Mactaquac Aquatic Ecosystem Study (MAES) *Future of the* Mactaquac Hydro-Electric Generation Station



Rivers Institute

CANADA

Project Summary



- MAES is a **multi-year, whole-river ecosystem study**
 - *Phase 1* Modelling of the structure and function of a large river ecosystem
 → the first four years of study (2014-8)
 - *Phase 2* "Construction" (the experiment phase)- Manipulating flow, sediment transport, and the thermal regime (10 years)
 - *Phase 3* Monitoring the river's recovery to a new state (10 years)

Phase 1 - Three key components:

(1) whole ecosystem; (2) fish passage; and (3) environmental flows

• Key outputs:

- Deliverables to NB Power planning of the project
- Training of 49 HQP (Undergraduate, M.Sc., M.Eng., Ph.D., and PDF)
- Dissemination of results to public and scientific community



MAES Management Team / Science Advisory Board

- Allen Curry
 Principal Investigator
- Gordon Yamazaki Project Manager
- Tommi Linnansaari Research Associate – Co-Lead
- Wendy Monk Research Associate – Co-Lead

Science Advisory Board

- Stuart Bunn, ARI/Griffiths
- Jeff Duda, USGS
- Loren Greig, ESSA













Canada

Canada

DI. Anure St-Imane (INAS and GAI)



MAES Project Team

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MAES Collaborators

- NB Power
- Fisheries and Oceans Canada
- New Brunswick Department of Natural Resources
- New Brunswick Department of Environment
- Acadian Sturgeon and Caviar, Inc.
- Universität Stuttgart (Schneider & Jorde Ecohydraulic Engineering)
- Canadian Hydrographic Service
- Biodiversity Institute of Ontario (Dr. Mehrdad Hajibabaei)
- Mount Allison University (Dr. Felix Bärlocher, Dr. Josh Kurek)





The Saint John River Basin









MAES Project outline

• 1. Whole Ecosystem

- 1A.1 Defining the river environment (**3 projects**)
- 1A.2 River biomonitoring baselines and metric development (**8 projects**)
- 1B.1 Defining the reservoir environment (6 projects)
- 1B.2 Downstream water release (2 projects)

• 2. Fish Passage

• 2.1 - 2.6 Atlantic salmon, striped bass, sturgeons, American eel, muskellunge (6 projects)

• 3. Environmental Flows

 3.1 - 3.4 Climate and future hydrological regimes, riparian zone insects, floodplain connectivity (4 projects)



1. Whole Ecosystem Physical Baselines - River Bathymetry

establish downstream bathymetry (MGS to Fredericton)
acoustic surveys, "Biobase", LiDAR low flow BOTTELSE





Reservoir Mapping 1.Knudsen KEL 320 Echosounder (28 kHz continuous wave, 3.5 kHz chirp transducers; MVP) 2.IKB Seistec 3 System



Reservoir sediment composition, chemistry, and potential for downstream displacement

 Baseline data on sediment composition and contaminants model downstream effects















Modelling predicted thermal regimes downstream during reservoir drawdown (and future climate scenarios)

- CEQUEAU (St. Hilarie et al.)
- Coupled hydrological model
- Semi-distributed
- Lower river = 689 grid squares (5 x 5 km²) and1271 partial grid squares





River Biotic Structure Developing metrics, habitat models







2.0 Fish Passage



- 55 species
- <10 cm to 3 m body lengths</p>
- Freshwater benthivores to diadromous
- Expert Fish Passage Workshop
- 6 species of special concern:
 - → American Eel
 Striped Bass
 Atlantic & Shortnose Sturgeon
 Atlantic Salmon
 Muskellunge



Reservoir transit and downstream approaches to a large dam by Atlantic salmon

- Navigation of headpond, and MGS approach is not well understood
 - Smolts (downstream) Vemco and HTI (dam face)
 - Kelts = Post-Spawn Adults (downstream and upstream)









Ecology and Habitats

Striped Bass, American Eel, Atlantic & Shortnose sturgeons, Muskellunge

Acoustic tracking (Vemco)













3.0 Environmental Flows

Climate and future hydrological regimes, appropriate flow regimes

- Quantify trends for hydrological and thermal regimes (models and climate downscaling)
- ELHOA approach underway (2 workshops completed)



Poff et al. (2010), Pahl-Wostl et al. (2013)





Environmental and future flows with habitat implications for riparian insect species

Two dragonflies

- Gomphus ventricosus (Skillet Clubtail – endangered)
- ✓ Ophiogomphus howei (Pygmy Snaketail - special concern)

Beetle

Cicindela marginipennis

 (Cobblestone Tiger Beetle –
 endangered)







Photos: Zoe O'Malley



