

PI Name/Short Description: Amphibian species (frogs, toads, peepers) - reproductive habitat surface area (Lake St. Louis to Trois-Rivières) [E27]

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



Performance indicator Metric: Reproduction habitat of amphibians, including frogs, toads and peepers, in wetlands of the St. Lawrence River. Available surface area of reproduction habitat for different conditions in spring time.

Ecological Importance/Niche: The amphibians play an important role in the wetlands because of their position in the food chain and their important biomass. The vegetation of the floodplain (marsh, submerged vegetation, wet meadow, etc.) is an important part of amphibian's habitat in their life cycle, they use both the aquatic environment and the terrestrial environment, making them very sensitive to water level variation. Water level fluctuations offer food and shelter against potential predators. The variation in water level can affect these habitats, therefore affecting frogs.

Temporal validity: This indicator is applied and computed to QM 14 to 23 (reproduction) and 23 to 30 (mortality) of each year.

Spatial validity: From Lake Saint-Louis to Trois-Rivières.

Hydrology Link: Amphibians prefer to spawn in wetland vegetation flooded by a depth of less than 50 cm. The flooding of St. Lawrence River wetlands is directly associated with spring flood amplitude and duration.

Algorithm: The 2-D algorithm is based on the mean discharge at Sorel from QM14 to QM23 for the reproduction period and from QM23 to QM30 for the mortality potential period. The high water level during spring time will favour frog reproduction in emergent vegetation. Following the spawning period, variation in water level will serve as a limiting factor in the survival of the eggs and tadpoles.

- 1) Vegetation types: Amphibians are known to use marsh areas to deposit their eggs. Terrestrial or aquatic vegetation are not utilized as spawning areas.
- 2) Water depth: Amphibians are not good swimmers, so they use shallow water near the shore to accomplish their reproduction.
- 3) Current velocity: reproduction takes place in standing water.

Potential nesting habitat model (QM 14 to 23)

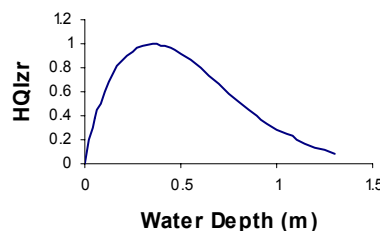
Habitat is calculated over the entire domain (at nodes) with the following algorithm

$$\text{Reproduction HQI} = (\text{HQI}_{\text{TV}} * \text{HQI}_{\text{Zr}} * \text{HQI}_{\text{V}})^{1/3}$$

Where HQI_{TV} (vegetation):

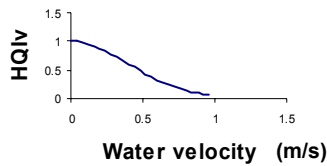
in Wet meadow $\text{HQI}_{\text{TV}}=0.8$, in Shallow marshes $\text{HQI}_{\text{TV}}=1.0$, in Deep marshes $\text{HQI}_{\text{TV}}=0.6$, in Aquatic macrophytes $\text{HQI}_{\text{TV}}=0.2$, in Open water $\text{HQI}_{\text{TV}}=0.0$

Where HQI_{Zr} (water depth) :



.5 m = 1.64 ft
1.0 m = 3.28 ft
1.5 m = 4.92 ft

Where $HQI_{V(\text{water velocity})}$:



.5 m/s = 1.64 ft/s

2.0 m/s = 3.28 ft/s

1.5 m/s = 4.92 ft/s

Mortality model (QM 23 to 30)

From the resulting potential habitat, the mortality model removes all the nodes where the water level drop down to < 0.1 m (< 3.94 inches) during at least one of the considered QM.

A 2D habitat model computes the probability of the presence of safe habitat considering the water depths at a variety of flows. The term “safe” means that for each year, the model excludes the portion of potential habitat that can be adversely affected by water level fluctuations (resulting in mortality). The full 2D models are reduced to a simplified matrix that is function of flow and water level decrease.

Calibration Data: No data available

Validation Data: Occurrences of tadpole catch from field surveys.

Documentation and References:

Armellin, A et C. Plante (mars 2004) Diversité et abondance des amphibiens et Reptiles des milieux humides du Saint-Laurent (*Diversity and Abundance of Amphibians and Reptiles of St. Lawrence river's Wetlands*) IJC Report.

Risk and Uncertainty Assessment: We are confident that this model will accurately predict which spring flows are better or worse for amphibian reproduction success. The PI can be used to distinguish a good year from a bad year, but further thought is required to distinguish a good 101 years from a bad 101 years. We recommend the average annual habitat be used to rank plans. The PI also does not reflect other important factors that affect amphibian population, such as water quality, availability of food or predation. In our expert opinion, this does not significantly diminish the value of this PI because we feel available spawning area is generally the factor that drives population.

Significance : 3

Uncertainty: 2

Sensitivity: 4

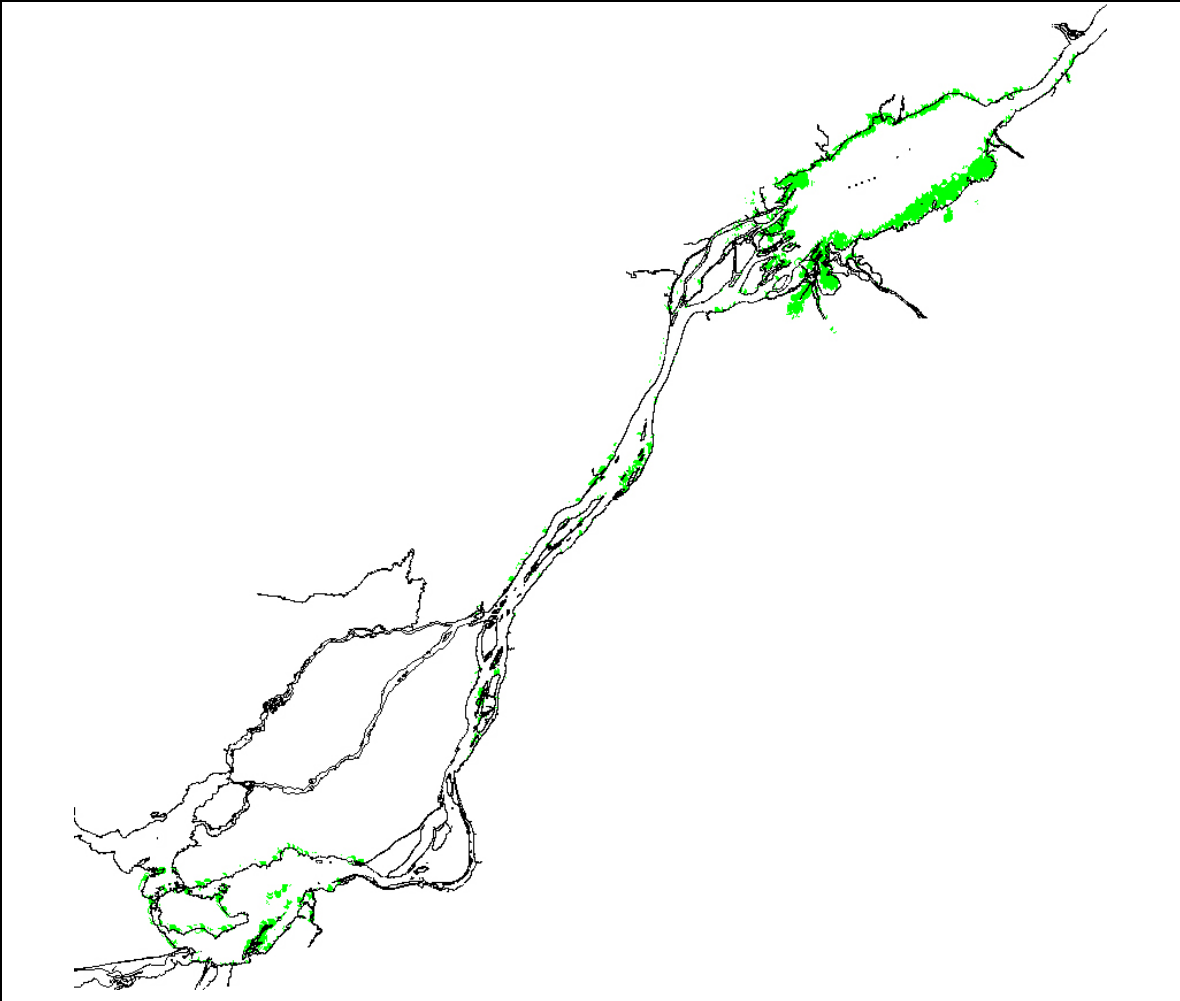


Figure 1. Map of the suitable reproduction habitat for of amphibians (frogs, toads and peepers) for an average discharge (9500 m³/s at Sorel)

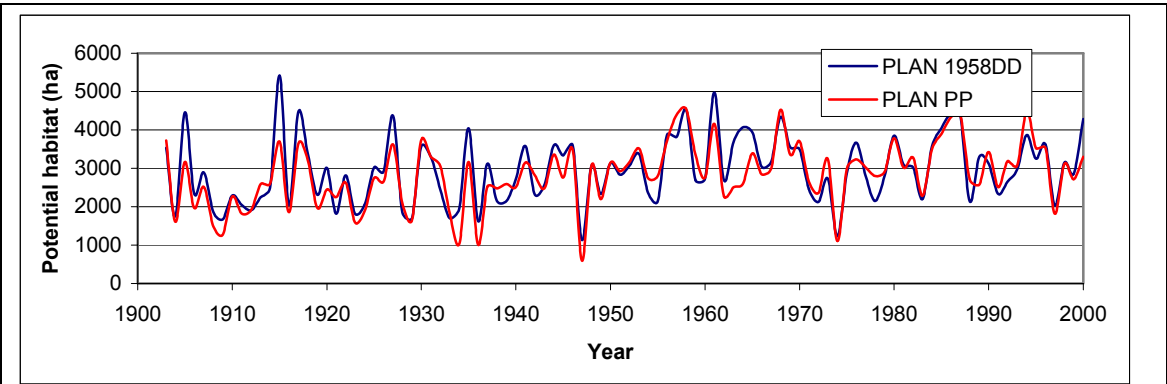


Figure 2. Comparaision of reproductive habitat surface area for the frog for Plan 1958DD and Plan PP