CHIF Funded Projects 2010

DFO's Center of Expertise on Hydropower Impacts on Fish and Fish Habitat (CHIF)

Projects in support of HydroNet's Objectives

Dr. Karen Smokorowski

DFO, Sault Ste. Marie

- **CHIF is a national Centre of Expertise within DFO. It was created to coordinate DFO's research activities on hydroelectricity and its impact on fish and fish habitat and to promote collaboration between scientists, managers, and the industry in Canada**
- **Director: Dr. K. Smokorowski email: karen.smokorowski@dfo-mpo.gc.ca**
- **CHIF website: www.dfo-mpo.gc.ca/science/coe-cde/chip-chif/index-eng.asp**

Thermal aspects of fish entrainment risk in Kinbasket reservoir with relevance to other large hydropower facilities in Canada

Dave Patterson, DFO

Directly linked to Cooke CRD project by providing scientific support and equipment, this project will determine how reservoir thermal properties vary seasonally and with respect to hydropower operations to influence entrainment risk for a variety of key fish species.

NSERC HydroNet CRSNG

LONGITUDINAL AND LATERAL RESPONSES IN RIVERINE COMMUNITIES TO ALTERED SEASONAL FLOW REGIMES: A COMPARTIVE ANALYSES OF RIVER SYSTEMS IN ONTARIO AND NEWFOUNDLAND

Project Lead: Keith Clarke, DFO Science NL.

Fisheries and Oceans collaborators:
Brian Dempson, DFO Science NL.
Karen Smokorowski, DFO Science ON.
Bob Randall, DFO Science ON

University and Industry collaborators:
Rick Cunjak, Canadian Rivers Institute, UNB.
Mike Power, Department of Biology, University of Waterloo.
Rob Steele (for Brookfield Power), Natural Resource Solutions Inc.
Brent Sellars, Nalcor Energy

Main Question

Does instream connectivity, both lateral and longitudinal, change with a seasonally altered flow regime in ways that significantly affect resident fish populations?”

Hypotheses

[1] relative to natural flow regimes, regulated flows will result in food web simplification;

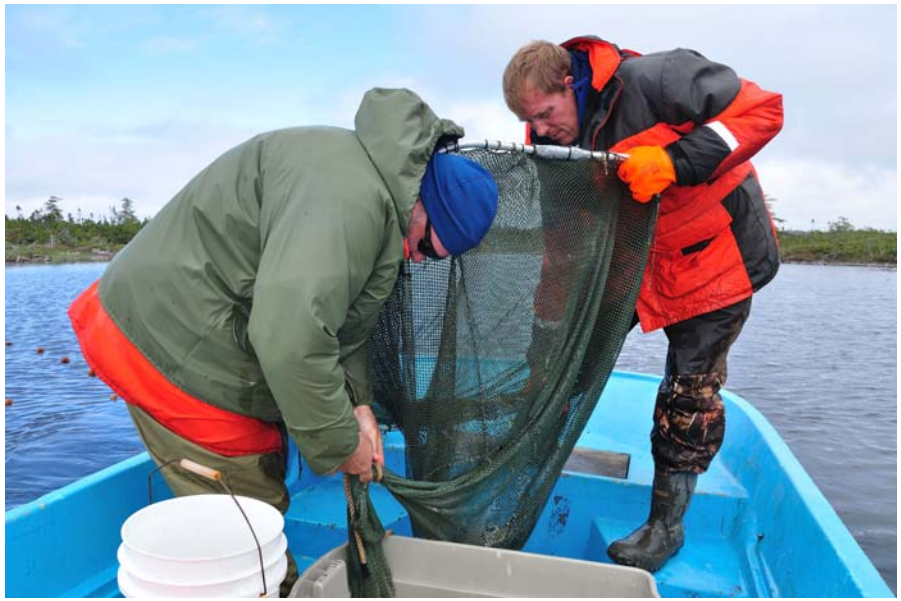
[2] dams will alter the pattern of mean channel velocities, with consequent effects for baseline algal carbon isotope signatures, and perturb the pattern of progressive downstream enrichment observed in natural rivers;

[3] altered flow regimes in regulated rivers will alter accessibility to preferred summer feeding habitats, thereby, reducing size and growth rate, nutritional status and winter survival.

[4] ice accumulations and/or related flow constrictions will reduce suitability of habitats such that fish will experience increased energy expenditure in high flow habitats, and reduced winter survival.

Work Plan

- Food web connectivity will be investigated via stable isotope analysis in both NL and ON. 1 PhD Student housed at U of W and co-sponsor by a NSERC CRD (Brookfield Renewable Power Ltd.).
- Seasonal aspects related to Growth and Movement will be studied in NL. 1 PhD housed at UNB (start in year 2; 2011).



Study Sites:

Studies will be conducted in paired design with one hydro site and one control. Efforts will be made to use HydroNet sites:

Magpie (H) – Batchawana in Ontario, and,

West Salmon (H) and Twillick Brook (Conne system) in NL.

Data collected:

- SI samples (C&N): algae (periphyton), invertebrates, fish, terrestrial veg, terrestrial inverts, DIC/DOC, nutrients.
- Growth/movement: PIT tag fish for movement, recaptures for growth, lipid reserve.

Fish behavior in relation to trashracks

Eva Enders
Riverine Ecology Lab
Environmental Science Division, Fisheries & Oceans Canada

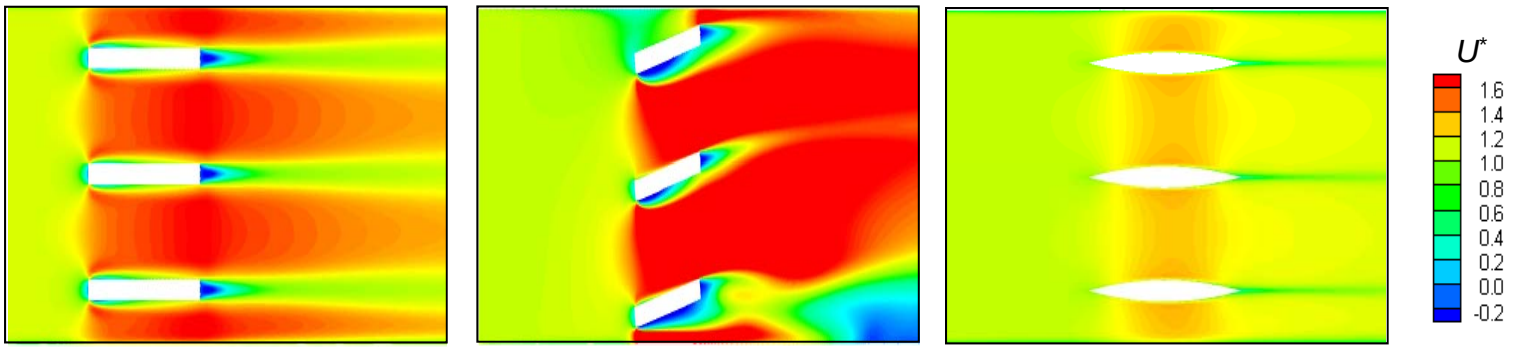
Shawn P. Clark
Department of Civil Engineering, University of Manitoba

Manitoba Hydro

Center of expertise on hydropower impacts on fish and fish habitat - CHIF

Project objectives

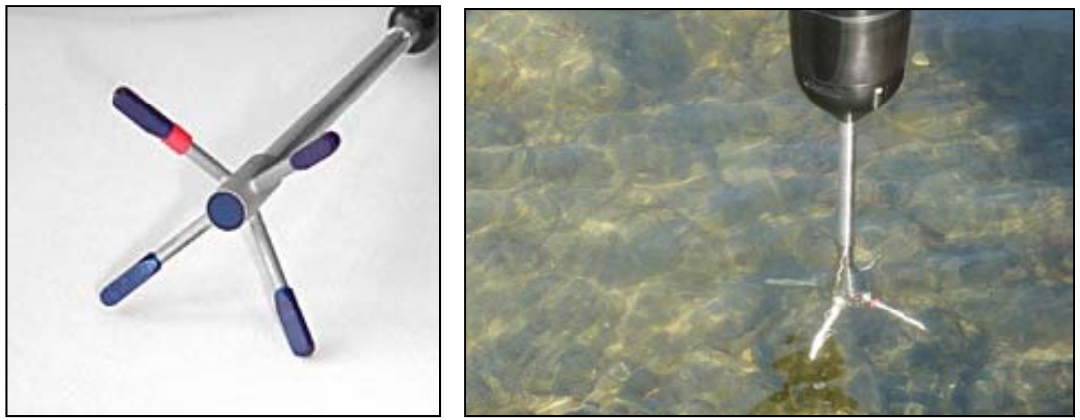
- evaluate the performance of the trashrack designs from both a hydraulic and biological point of view;
- analyze the behavioral response of fish approaching trashracks in flume experiments (just starting spring 2011);
- monitor entrainment and impingement of fish on the trashracks at a hydro dam (anticipated for summer 2011).



Figures obtained from “A numerical investigation to select a turbulence-closure model for simulating turbulent flows near trashracks by DFO, U of M and MH

CHIF 2010/11 funding for a velocimeter

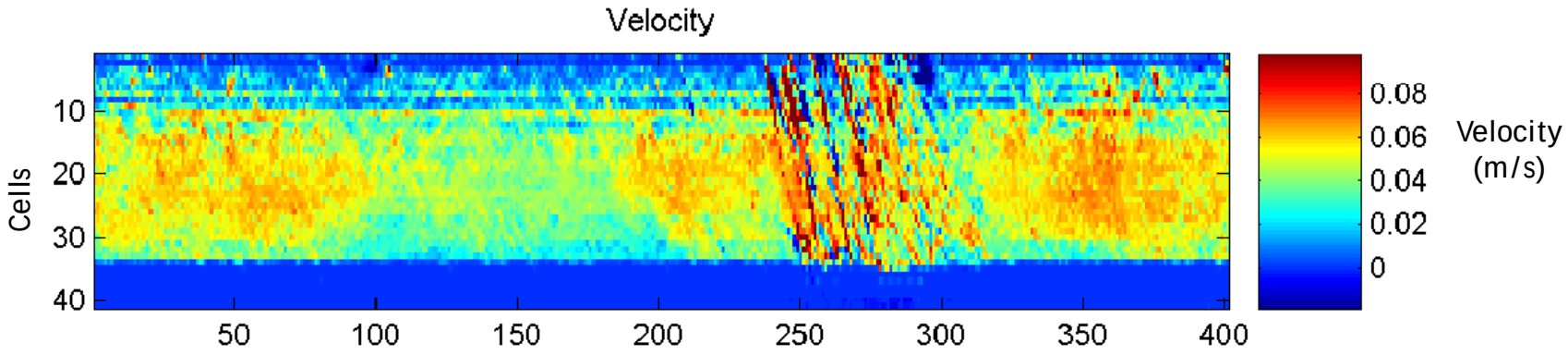
Vectrino II (beta-version)



Specifications

- high temporal frequency (100 Hz) in order to analyze turbulent flow structures
- high spatial resolution (30 cells each of 1-2 mm height and 10 mm width in a defined range centered in 5 cm distance) allowing turbulent boundary layer measurements

Anticipated results



Contour plot of flow

Sample rate is up too 100 Hz. The x axis is sample number.

Individual cell size is 1 mm

Numerical Investigation of Turbulent Flow Through Trashracks in Closed Conduits

S. Paul and Haitham Ghamry

Fisheries and Oceans, Fresh Water Institute

Winnipeg, Manitoba

In collaboration with University of Manitoba and Manitoba Hydro

Evaluating uncertainty in the BC instream flow methodology

Dr. Mike Bradford, DFO

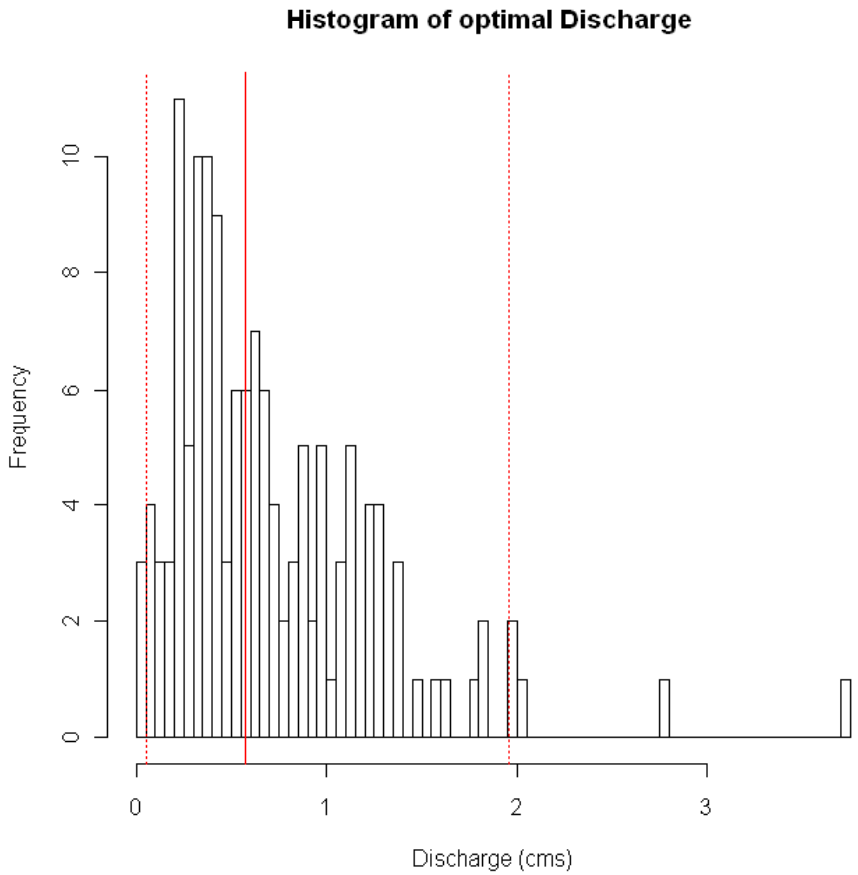
- BC has dozens of small, independent hydro projects currently being reviewed
- A “BC IFM” has been developed that is an empirical version of PhabSim
- Agencies and companies are unsure of the sources of uncertainty in the assessment protocol

Using simulation to evaluate uncertainty

- Two datasets available:
  - BC Hydro
  - Our own collected in 2010
- Uncertainty considered:
  - Measurement error
  - Transect # and location
  - HSI Curve choice
  - Model choice

Expected results

- How much error is in assessments of habitat change with flow change?
- Can the BCIFM be optimized?
- Are there cost-effective alternatives?



Frequency histogram of 200 bootstrap samples of the optimal flow calculations for rainbow trout fry in the North Alouette River, BC. The optimal flows are calculated using the BC Instream Flow Methodology and taking into account uncertainty via random transect selection. The solid red vertical line represents the median, while the dashed vertical red lines represent the lower and upper 95% credible intervals

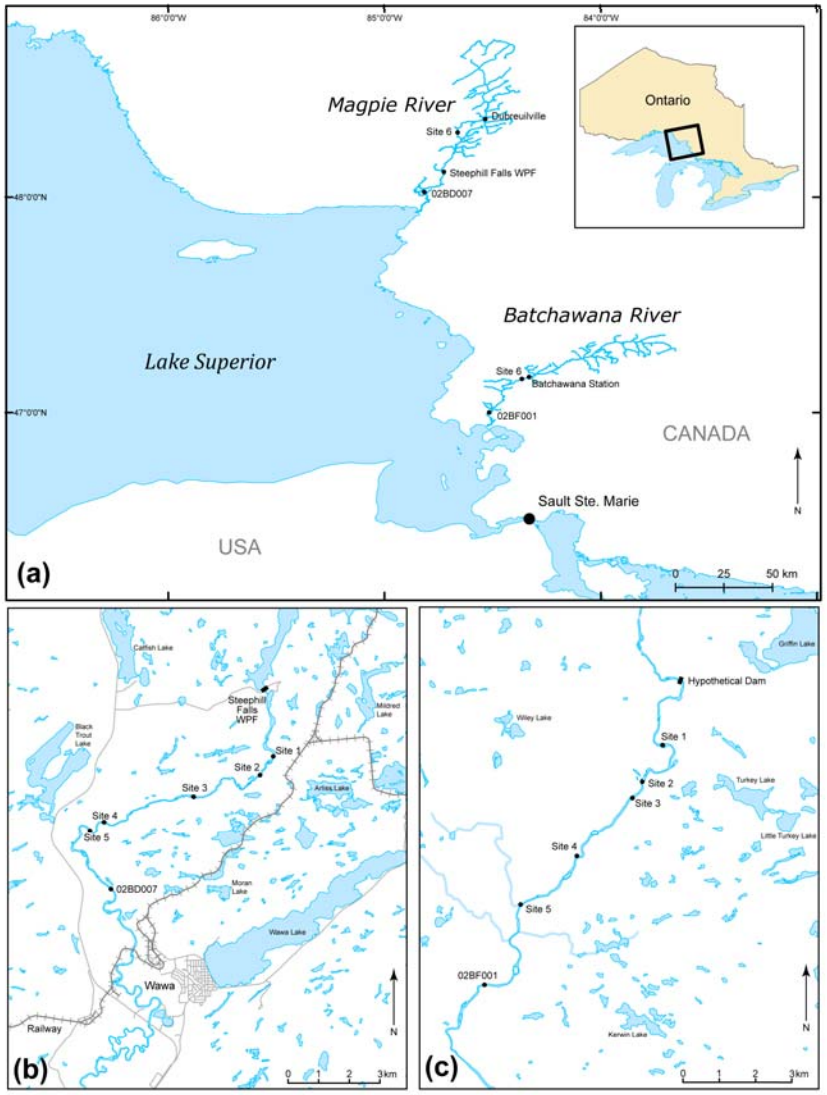
Experimental determination of ramping rate effects on downstream biota: Magpie River, Ontario

Dr. Karen Smokorowski, DFO

- Use a Before-After-Control-Impact design to assess the impacts of changing from restricted ramping rates to unlimited ramping rates at a peaking hydroelectric facility (Before 2002-2004; After 2005-current).
- Impacts being assessed on hydrology, geomorphology, fish, invertebrates, food webs and economics.
- Magpie River (ON – impact), Batchawana River (ON – control)

Satellite Project #1

- Ongoing study since 2002. New NSERC CRD with Waterloo (Mike Power) and Brookfield Renewable Power starting in 2010. (OMNR also supports the project).
- Food web PhD student co-funded by CHIF and also working in NL to start in 2011
- Fish growth PhD to start in 2011



Experimental Site:

Magpie River below Steephill Falls.

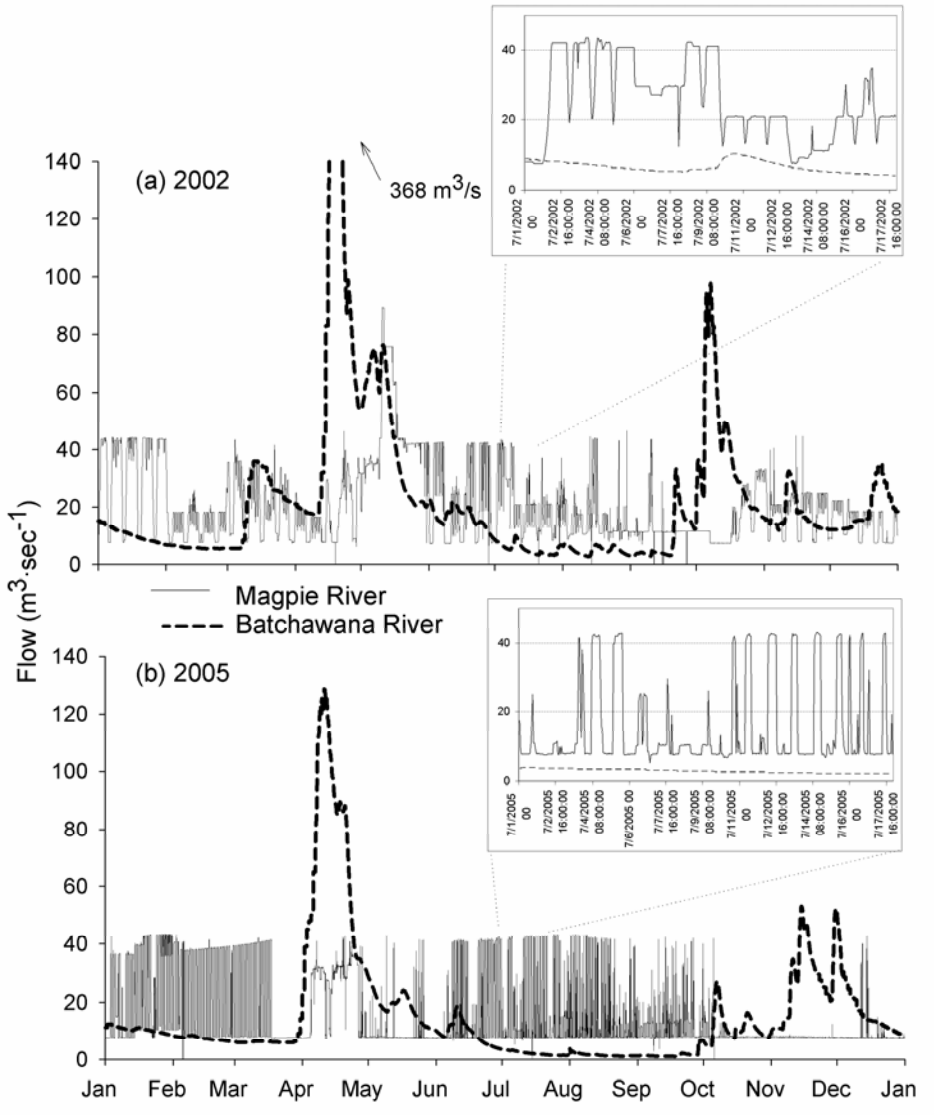
Restricted ramping rate (1989) 2002-2004

Unrestricted ramping rate 2005-2013

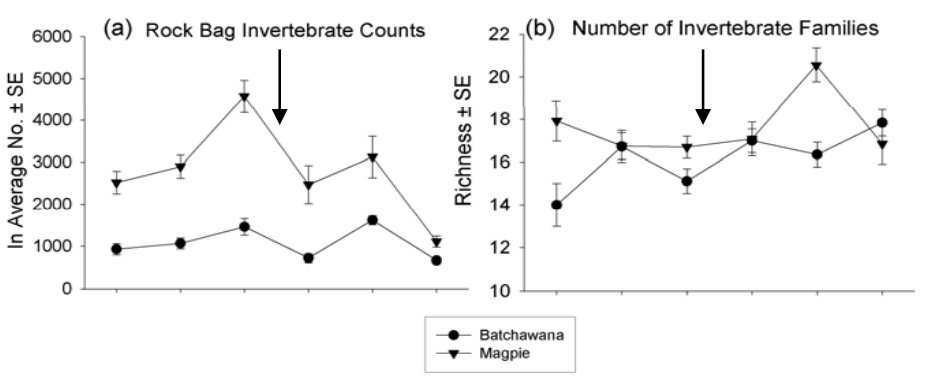
Reference Unregulated:

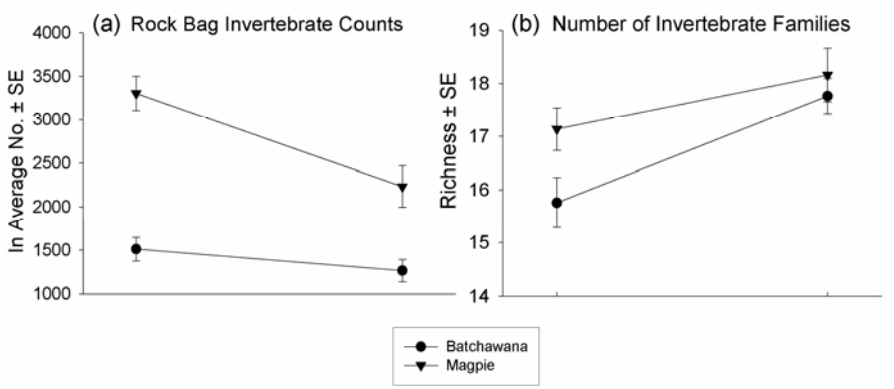
Batchawana River

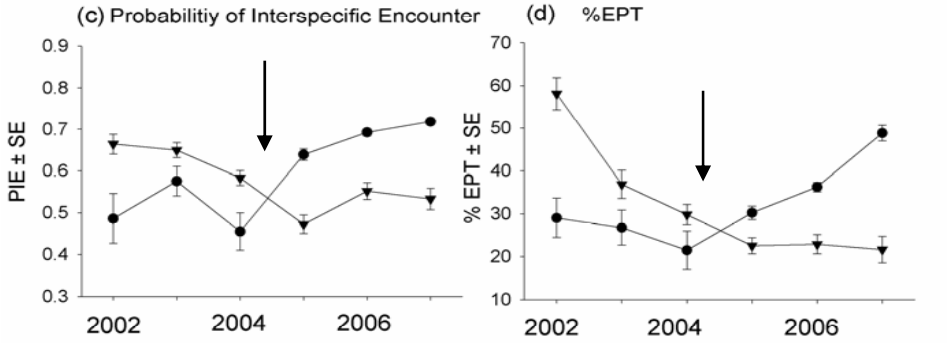
Hydrology

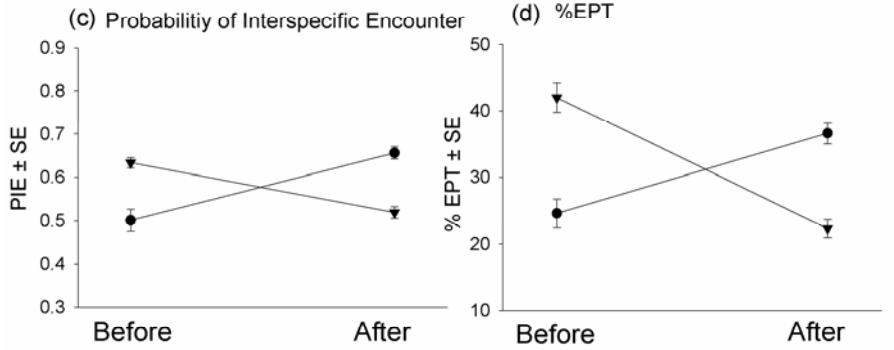

(a) 2002
368 m3/s
(b) 2005
Magpie River
Batchawana River
Flow (m3·sec-1)
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Jan

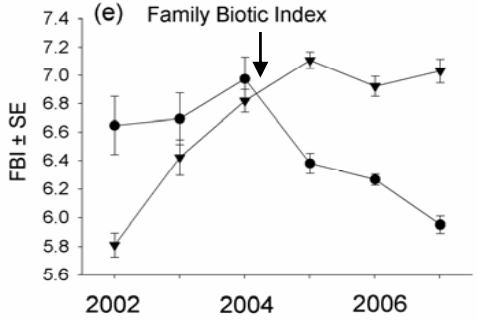
Invertebrate Community

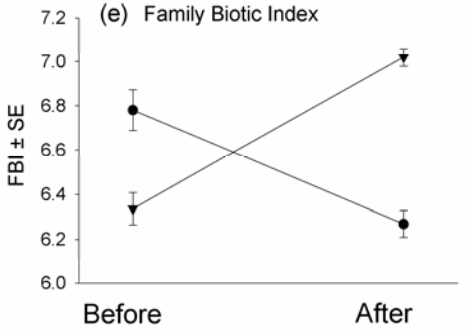






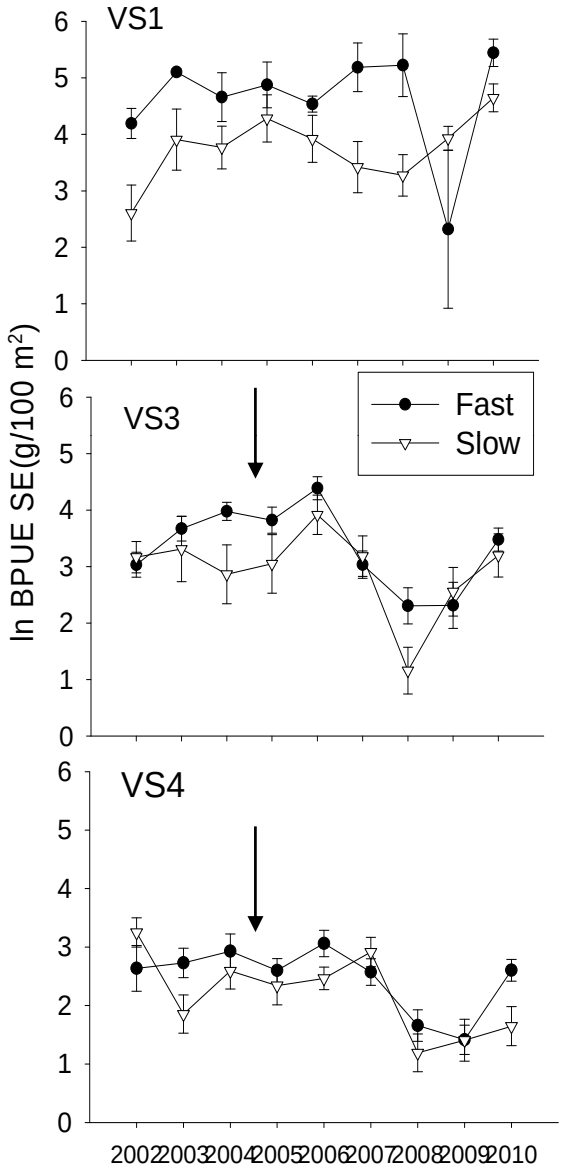




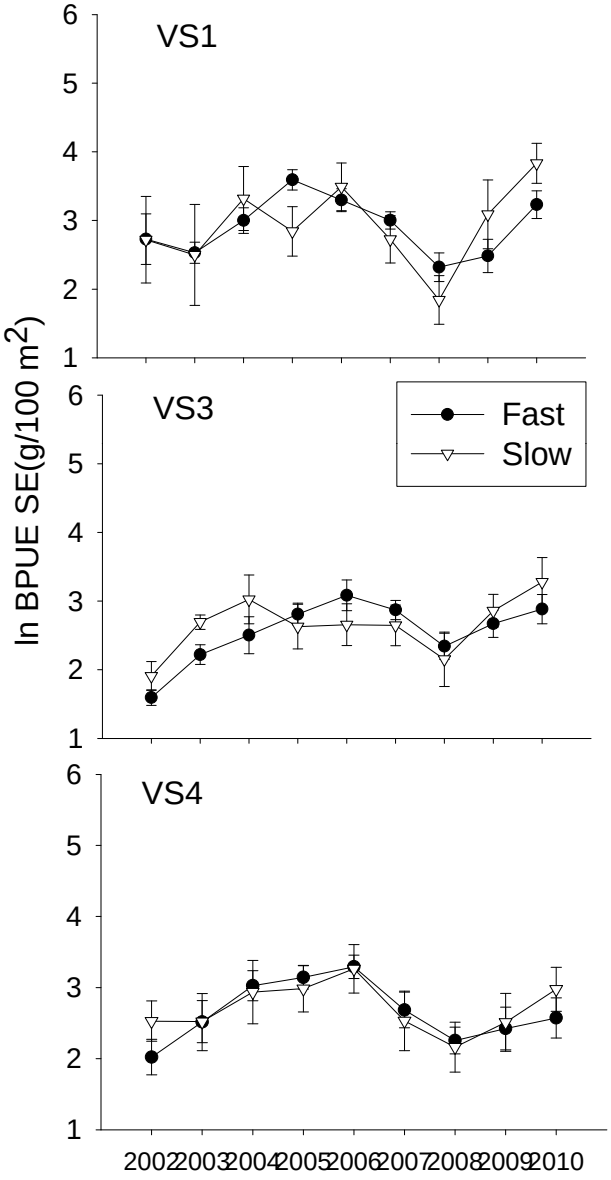


Fish Community

Magpie



Batchawana



Analyzed Rivers Separately – Year x VS x Habitat

Magpie:

Year x VS ($p < 0.007$)

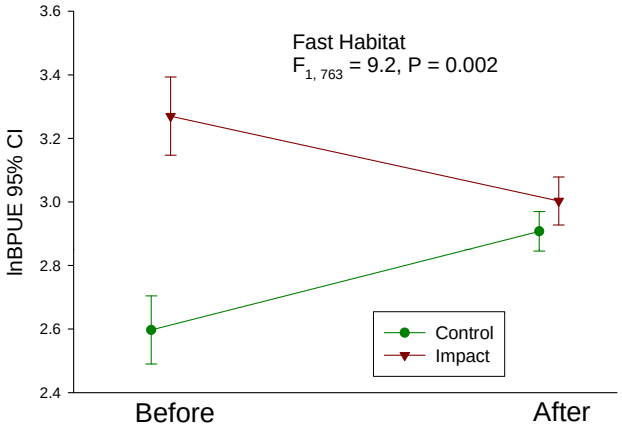
Habitat ($p < 0.001$)

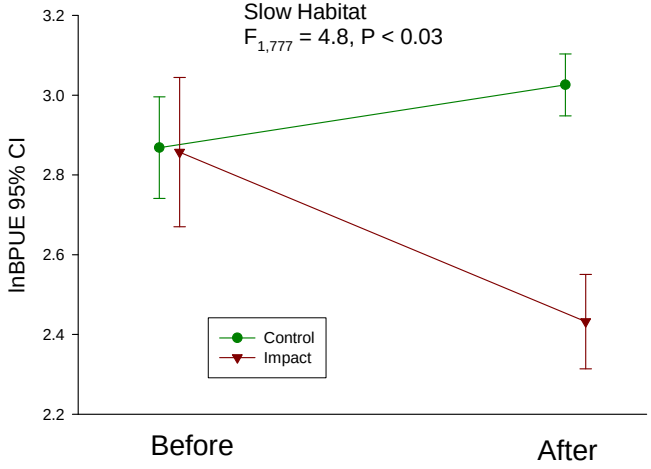
Batch: all n.s. except

Year ($p < 0.001$)

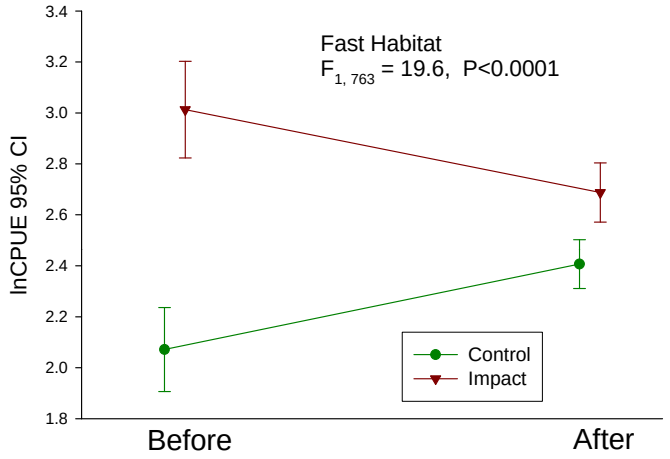
Habitat ($p = 0.02$)

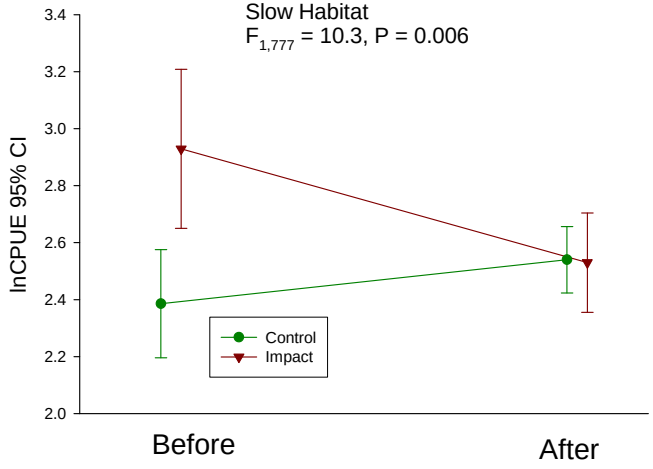
Fish Biomass BACI





Fish Count BACI





Management Implications

Results will be applied:

- Towards science based operations negotiated during the Water Management Planning Process on the Magpie River

Research will provide:

- **a greater understanding of the environmental effects of ramping on river ecology**
- **methodologies can be readily applied in monitoring and research on other regulated systems**
- **science-based guidelines to maximize energy production and reduce costs while protecting the environment**