

**PI Name/Short Description:** Northern Pike – young-of-year (YOY) recruitment index (Lake Ontario) [E5]

**Technical Workgroup:** Environmental TWG

**Researched by:** Minns, Doka, (Chu, Bakelaar, Leisti), Casselman, Farrell

**Modeled by:** Moore, LTI (DePinto, Redder)

**Performance Indicator Metric:** This performance indicator provides an index of YOY recruitment for Northern pike in Lake Ontario. A daily average of the temperatures within the Lake Ontario area is used to estimate daily growth of Northern pike parameterized for specific life stages. In addition, WSA is used to apply density-dependent effects on growth and survival based on space requirements at different life stages. (See WSA PI documentation for additional information.)

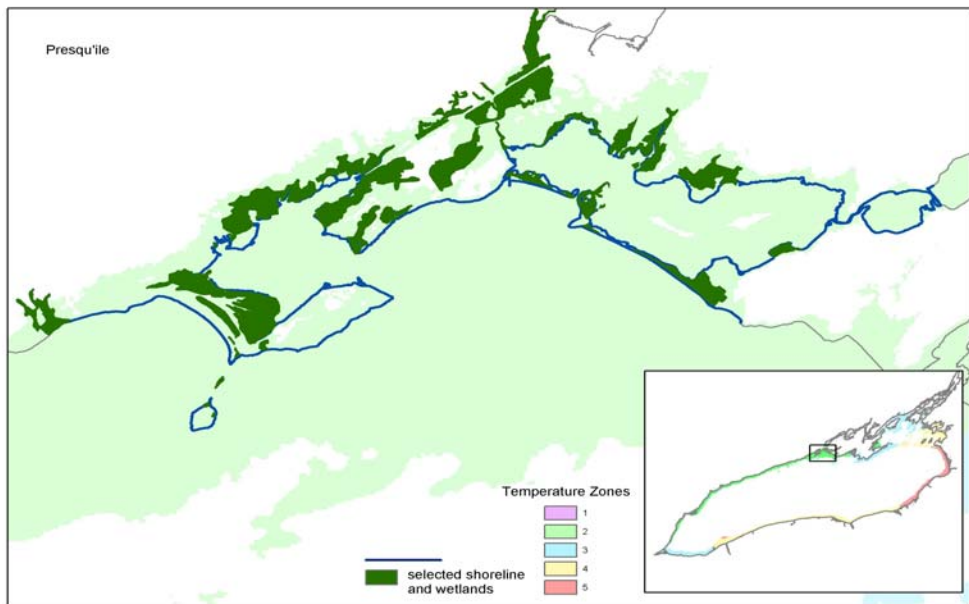
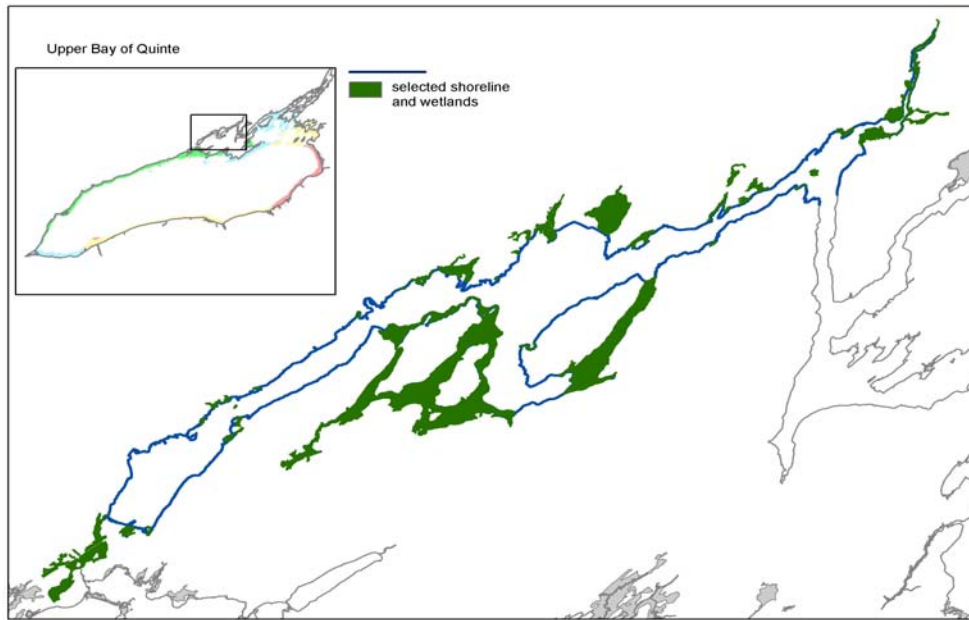
**Ecological Importance/Niche:** Northern pike is an important top predator that is a recreationally important species, spawning in early spring and belonging to the cool water fish guild in nearshore systems.

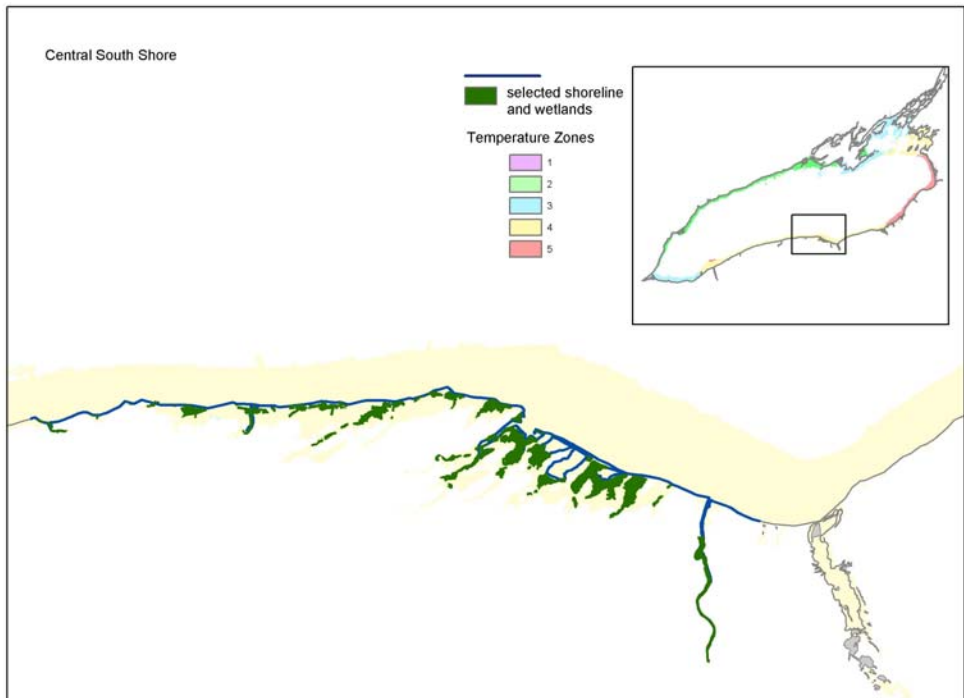
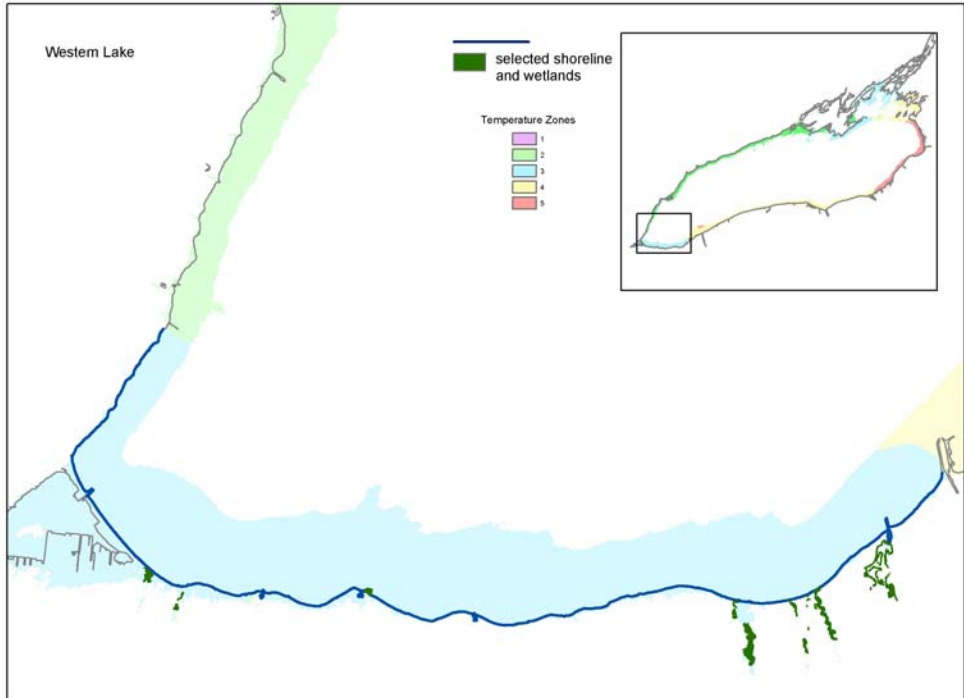
**Temporal Validity:** Northern pike recruitment is computed on an annual basis and is affected by daily habitat supply results. Each year the total surviving recruits or young-of-the-year are tallied. Currently, a ratio of northern pike recruitment between baseline (1958DD) and proposed regulation plans is calculated annually and then the ratios are averaged and a coefficient of variation is calculated over the 101-year simulation period to generate two metrics for comparison.

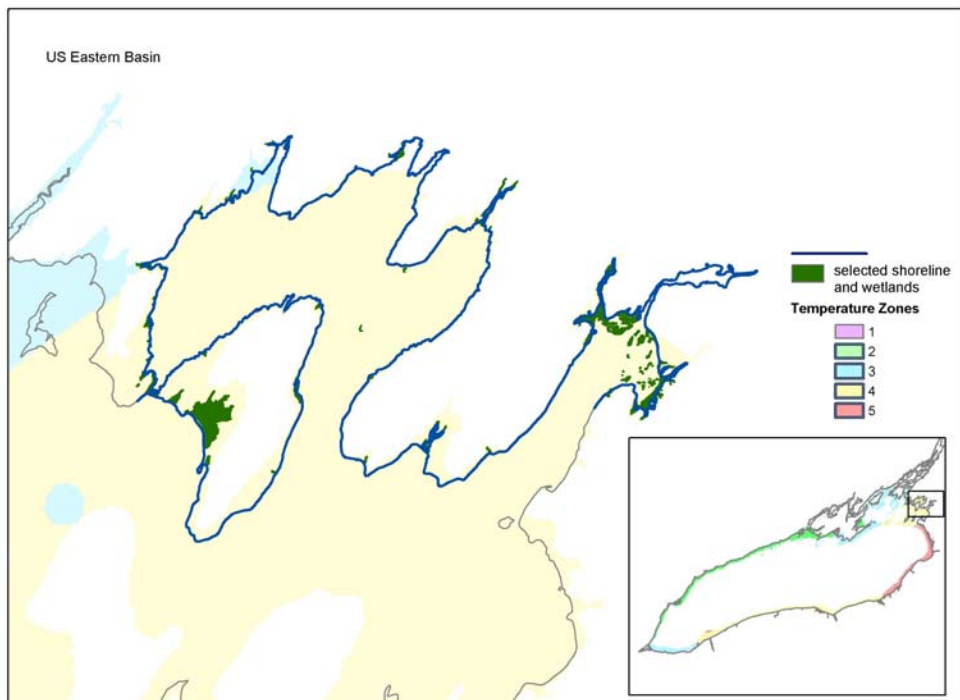
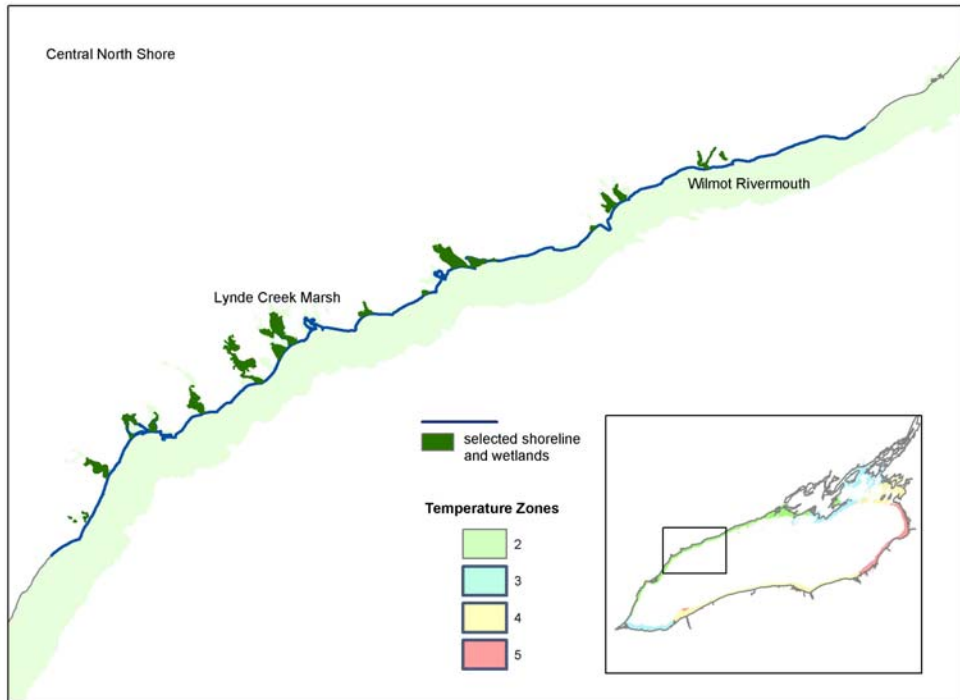
**Spatial Validity:** This northern pike performance indicator is valid for the following six contiguous groups, with the number of reaches and wetlands indicated:

- Bay of Quinte: 279 reaches and 56 wetlands
- Presquile: 139 reaches and 31 wetlands
- North Central Shore: 100 reaches and 19 wetlands
- West Shore: 83 reaches and 9 wetlands
- South Central Shore: 102 reaches and 33 wetlands
- Outlet Basin: 141 reaches and 51 wetlands

Each reach group was selected to represent temperature zones, sampled wetlands, and different geographic regions across Lake Ontario. The size of the reach group area is adequate for supporting distinct northern pike populations. Population estimates can be combined across reach groups, where appropriate, based on weightings determined by responsiveness to hydrologic changes. The population modeling reach groups were selected based on habitat variables such as temperature zone, presence of sampled wetlands and represent general geographic zones across the lake. The size of the reach group area is adequate for supporting distinct northern pike populations. WSAs can be combined across reach groups with a region, where appropriate, based on weightings determined by responsiveness of the PI to hydrology.







**Hydrology Link:** Daily weighted suitable area, partly a function of hydrology, is used to calculate the density-dependent effects on growth and mortality of the appropriate life stages of northern pike in the six study areas. In addition, a stranding factor is applied to the northern pike spawning component of the model. This factor simulates the mortality of developing eggs and hatchlings associated with catastrophic stranding events in wetland and nearshore habitats. A decrease in water level results in a proportional decrease in egg and hatchling survival.

**Calibration Data:** No specific calibration data are available for northern pike recruitment, but the bioenergetic and mortality rates used are based on a large body of literature and information available on the species in the Great Lakes. Bioenergetics parameters used in the northern pike model for early life stages were calibrated specifically for the IJC study area (Farrell).

**Validation Data:** No specific validation datasets are available for weighted suitable areas. Temperatures used in the habitat supply calculations have been validated using simulated data from different thermal models for Lake Ontario or empirical datasets specific to the study areas, when available.

**Algorithm:** Specific equations and algorithms used in the calculation of weighted suitable areas have been documented in IJC Lake Ontario – St. Lawrence Study reports and are too extensive to list here. The equations are part of a habitat supply submodel and database of the IERM for northern pike in Lake Ontario.

**Documentation & References:** The documentation and details of the algorithms used to calculate this PI are summarized in:

Minns, C.K.; S. Doka; C. Bakelaar; C. Chu; K. Leisti, and J.E. Moore. 2005. Year 4 Final Report for Burlington Fish Habitat & Modelling Group.

**Risk and Uncertainty Assessment:** Population models assume prey is abundant and growth is limited by density-dependent effects and temperature. Uncertainties exist in our density-dependent effects on growth, as currently growth decreases as densities increase. Currently cumulative uncertainties have not been estimated but errors and uncertainties exist at four levels of the analysis: spatial habitat information, habitat models, weighted suitable area calculations, and population models. The relative differences between scenarios should be equally affected by these cumulative uncertainties.