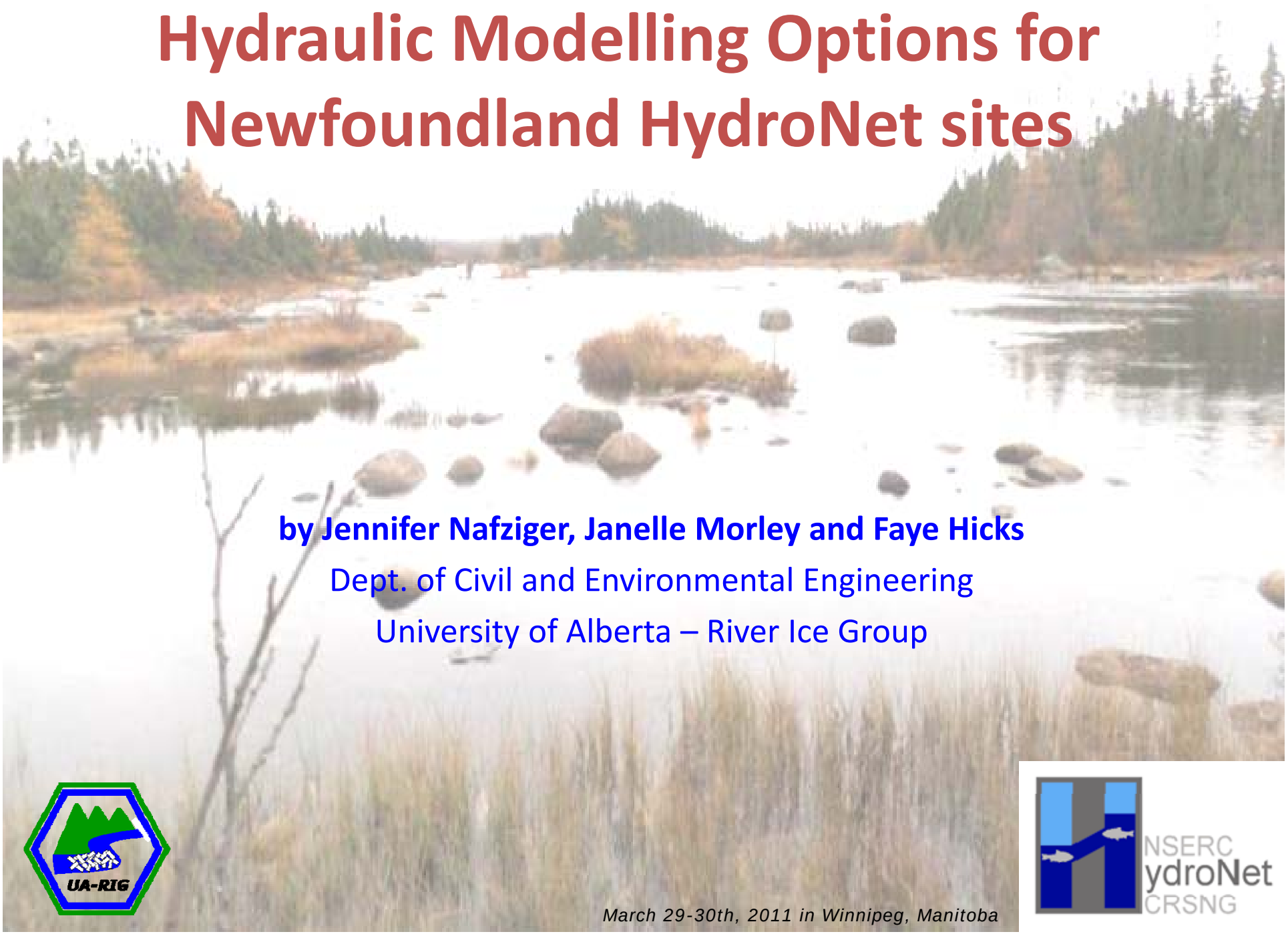
Hydraulic Modelling Options for Newfoundland HydroNet sites



by Jennifer Nafziger, Janelle Morley and Faye Hicks

Dept. of Civil and Environmental Engineering

University of Alberta – River Ice Group

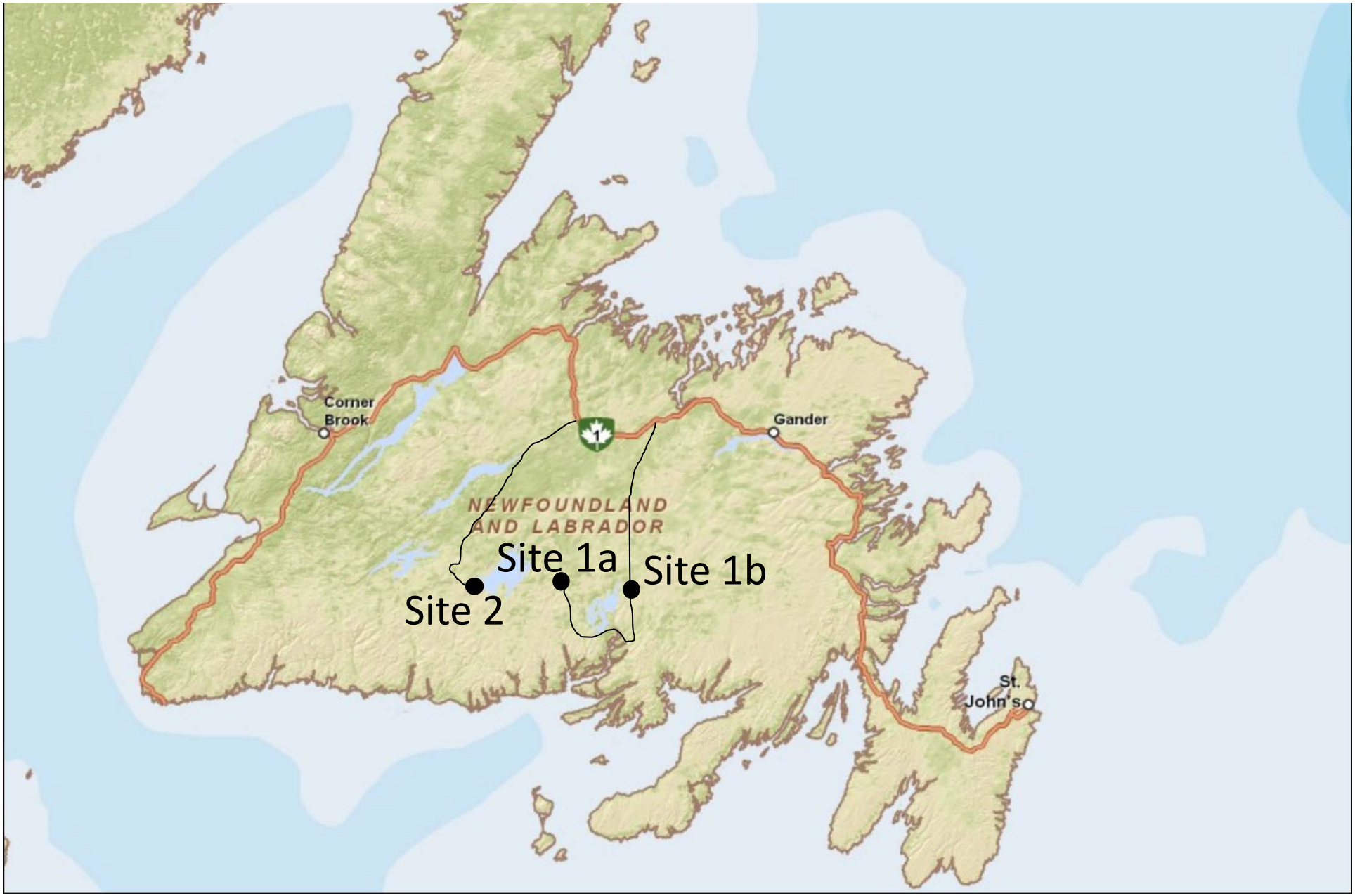
March 29-30th, 2011 in Winnipeg, Manitoba

Project SNG 3.4 - Winter Stressors for Fish in Rivers

Objectives

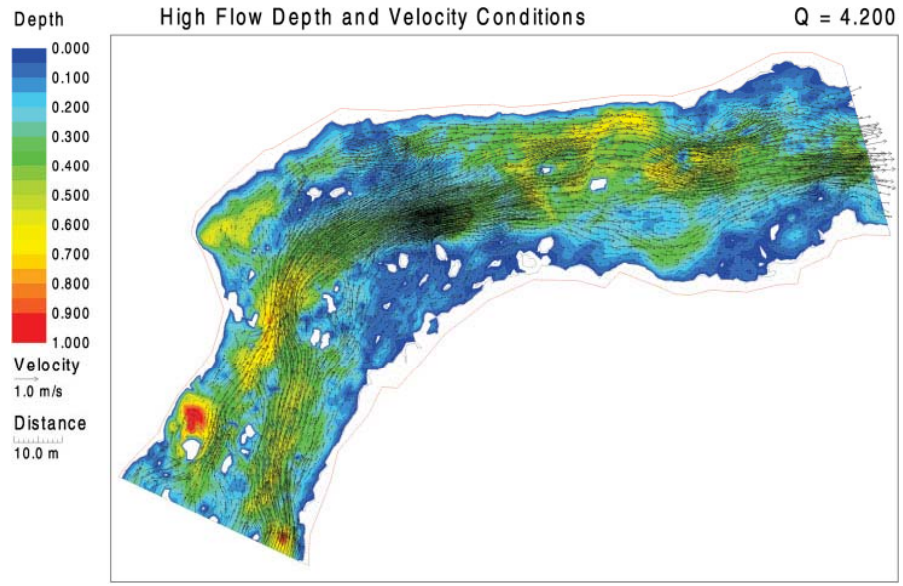
- To broadly characterize and quantify the winter regime of rivers:
  - to identify those environmental stressors that directly influence fish habitats and productive capacity, and
  - To distinguish how those stressors may vary in regulated versus unregulated systems

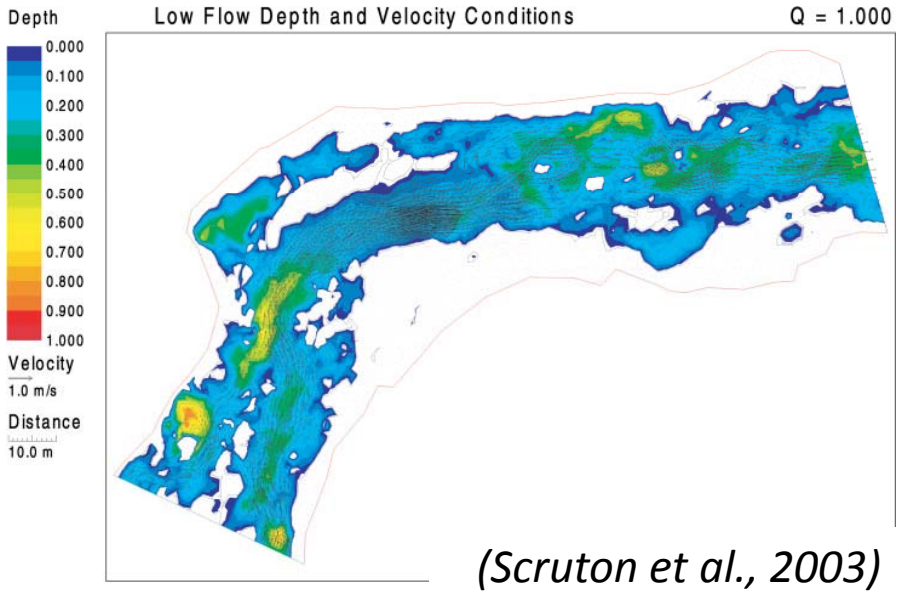
Location - Newfoundland



Modelling at Our Sites

- West Salmon River Reach:
  - Experimental hydropeaking possible
  - Has been modelled in River2D by Scruton et al.
  - Studied fish behaviour response to hydropeaking





(Scruton et al., 2003)

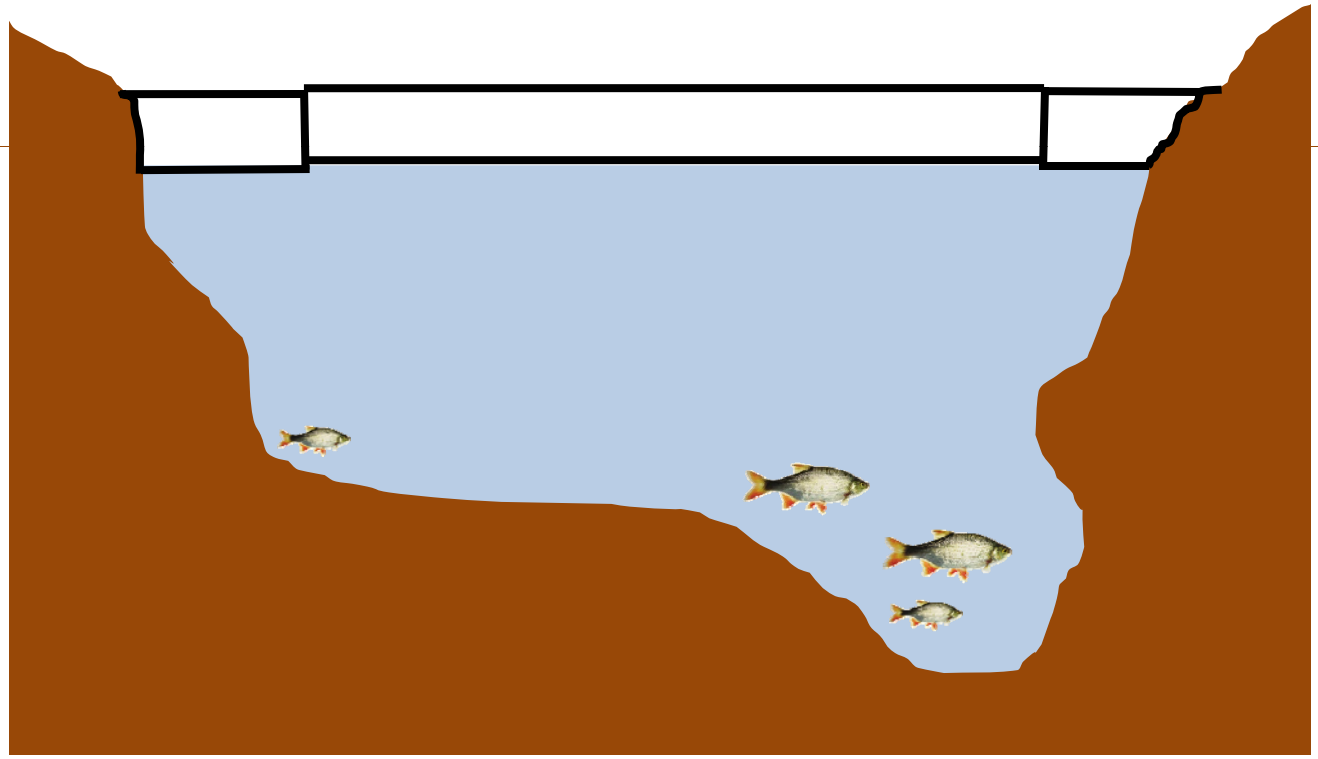
Hydraulic Modelling: Winter Processes

- Simulates ice-affected conditions
  - 2D ice models are now available
- Options for ice process modelling:
  - Depends on ice processes observed

(Photo by F.Hicks)

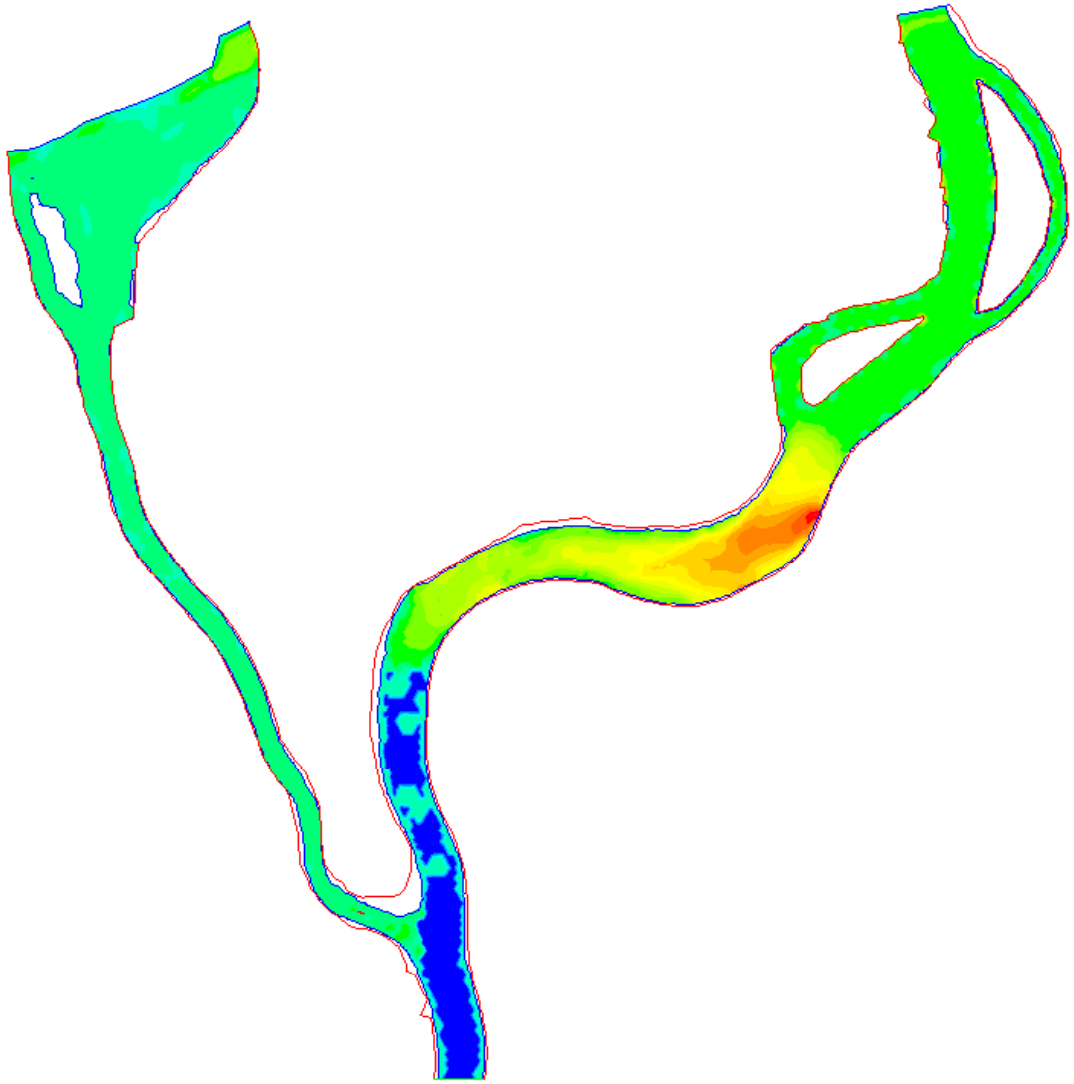
(Photo by R. Brown)

Floating Ice Cover



2-D Ice Process Modelling

Hay River freeze-up example

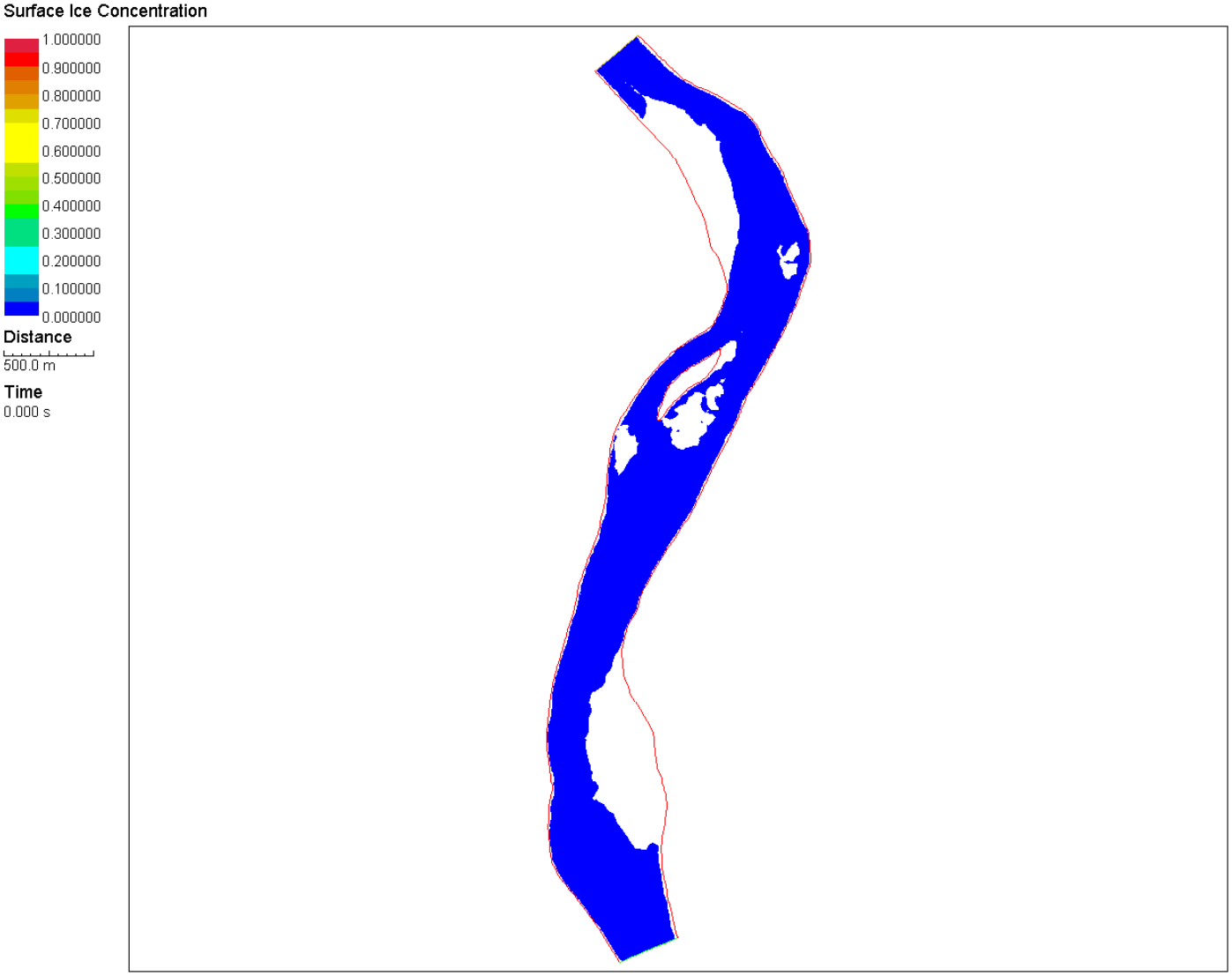


CRISSP 2D

(Brayall and Hicks, 2009)

2-D Ice Process Modelling

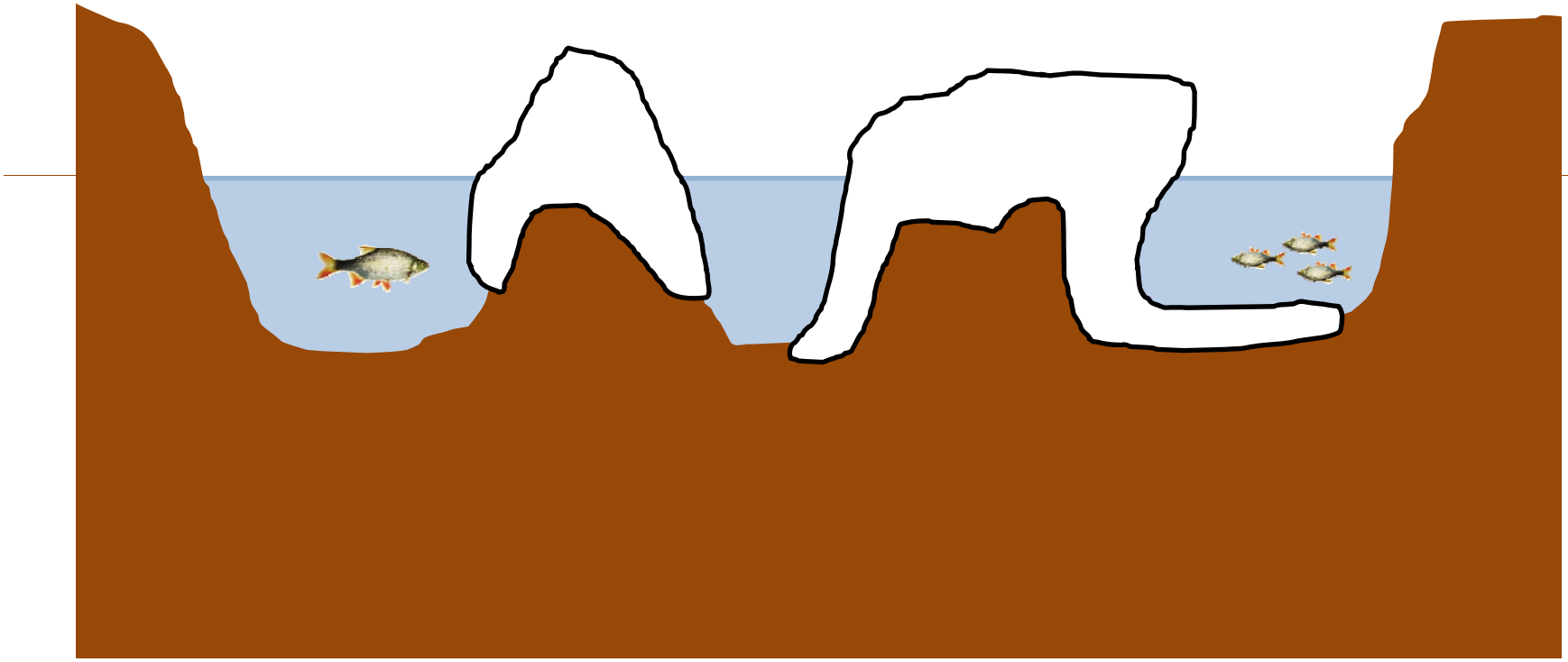
Athabasca River freeze-up example



RIVER 2D

(Blackburn, Steffler, Hicks, and Hall, in prep)

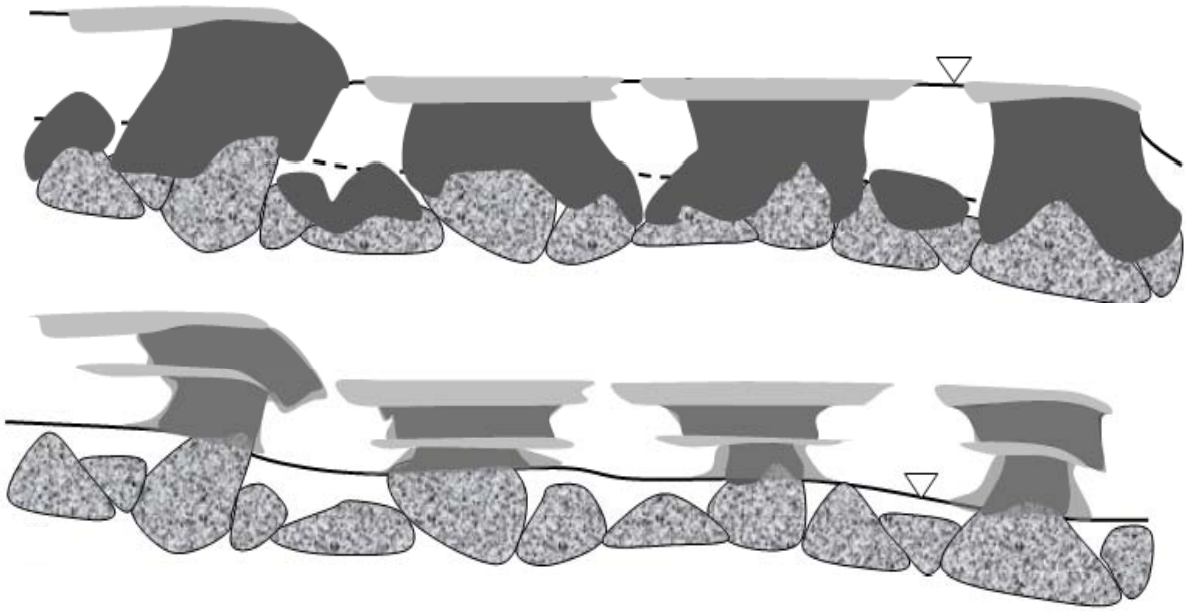
Non-Typical Ice Covers

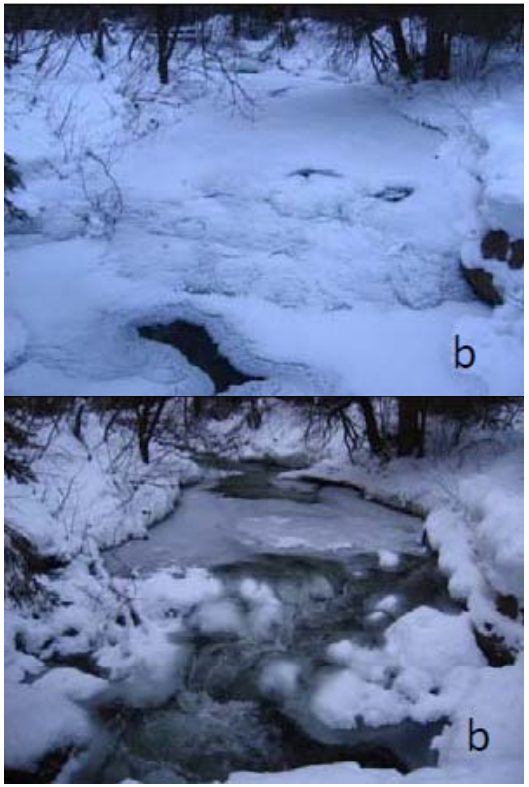


Non-Typical Ice Covers

(Ram River, Alberta, photo by R. Brown)

Non-Typical Ice Covers





(Turcotte and Morse, 2011 In Press, JCRST)

Modelling Options

- No conventional modelling options that can simulate the growth of anchor ice
- Change the river bed topography based on field observations

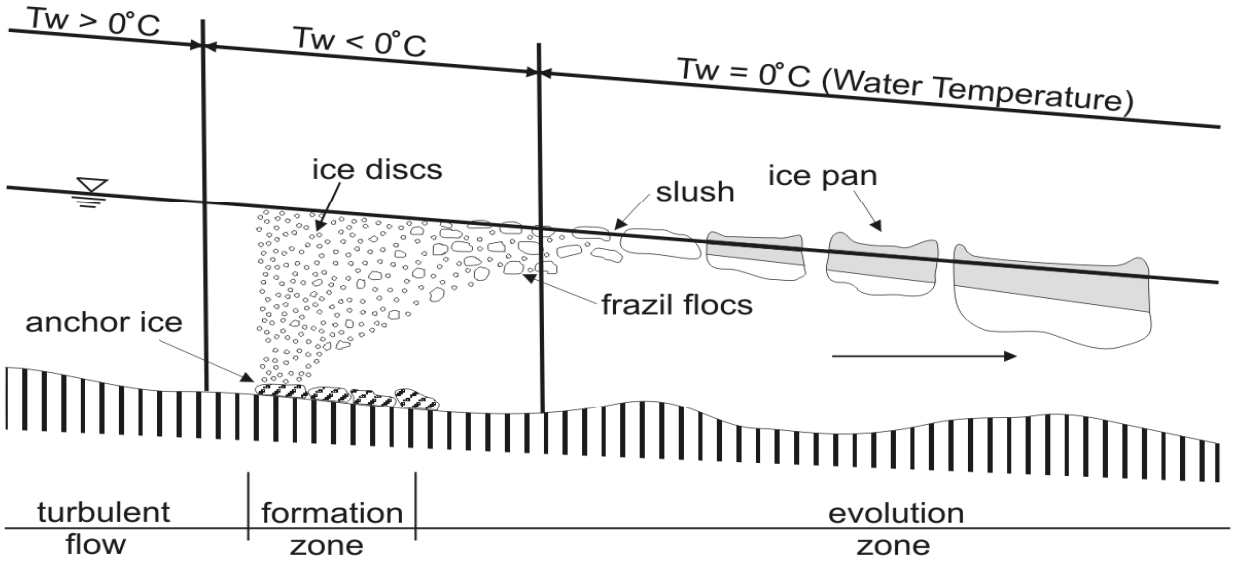
(Turcotte and Morse, 2011 In Press, JCRST)

Regulation

- Thermal effects
- Flow effects

Regulation: Thermal Effects

- Heat storage in reservoir
- No ice cover formed downstream
- Increased frazil ice production
- Thermal effects can be modelled



Regulation: Flow Effects

- Change in flow conditions
- Can change ice conditions
  - Consolidation of an intact ice cover
  - Effects on anchor ice

Hummocky Ice Cover, Bow River, Calgary

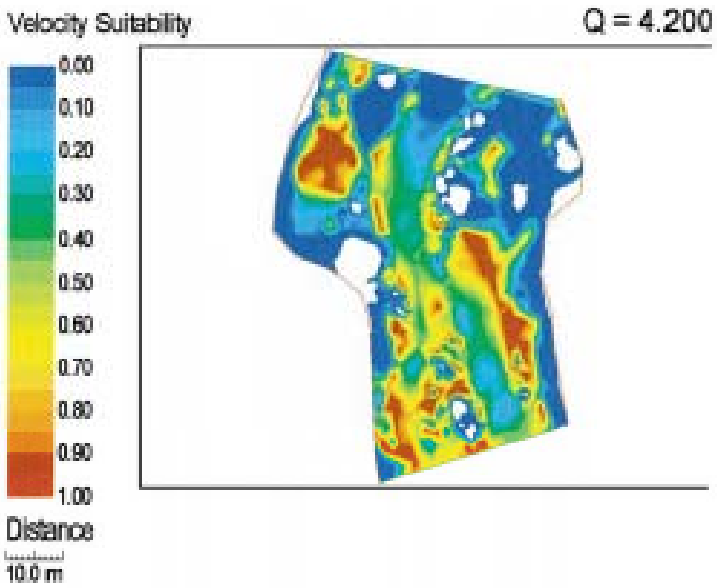
(Photo by J. Blackburn)

Rafting Anchor Ice

(Video by E. Kempema, U of Wyoming)

Conclusion

- Interplay between ice processes, fish habitat, and stream regulation
- Model simulations key to understanding the influence of regulation on streams



(Scruton et al., 2002)

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