HydroNet 1.3 Component: Physical Drivers of the Productive Capacity of Fish Habitats

Rationale: Physical factors, such as flow rate and water temperature, are an integral part of the environmental conditions affecting key biological processes, such as egg survival, fish growth, and fish passage and thus the productive capacity of fish habitats. A better understanding of the specific impacts of hydropower operations on the physical drivers of PCFH can help to minimize and mitigate effects on fish and their habitats.

Description*: The four projects to examine the physical drivers of PCFH address key abiotic factors impacting fish behaviour and habitat when river discharge is regulated for hydropower, as compared to natural rivers:*

- ***Flow regime*** of natural versus regulated rivers (*Lead: Michel Lapointe, McGill University*); analysing how dam types (base power, peaking) affect natural flow regimes and river habitat changes as well as fish biodiversity and productivity, serves to understand the ecological effects of various discharge regimes;
- ***Thermal regime*** of rivers (*Lead: André St-Hilaire, INRS-ETE);* examining the effects of dams on water temperature and temperature distribution helps to understand how this important habitat variable affects stream biota;
- ***Physical (geomorphic) structure*** (*Lead: Michel Lapointe, McGill University*); examining the effects of changes to flow and sediment regimes caused by dams on the physical structure of downstream river and floodplain habitats, will help to predict changes in habitat availability and fish community;
- ***Winter regime of rivers*** (*Leads: Richard Cunjak, UNB-CRI* ; *Faye Hicks, University of Alberta*); characterizing and quantifying winter regimes of rivers serves to identify those environmental stressors that directly influence fish habitats and PCFH.

List of Student Projects related to this component:

- *Flow regime of natural versus regulated rivers* – Fraser McLaughlin (M.Sc. McGill)
- *Comparative thermal modeling of a regulated and unregulated river* – Laurie Beaupré (M.Sc. INRS-ETE)
- *Water temperature modelling at the local scale and characterization of the thermal regime of regulated and natural rivers* –Audrey Maheu (Ph.D. INRS-ETE)
- *Studying the geomorphic aspects of changes to fish habitat below hydro dams: changes to bed substrate characteristics, as well as changes to size and morphology of channels* - Fabien Hugue (Ph.D. McGill)
- *Physical habitat and invertebrate communities below a hydropeaking dam: Examining progressive downstream change* - Lesley Winterhalt (M.Sc. UBC)
- *Morphodynamics of a hydropeaking system: Geomorphic and ecologic change along the Kananaskis River* - Holly Buehler (M.Sc. UBC)
- *Geomorphic controls on physical habitat variability in a hydropeaking system* - Aaron Tamminga (Ph.D., UBC)
- *Winter stressors for fish in rivers: The effect of flow regulation* – Jennifer Nafziger (Ph.D. U Alberta)
- *The effects of flow regulation on dynamic winter ice processes*– Stefan Emmer (M.Sc. U Alberta)
- *Effects of winter releases from headwater reservoirs on fish habitat in small streams* – Dr. Tommi Linnansaari (Post-doc UNB-CRI)

Outcomes /Deliverables:

- Baseline data: cross region patterns of effects of operation regime on flows; spatio-temporal dynamics of water temperature distribution; physical habitat set by habitat type and reach; winter regime of rivers: ice cover development and decay.
- High resolution satellite Image analysis of reach-scale river habitat types; comparisons with historical patterns based on archival imagery
- Impact assessments: geomorphic changes to fish habitat by physiographic setting and dam type;
- Model development: two-dimensional distribution of water temperature below dams
- Flow management strategy to preserve fish habitat productivity

Benefits from this research

This research will improve approaches to estimate and model physical drivers of PCFH; identify the relative importance of physical drivers on PCFH and on large-scale (ecosystem level) and small scale (habitat patches) environmental conditions; and improve the understanding of physical driver on key biological processes.