moss), rare

Wequiock Creek contains the invasive Eurasian water-milfoil (*Myriophyllum spicatum*) and curly-leaf pondweed (*Potamogeton crispus*), which are locally common in the sloughs of the creek. The flora otherwise contains 14 native species, including:

- Common waterweed (*Elodea canadensis*), frequently common
- Turion duckweed (*Lemna turionifera*), common throughout
- Coontail (*Ceratophyllum demersum*), moderately common throughout
- Sago pondweed (*Stuckenia pectinata*), occasionally moderately common
- Thread-leaved pondweed (*Stuckenia filiformis*), rare, but throughout
- Slender waterweed (*Elodea nuttallii*) mostly rare, locally common
- Bull-head pond-lily (*Nuphar variegata*), locally common
- Long-leaved pondweed (*Potamogeton nodosus*), rare, but throughout

On the very southern edge of Pt. au Sable is a large stand of **other forest** consisting of younger trees and shrubs, including²:

- Green ash (*Fraxinus pennsylvanica*)
- Cottonwood (*Populus deltoides*)
- Trembling aspen (*Populus tremuloides*)
- White cedar (*Thuja occidentalis*)
- Eastern red-cedar (*Juniperus virginiana*)
- Gray dogwood (*Cornus foemina*)

<p>Significant Animals</p>	<p>Birds:</p> <ul style="list-style-type: none"> • >200 bird species have been recorded across all seasons, including⁸: <ul style="list-style-type: none"> ○ Two federal special concern species (Common Tern [<i>Sterna hirundo</i>], Golden-winged Warbler [<i>Vermivora chrysoptera</i>]) ○ Five state endangered species (Caspian Tern [<i>Hydroprogne caspia</i>], Forster's Tern [<i>Sterna forsteri</i>], Common Tern, Peregrine Falcon [<i>Falco peregrinus</i>], and Red-necked Grebe [<i>Podiceps grisegena</i>]) ○ One state threatened species (Great Egret [<i>Ardea alba</i>]) ○ Thirty-five Wisconsin Wildlife Action Plan Species of Greatest Concern (e.g., waterfowl, raptors, grebes, songbirds) ○ Forty-four state special concern species (e.g., American Bittern [<i>Botaurus lentiginosus</i>], Canada Warbler [<i>Cardellina canadensis</i>], Red-headed Woodpecker [<i>Melanerpes erythrocephalus</i>], Swainson's Thrush [<i>Catharus ustulatus</i>]) ○ Eight International Union for Conservation of Nature-listed species as near threatened (e.g., Chimney Swift [<i>Chaetura pelagica</i>], Red-headed Woodpecker [<i>Melanerpes erythrocephalus</i>]) or vulnerable (e.g., Rusty Blackbird [<i>Euphagus carolinus</i>], large flocks stage at Pt. au Sable during migration) ○ Large numbers of migratory diving ducks (e.g., goldeneye, scaup, mergansers, Ruddy Ducks [<i>Oxyura jamaicensis</i>]⁹), dabbling ducks (e.g., Mallards [<i>Anas platyrhynchos</i>], teal [other <i>Anas</i> spp.], Gadwall [<i>Anas strepera</i>]), and gulls (e.g., Bonaparte's Gull [<i>Chroicocephalus philadelphia</i>]) use the open water lagoon and offshore areas near Pt. au Sable^{5,9} ○ Large numbers of Ruby-crowned Kinglets (<i>Regulus calendula</i>), Golden-crowned Kinglets (<i>Regulus satrapa</i>), Tennessee Warblers (<i>Oreothlypis peregrina</i>), Blackpoll Warblers (<i>Setophaga striata</i>), Yellow-rumped Warblers (<i>Setophaga coronata</i>), and White-throated Sparrows (<i>Zonotrichia albicollis</i>), migrate through lower Green Bay and use Pt. au Sable for stopover habitat¹⁰ • At least 40 bird species are known (or very likely) to breed at Pt. au Sable¹¹: <ul style="list-style-type: none"> ○ Waterfowl (e.g., Wood Duck [<i>Aix sponsa</i>], Canada Goose [<i>Branta canadensis</i>]), Bald Eagles, woodpeckers (e.g., Red-headed Woodpecker), flycatchers (e.g., Eastern Kingbird [<i>Tyrannus tyrannus</i>], Great Crested Flycatcher [<i>Myiarchus crinitus</i>]), warblers (e.g., Common Yellowthroat [<i>Geothlypis trichas</i>]), marsh-nesting birds (e.g., Red-winged Blackbird [<i>Agelaius phoeniceus</i>]), and others (e.g., Green Heron [<i>Butorides virescens</i>], Tree Swallow [<i>Tachycineta bicolor</i>], Rose-breasted Grosbeak [<i>Pheucticus ludovicianus</i>]). • Not surprisingly, Pt. au Sable is officially a "Migratory Bird Concentration Site" according to the Wisconsin Department of Natural Resources¹². <p>Fish:</p> <ul style="list-style-type: none"> • >40 species of fish have been detected within Pt. au Sable's waters, such as Wequiock Creek or offshore^{6,8,13,14} including: <ul style="list-style-type: none"> ○ Yellow perch use Wequiock Creek for nursery habitat and are extremely common^{6,13}. Bowfin and shortnose gar also use it for nursery habitat¹³ ○ Gizzard shad (<i>Dorosoma cepedianum</i>)¹⁴ ○ White sucker (<i>Catostomus commersonii</i>), relatively common^{6,13}
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⁸ LGB&FR AOC comprehensive biota database: file "AOCBiota_DB_ShareableVersion_20171210.acddb"

⁹ LGB&FR AOC 2016 migratory waterfowl surveys

¹⁰ Stephanie Beilke's UW-Green Bay master's thesis 2014.

¹¹ Wisconsin Breeding Bird Atlas II Project (2015-2019):

http://ebird.org/ebird/atlaswi/block/4408758CE?atlasPeriod=EBIRD_ATL_WI_2015&rank=mrec&hs_sortBy=category&hs_o=desc (as of 11 Oct 2016).

¹² Wisconsin Department of Natural Resources. 2009. Wisconsin Natural Heritage Working List.

<http://dnr.wi.gov/topic/NHI/WList.html>. (Accessed: 1 Nov 2014).

¹³ Fish survey data collected at Pt. au Sable in 2016 led by Collin Moratz.

- Bluegill sunfish (*Lepomis macrochirus*), relatively common⁶
- Green sunfish (*Lepomis cyanellus*), relatively common⁶
- Freshwater drum (*Aplodinotus grunniens*), relatively common¹³
- Emerald shiner (*Notropis atherinoides*), somewhat common^{6,13}
- Black bullhead (*Ameiurus melas*), common to uncommon¹³
- Central mudminnow (*Umbra limi*), somewhat common to common¹³
- Banded killifish (*Fundulus diaphanous*), a state special concern species, Wisconsin Wildlife Action Plan Species of Greatest Concern, and somewhat uncommon⁶
- Northern pike are known to spawn here though uncommon^{6,13}
- Walleye (*Sander vitreus*), uncommon⁶
- Largemouth bass (*Micropterus salmoides*)^{6,14}
- Smallmouth bass (*Micropterus dolomieu*)¹⁴

Mammals:

- 25 mammal species have been documented at Pt. au Sable⁸:
 - Fur bearers: American mink (*Neovison vison*), muskrat (*Ondatra zibethicus*)¹⁵, North American river otter (*Lontra canadensis*), and red fox (*Vulpes vulpes*)
 - At least 15 muskrat (*Ondatra zibethicus*) lodges were found in the lagoon area of Pt. au Sable in 2015¹⁶
 - Seven bat species were found during migration, including four state threatened species (big brown bat [*Eptesicus fuscus*], little brown bat [*Myotis lucifugus*]; also globally vulnerable), northern long-eared bat [*Myotis septentrionalis*], and tricolored bat [*Perimyotis subflavus*])
 - Rodents: white-footed mouse (*Peromyscus leucopus*) and meadow jumping mouse (*Zapus hudsonius*)

Amphibians:

- Six anuran (frog/toad) species⁸:
 - American toad (*Bufo americanus*), eastern gray treefrog (*Hyla versicolor*), green frog (*Lithobates clamitans*), northern leopard frog (*Lithobates pipiens*), spring peeper (*Pseudacris crucifer*), and wood frog (*Lithobates sylvaticus*)
 - Northern leopard frog is both a federal and state species of special concern

Mollusks:

- Six native species of mussels: fatmucket (*Lampsilis siliquoidea*), fragile papershell (*Leptodea fragilis*), giant floater (*Pyganodon grandis*), pink heelsplitter (*Potamilus alatus*), three-ridge (*Amblema plicata*), and wabask pigtoe (*Fusconaia flava*)⁸

Reptiles:

- Three turtle species: eastern snapping turtle (*Chelydra serpentina*), painted turtle (*Chrysemys picta*), and eastern spiny softshell turtle (*Apalone spinifera*)⁸
- One snake species: common garter snake (*Thamnophis sirtalis*)⁸

Arthropods:

- Many aquatic invertebrates: water beetles (e.g., *Laccophilus* sp.), midges (e.g., *Chironomidae* family), water boatmen (e.g., *Corixidae* family), biting midges (e.g., *Probezzia* sp.), and dragonflies (e.g., black saddlebags [*Tamea lacerate*])⁸
- Over 90 spider species have been recorded⁸

¹⁴ Wisconsin Department of Natural Resources Fish Trawling Survey Data 1980-2015; sampling points located offshore to south of the Point.

¹⁵ Wisconsin Department of Natural Resources 2015 muskrat house survey; noted in AOC Conservation Project Catalogue.

¹⁶ UW-Green Bay personal communication with Dr. Bob Howe and Michael Stiefvater.

<p>Habitat Quality</p>	<p>The overall ecological quality of Pt. au Sable depends on the habitat type. While there are a few relatively high quality areas in portions of its hardwood swamps, southern sedge meadow, Great Lakes beaches, and submergent marshes, the Point's emergent marsh and parts of its hardwood swamp are in relatively poor ecological condition. The emergent marshes are partially invaded by <i>Phragmites</i>, hybrid cattail, and reed canary grass. Few native plants occur in these marshes, though the Cofrin Center for Biodiversity is actively working to control <i>Phragmites</i>. Much of the forests are invaded by several woody understory shrubs, garlic mustard (<i>Alliaria petiolata</i>), and dame's rocket (<i>Hesperis matronalis</i>).</p> <p>That being said, there are small pockets of high quality areas within four habitats:</p> <ol style="list-style-type: none"> 1. Hardwood Swamp <ol style="list-style-type: none"> a. Located just south of Point Lane. b. Contains an extremely high native graminoid diversity (50+ species). 2. Southern Sedge Meadow <ol style="list-style-type: none"> a. Southern sedge meadow is a rare habitat both in the LGB&FR AOC and across the state making this meadow extremely important ecologically-speaking. It is dominated by tussock sedge and grasses. 3. Great Lakes Beach <ol style="list-style-type: none"> a. Most of the perimeter of the Point contains Great Lakes beach that largely consists of crushed quagga and zebra shells with sand. Great Lakes beach is a relatively rare habitat in the LGB&FR AOC and statewide, and Pt. au Sable's beach consists of some high quality, native plants like beach rocket. 4. Submergent Marsh <ol style="list-style-type: none"> a. Two, distinctive submergent marsh communities exist at the Point: 1) the lagoon and 2) the Wequiock Creek complex. Both are among the most native plant species-rich submergent marsh communities in the LGB&FR AOC, and they have somewhat contrasting species composition.
<p>Significant Invasive Species Issues</p>	<p>Invasive Plant Species²: Each of these species outcompetes and crowds out native plants:</p> <ul style="list-style-type: none"> • Common reed (<i>Phragmites australis</i>) <ul style="list-style-type: none"> ○ Common and continuing problem; occurs along shoreline, open water lagoon, and emergent marsh; currently being managed. • European buckthorn (<i>Rhamnus cathartica</i>) <ul style="list-style-type: none"> ○ Common and continuing problem; found in understory of hardwood swamp and northern mesic forest; currently being managed. • Glossy buckthorn (<i>Frangula alnus</i>) <ul style="list-style-type: none"> ○ Common and continuing problem; found in understory of hardwood swamp and northern mesic forest; currently being managed. • Hybrid cattail (<i>Typha × glauca</i>) <ul style="list-style-type: none"> ○ Common and continuing problem; occurs in open water lagoon, emergent marsh, and occasionally in understory of hardwood swamp; currently being managed in sedge meadow and in patches in estuary. • Garlic mustard (<i>Alliaria petiolata</i>) <ul style="list-style-type: none"> ○ Common and continuing problem; found in understory of hardwood swamp and northern mesic forest; currently being managed. • Eurasian water-milfoil (<i>Myriophyllum spicatum</i>) <ul style="list-style-type: none"> ○ Locally common and sometimes relatively dense upstream in Wequiock Creek; likely negatively affecting fish habitat; not currently being managed¹⁷. • Curly-leaf pondweed (<i>Potamogeton crispus</i>)

¹⁷ Point au Sable Phase II Fish Restoration Project 2016.

	<ul style="list-style-type: none"> ○ Locally common and sometimes relatively dense upstream in Wequiock Creek; likely negatively affecting fish habitat; not currently being managed¹⁸. • Showy bush honeysuckle (<i>Lonicera × bella</i>) <ul style="list-style-type: none"> ○ Common and continuing problem; found in understory of hardwood swamp and northern mesic forest; currently being managed. • Purple loosestrife (<i>Lythrum salicaria</i>) <ul style="list-style-type: none"> ○ Found occasionally in southern sedge meadow and emergent marsh; not currently being managed. • Reed canary grass (<i>Phalaris arundinacea</i>) <ul style="list-style-type: none"> ○ Primarily occurs in southern sedge meadow, emergent marsh, and hardwood swamp; currently being managed in sedge meadow and in patches in estuary. • Canada thistle (<i>Cirsium arvense</i>) <ul style="list-style-type: none"> ○ Common and ongoing problem; currently being managed. • Spear thistle (<i>Cirsium vulgare</i>) <ul style="list-style-type: none"> ○ Especially invasive in the Great Lakes beach community; not currently being managed. • Siberian elm (<i>Ulmus pumila</i>) <ul style="list-style-type: none"> ○ Especially invasive in the Great Lakes beach community; not currently being managed. • Couchgrass (<i>Elymus repens</i>) <ul style="list-style-type: none"> ○ Especially invasive in the Great Lakes beach community; not currently being managed. • Canada bluegrass (<i>Poa compressa</i>) <ul style="list-style-type: none"> ○ Especially invasive in the Great Lakes beach community; not currently being managed. • Soapwort (<i>Saponaria officinalis</i>) <ul style="list-style-type: none"> ○ Especially invasive in the Great Lakes beach community; not currently being managed. • Dame's rocket (<i>Hesperis matronalis</i>) <ul style="list-style-type: none"> ○ Somewhat common and ongoing problem; currently being managed. <p>Exotic Plant Species:</p> <ul style="list-style-type: none"> • Crack willow (<i>Salix × fragilis</i>) <ul style="list-style-type: none"> ○ Found in the Great Lakes beach community; not currently being managed. • Bittersweet nightshade (<i>Solanum dulcamara</i>) <ul style="list-style-type: none"> ○ Common; not currently being managed. • Hedge-parsley (<i>Torilis japonica</i>) <ul style="list-style-type: none"> ○ Found in the hardwood swamp; all individuals were hand pulled in fall 2016. • Creeping-Charlie (<i>Glechoma hereracea</i>) <ul style="list-style-type: none"> ○ Common, especially in lowland hardwoods near Point Lane homes; not currently being managed. • Butter-and-eggs (<i>Linaria vulgaris</i>) <ul style="list-style-type: none"> ○ Common; not currently being managed. • Common mullein (<i>Verbascum thapsus</i>) <ul style="list-style-type: none"> ○ Common; not currently being managed. • Gold-moss stonecrop (<i>Sedum acre</i>) <ul style="list-style-type: none"> ○ Common; not currently being managed. • Hoary-alyssum (<i>Berteroa incana</i>) <ul style="list-style-type: none"> ○ Common; not currently being managed. • Worm-seed mustard (<i>Erysimum cheiranthoides</i>) <ul style="list-style-type: none"> ○ Common; not currently being managed.
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¹⁸ Point au Sable Phase II Fish Restoration Project 2016.

	<ul style="list-style-type: none"> • Russian olive (<i>Elaeagnus angustifolia</i>) <ul style="list-style-type: none"> ○ Less common than buckthorns and honeysuckle; found in upland and lowland hardwoods; currently being managed. • Common mouse-ear chickweed (<i>Cerastium fontanum</i>) <ul style="list-style-type: none"> ○ Common; not currently being managed. • White mulberry (<i>Morus alba</i>) <ul style="list-style-type: none"> ○ Common in upland hardwoods; not currently being managed. <p>Invasive Animal Species²⁸:</p> <ul style="list-style-type: none"> • <i>Arthropods</i> <ul style="list-style-type: none"> ○ Cobweb weaver (<i>Enoplognatha ovata</i>); not currently being managed • <i>Birds</i> <ul style="list-style-type: none"> ○ European Starling (<i>Sturnus vulgaris</i>) <ul style="list-style-type: none"> ▪ Poses some threat to native species, particularly cavity nesters (e.g., Tree Swallow), by outcompeting them and occupying potential nest sites; not currently being managed. ○ Other exotic or invasive bird species occur at Pt. au Sable, notably Brown-headed Cowbird (<i>Molothrus ater</i>), House Sparrow (<i>Passer domesticus</i>), and Rock Pigeon (<i>Columba livia</i>); however, these species generally do not significantly affect native birds at Pt. au Sable because they tend to inhabit human areas (e.g., developed or agricultural areas). • <i>Fish⁸</i> <ul style="list-style-type: none"> ○ Alewife (<i>Alosa pseudoharengus</i>) <ul style="list-style-type: none"> ▪ Poses a threat to native fish species by consuming a lot of zooplankton and disturbing the natural food web; not currently being managed¹⁹. ○ Common carp (<i>Cyprinus carpio</i>) <ul style="list-style-type: none"> ▪ Destroy vegetation by uprooting plants and increasing cloudiness of water; not currently being managed²⁰. ○ Rainbow smelt (<i>Osmerus mordax</i>) <ul style="list-style-type: none"> ▪ Negatively affect uncommon to rare native fish species; not currently being managed²¹. ○ Round goby (<i>Neogobius melanostomus</i>) <ul style="list-style-type: none"> ▪ Prey on small native fish and eggs (e.g., darters) and outcompete similarly sized native fish; not currently being managed²². ○ White perch (<i>Morone americana</i>) <ul style="list-style-type: none"> ▪ Prey on native fish eggs, such as walleye; not currently being managed²³. • <i>Freshwater mussels</i> <ul style="list-style-type: none"> ○ Quagga mussel (<i>Dreissena rostriformis</i>)
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¹⁹ Fuller, P., E. Maynard, D. Raikow, J. Larson, A. Fusaro, and M. Neilson. 2016. *Alosa pseudoharengus*. USGS Nonindigenous Aquatic Species Database, Gainesville, FL. <https://nas.er.usgs.gov/queries/factsheet.aspx?SpeciesID=490> Revision Date: 9/25/2015. Accessed 17 Oct 2016.

²⁰ Nico, L., E. Maynard, P.J. Schofield, M. Cannister, J. Larson, A. Fusaro, and M. Neilson. 2016. *Cyprinus carpio*. USGS Nonindigenous Aquatic Species Database, Gainesville, FL. <https://nas.er.usgs.gov/queries/FactSheet.aspx?SpeciesID=4> Revision Date: 7/15/2015. Accessed 17 Oct 2016.

²¹ Fuller, P., E. Maynard, J. Larson, A. Fusaro, T.H. Makled, and M. Neilson. 2016. *Osmerus mordax*. USGS Nonindigenous Aquatic Species Database, Gainesville, FL. <https://nas.er.usgs.gov/queries/FactSheet.aspx?SpeciesID=796> Revision Date: 9/29/2015. Accessed on 17 Oct 2016.

²² Fuller, P., A. Benson, E. Maynard, M. Neilson, J. Larson, and A. Fusaro. 2016. *Neogobius melanostomus*. USGS Nonindigenous Aquatic Species Database, Gainesville, FL. <https://nas.er.usgs.gov/queries/FactSheet.aspx?SpeciesID=713> Revision Date: 1/7/2016. Accessed on 17 Oct 2016.

²³ Fuller, P., E. Maynard, D. Raikow, J. Larson, A. Fusaro, and M. Neilson. 2016. *Morone americana*. USGS Nonindigenous Aquatic Species Database, Gainesville, FL. <https://nas.er.usgs.gov/queries/FactSheet.aspx?SpeciesID=777> Revision Date: 1/15/2016. Accessed on 1/7 Oct 2016.

	<ul style="list-style-type: none"> ▪ Poses threat to native freshwater mussels; not currently being managed. ○ Zebra mussel (<i>Dreissena polymorpha</i>) <ul style="list-style-type: none"> ▪ Poses threat to native freshwater mussels; not currently being managed.
<p>Management and Restoration Recommendations</p>	<ul style="list-style-type: none"> • Continue current invasive plant species management efforts to control invasives noted above (e.g., <i>Phragmites</i>, woody understory plants [honeysuckle, buckthorn]). Efforts to control <i>Phragmites</i> may include water level manipulation with pump in open water lagoon and removing invasives. • Ensure that native emergent and submergent plants replace their invasive counterparts to provide high quality fish and wildlife habitat. • Enhance Great Lakes beach habitat by removing invasive plant species, which will improve shorebird habitat. <ul style="list-style-type: none"> ○ To create potential breeding habitat for the federally endangered Piping Plover (<i>Charadrius melodus</i>), provide a few long stretches of Great Lakes beach with sand, cobble, or shells with little to no vegetation. • Expand existing southern sedge meadow by controlling reed canary grass. • Install permanent floating nest platforms for Black Terns (<i>Chlidonias niger</i>) in lagoon²⁴. • Introduce mayflies (<i>Hexagenia</i> sp.) near the lagoon²⁴. • Improve substrate for freshwater mussels and crayfish, which help improve water quality and provide food for migratory waterfowl. • Ensure that native woody shrubs (e.g., grape vine, dogwood, blackberry, raspberry) replace woody invasives to provide food to migratory songbirds.
<p>Reference Links and Documents</p>	<p>Links:</p> <ul style="list-style-type: none"> • Background information on Pt. au Sable prepared by the University of Wisconsin-Green Bay's Cofrin Center for Biodiversity webpage: http://www.uwgb.edu/biodiversity/natural-areas/pt-au-sable/. • Drone footage of Point au Sable taken on 18 July 2015 by Cody Becker: https://www.youtube.com/watch?v=IjRH8sA39eA. • WDNR's Webpage on Point Sable: http://dnr.wi.gov/topic/wetlands/cw/NLMich/index.asp?mode=detail&RecID=1E8D922A009 • Patterns of bird migration at the Point au Sable Nature Preserve: http://www.wisconsinbirds.org/migratory/docs/PtSableMigrationPatterns2013.pdf • Coastal Wetland Restoration at the Point au Sable Nature Preserve: http://www.sustainourgreatlakes.org/projects/coastal-wetland-restoration-at-the-pt-sable-nature-preserve/ <p>Reference Documents:</p> <ul style="list-style-type: none"> • Epstein, E.J., E. Spencer, and D. Feldkirchner. 2002. A data compilation and assessment of coastal wetlands of Wisconsin's Great Lakes, final report. Natural Heritage Program, Bureau of Endangered Resources, Wisconsin Department of Natural Resources, Madison, WI, USA. PUBL ER-803 2002. <ul style="list-style-type: none"> ○ Available: http://dnr.wi.gov/files/pdf/pubs/er/er0803.pdf. • Frieswyk, C.B., C.A. Johnston, and J.B. Zedler. 2007. Identifying and characterizing dominant plants as an indicator of community condition. Journal of Great Lakes Research. 33(3):125-135. <ul style="list-style-type: none"> ○ Available: http://glei.nrri.umn.edu/default/documents/frieswyk_jglr_2007.pdf. • Howe, R., A. Wolf, J. Martinez, B. Galbraith, and G. VanVreede. 2013. Pt. au Sable Nature Preserve Coastal Wetland Restoration Plan - Phase 1.

²⁴ UW-Green Bay personal communication with Thomas Erdman.

	<ul style="list-style-type: none"> ○ Available: http://www.uwgb.edu/biodiversity/files/pdf/Pt%20Sable%20Management%20Plan%20Phase%201%20v20130501.pdf. • Tulbure, M.G., C.A. Johnston, and D.L. Auger. 2007. Rapid invasion of a Great Lakes coastal wetland by non-native <i>Phragmites australis</i> and <i>Typha</i>. Journal of Great Lakes Research. 33(3):269-279. <ul style="list-style-type: none"> ○ Available: http://www.sciencedirect.com/science/article/pii/S0380133007701569.
<p>Site History (e.g., original vegetation, past conservation projects)</p>	<p>In the early 1630s, Frenchman Jean Nicolet first arrived in lower Green Bay when it was primarily inhabited by Native American tribes²⁵. Through the 1700s and 1800s, European fur trade, duck hunting, logging, shipping, and agriculture were important early industries in lower Green Bay^{26,27}. Most of Pt. au Sable became privately owned by a small duck hunting club in the 1800s through the 1900s^{4,28}, which is primarily why it is relatively undeveloped today. This duck hunting club recognized the importance of the Point for migratory waterfowl use²⁸. In fact, among many places in lower Green Bay, Pt. au Sable was known (and is still known) as one of the best duck hunting areas in northeastern region of Wisconsin²⁸.</p> <p>Up until the mid-1800s, Native Americans inhabited this region and were known to have a settlement just south of the Point (<0.5 km)²⁹. A large estuarine emergent marsh and open water lagoon dominated most of the peninsula⁴. As noted in the 1834 Wisconsin Public Land Survey System (PLSS) records, Great Lakes beach with fine-grained sand traced most of the perimeter of the peninsula with a small but extremely dynamic and fluctuating stream in the southern central portion of the tip²⁹. This small inlet connected the Bay of Green Bay with the inner, open water lagoon. Like most Great Lakes coastal wetlands, Pt. au Sable is regularly affected by fluctuating Great Lakes water levels, which causes changes in water depth and plant communities, especially emergent marshes. In the 1970s, for example, Great Lakes water levels rose, which flooded out Pt. au Sable's emergent marsh and lagoon³⁰. Wequioc Creek, a stream that traverses across the Point's hardwood swamps and emergent marshes, empties into the bay from the southern part of the peninsula. Most of the emergent marsh historically consisted of native cattail (<i>Typha latifolia</i>), broad-leaved arrowhead (<i>Sagittaria latifolia</i>), and soft-stem bulrush (<i>Schoenoplectus tabernaemontani</i>)^{4,30}. The southern sedge meadow, which is still present today on a small scale, likely consisted of sedges and Canada bluejoint grass (<i>Calamagrostis canadensis</i>)³¹.</p> <p>Over time, by the late 1960s, each of the early duck hunting club members sold their shares of the Point to club member John ("Jake") Rose²⁸. In 1997 John Rose donated most of his property to The Nature Conservancy (TNC) in order to protect the Point for waterfowl²⁸. TNC then gave it to UW-Green Bay through the Cofrin Center for Biodiversity (CCB) who still owns the Point today²⁸. In the late 1990s and early 2000s, Great Lakes water levels dropped significantly while simultaneously, zebra and quagga mussels piled up along the shore. Both the low water levels and invasive mussels severed the water connection between the small inlet and the bay. Unfortunately, roughly around the same time, <i>Phragmites</i> had already colonized along Lake Michigan shorelines and invaded the Point's formerly open water lagoon, emergent marsh, and Great Lakes beach shoreline. The heavily invaded <i>Phragmites</i> marsh coupled with low lake levels caused the open water lagoon to dry out almost entirely. Later, in 2011, an adjacent landowner sold other small parcels to the</p>

²⁵ Jean Nicolet: French Explorer. By The Editors of Encyclopaedia Britannica. Available: <https://www.britannica.com/biography/Jean-Nicolet> (accessed on 24 Oct 2016).

²⁶ City of Green Bay's History Webpage: <http://www.ci.green-bay.wi.us/history/1800s.html> (accessed on 20 Oct 2016).

²⁷ Excerpt from "Recollections of Green Bay in 1816-17" by James W. Biddle. Available: <http://s3.amazonaws.com/labave/data/Recollections%20of%20Green%20Bay%20in%201816-1817.pdf> (accessed on 24 Oct 2016).

²⁸ Point au Sable Cofrin Center for Biodiversity Blog: <http://www.uwgb.edu/biodiversity/natural-areas/pt-au-sable/>

²⁹ Wisconsin Public Land Survey System (1834) from file "PLSS_SurveyData.shp", compiled by UW-Green Bay's Ellie Roark

³⁰ Tulbure et al. 2007: Rapid Invasion of a Great Lakes Coastal Wetland by Non-native *Phragmites australis* and *Typha*

	<p>University, who currently owns approximately 77 ha (190 ac) at Pt. au Sable. Most of the sandy beaches were replaced by piles of crushed zebra and quagga mussels.</p> <p>Since the early 2000s, CCB staff and students and UW-Green Bay biology classes have actively managed invasive plants at the Point. Invasives present at Pt. au Sable include <i>Phragmites</i>, showy bush honeysuckle, European buckthorn, glossy buckthorn, garlic mustard, reed canary grass, and others. Many of these invasive species management efforts have been successful, such as the pulling or cut-stump treatment of woody shrubs, such as honeysuckle and buckthorn. Native cherry trees and dogwood have since flourished on their own and started replacing these invasive shrubs within the past couple of years. CCB staff have continued to manage invasive woody shrubs, planting native shrubs in the areas where invasives once dominated, and establishing monitoring plots so that progress can be monitored over time.</p> <p>The CCB hired contractors to conduct a prescribed burn (May 2012) and an aerial herbicide spraying (September 2012) of the <i>Phragmites</i> located in the area formerly known as the lagoon and the estuarine marsh along Wequiock Creek³¹. Contractors were hired to treat <i>Phragmites</i> along the shoreline in 2015 and to treat <i>Phragmites</i> in the lagoon and estuary in 2015 and 2016. CCB staff and students have actively cut and bundled remaining patches of <i>Phragmites</i> in 2015 and 2016 in the lagoon area. These management actions coupled with higher Great Lakes water levels have significantly cut back on the amount of <i>Phragmites</i> present in the lagoon and along the shoreline today. The CCB also purchased and installed a pump near the former inlet on the south side of the Point, which allows them to manipulate the lagoon water levels by pumping water from the bay of Green Bay into the lagoon as needed to maintain stands of native emergent plants³¹. Today, a large portion of the original open water lagoon has returned for the first time in 10-15 years, and some native emergent plants have since colonized the area. Remaining patches of <i>Phragmites</i> are still actively being treated or managed by CCB staff. Many adjacent private landowners have also been engaged in and supportive of the CCB's restoration and management efforts.</p> <p>Because Pt. au Sable is owned by UW-Green Bay's CCB, many conservation projects, including research, monitoring, and management, have taken place there for over 30 years. Birds, fish, and plants in particular, have been heavily studied by university faculty, staff, and students and agencies (Wisconsin Department of Natural Resources and U.S. Fish and Wildlife Service)^{32,33,34}. Others have studied mammals (bats and muskrats), water quality, plants, aquatic invertebrates, spiders, mussels, odonates (dragonflies and damselflies), and anurans (frogs + toads) at the Point³².</p>
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³¹ Howe et al. 2013: Pt. au Sable Nature Preserve Coastal Wetland Restoration Plan – Phase 1:

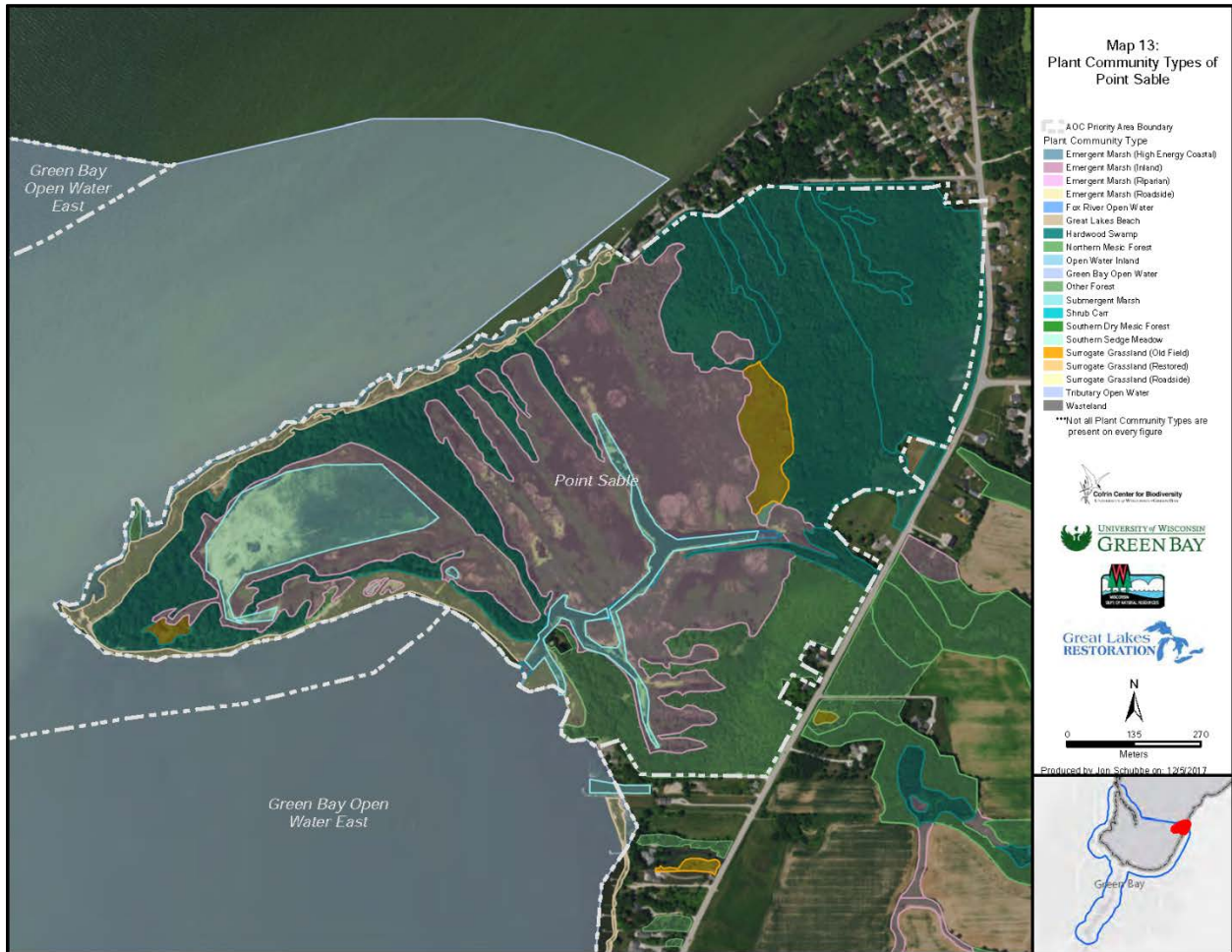
<http://www.uwgb.edu/biodiversity/files/pdf/Pt%20Sable%20Management%20Plan%20Phase%201%20v20130501.pdf>

³² LGB&FR AOC Comprehensive Conservation Project Catalogue

³³ Led by Dr. Patrick Forsythe and Dr. Christopher Houghton: Study on coastal wetland-nearshore linkages of Green Bay sport fishes and habitat food webs. Two of their seven survey locations are in the LGB&FR AOC, namely Dead Horse Bay and Point Sable.

³⁴ Study on assessment of fish assemblages in lower order tributaries of Green Bay (includes Wequiock Creek); led by Dr. Forsythe and Dr. Houghton

Map of Point Sable's plant communities, which are delineated based on the UW-Green Bay 2015 habitat mapping effort and 2017 submerged aquatic vegetation surveys. Map made by UW-Green Bay's Jon Schubbe.



Land ownership boundaries at Point Sable. Map made by UW-Green Bay's Jon Schubbe.



Photograph of the Point au Sable peninsula featuring Great Lakes beach habitat along the perimeter, lagoon, emergent marsh, and hardwood swamp (facing east). Photograph taken by Erin Giese on 2 December 2016.



Photograph of the Point Sable peninsula featuring Great Lakes beach habitat along the perimeter, Wequiock Creek, emergent marsh, and hardwood swamp (facing southeast). Photograph taken by Erin Giese on 2 December 2016.

