

PI Name/Short Description: Wetland Meadow Marsh Community – surface area, supply-based (Lake Ontario & Thousand Islands) [E1]

Technical Workgroup: Environmental TWG

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Performance Indicator Metric: Basin level area estimate of meadow marsh vegetation (hectares/year) in years following a low water supply period.

Ecological Importance/Niche: Meadow marsh vegetation typically develops between the maximum long-term high water level and the long-term mean. Plant species within this community are intolerant to prolonged flooding, but occasional flooding is required to prevent woody plant species from expanding downslope into the meadow marsh community. In addition, periodic low water levels are also required to prevent the expansion of aggressive emergent plants upslope into the meadow community. Meadow marsh habitats typically also contain some emergent, shrub, or upland plant species. The relative amount of these species is dictated by the years since the last high or low water-level cycle. For this reason the meadow marsh community supports a great diversity of plant species, but it occurs in a relatively narrow hydrologic range in comparison to the other wetland vegetation communities.

Awned sedge (*Carex atherodes*) was also documented to occur in Lake Ontario coastal wetlands and within the meadow marsh community specifically. Awned sedge is designated as endangered in New York State.

Temporal Validity: An area estimate is computed for each simulation year and is assumed to represent the growing season for that year. Quarter monthly water levels surrounding the annual peak are used to determine frequency of flooding and dewatering at specific elevations.

Spatial Validity: Percent cover of meadow marsh habitat is computed using generalized wetland plant community and elevation models for four wetland types. The generalized plant community and elevation models are assumed to be representative of all coastal wetlands of each geomorphic type located within all the Lake Ontario shore units and the Upper St. Lawrence RIV 1 shore unit (see Calibration Data). As such, the model outputs are extrapolated to a complete coastal wetland database for Lake Ontario and the Upper St. Lawrence River to obtain a basin-level annual estimate of meadow marsh area.

Hydrology Link: Wetland plant community evolution is strongly dependent on the hydroperiod (i.e., flooding and dewatering history) at a particular elevation. The wetland plant model uses flooding and dewatering intervals at specific elevations based on a 0.05-meter (approx. 2-inch) interval between 73.00 and 75.75 meters (239.50 and 248.52 ft) (IGLD85) to assign a plant community, such as meadow marsh or emergent marsh to those elevations on an annual basis.

Algorithm: The performance indicator model is based upon field sampling completed for the IJC study. Specific elevations with ecological significance based on past water-level history were located and sampled within 32 wetland study sites. Since the existing wetland vegetation in the lake has developed in response to the history of high and low lake levels, the selected elevations reflect unique growing season water-level histories. The elevations (IGLD85) are as follows: A) 75.60 m (248.03 ft), last flooded 30 years ago; B) 75.45 m (247.54 ft), last flooded 10 years ago; C) 75.35 m (247.21 ft), last flooded 5 years ago; D) 75.0 m (246.06 ft), last flooded 1 year ago and last dewatered during growing season 2 years ago (variable flooding and dewatering over past 3 years); E) 74.85 m (245.57 ft), last dewatered during growing season 4 years ago; F) 74.7 m (245.08 ft) last dewatered during growing season 38 years ago; G) 74.25 m (243.60 ft), last dewatered during growing season 68 years ago.

Vegetation assignments to various elevations ranges are based upon the following vegetation rules-based models.

Open Embayment Wetlands

Not flooded >30 years: assign to U (transition to Upland) and go up to elevation of 75.75m (248.50 ft)

Not flooded 5-30 years: assign to (A+B+C) and go up to elevation of 75.75m (248.50 ft)

Not flooded <5 years or not dewatered <4 years: assign to (D)

Not dewatered 4-39 years: assign to (E+F)

Not dewatered 40 years or more: assign to (G) and go down to elevation of 73.0m (239.50 ft)

Protected Embayment Wetlands

Not flooded >30 years: assign to U (transition to Upland) and go up to elevation of 75.75m (248.50 ft)

Not flooded 5-30 years: assign to (A+B+C) and go up to elevation of 75.75m (248.50 ft)

Not flooded <5 years or not dewatered <4 years: assign to (D)

Not dewatered 4-20 years: assign to (E)

Not dewatered 21-39 years: assign to (F)

Not dewatered 40 years or more: assign to (G) and go down to elevation of 73.0m (239.50 ft)

Barrier Beach Wetlands

Not flooded >30 years: assign to U (transition to Upland) and go up to elevation of 75.75m (248.5 ft)

Not flooded 5-30 years: assign to (A+B+C) and go up to elevation of 75.75m (248.50 ft)

Not flooded <5 years or not dewatered <4 years: assign to (D)

Not dewatered 4-39 years: assign to (E+F)

Not dewatered 40 years or more: assign to (G) and go down to lowest elevation in model

Drowned River Mouth Wetlands

Not flooded >30 years: assign to U (transition to Upland) and go up to elevation of 75.75m (248.50 ft)

Not flooded 5-30 years: assign to (A+B+C) and go up to elevation of 75.75m (248.50 ft)

Not flooded <5 years or not dewatered <4 years: assign to (D)

Not dewatered 4-39 years: assign to (E+F)

Not dewatered 40 years or more: assign to (G) and go down to lowest elevation in model

The A+B+C transect plant species assemblage represents a meadow marsh vegetation community within the above wetland models.

Calibration Data: Within each of the 32 wetland study sites (8 wetlands of each geomorphic type), quadrat sampling was completed along specific elevation transects (see above) within two randomly placed study areas. In each quadrat, the plant species present were identified, and percent cover estimations were made by visual inspection. Correlations between specific elevations and accompanying vegetation data were analyzed by species prominence using non-metric multidimensional scaling (NMDS). Transects A, B, and C showed the highest species diversity and were similar across wetland types. Transect D vegetation was identified as a second community and was similar across all wetland types. Transects E and F comprised a third community and were similar in all wetland types, except protected embayments in which E and F were separate communities. Vegetation at transect G was identified as the fourth unique community and was also found to be similar across all wetland types.

Plant species were then assigned vegetation structural categories and summarized by mean cover for each unique transect in order to provide generalized habitat information for performance indicator development and faunal models. Based on this analysis, transects A+B+C were assigned to a meadow marsh vegetation community within the wetland models.

Validation Data: Wetland vegetation mapping from historically aerial photography of the study sites were used to validate model predictions.

Documentation & References:

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Confidence, Significance and Sensitivity:

1) Confidence: Plant quadrat sampling along specific elevations representing unique flooding and dewatering histories clearly demonstrated the ordination of wetland plant species along a hydrologic gradient. The wetland study results only represent a ‘snapshot’ in time, but the flooding/dewatering histories of the transects add the time dimension to the study. The timing of response of various plant communities to low and high water-level cycles was inferred from the current plant community distribution, published literature, and expert opinion. Shifts in the distribution and abundance of wetland plant communities in response to changing inter-annual water levels is a certainty, the specific timing of response and persistence of communities may vary from that within the vegetation rules-based model.

The area estimates should be considered as representative for plan comparison and not absolute. Sampling only occurred within a subset of the wetlands, and basin-level estimates were created by extrapolating from generalized models. There will be error in the area estimates for any specific wetland due to inaccuracies in the site-level elevation models and extrapolations. Overall, we are very confident in the models and the PI.

2) Significance: The wetland habitat models are very significant, as many of the other wetland PIs are dependant on the habitat model outputs. The meadow marsh specifically represents vegetation that typically develops between the maximum long-term high water level and the long-term mean. Plant species within this community are intolerant to prolonged flooding, but occasional flooding is required to prevent woody plant species from expanding downslope into the meadow marsh community. More importantly, periodic low water-level cycles are required to arrest the expansion of aggressive emergent plants upslope into the meadow community. During the low water period, emergent plant species will die back at higher elevations where the hydrology is no longer suitable. Coincidentally, the hydrology does become suitable for meadow marsh plant species, which will expand, and result in the meadow marsh habitat expanding downslope. This low water cycle is of critical importance for maintaining the area of meadow marsh within Lake Ontario coastal wetlands. As water levels fluctuate between the high and low water-level cycles, the meadow marsh will typically also contain some emergent, shrub, or upland plant species. The relative amount of these species is

dictated by the years since the last high or low water-level cycle. For this reason, the meadow marsh community supports a very great diversity of plant species but occurs in a relatively narrow hydrologic range in comparison to the other wetland vegetation communities.

There are many species of amphibians, reptiles, birds and fish that specifically require meadow marsh habitats within their life cycle.

Awned sedge (*Carex atherodes*) was also documented to occur in Lake Ontario coastal wetlands and within the meadow marsh community specifically. Awned sedge is designated as endangered in New York State.

3) Sensitivity: Regulation of the Lake Ontario and Upper St. Lawrence River system impacts over 1,000 kilometres of shoreline and thousands of hectares of wetlands. Due to the area of influence, small alterations in the hydrograph can lead to large changes in area of wetland habitats and numbers of dependant fauna. Wetland plant communities represent a critical component of habitat requirements for hundreds of fish and wildlife species and must be incorporated into the environmental assessment of alternate water-level regulation plans.