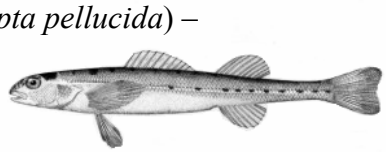
PI Name/Short Description: Eastern Sand Darter (*Ammocrypta pellucida*) – reproductive habitat surface area (Lake St. Louis to Trois-Rivières) **[E30]**



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Performance Indicator Metric: The PI gives an annual value of the available safe potential surface area of spawning and egg development habitat (measured at the Sorel gage). The aggregated 100 year plan scenarios are expressed by the percent of time that the PI exceeds the first quartile value for plan 1958DD for the comparable water supply series (e.g. Historic, S1, S2 S3, etc). This metric will be used for plan evaluation by calculating a ratio of metrics between two plans.

Ecological Importance/Niche: The Eastern Sand Darter is a small (4 cm to 7 cm or 1.57 inches to 2.76 inches) sedentary percid fish. The Sand Darter is designated as Threatened by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC). The species is listed in the Schedule 1 of the *Species at risk Act*; the species and its critical habitat are legally protected under this Act. Critical habitat protection will be applied when it is identified within the Recovery Strategy or Action Plan. Spawning and egg development of the Sand Darter is influenced by hydraulic attributes.

Temporal validity: We measure the potential spawning habitat for the three last quarter month (QM) of June and the two first of July while we measure the risk to dry up eggs and larvae from the second QM of June until the third one of July.

Spatial validity: The PI is valid for the Lower St. Lawrence between Lake St. Louis and Lake St. Pierre (except Laprairie Basin). The total region is used to evaluate water regulation plans.

Hydrology Link: This PI is influenced by hydraulic attributes responsible for spawning habitat availability and eggs/larvae survival. More specifically, the PI was developed using 2D modeling based on the combination of hydrodynamic and substrate models. Three hydraulic variables were considered: *mean water depth*, *mean current velocity* and *water level decrease*.

The Sand Darter prefers to spawn in 15 cm to 120 cm (5.91 inches to 47.27 inches) of water with a current velocity less than 20 cm/s (7.87 inches/second) that create silt-free sandy bottoms. Water levels fluctuations have two known linkages to this fish reproduction:

1) Local flow velocity is a good indicator of what the river bottom substrate will be made up of.
2) Water level drops can dry up eggs and larvae.

Algorithm: The PI is made from the potential spawning and eggs/larvae development habitat model, from which the mortality model removes all portions where water levels fluctuations create "unsafe" conditions to the eggs/larvae development. The two models built to create the PI are presence / absence type models that are based on the parameters and values coming from literature review (more info in Giguère and al. (2005)).

Potential spawning habitat model (QM 22 to 26)
Habitat is considered as suitable if all the following features are present: presence of sand > 70% in the substrate polygon; current velocity > 0 m/s & < 0.2 m/s (7.87 inches/second); water depth > 0.15 m (> 5.91 inches) & < 1.20 m (<3.94 ft).

Mortality model (QM 22 to 27)
From the resulting potential habitat, the mortality model removes all the nodes where the water depth became < 0.1 m (<3.94 inches) during at least one of the considered QM.

Calibration Data: No data available

Validation Data: In the study area, there is no known recorded observation of Sand Darter during the reproduction period. However, this fish species has been observed in the Châteauguay River, Yamaska River and St. François River. The mouth of these rivers matches the habitat characteristics used for modeling its potential presence. In the St. Lawrence River, the species has been caught in the Chenal-aux-Ours, an area where all habitat characteristics appear to be suitable for spawning under certain flow conditions. The ministère des Ressources naturelles, de la Faune et des Parcs (MRNFP) has also recorded four observations during summer 2002. Considering that this poor swimmer possibly use similar habitat for reproduction than those observed during summer time, we have build a model that predicts its habitat availability based on summer observations. For the model, velocities, water depth and substratum were used. The comparison of observed locations with the predicted habitat is not very good with the 4 samples available.

Documentation and References:
Giguère, S, J. Morin, P. Laporte and Mingelbier, M. (2005) Évaluation des impacts des fluctuations hydrologiques sur les espèces en péril. Tronçon fluvial du Saint-Laurent (Cornwall – Pointe-du-Lac). Rapport final déposé à CMI (2002 - 2005). Environnement Canada, Région du Québec, Service canadien de la faune.

Risk and Uncertainty Assessment:

This PI is based on the following assumptions:

- Spawning habitat supply and egg/larvae survival are significant factors influencing the size and integrity of Sand Darter populations.
- Predicted fish response to hydrologic conditions based upon literature review is valid.

- Quarter month hydrologic data is representative of real hydrologic conditions.
- Predicted fish response to hydrologic conditions based on statistical modeling is valid.
- Transformation from a 2D to 1D hydrologic model is correct.

Confidence rating: The PI allows for a relative comparison among alternate water regulation plans. This PI has been built with a "precaution" principle from a moderate amount of literature information that was available from outside of the region of interest. The potential habitat model has been validated with independent data. Some of them, that are general description, seem to match well the characteristics selected while other precise observations do not match well with the highlighted areas. The substratum map is responsible of this poor validation score. The substrate composition is applicable to large polygons of several km² in size while the sand darter can use very small patch of sand for spawning. This explains that all suitable micro habitats comprise in the large polygons have not been caught by the modeling effort. On the other hand, the four observations are coming from a survey where the predicted good habitats were not sampled. Therefore these areas are possibly good reproduction/living habitat. Even considering the coarse substratum map used, the model can be used to rank plans in a relative fashion. Obviously more work need to be done for managing properly this species.

Although hydrologic variables are strongly associated with habitat and Sand Darter occurrence, there is also a significant amount of variation not explained by hydrology. In order to assess 100 year water level scenarios, the predictive models necessarily ignore, or hold constant other important population variables (e.g. productivity, age and sexes distribution) and environmental variables (e.g. predation, food availability, siltation, exotic species) that can also impact reproductive success, and have an influence on regional Sand Darter populations. For these reasons the PI values should only be considered as relative measures between plans.

Significance of the species: The Sand Darter is designated as Threatened by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC). The species is listed in the Schedule 1 of the *Species at risk Act*; the species and its critical habitat are legally protected under this Act. Critical habitat protection will be applied when it is identified within the Recovery Strategy or Action Plan.

Sensitivity to water levels management: The scientific literature document the close association between Sand Darter occurrence, during spawning period, and specifics hydrological condition. Sand Darter PI is retained as a Key PI because it clearly shows an important vulnerability and sensitivity to alternations in water levels and flows, and is listed as a Species at risk. As such it should be used to evaluate potential environmental responses to alternative water regulation plans.