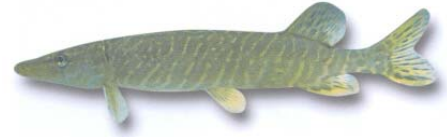


PI Name/Short Description: Northern Pike (*Esox lucius*) – suitable reproductive habitat surface area (Lake St. Louis to Trois-Rivières) [E22]

Technical Workgroup: Environment TWG

Researched by: Brodeur P., M. Mingelbier and J.Morin

Modeled by: Morin J, S.Martin and O.Champoux. Modeled using full 2D system and reduced to relation with discharge.



Performance Indicator Metric: Suitable spawning habitat and potential mortality of N. pike. The calculation of this indicator includes (i) the number of hectares of habitat suitable for Northern pike spawning from which we subtract (ii) the number of hectares dewatered within the periods following the egg deposition. The reference water discharge gage is located at Sorel.

Ecological Importance/Niche: The Northern pike is an ecologically important top predator in the fluvial St. Lawrence River and is targeted by sport fishermen. The pike reproductive success is favoured by high water levels during the spawning period and stable levels during the incubation period. A water level lowering would have substantial impacts on the reproductive success while reducing the access to spawning grounds and increasing the potential mortality.

Temporal Validity: Valid for the period between the spawning time (egg deposition) and 30 days after (4 quarter months). The date of spawning varies from year to year between early April and late May. Therefore, the quarter-months included in the computation are based on the accumulated degree-days at Dorval.

Spatial Validity: Valid between Lake St. Louis and Lake St. Pierre (not including Lachine Rapids and Laprairie Basin).

Hydrology Link: During the springtime, the Northern pike spawns in shallow water of the St. Lawrence floodplain. The access to high quality spawning habitats is controlled by water level. There is potential fish mortality due to short-term or atypical water level variations (intra-annual) in the floodplain, particularly for young life stages. Northern pike, with shallow preferences for spawning, is vulnerable to dewatering after egg deposition – eggs may become dry reducing reproduction success, or rapid dewatering could trap larvae in the floodplain.

Algorithm: The algorithm is based on the mean value of discharge estimation at Sorel for the determined computing quarter-month. A habitat suitability index (HSI) was developed to estimate the spawning habitat quality. Three variables were used in the HSI: water temperature, water velocity and wetland type. The HSI was then coupled with a 2D physical model to compute, for eight different discharge scenarios, the weighted suitable area (WSA) calculated as the product between the suitable habitat surface and the HSI. For each discharge scenario, six scenarios of water level decrease after spawning were applied to estimate the potential mortality by subtracting the WSA where spawning grounds were dewatered. The annual chronology of pike spawning was determined using a predictive model based on air temperature.

Calibration Data: No calibration data available

Validation Data: The HSI was based on data from the field and the literature. Historical data on year class strength were used to validate the WSA. The predictive model of spawning chronology was validated with historical data (20 site-years).

Documentation and References:

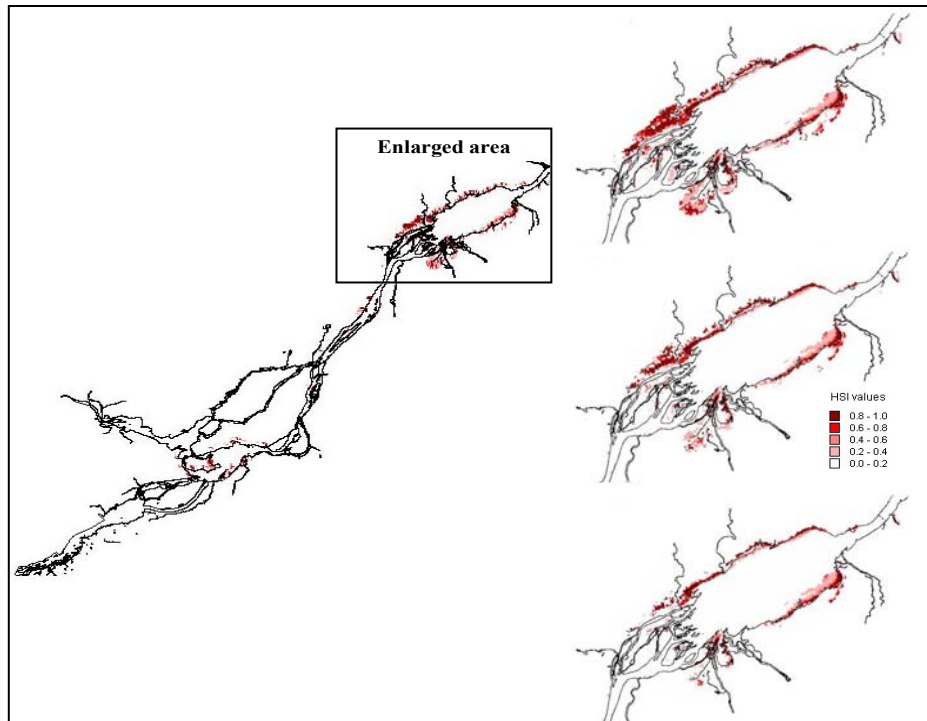
Brodeur P., M. Mingelbier et J. Morin 2004. Impact des variations hydrologiques sur les poissons des marais aménagés du Saint-Laurent fluvial. *Nat. Can.* 128-2: 66-77.

Brodeur P., M. Mingelbier et J. Morin 2004. Impact of water discharge on fish reproduction using 2D numerical habitat in the St. Lawrence River, Canada. Proceedings of the 5th International Symposium on Ecohydraulics. Aquatic Habitats: Analysis and Restoration. Sept. 2004. Madrid, Spain.

Brodeur P., M. Mingelbier et J. Morin. in press. Impact du débit sur la disponibilité des habitats de reproduction des poissons de la plaine inondable du Saint-Laurent, mesuré avec un modèle numérique 2 D. *Nat. Can.*

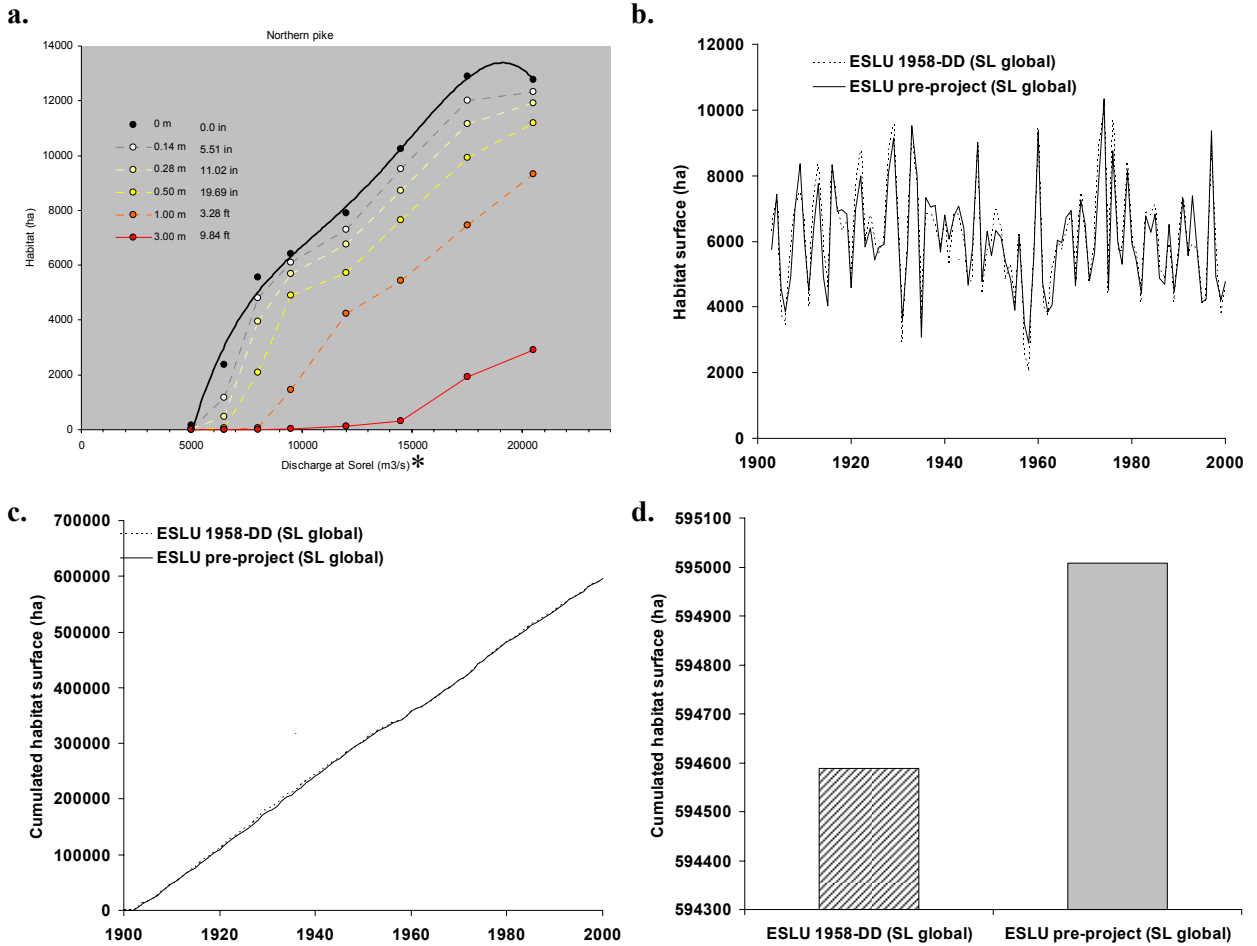
Mingelbier M., P. Brodeur et J. Morin 2004. Recommandations préliminaires concernant les poissons du Saint-Laurent et leurs habitats pour la révision des critères de régularisation du système lac Ontario-Saint-Laurent. Société de la faune et des parcs du Québec, Direction de la recherche sur la faune. 124 p.

Risk and Uncertainty Assessment: The present performance indicator was especially designed to evaluate the sensitivity of fish habitat to water discharge variations. It does not take into account any other confounding factors such as over fishing, anthropogenic habitat losses, biological interactions, agriculture impacts, toxics, etc. This indicator assumes that most of the reproduction occurs in the St. Lawrence River, not in the tributaries. This assumption comes from the geographical limits of the IJC study area and the 2D model.



Suitable spawning habitat of N. pike for an average spring discharge at Sorel (14 500 m³/s). Habitat losses corresponding to 0.5 m and 1 m (1.64 ft and 3.28 ft) water level drawdown after eggs deposition are presented for the lake St. Pierre area.

Transformation from 2D explicit models to 1D simplified SMV curves:



(a) Global relationship between “Surface area of suitable summer habitat” for ESLU and the discharge in Sorel; (b) suitable average summer habitat (ha) for the period 1900-2000, calculated with the 1958-DD and Pre-project Plans; (c) cumulated suitable habitat (ha) over time for the period 1900-2000; (d) difference in suitable habitat between the two scenarios 1958-DD and Pre-Project after 100 years.

* 5000 m³/s = 176,578 ft³/s
 10000 m³/s = 353,156 ft³/s
 15000 m³/s = 529,734 ft³/s
 20000 m³/s = 706,312 ft³/s