Great Lakes Shore Fen (Global Rank NA; State Rank S2)

Overview: Distribution, Abundance, Environmental Setting, Ecological Processes

The Great Lakes Shore Fen is a circumneutral, moderately minerotrophic, open peatland community of intermediate richness that is an integral part of the diverse vegetation mosaics of estuaries and lagoons at sites along Lake Superior in northwestern Wisconsin and at several protected Lake Michigan embayments on the margins of the Door Peninsula.

On Lake Superior, the Great Lakes Shore Fens are often partially protected from wind, wave, and ice disturbance by a sandspit. On Lake Michigan, horizontal exposures of dolomite bedrock, which sometimes extend well out into the lake, may serve a similar function. Many of the documented occurrences are within estuarine wetland complexes that develop at drowned river mouths, especially along Lake Superior’s southwestern shore. Other examples occur in the complex community mosaics associated with Great Lakes coastal lagoons, such as those on Stockton, Outer, and Michigan islands in the Apostles Archipelago.

Along Lake Superior’s southwestern shore, drowned river mouths are common features because of the geological phenomenon referred to as differential isostatic rebound (Lee and Southan 1994). Wetlands along eastern Lake Superior are becoming more separated from the lake as the land rebounds from the historical weight of the glacial ice, while lands on the western end of the lake—including the coastal wetlands—are becoming increasingly inundated.

Great Lakes Shore Fens may be distinguished from other nonforested boreal peatlands such as Poor Fen, Boreal Rich Fen, and Open Bog (which sometimes co-occur with them in the same wetland complex) by their direct hydrologic connections to both oligotrophic, low-nutrient Great Lakes waters and the more mineral-enriched waters of the streams draining into the coastal wetlands. Limited ground and other surface water inputs (e.g., runoff) from adjoining uplands are also likely to have effects on the water chemistry of some coastal peatlands, depending on vegetative cover and local land use.

Great Lakes Shore Fen may be differentiated from Northern Sedge Meadow by its ability to float as water levels rise, and it is seldom, if ever, truly inundated. Other attributes of Great Lakes Shore Fen are the scarcity or absence of mosses in the Sphagnaceae family (especially the genus Sphagnum) and higher pH values than those associated with the boggier and more acid peatlands mentioned above. Boreal Rich Fen has higher pH values, lacks direct hydrologic connections to the Great Lakes, and may support indicator species (Harris et al. 1996) that are absent from or rare in Great Lakes Shore Fen; these include linear-leaved sundew (Drosera linearis), fen grass-of-Parnassus (Parnassia glauca), false asphodel (Trianda glutinosa), and beaked spike-rush (Eleocharis rostellata).

Lake Michigan sites on the margins of the Door Peninsula (and perhaps in the Grand Traverse Islands) do contain at least a few “rich fen” indicators, such as shrubby cinquefoil (Pentaphylloides floribunda). Presumably this is due to the calcareous bedrock (which is at or close to the surface) and the chemistry of the groundwater inputs, springs, and streams entering the Lake Michigan sites. However, the coastal fens along Lake Michigan also come into direct contact with the lake water, which is much softer than that originating in the strongly alkaline substrates of the Door Peninsula. Sediment cores taken from the Mink River estuary in northeastern Door County reveal several feet of peat, interlayered with marl (to my knowledge this does not occur in northwest Wisconsin—where neither the bedrock nor the glacial deposits are as alkaline).

Associated natural communities in these exceptionally diverse coastal wetland complexes include Great Lakes Beach, Great Lakes Dune, Great Lakes Barrens, Northern Dry Forest, Boreal Forest, Interdunal Wetland, Emergent Marsh, Wild Rice Marsh, Northern Sedge Meadow, Poor Fen, Shrub-carr (and a “Shrub Fen” type that needs additional description), Northern Tamarack Swamp, and Northern Wet-mesic Forest.

The open sedge mat of the Great Lakes Shore Fen may be contiguous with emergent marsh vegetation on the wetter side and with a firm grounded mat in which sphagnum
mosses become increasingly important on the upland side. At several Lake Superior sites, a repeated progression of a subset of the peatland communities may be apparent, with the vegetation becoming increasingly acidic as distance from the Great Lakes increases and isolation from ground and surface waters decreases. The more sensitive Shore Fen specialties drop out or become very scarce as the community becomes more bog-like, and if sediment and nutrient inputs increase, the entire community may shift to a marsh dominated by robust emergent graminoids (this has apparently happened within the St. Louis River estuary Fish Creek Slough).

The wetland complexes supporting Great Lakes Shore Fen may encompass only a few acres (e.g., Little Sand Bay in northern Bayfield County) or cover tens to hundreds of acres. The Bad River-Kakagon Sloughs occupies roughly 10,000 acres of fen, marsh, sedge meadow, shrub swamp, conifer swamp, and estuarine lagoon. This site is far larger than all of the others combined, and there is relatively little agricultural, residential, and industrial development there at this time.

Community Description: Composition and Structure
At the Lake Superior sites, the vegetation typically forms an extensive floating mat composed mostly of sedges, with the strongly rhizomatous woolly-fruit sedge (*Carex lasiocarpa*) usually the dominant species. The sedge mat may be in direct contact with Great Lakes waters, occupy a lagoon or coastal lake behind a sandspit or baymouth bar, or occur in an estuary where there is mixing of Great Lakes waters with those of a stream. Tall shrub and tree cover is low, less than 25% and often considerably less than 10%, and the general aspect is one of dominance by the narrow-leaved sedges (or “wiregrasses”). Common, occasionally co-dominant, vascular associates are twig-rush (*Cladium mariscoides*) and sweet gale (*Myrica gale*). Other graminoids are water sedge (*Carex exiis*), Buxbaum's sedge (*C. buxbaumii*), creeping sedge (*Carex chordorrhiza*), livid sedge (*C. livida*), alpine cotton-grass (*Trichophorum alpinum*), elliptic spike-rush (*Eleocharis elliptica*), marsh muhly (*Muhlenbergia glomerata*), and white beak-rush (*Rhynchospora alba*). Other representative vascular plants of this floristically diverse community include marsh cinquefoil (*Comarum palustre*), water horsetail (*Equisetum fluviatile*), several bladderworts: horned, northern, and small (*Utricularia cornuta, U. intermedia, and U. minor*), brown bellflower (*Campanula aparinaeoides*), linear-leaf willow-herb (*Epilobium leptophyllum*), bogbean (*Menyanthes trifoliata*), bog willow (*Salix pedicellaris*), purple pitcher plant (*Sarracenia purpurea*), bog St. John’s-wort (*Triadenum fraseri*), and northern yellow-eyed-grass (*Xyris montana*). Where the mat is grounded there is a transition, which may be gradual or rather abrupt, to other peatland types (such as Poor Fen, Northern Tamarack Swamp, or Black Spruce Swamp).

Sphagnum cover in the floating mats is discontinuous and may be quite low—well under 50%. Brown mosses potentially associated with Shore Fen include *Plagiomnium ssp.*, *Tomentypnum nitens*, *Campylium stellatum*, *Drepanoclados revolvens*, and *Scorpidium scorpioides* (Harris et al. 1996).

Tree cover is very low, typically consisting only of seedlings and small saplings. Tamarack (*Larix laricina*) is the most common species. Tall shrubs are sparsely distributed and seldom dominant, except toward the uplands margins. Among the characteristic tall shrubs are speckled alder (*Alnus incana*), bog birch (*Betula pumila*), and sweet gale. Others are sage-leaved willow (*Salix candida*), bog willow (*S. pedicellaris*), and white meadowsweet (*Spiraea alba*). The low shrubs are mostly ericads, and include bog-rosemary (*Andromeda glaucophylla*), leather-leaf (*Chamaedaphne calyculata*), large cranberry (*Vaccinium macrocarpon*), and small cranberry (*V. oxycoccos*).

Rare and otherwise unusual plants include common bog arrow-grass (*Triglochin maritima*), coast sedge (*Carex exilis*), livid sedge, Michaux’s sedge (*C. michauxiana*), English sundew (*Drosera anglica*), brown beak-rush (*Rhynchospora fusca*), and boreal bog orchid (*Platanthera dilatata*). Several of these rarities, such as coast sedge and brown beak-rush, may be locally common or even abundant, but their statewide distribution is limited to a small number of sites.

Breeding birds of high conservation interest because of their rarity, declining populations, or use of a narrow range of habitats occur in the coastal wetland complexes, including Great Lakes Shore Fen. Some examples are American Bittern (*Botaurus lentiginosus*), Northern Harrier (*Circus cyaneus*), Merlin (*Falco columbarius*), Yellow Rail (*Gallinago hardwickii*), Le Conte’s Sparrow (*Ammodramus leconteii*), Common Loon (*Gavia immer*), Common Tern (*Sterna hirundo*), and Black Tern (*Chlidonias niger*). In recent years, the Black Tern has disappeared as a breeding species in wetlands along the southwestern Lake Superior coast.

Use of the coastal wetlands and adjacent aquatic and terrestrial habitats by migrating birds is heavy, especially among waterfowl, other waterbirds, gulls and terns, shorebirds, raptors, and passerines.
Rare Odanata (dragonflies and damselflies) have been collected recently in coastal peatland complexes on both lakes Superior and Michigan. On Lake Superior the rare odanates collected in and around the coastal fens included zigzag darter (*Aeshna sitchensis*), alkali bluet (*Enallagma clausum*), and incurvate emerald (*Somatochlora incurvata*) (Dubois et al. 2006). The federally endangered Hines emerald (*Somatochlora hineana*) occurs in the vicinity of fens, sedge meadows, and other coastal wetlands at several Lake Michigan sites.

**Management and Conservation Considerations**

In the past, outright destruction occurred due to the filling of the coastal wetlands for industrial or residential uses or because of dredging to create and deepen channels to accommodate shipping and some recreational uses. This was especially common in the lower parts of the estuaries associated with the mouths of larger rivers such as the St. Louis and Nemadji but has also occurred on some smaller streams such as the Flag River and at Fish Creek just west of Ashland.

More insidious have been the changes due to increased inputs of sediments and nutrients, which are the driving forces behind wholesale change from narrow-leaved sedge-dominated coastal peatlands to emergent marsh (Meeker and Fewless 2008). Protection of site hydrology and water quality (nutrient and sediment loads) is critical. Maintaining water level fluctuations within a range that will support these dynamic wetlands over time may be a major challenge, due to human activities and geologic processes. If the coastal sites experience excessive, prolonged drying, woody vegetation will encroach on and eventually take over from the sedges and mosses. If water levels rise permanently or for long periods of time without receding, conversion to marsh vegetation is possible. Inputs of nutrients, sediments, and pollutants will alter water chemistry (and perhaps the rate of peat formation), leading to the decline or loss of the more sensitive fen specialists. This has apparently already happened in some of the more developed and industrialized coastal areas on Lake Superior, such as at the Fish Creek estuary at the head of Chequamegon Bay near Ashland and along the lower St. Louis and Nemadji rivers at Duluth-Superior. Wetlands still occur at these sites, but today they are mostly marshes, composed mostly of a few widespread and abundant plants such as cat-tails, bulrushes, arrowheads, bur-reeds, and common reed. Small patches of wire-leaved sedge fen remain on the margins of the estuary and in the St. Louis River across from the village of Oliver. These are likely remnants of the vegetation that was much more abundant prior to Euro-American settlement and development of the estuary. (This is in part an inference, based on the currently prevalent vegetation in the intact, less developed, less disturbed estuaries along the southwestern Lake Superior coast and from discussions with biologists familiar with the Euro-American settlement histories of this region.)

Invasive plants documented in Great Lakes Shore Fen include common reed (*Phragmites australis*), reed canary grass (*Phalaris arundinacea*), narrow-leaved cat-tail (*Typha angustifolia*), hybrid cat-tail (*Typha x glauca*), and purple loosestrife (*Lythrum salicaria*). The nonaggressive native strain of common reed is present at some of the Lake Superior coastal sites, and the management implications are uncertain. However, it has been observed by wetland managers that both the native and nonnative strains of this plant can overwhelm other members of the wetland communities here. The prevailing philosophy among the managers of Great Lakes coastal wetlands in Wisconsin currently seems to be “don’t take chances—get rid of it all.” More study of this problem is needed.

Wisconsin has an especially important role to play in the conservation of these fragile, complex, and diverse wetlands, along with the unusual biota they support. The concentration of occurrences on the southwestern Lake Superior shore, especially in the Apostle Islands and the northern Bayfield County mainland, is especially noteworthy owing to their number, size, condition, and species composition. Geographic location is also a key characteristic as many of the coastal sites supporting Great Lakes Shore Fen receive use by large numbers of migratory birds (Wisconsin Stopover Initiative 2011).
The vast Kakagon-Bad River Sloughs complex in northern Ashland County is an exceptional site for all of these reasons, for its cultural significance, and for the irreplaceable biodiversity it supports. Because of postglacial Great Lakes dynamics, the Shore Fens are scarce or absent elsewhere, or in areas where they had been present, they were either destroyed or converted to other plant communities, usually marshes. The reversibility of conversion to marsh is highly questionable, and no examples of successful restorations of Great Lakes coastal fens are known to the author. Protection of the Shore Fens, their associated wetland communities, the beaches and dunes, and the processes that support them are appropriate conservation priorities for the State of Wisconsin and its partners in resource protection and management.

Because of the natural dynamics of Great Lakes wetlands, effective conservation will depend on managing at multiple scales: at the site level, including the individual natural communities within a specific coastal wetland sites; throughout the local watershed, beyond the delineated wetland boundaries; and at the Great Lakes basin level, for actions that are apt to have widespread effects on water level dynamics, water quality, and vegetation. Impacts of climate change are uncertain but are likely to be significant.

Data needs include additional vegetation sampling on Lake Michigan coastal fens and analyzing some of the changes that have been observed and continue to occur at the Lake Superior sites. Taxa previously overlooked in the Great Lakes Shore Fens, especially the nonvascular plants, should be treated as information gaps and addressed by future field work. Updated information on water sources, land cover at the local watershed level, and changing land uses is needed. The sites could be prioritized based on degree of threat to the fen community (and to other sensitive co-occurring wetland communities such as wild rice marsh and beach and dune complexes), the presence of species known to be rare and/or sensitive to water quality or unusual water level changes, and size and overall condition of the communities within a given coastal site. Actions that will affect hydrology, water sources, land cover, and inputs of sediments and nutrients into coastal wetlands will need to be monitored carefully, assessed, and addressed as necessary.

**Additional Information**

For information on similar communities, see descriptions for Poor Fen, Boreal Rich Fen, Calcareous Fen, Northern Tamarack Swamp, Open Bog, Northern Sedge Meadow, and Interdunal Wetland. The U.S. National Vegetation Classification (US NVC) association most closely resembling Great Lakes Shore Fen is CEGL005229 Wiregrass Shore Fen (Faber-Langendoen 2001). It’s possible that CEGL005275 Shrubby Cinquefoil – Sweetgale Rich Shore Fen occurs on the Door Peninsula or in the Grand Traverse Islands.

Preliminary descriptions for several shrub fen community types are also found in the US NVC and in Harris et al. (1996). In northwestern Wisconsin, the dominant shrubs are most often bog birch, sweet gale, willows, and speckled alder. Wisconsin will likely add a northern shrub fen community in the future.

**Also see:**
- Bedford and Godwin (2003)
- Best (2015)
- Crum (1988)
- Lee and Southam (1994)