Flow needs for large river deltas

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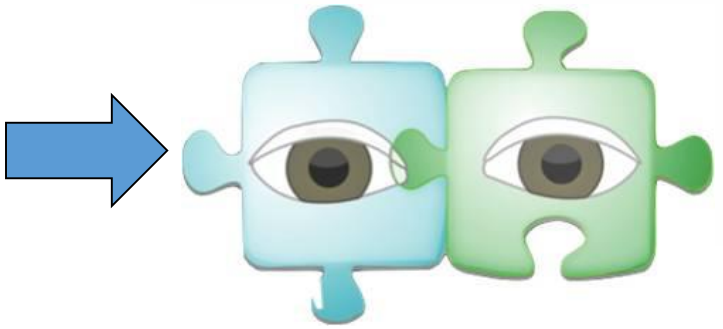
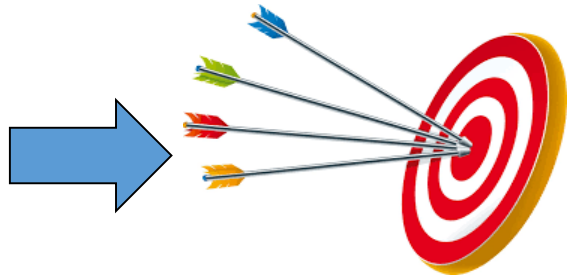
Big Picture – What's happening in the Deltas

- Change in seasonality of flows
- Less water
- Less lateral connectivity between river and wetlands
- Loss of traditional livelihood, language and identity

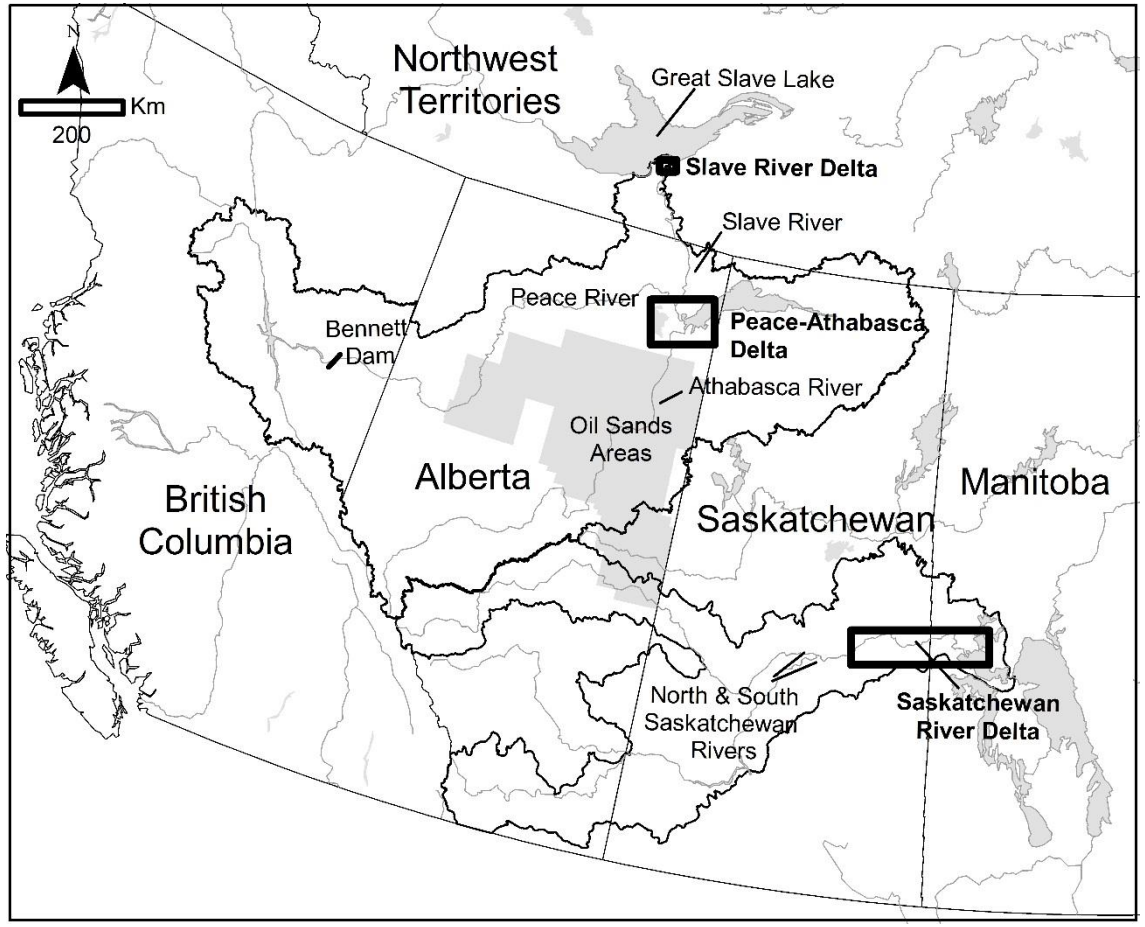

Saskatchewan River Delta
Image credit: Norm Smith

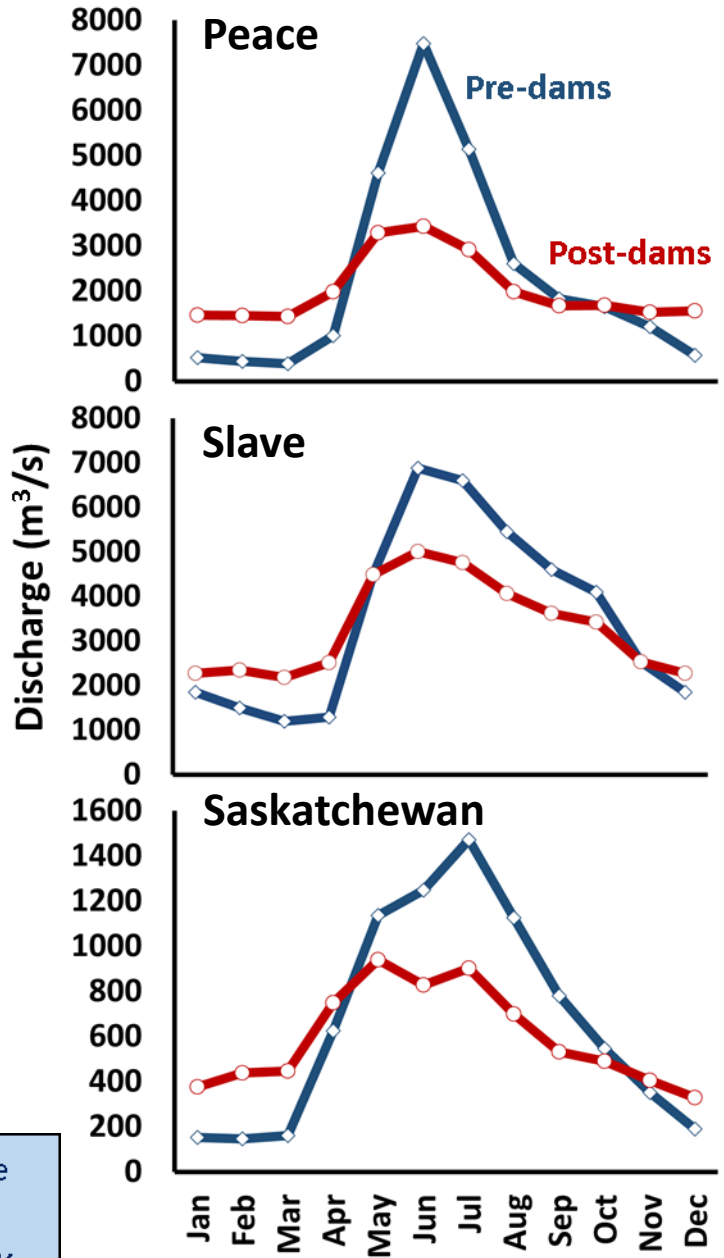
Bridging knowledge systems





Protocols!!





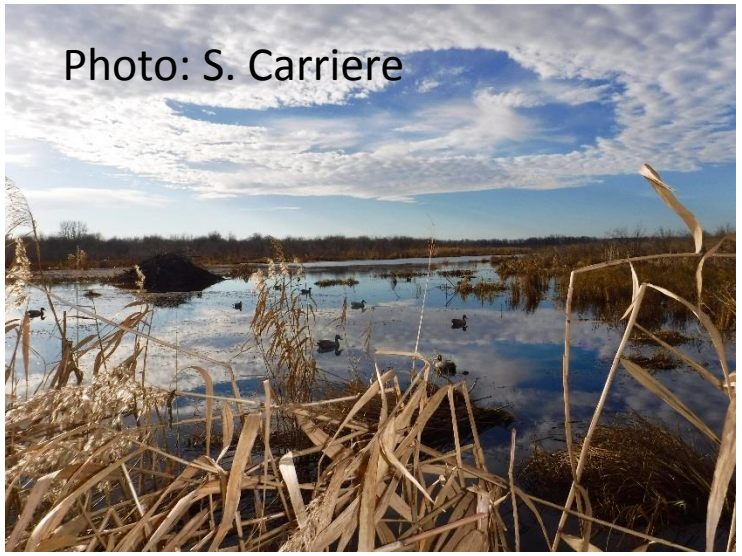
"The Peace Athabasca Delta is Mikisew's life source"
Melanie Dene, Fort Chipewyan, AB

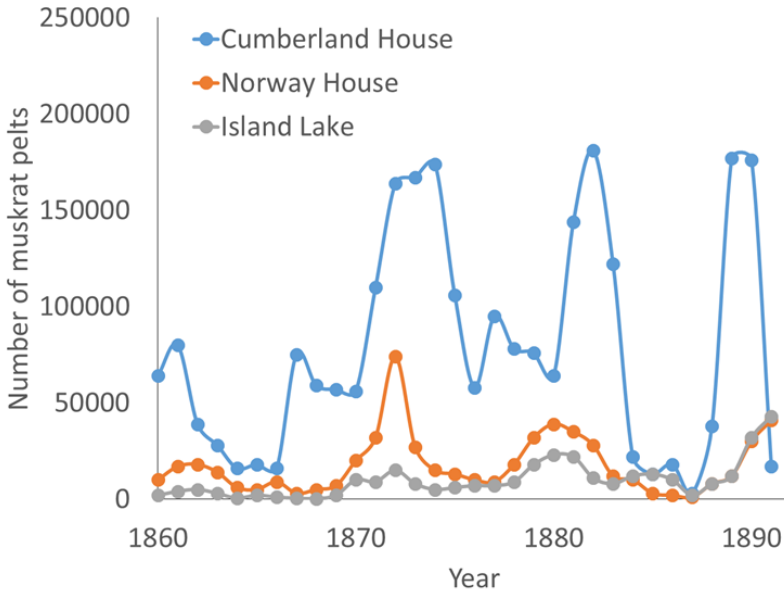
"The hunters and trappers now are probably 10% of the number that was there before"
Brad Laviolette, Fort Smith, NWT

"If the deltas are healthy, the people will be healthy"
Gary Carriere, Cumberland House, SK

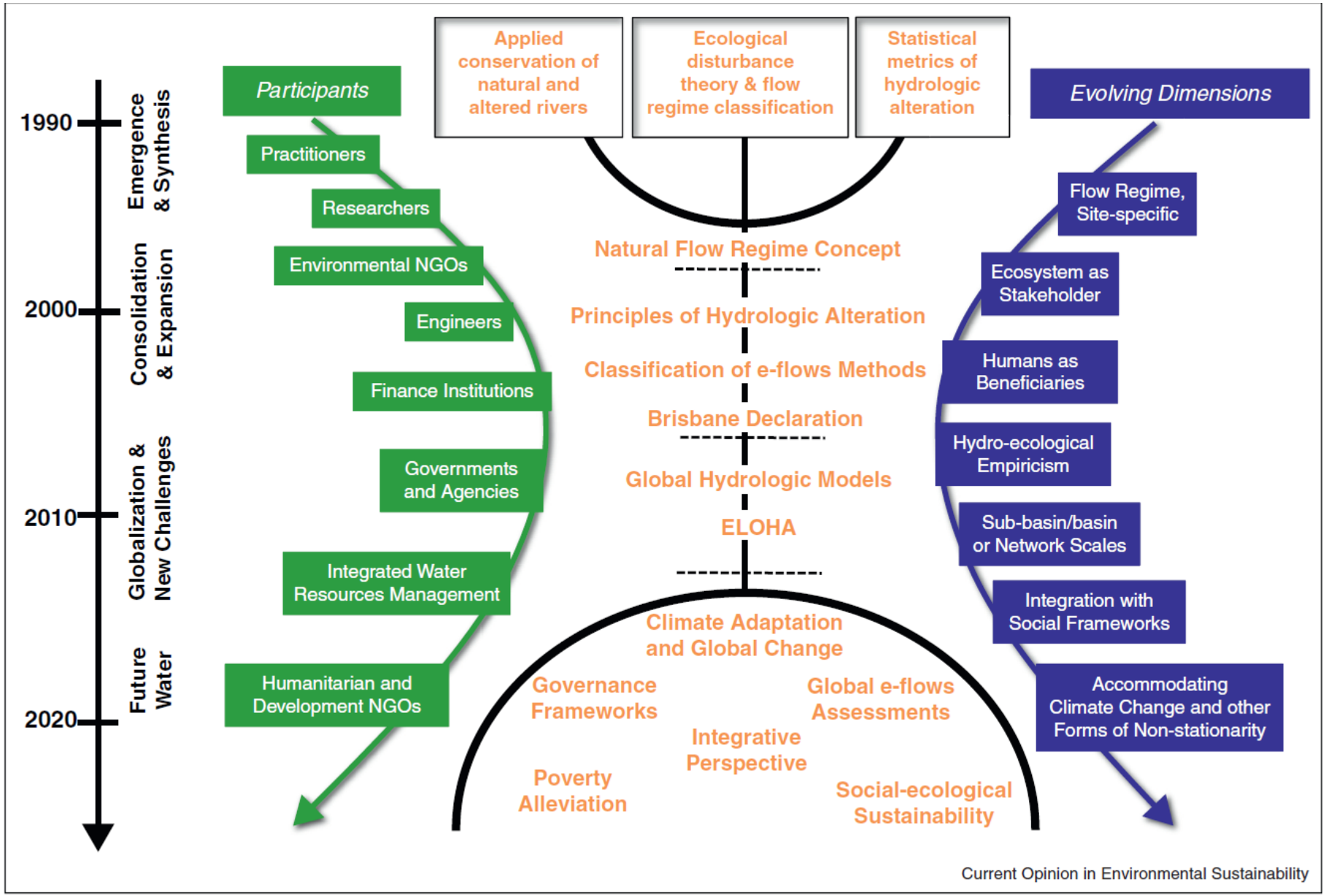
The message from Delta people: *Bring back nature's flow to restore our deltas' rhythms*

Environmental and socio-cultural flows



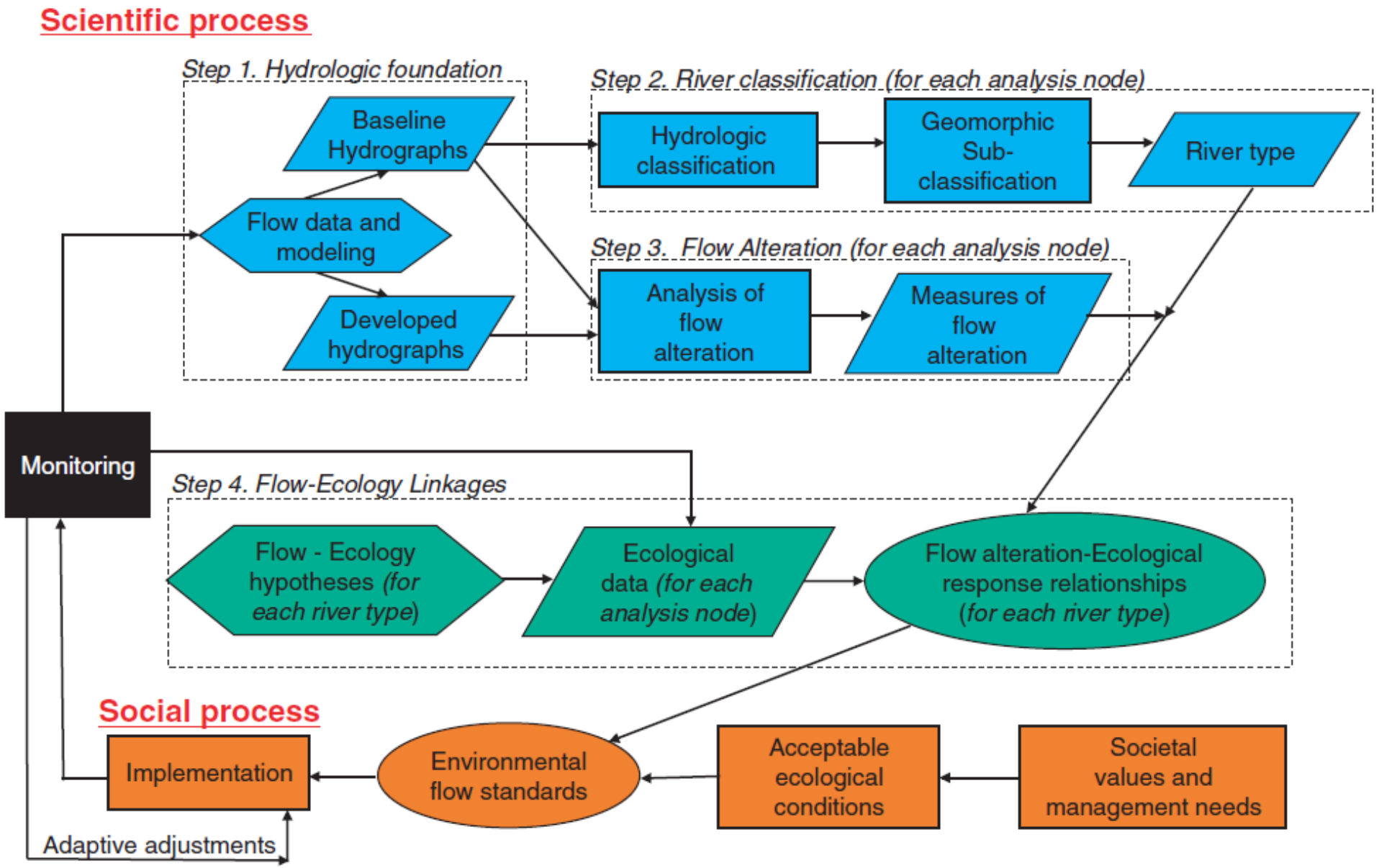


The evolution of e-flows: 1990s to today



Poff and Matthews 2013 Current Opinion in Env Sustain.

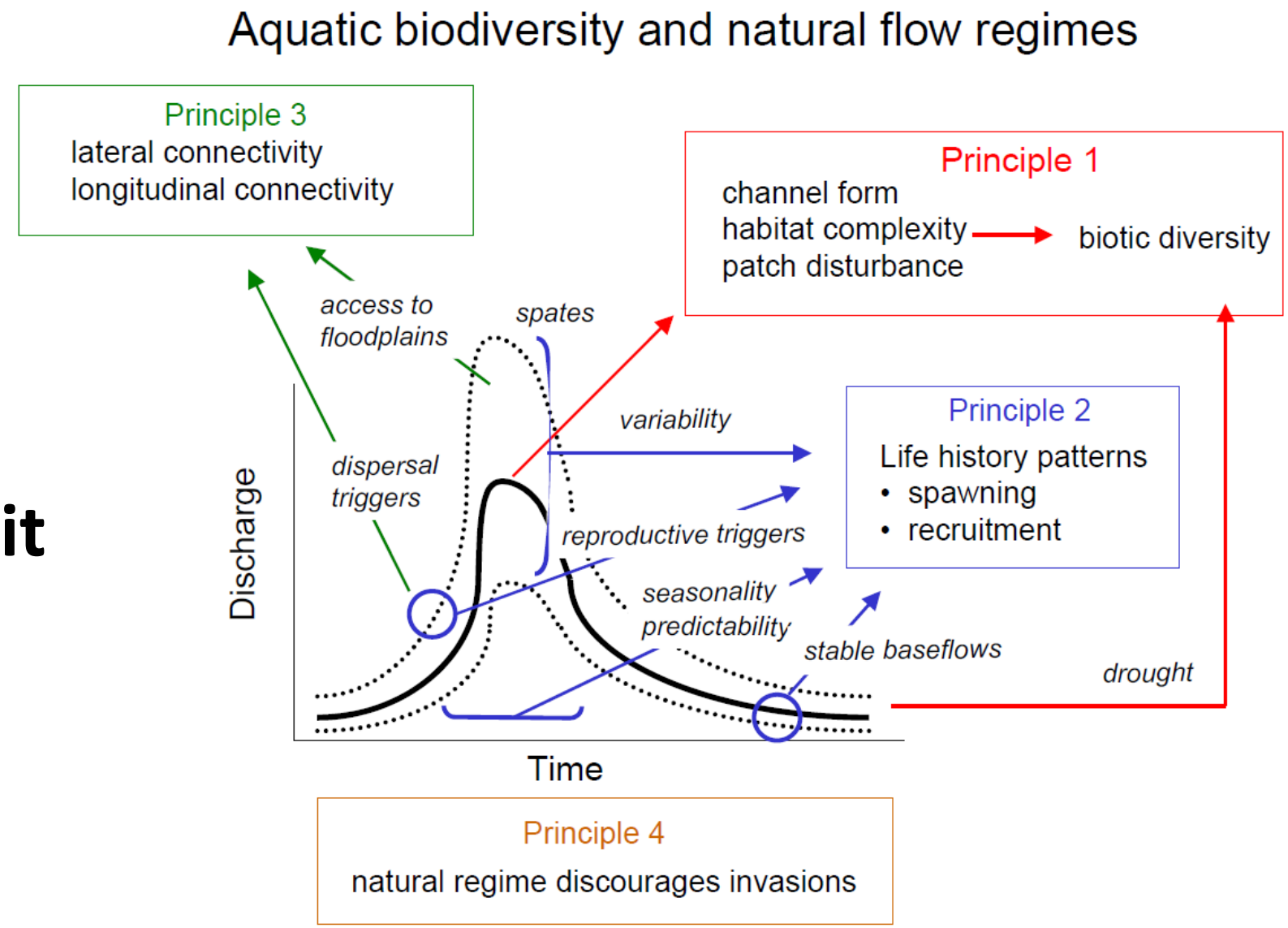
ELOHA: Ecological limits of hydrological alteration



Poff et al. 2010 FW Biology

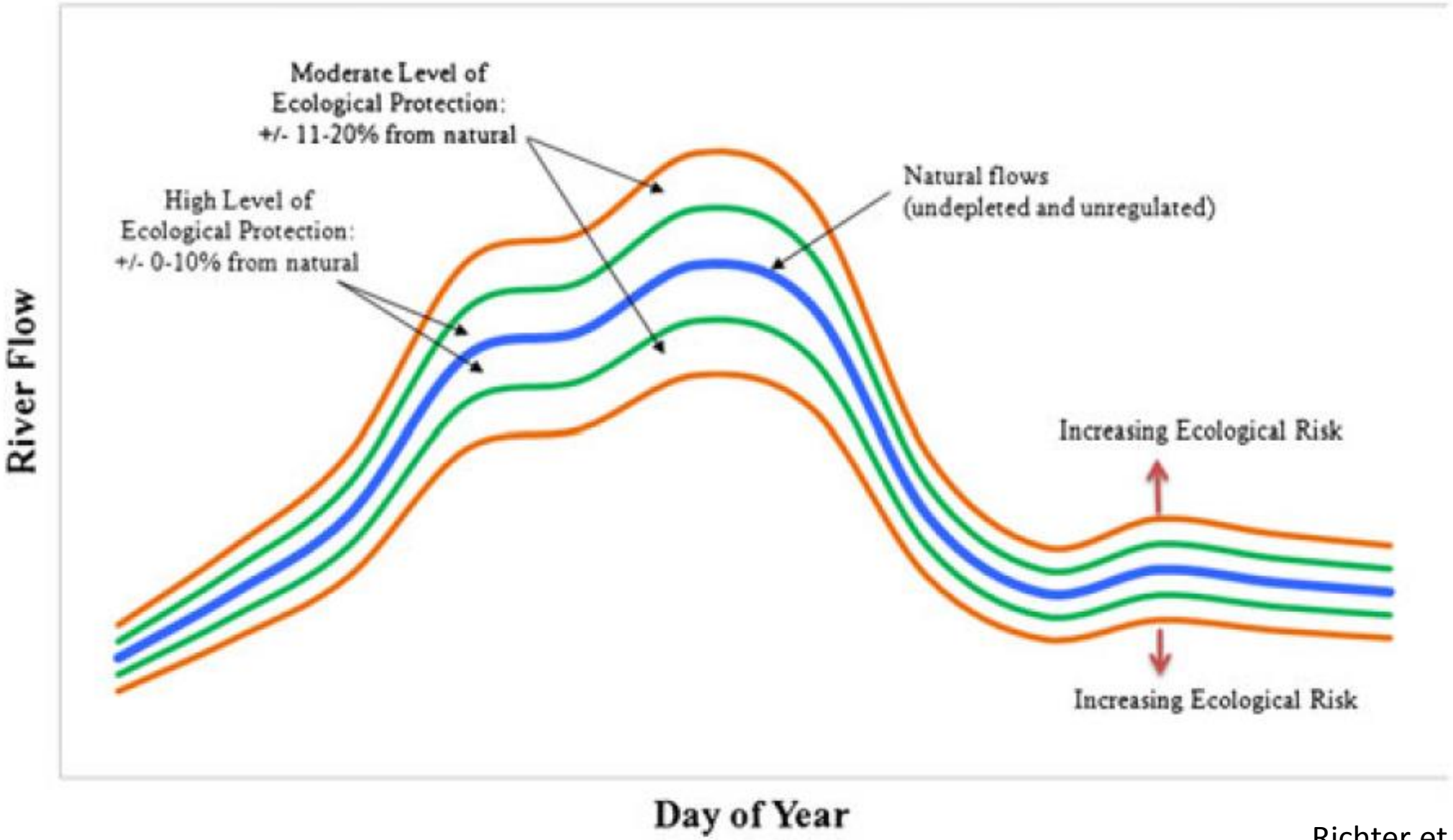
Newer methods use holistic approaches

The hydrograph remains the fundamental unit of analysis

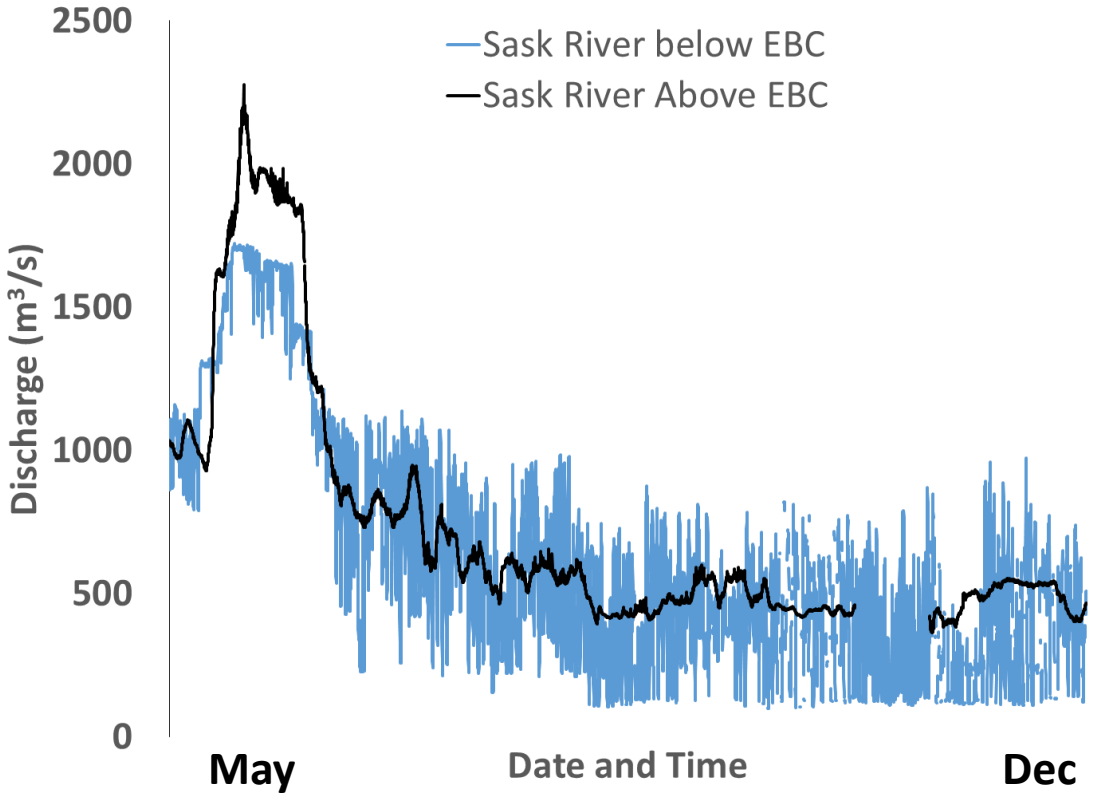


Bunn and Arthington 2002 Env Management

Current performance - Presumptive Standards

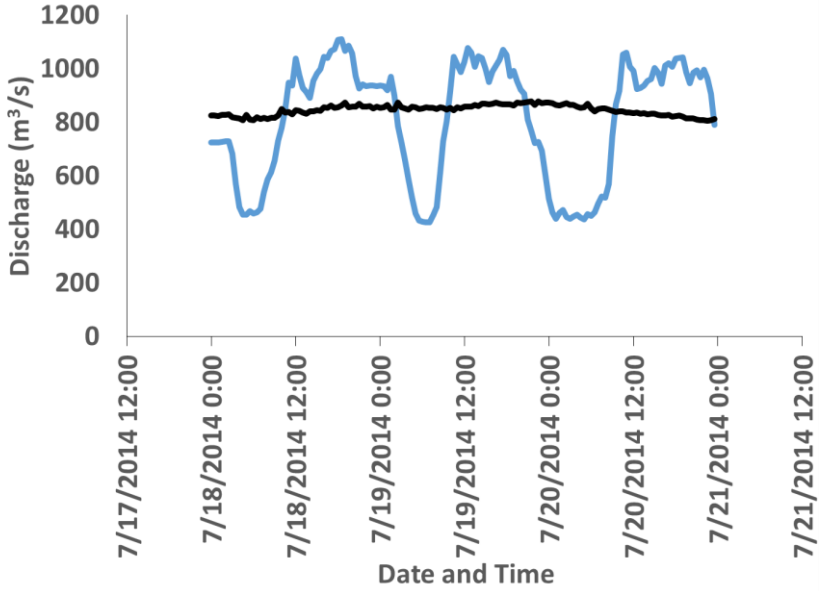


Richter et al. 2012 River Res. Appl.



EB Campbell Dam – 100 km upstream from the Saskatchewan River Delta

Approximately 25% reduction in peak flow, and hourly deviations of >50% above and below ‘natural’ due to hydropeaking



Existing management is not meeting the e-flows or cultural flow needs of the Saskatchewan River and Delta

Hydropeaking is a concern here because of the proximity of EB Campbell Dam (eventual attenuation)

Loss of flood peaks is common to all three deltas under existing management

IMPC e-flows

- Develop flow-ecology relationships
  - Species of special concern

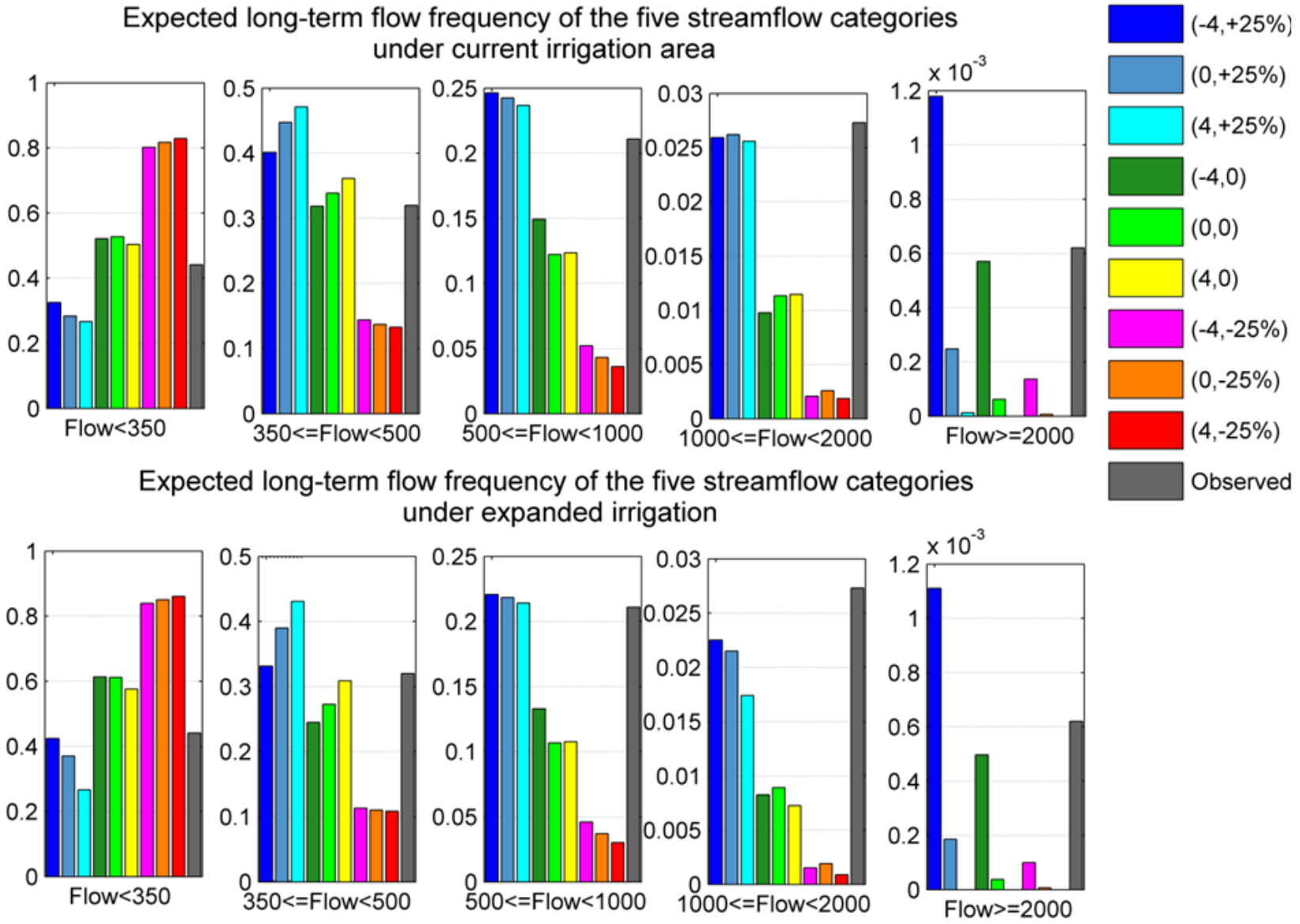



  - Mechanistic or process-based
  - Expert knowledge

- Develop rule curves for those relationships
- Take outputs from water resource management models to assess ecological implications
  - Current performance with existing management

Future performance

- Assess future scenarios
  - Future “acceptable” performance
  - Relative to economic and social objectives

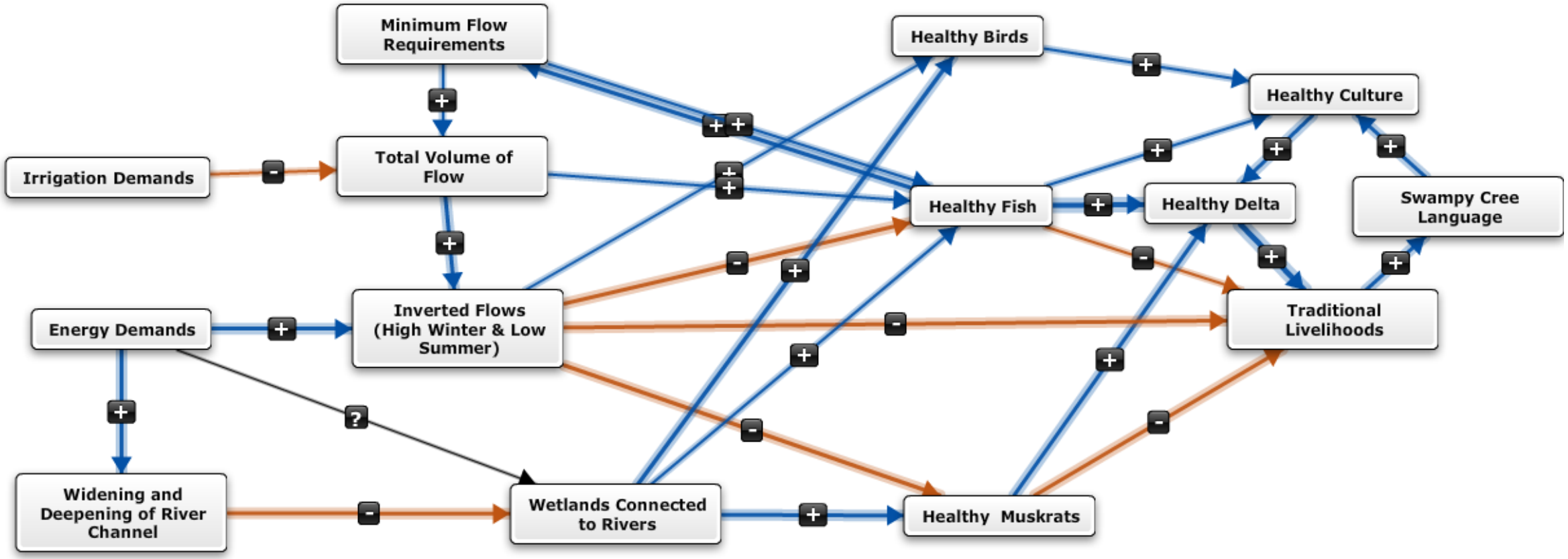


Hassanzadeh et al. in press Ecohydrology

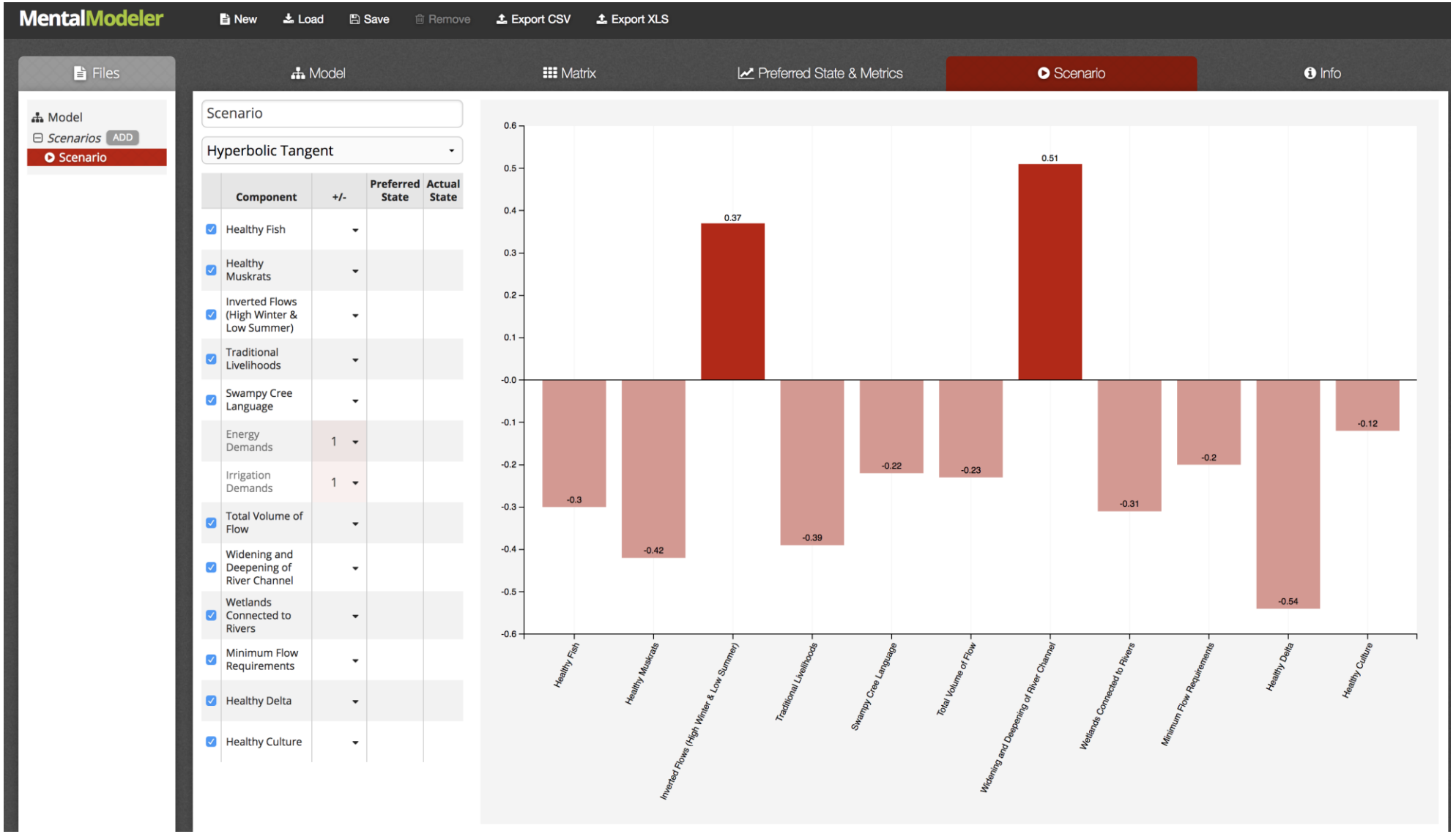
Impacts on Livelihoods – Cultural Flows

- Impacts on food webs and thus traditional uses
- Impacts on access to the land (poor ice conditions and variable depths)
- Less people having experiences on the land (loss of language and knowledge routed in the land)
- Impacts to identity (“who are we if we aren’t Swampy Cree”)

Example expert elicitation



Example of Scenario Increase Energy and Irrigation Demands



Exploring Social learning in Participatory Modeling

1. Participatory Modeling (PM)

1.1 Trends in participatory Modeling

1.2 Integrating Knowledge Systems

2. Social Learning in PM

2.1 Social learning in participatory environmental management

2.2 Evaluating social learning

3. Participatory Water Resources management in Canada

3.1 Water research and management in Canada

3.2 Participatory watershed modeling in Canada

Legitimacy, credibility, saliency of models?

Relating different ways of knowing relate to social learning

Interplay between cognitive knowledge, values and technology

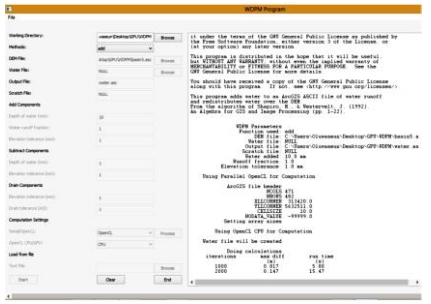
Social learning concept in sustainability

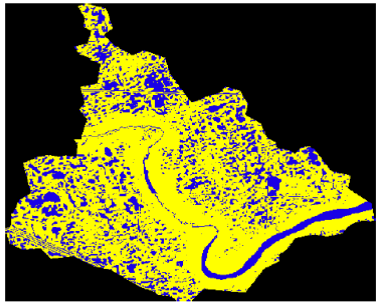
Mental models and Single-, double, triple-loop learning

Trends: from level of participation to using fcm

Exploring participatory approaches applied to water management in Canada

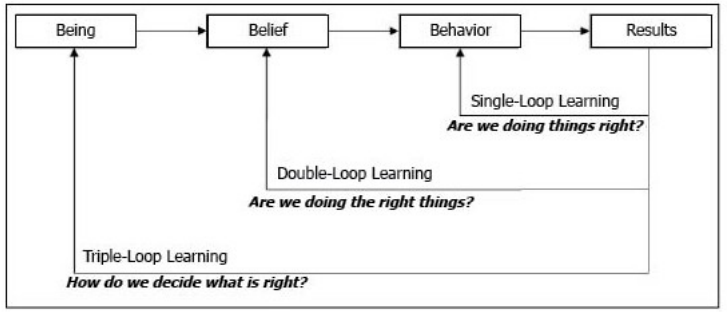
Indigenous communities Participation





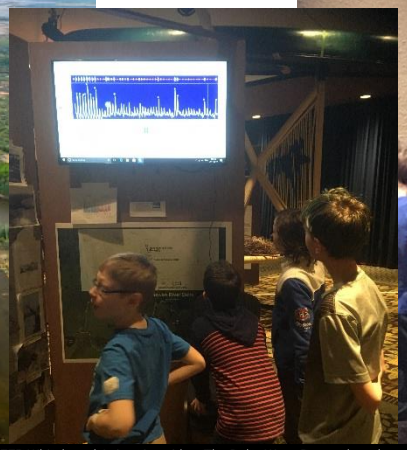
How do we incorporate learning in the modeling process?

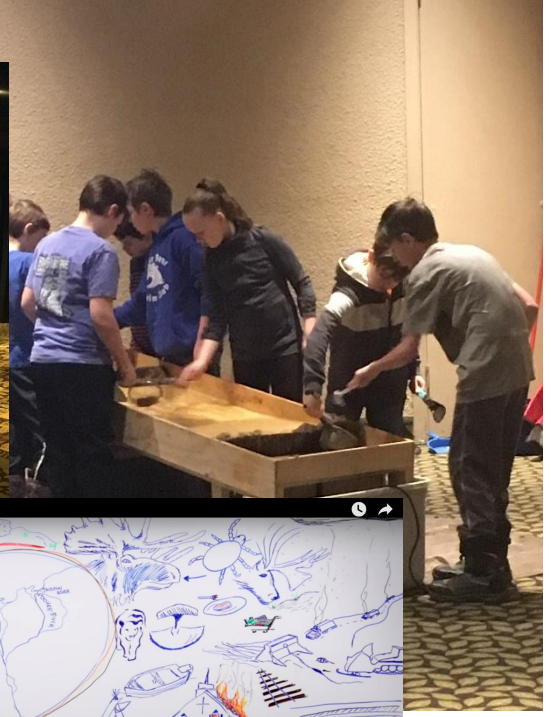
Learning Loops

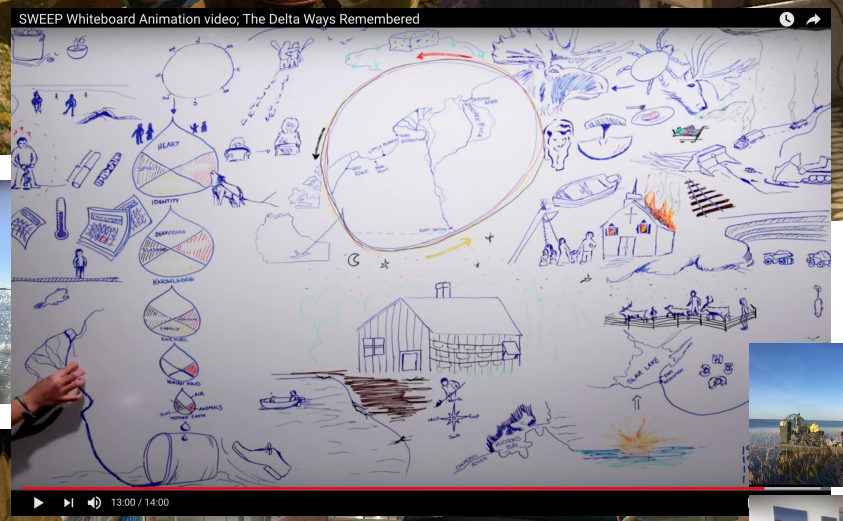


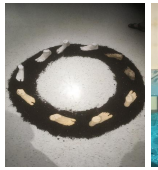
Research Question: In the context of participatory modeling with an indigenous community, are fuzzy cognitive maps and focus groups be appropriate tools for assessing social learning?

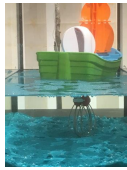

Garth Lenz/Canadian Geographic. Kindly do not distribute

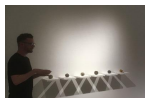


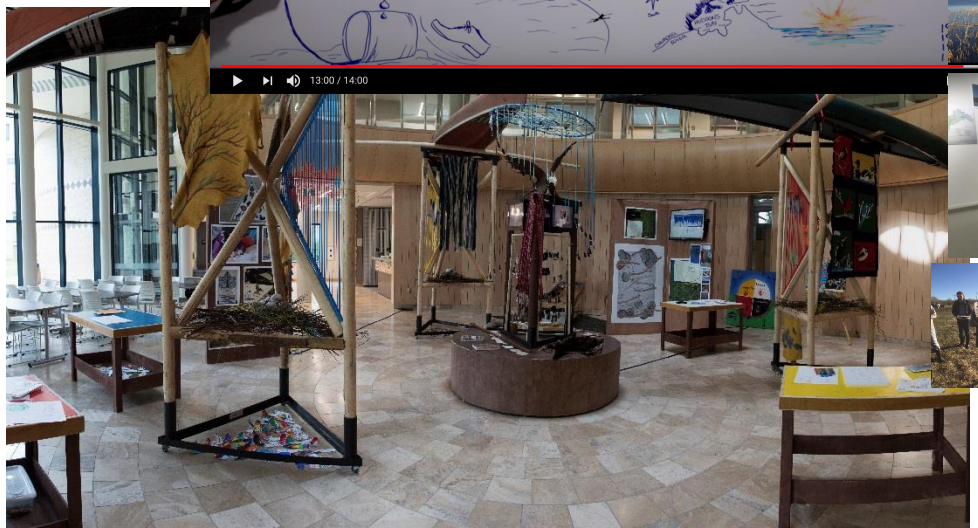



SWEEP Whiteboard Animation video; The Delta Ways Remembered
13:00 / 14:00









You’ve really got to get into the places to even begin to understand it

Summary

E-flows science has come a long way

Deltas are important but vulnerable

E-flows are difficult to implement but not impossible

Communication should be about whole systems

We need virtual ways to experiment

Acknowledgments

- Community partners in Fort Resolution, Fort Smith, Fort Chipewyan, Cumberland House and Opaskawayak Cree Nation
- Grad students, technicians and post-docs
- Collaborators in the Delta Dialogue Network
- Funders: NSERC, SaskPower, SSHRC, CWN, GWF

gwf.usask.ca/

Supplemental Slides below

What the community needs from modelers

- Understand
  - How changing seasonality impacts flows?
  - How different operational regimes impacts flows?
  - How changes in management could improve health of delta?
- Visualize
  - different water futures for the delta
  - connecting hydrological modelling with some hydraulic modelling
- Learn other ways of knowing
  - Communicate interculturally
  - Share in clear language how we know what we know
- Build capacity in the community
  - Support community in data **processing, analysis and interpretation**
- Responsiveness to the community
  - Be honest about our ability to use models to respond to communities' questions

What the modelers need from the community

- Understanding of how the delta functions in different flow conditions
- The ability to experiment virtually with different management regimes to explore alternative water futures
- How different flows and impacts on indicator species (e.g. fish, furbearers and waterfowl)
- Expression of flow needs into the future
- The ability to tell us how useful the models are to the community

Decolonized & participatory research

Emancipatory & empowering processes of doing research

Value Indigenous knowledge

Recognize Indigenous self-determination

Critical reflexivity

Co-learning process

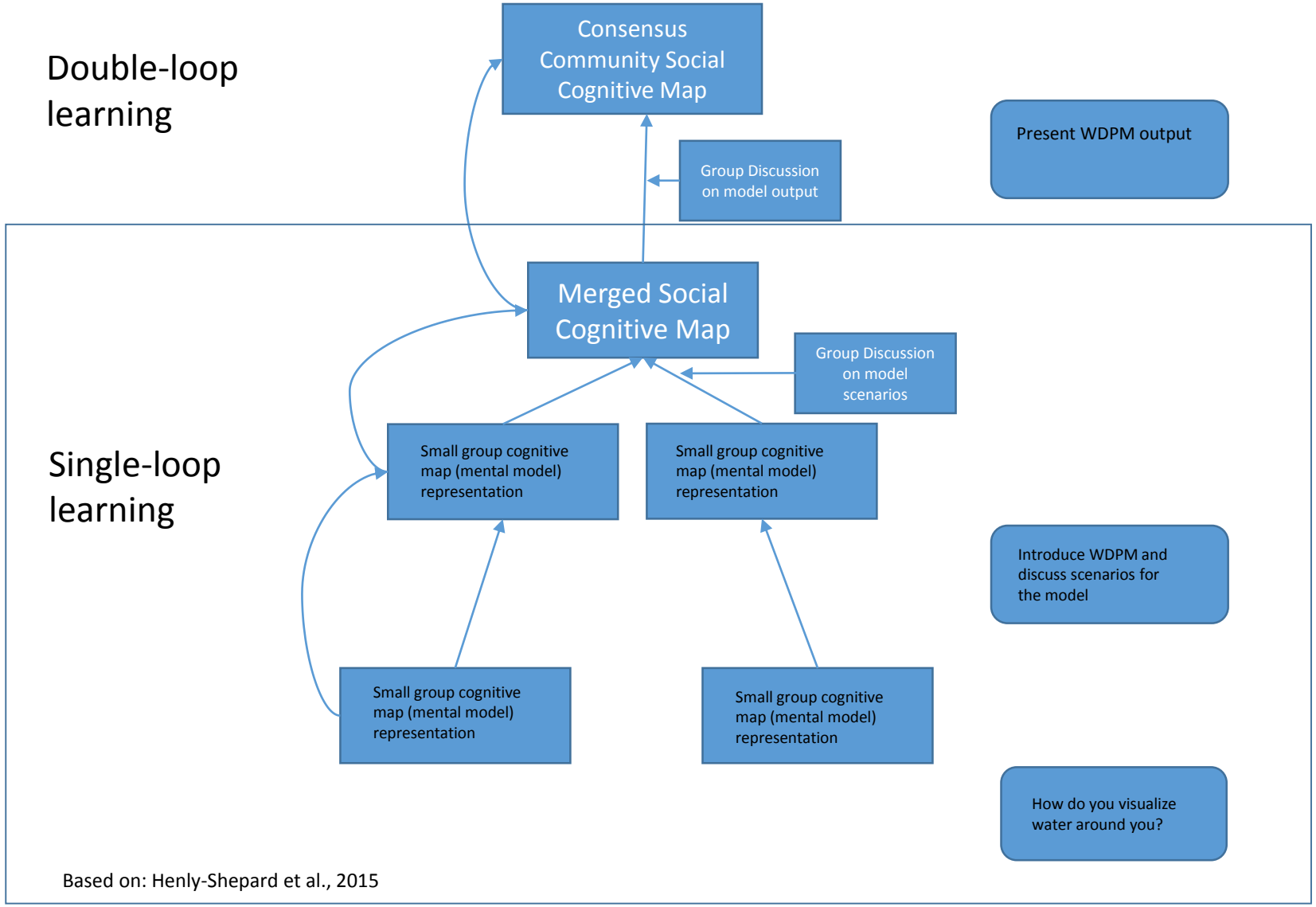
Co-identification: research questions, objectives, methods, & desired outcomes

Shared decision-making for mutual benefits

Innovative knowledge mobilization

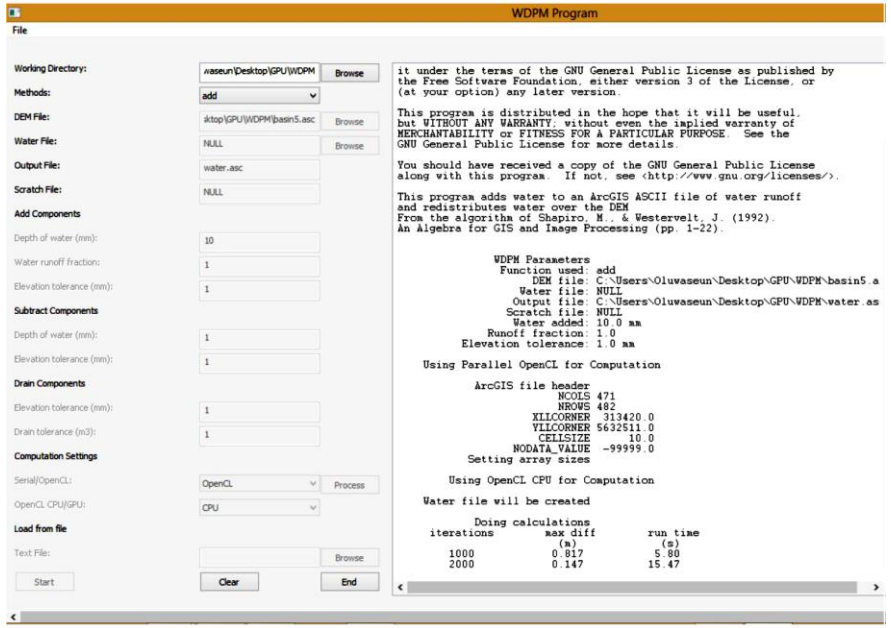
SOCIAL & ENVIRONMENTAL JUSTICE

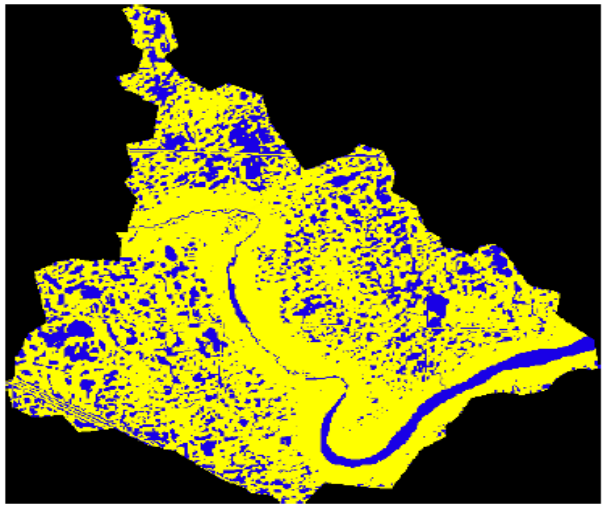
Research Framework



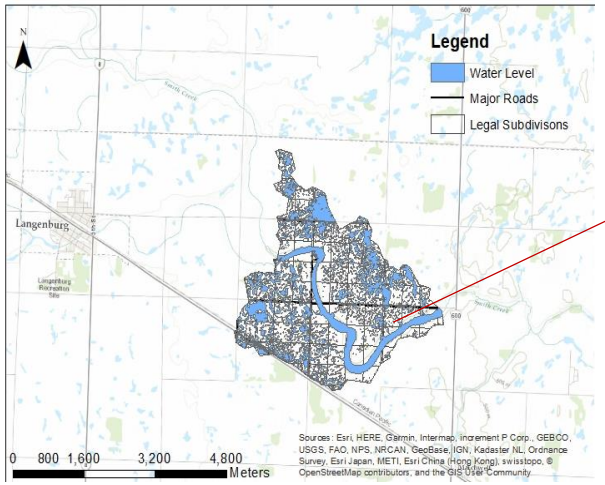
What is WDPM?

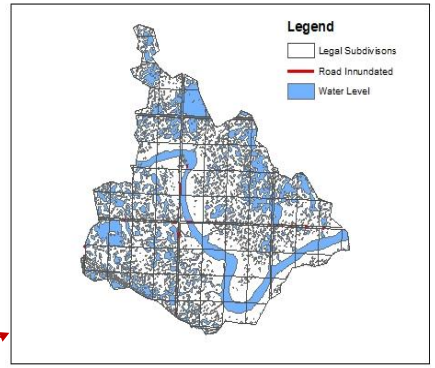
- Modelling approach: Spatial models
- How does excess runoff move across the landscape?
- Suitable for prairies, areas of poor drainage systems
- Pros: Does not require presence of stream to create flood hazard map, Requires less variables
- Cons: No hydrological processes, no real-time, requires additional GIS software, can take long time to simulate processes, limited scenarios
- Three modules: ADD, SUBTRACT, DRAIN
- Simulation Order example:
- ADD (simulating spring runoff) -→ DRAIN (If there is stream) ---> SUBTRACT (Simulating evaporation)-→ ADD (simulating summer rainfall)
- Scenarios previously used: maximum 24 hr accumulated rainfall (1:100 year return periods), ‘what if’ scenarios according of community’s concern (historical events, worst case scenario)





Simulated flooding event at 25mm water added





Saskatchewan River Delta

Garth Lenz/Canadian Geographic. Kindly do not distribute

Bringing people into the delta to experience
the “feeling” of wilderness

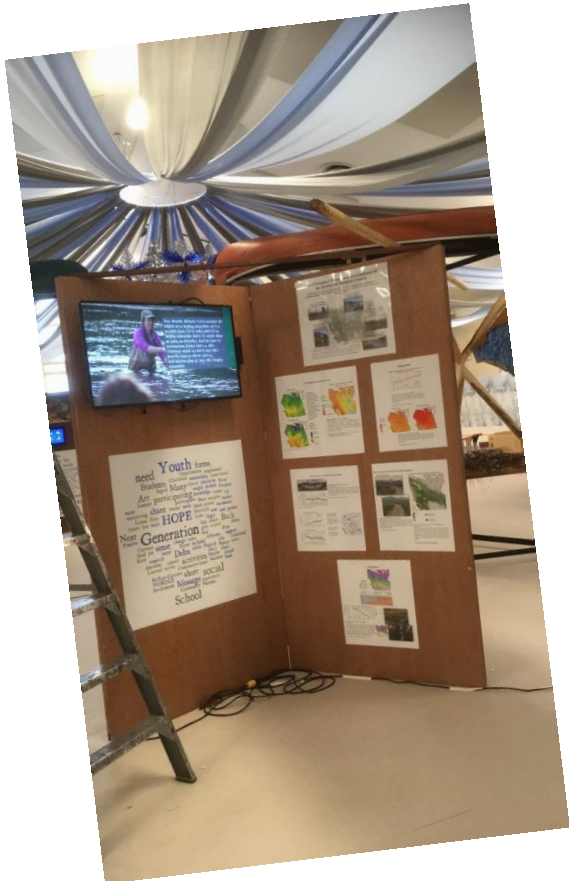
Animals are adapted to the wetting and drying occurring at particular times of the year


Garth Lenz/Canadian Geographic. Kindly do not distribute


SWEEP Whiteboard Animation video; The Delta Ways Remembered
HEART
SPIRIT
IDENTITY
BEHAVIOURS
REASONING
KNOWLEDGE
FAMILY
CULTURE
HUMAN KIND
AIR
ANIMALS
SUN
"MOTHER" EARTH
LITTLE BUFFALO
FORT RESOLUTION
HAY RIVER
PINE POINT
TALTSON RIVER
PEACE RIVER
FORT SMITH
North
West
East
South
HUDSONS BAY
CHURCHILL RIVER
SLAVE LAKE
FORT RESOLUTION
1950
1960
1970
1980


DELTA X
IN
XPLR
HALL


My Delta is
ALIVE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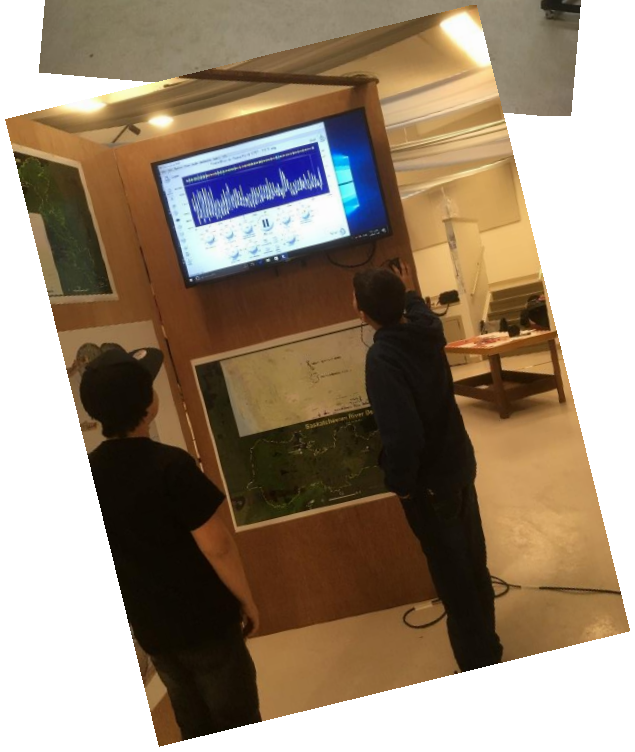


Protect our
drinking water
We must be the voices for our delta!

Becoming Water: Art and Science in Conversation