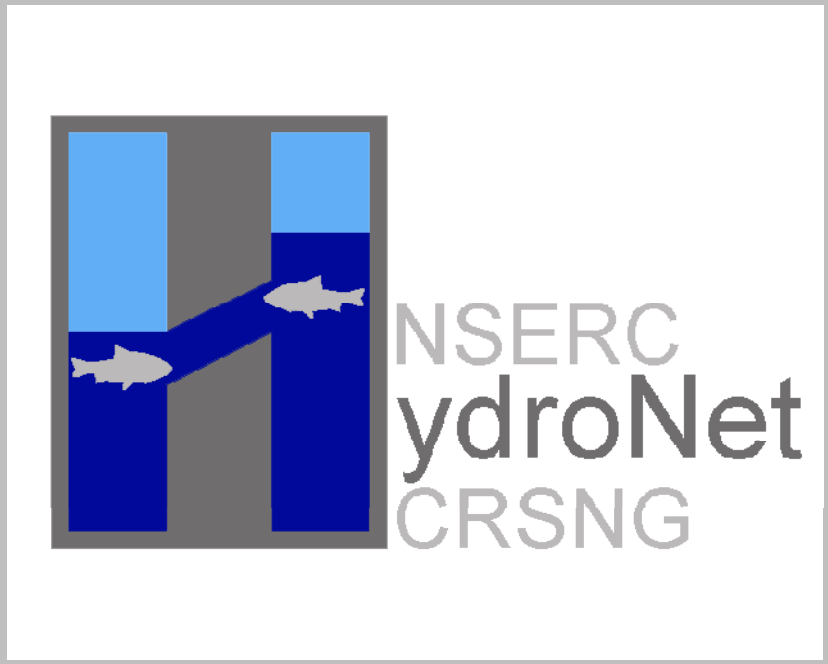
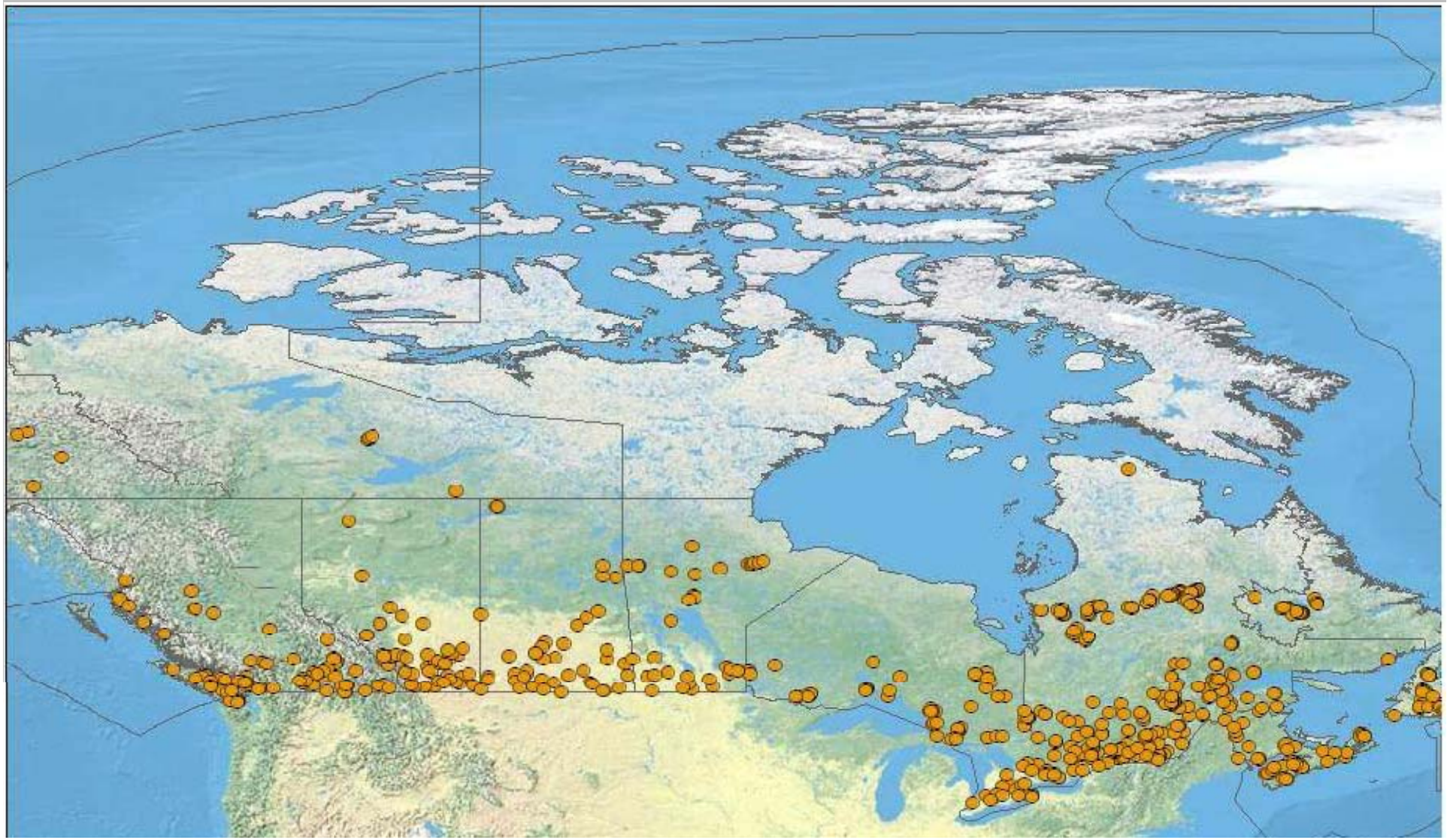
NSERC HydroNet
A national research network to promote sustainable hydropower in Canada



Canadian Dam Association; 933 large dams

Canadian Electricity Association; ca 470 hydroelectric facilities (60% of the electricity used by Canadians)



Hydroelectricity

- Contributes to the wealth/prosperity of Canadians
- Affects the physical, chemical and biological processes taking place in aquatic ecosystems

Regulatory framework

- Canadian Environmental Assessment Act
- Species At Risk Act
- Fisheries Act
  - Policy for the management of fish habitat

«...no net loss of the productive capacity of fish habitats...»

(Habitat policy; DFO 1986)

«...the achievement of an overall net gain of the productive capacity of fish habitats.»

(Habitat policy; DFO 1986)

- **Achievement of “no net loss” entails,**

    1) **The estimation of productive capacity before**

    2) **The prediction of productive capacity after**

- **Challenges**

    1) **Hydropower modifies many physical and chemical variables**

    2) **Prediction of the effect of these variables on Growth, Reproduction, and Survival for all species within a community may be difficult**

Steps towards collaboration

- **CEA-DFO Memorandum Of Understanding (2002)**
  -foster collaboration between industry and regulators-

- **CEA-DFO Science Workshop (2004)**
  -identify research priorities-

- **Centre of Expertise of Hydropower Impacts on Fish and Fish Habitat (CHIF; 2007)**
  -structure research activities within DFO-

- **Academia-Industry-Government Workshop (2007)**
  -define a plan of actions-

- **Proposal/Creation of NSERC HydroNet (2009)**
  -platform to realize the plan of actions-

General objectives

1) develop new knowledge and new tools to assess, minimize, and mitigate the effects of hydropower on fish and their habitats,

2) improve the decision-making process associated with hydropower,

3) reduce conflict among stakeholders.

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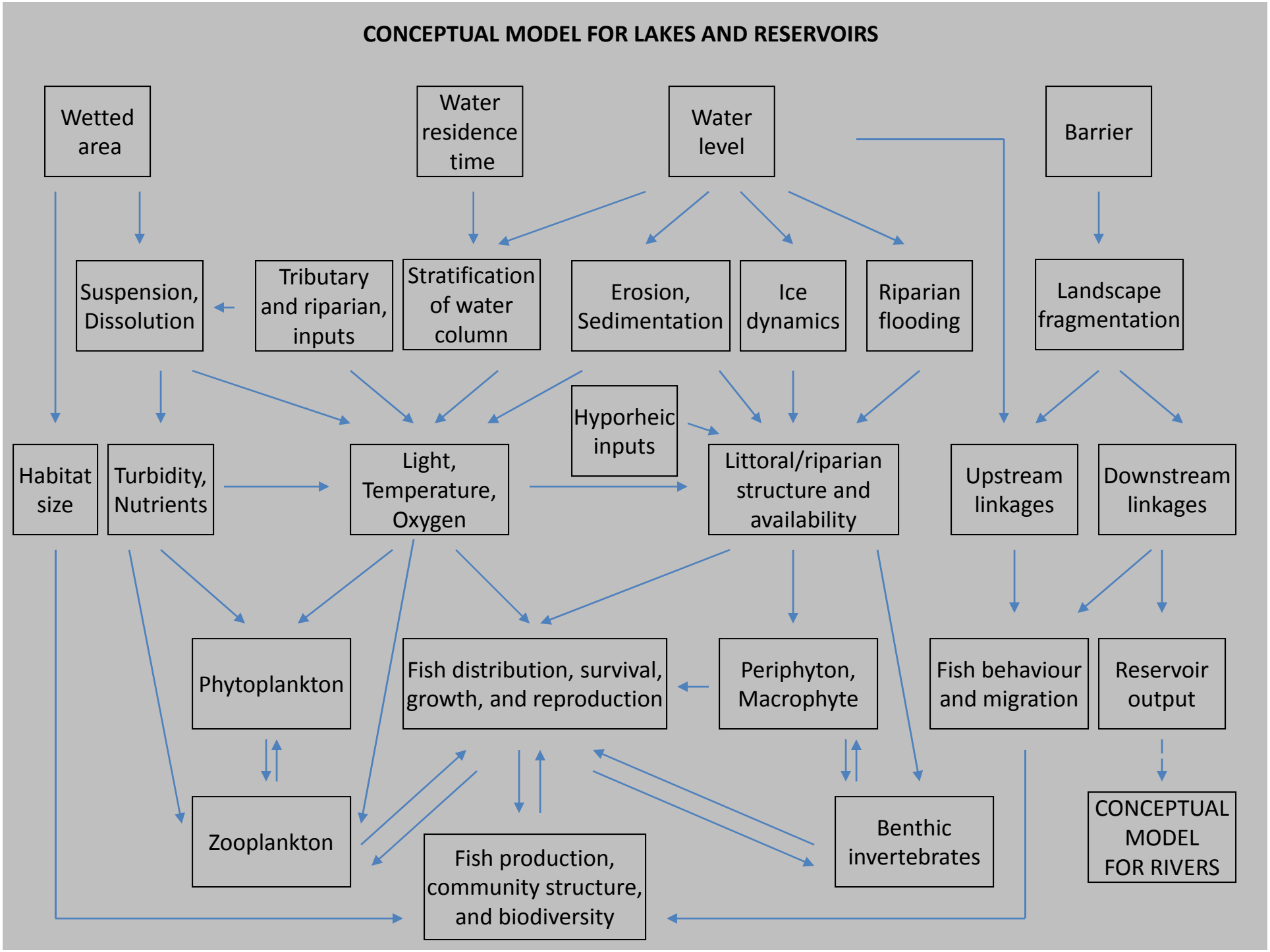
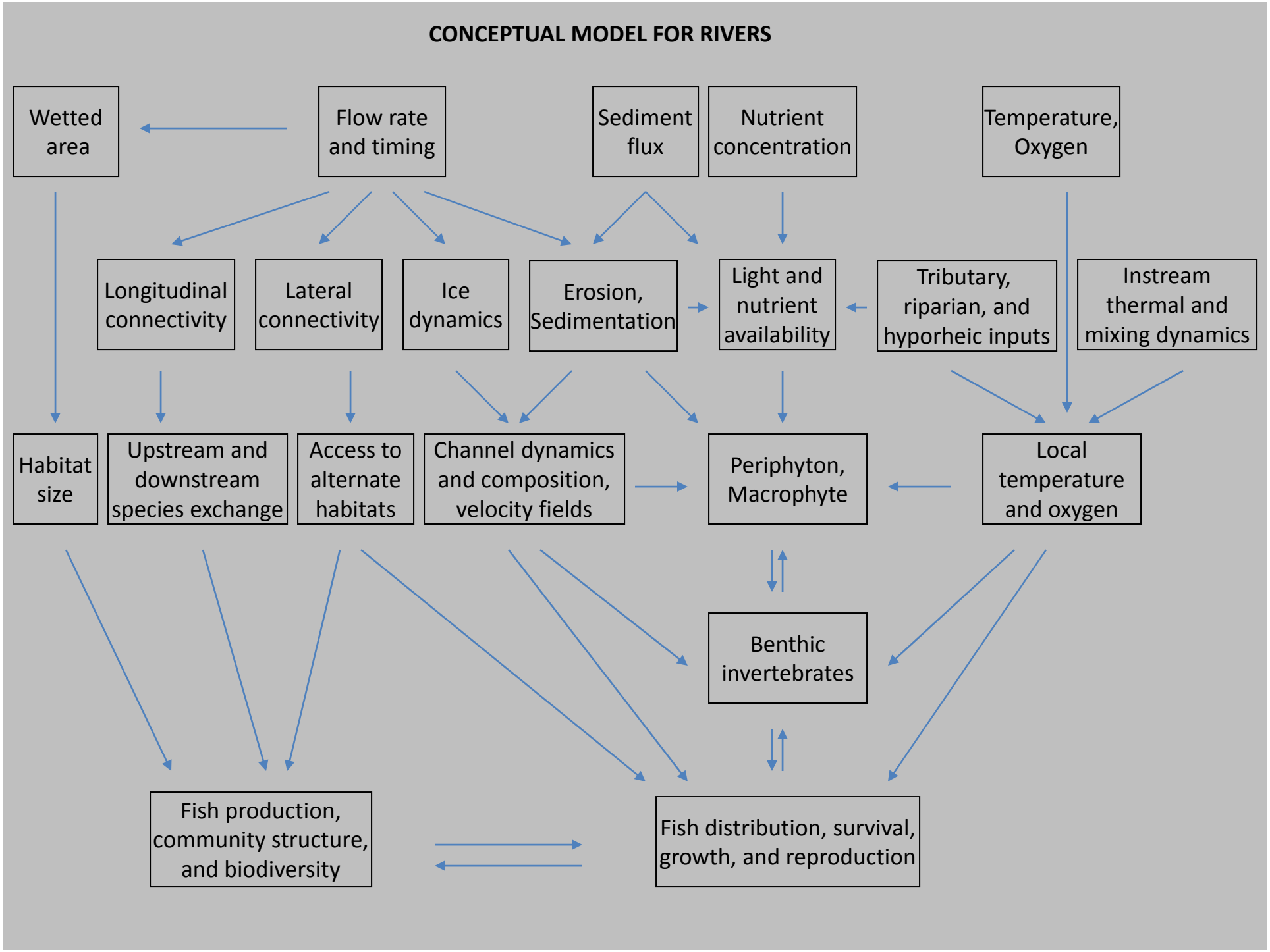
CENTRAL THEME:
THE PRODUCTIVE CAPACITY OF FISH HABITATS


CONCEPTUAL MODEL FOR LAKES AND RESERVOIRS
Wetted area
Water residence time
Water level
Barrier
Suspension, Dissolution
Tributary and riparian, inputs
Stratification of water column
Erosion, Sedimentation
Ice dynamics
Riparian flooding
Landscape fragmentation
Hyporheic inputs
Habitat size
Turbidity, Nutrients
Light, Temperature, Oxygen
Littoral/riparian structure and availability
Upstream linkages
Downstream linkages
Phytoplankton
Fish distribution, survival, growth, and reproduction
Periphyton, Macrophyte
Fish behaviour and migration
Reservoir output
Zooplankton
Benthic invertebrates
CONCEPTUAL MODEL FOR RIVERS
Fish production, community structure, and biodiversity


CONCEPTUAL MODEL FOR RIVERS
Wetted area
Flow rate and timing
Sediment flux
Nutrient concentration
Temperature, Oxygen
Longitudinal connectivity
Lateral connectivity
Ice dynamics
Erosion, Sedimentation
Light and nutrient availability
Tributary, riparian, and hyporheic inputs
Instream thermal and mixing dynamics
Habitat size
Upstream and downstream species exchange
Access to alternate habitats
Channel dynamics and composition, velocity fields
Periphyton, Macrophyte
Local temperature and oxygen
Benthic invertebrates
Fish production, community structure, and biodiversity
Fish distribution, survival, growth, and reproduction

- **Mechanistic approach:**

  -Advantages: Understanding of the mechanisms of action of variables
  Representation of the interactions between variables

  -Disadvantages: Challenge of scaling up
  Predictive tools require a quasi-complete picture

- **Empirical approach:**

  -Advantages: Predictive tools do not require all variables/processes
  The variable of interest is always part of the model

  -Disadvantages: No understanding of the mechanisms
  Interactions among variables is not defined

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NETWORK STRATEGY:
USE THE MECHANISTIC AND THE EMPIRICAL APPROACHES

Projects

STRATEGIC NETWORK GRANT (SNG)

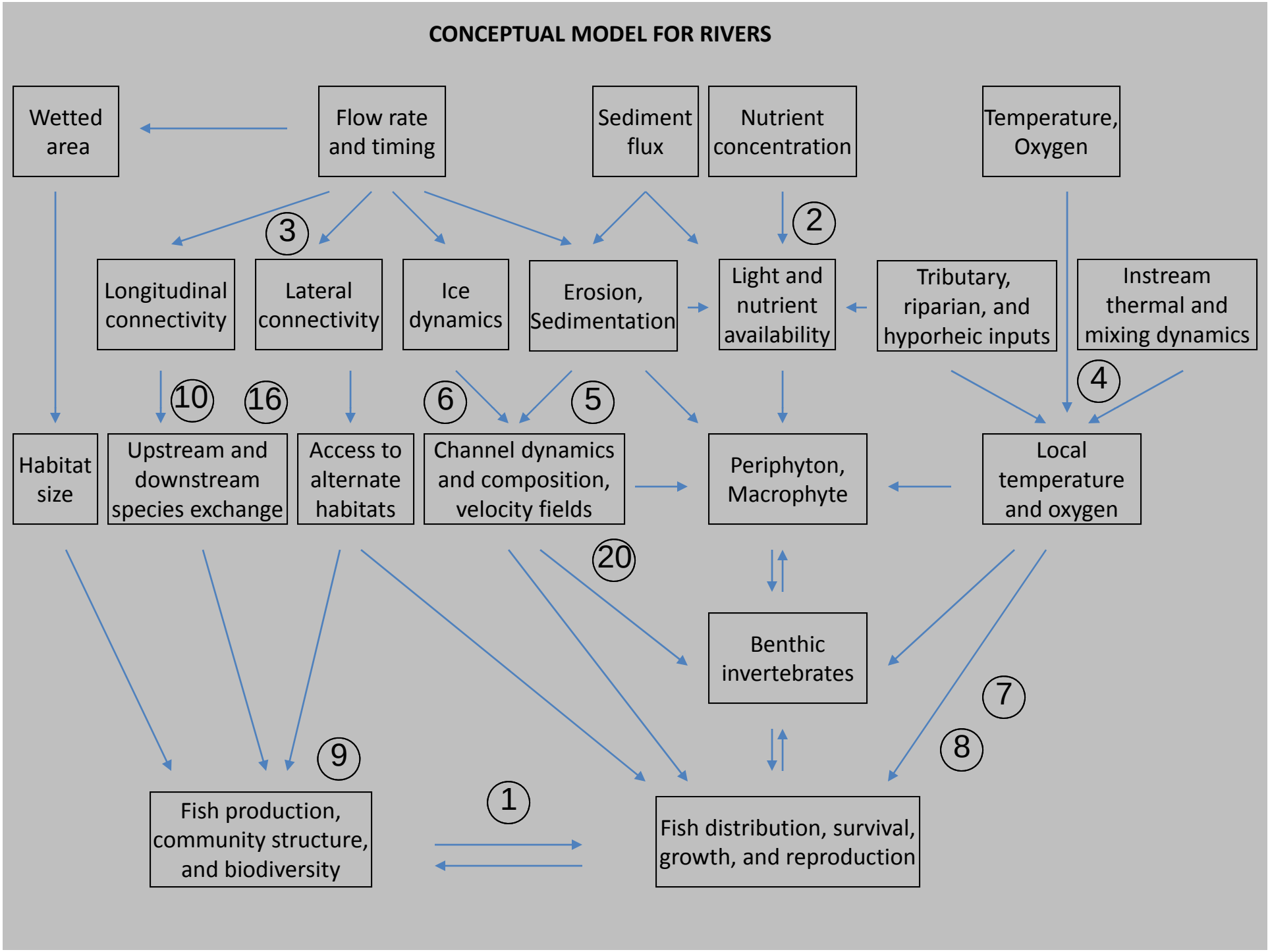
0	Networking of NSERC HydroNet	D. Boisclair
1	Productive capacity of fish habitats in rivers	D. Boisclair
2	Chemical drivers of the productive capacity of fish habitats	J. Rasmussen
3	Flow regime of natural versus regulated rivers	M. Lapointe
4	Effects of dams on the thermal regime of rivers	A. Saint-Hilaire
5	Long-term physical transformation of regulated river	M. Lapointe
6	Winter stressors for fish in rivers	R. Cunjak
7	Egg survival in response to river regulation	R. Cunjak
8	Thermal regime in regulated rivers and effects on fish growth	M. Power
9	Effect of biodiversity on fish production and trophic structure	J. Rasmussen
10	Hydraulic/biological evaluation of upstream sturgeon passage	S. Cooke

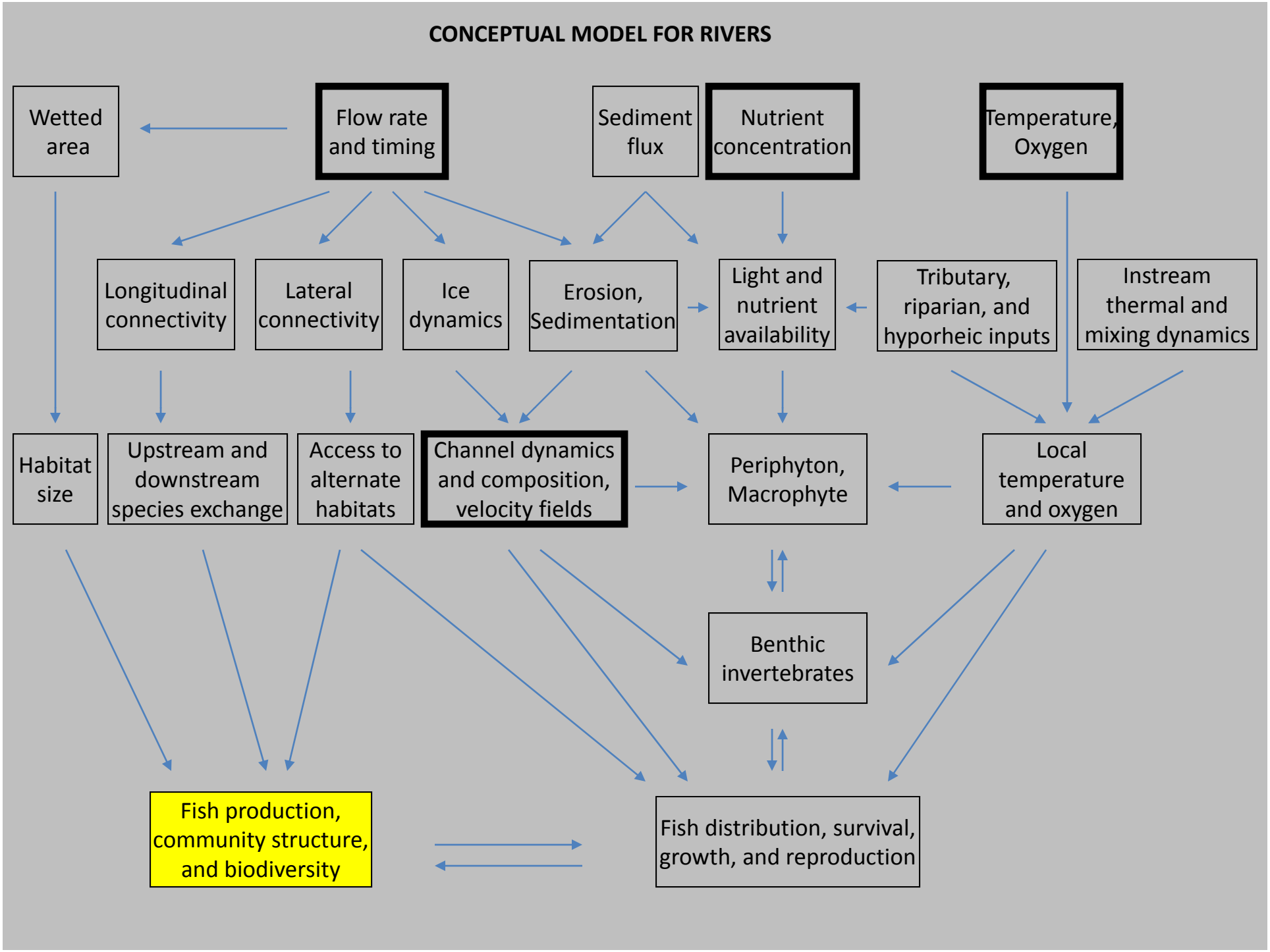
COLLABORATIVE RESEARCH AND DEVELOPMENT (CRD)

11	Hydroacoustic mapping of fish in the pelagic zone of reservoirs	G. Rose
12	Modelling of fish productive capacity in lakes and reservoirs	D. Boisclair
13	Hydraulic modelling of physical conditions in reservoirs	D. Zhu
14	Study of fish behaviour and thermal requirements in reservoirs	S. Cooke

CENTER OF EXPERTISE OF HYDROPOWER IMPACTS ON FISH AND FISH HABITATS (DFO-CHIF)

15	Thermal aspects of fish entrainment risk in reservoir	M. Patterson
16	Longitudinal and lateral responses in communities to altered flow regimes	K. Clarke
17	Fish behaviour in relation to trash racks	E. Enders
18	Numerical investigation of turbulent flows through trash racks	H. Ghamry
19	Changes in productive capacity of mountain streams	M. Bradford
20	Experimental determination of ramping rate effects on downstream biota	K. Smokorowski


CONCEPTUAL MODEL FOR RIVERS
Wetted area
Flow rate and timing
Sediment flux
Nutrient concentration
Temperature, Oxygen
3
2
Longitudinal connectivity
Lateral connectivity
Ice dynamics
Erosion, Sedimentation
Light and nutrient availability
Tributary, riparian, and hyporheic inputs
Instream thermal and mixing dynamics
4
10
16
6
5
Habitat size
Upstream and downstream species exchange
Access to alternate habitats
Channel dynamics and composition, velocity fields
Periphyton, Macrophyte
Local temperature and oxygen
20
Benthic invertebrates
7
8
9
1
Fish production, community structure, and biodiversity
Fish distribution, survival, growth, and reproduction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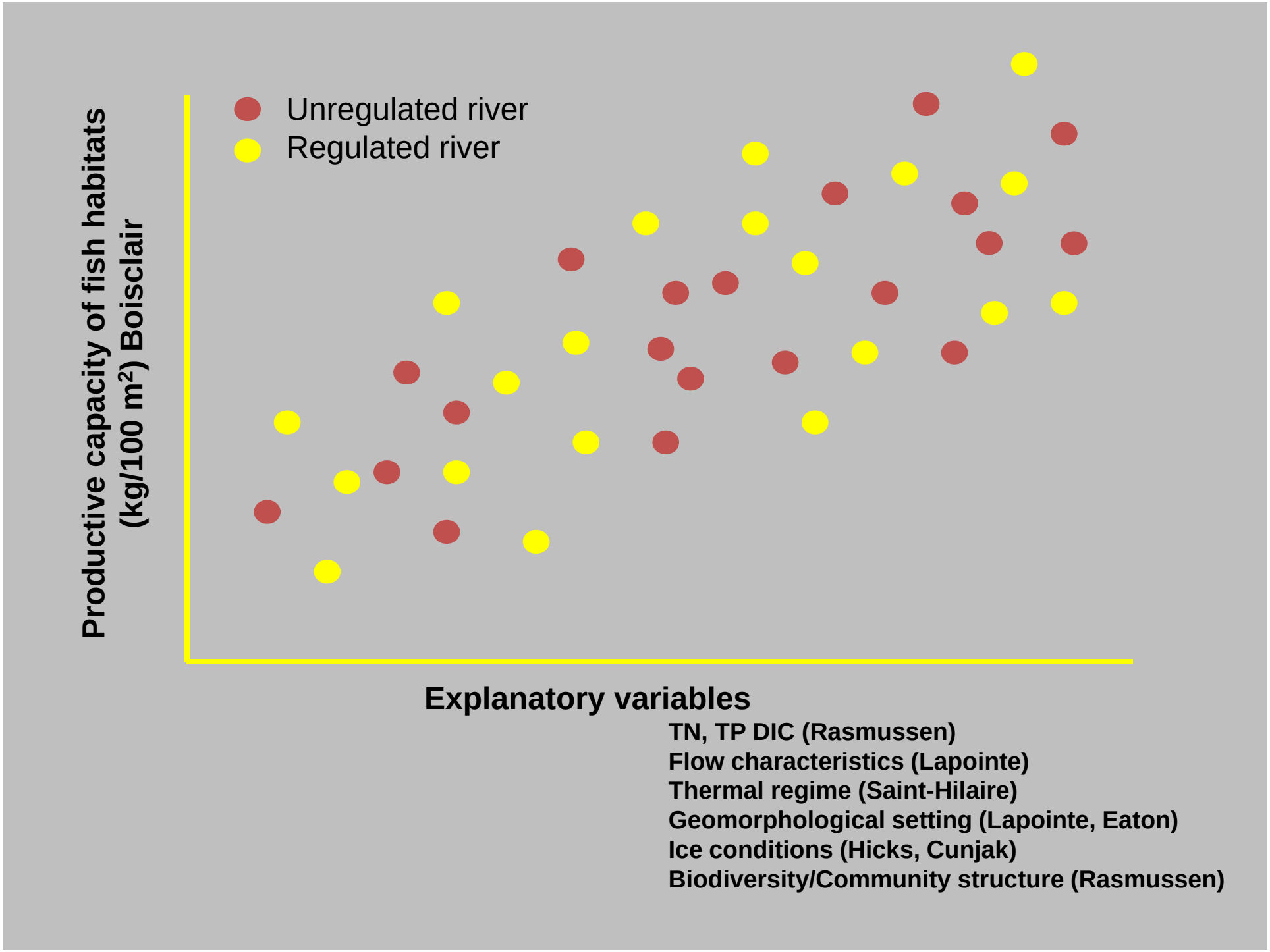
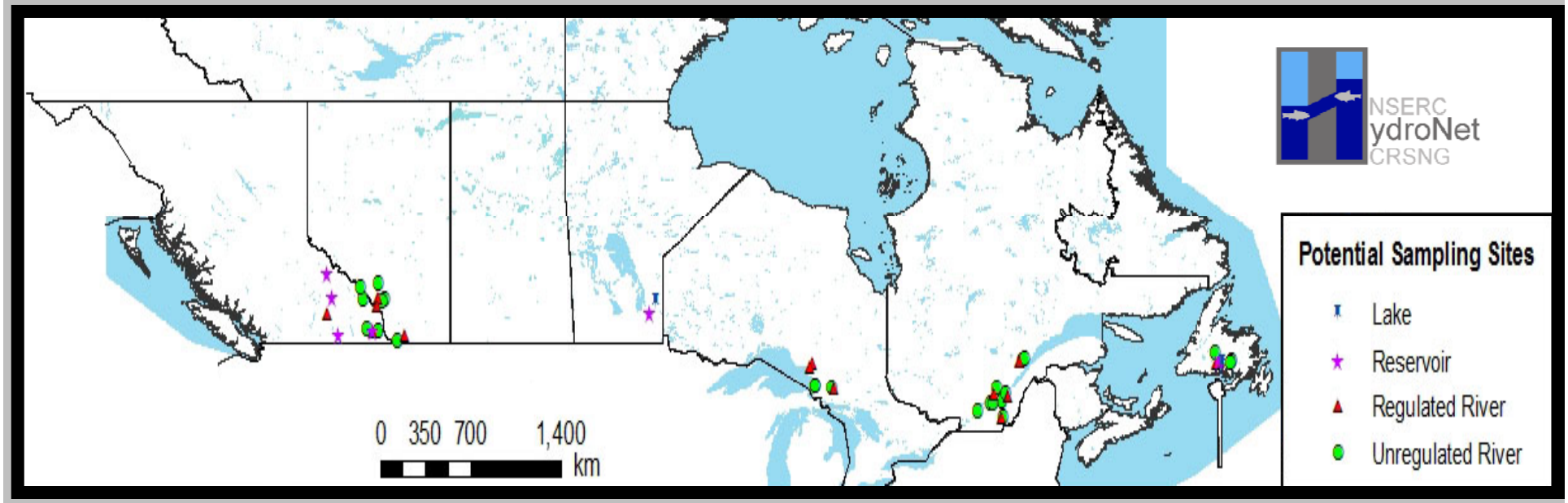

Unregulated river
Regulated river
Productive capacity of fish habitats
(kg/100 m²) Boisclair
Explanatory variables
TN, TP DIC (Rasmussen)
Flow characteristics (Lapointe)
Thermal regime (Saint-Hilaire)
Geomorphological setting (Lapointe, Eaton)
Ice conditions (Hicks, Cunjak)
Biodiversity/Community structure (Rasmussen)

Study sites

- 1 lake
- 5 reservoirs
- 26 unregulated rivers
- 15 regulated rivers



Attributes of sampling sites (river segments)

-an average flow of 5 to 100 cms;

-quasi wade-able (less than 2 m in maximum depth);

-the regulated rivers must be affected by a dam for more than 15 years;

-the rivers must be heterogeneous (within and among ecosystems variations);

-the sites must be in pairs (regulated and reference sites);

-each segment is at least 5 to 10 km long;

-the lakes and/or reservoirs must be at least 10 km downstream;

-sites must be accessible (within a one hour drive from lodging for 10 to 15 people; access at every 2 km of the river segment)

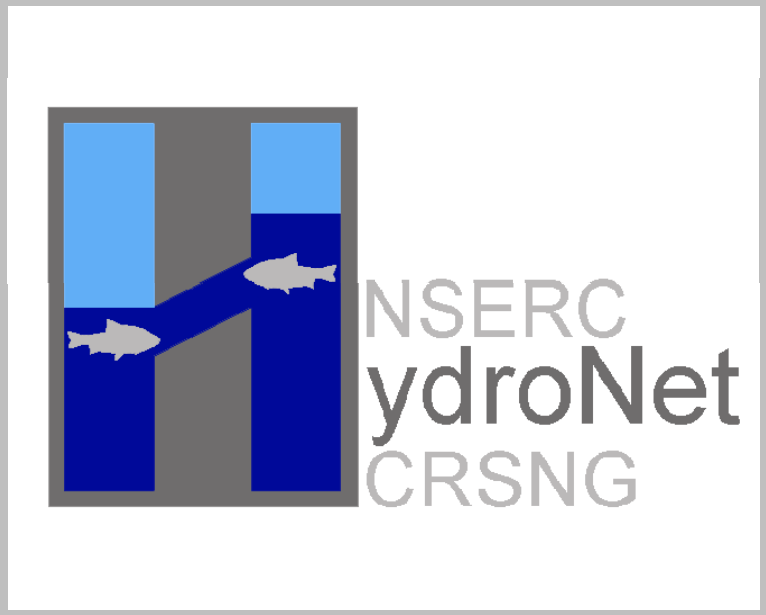
Research team

- **16 university professors (12 universities)**
- **7 industry collaborators**
  (BC Hydro, Manitoba Hydro, Brookfield Power)
- **9 scientists from federal agencies (DFO)**
- **4 scientists from provincial agencies**
  (MWS, OMNR, MRNFQ)
- **1 scientist from NGO (SLI)**

Vision

SNG
(2010-2015)

CRD ⟷



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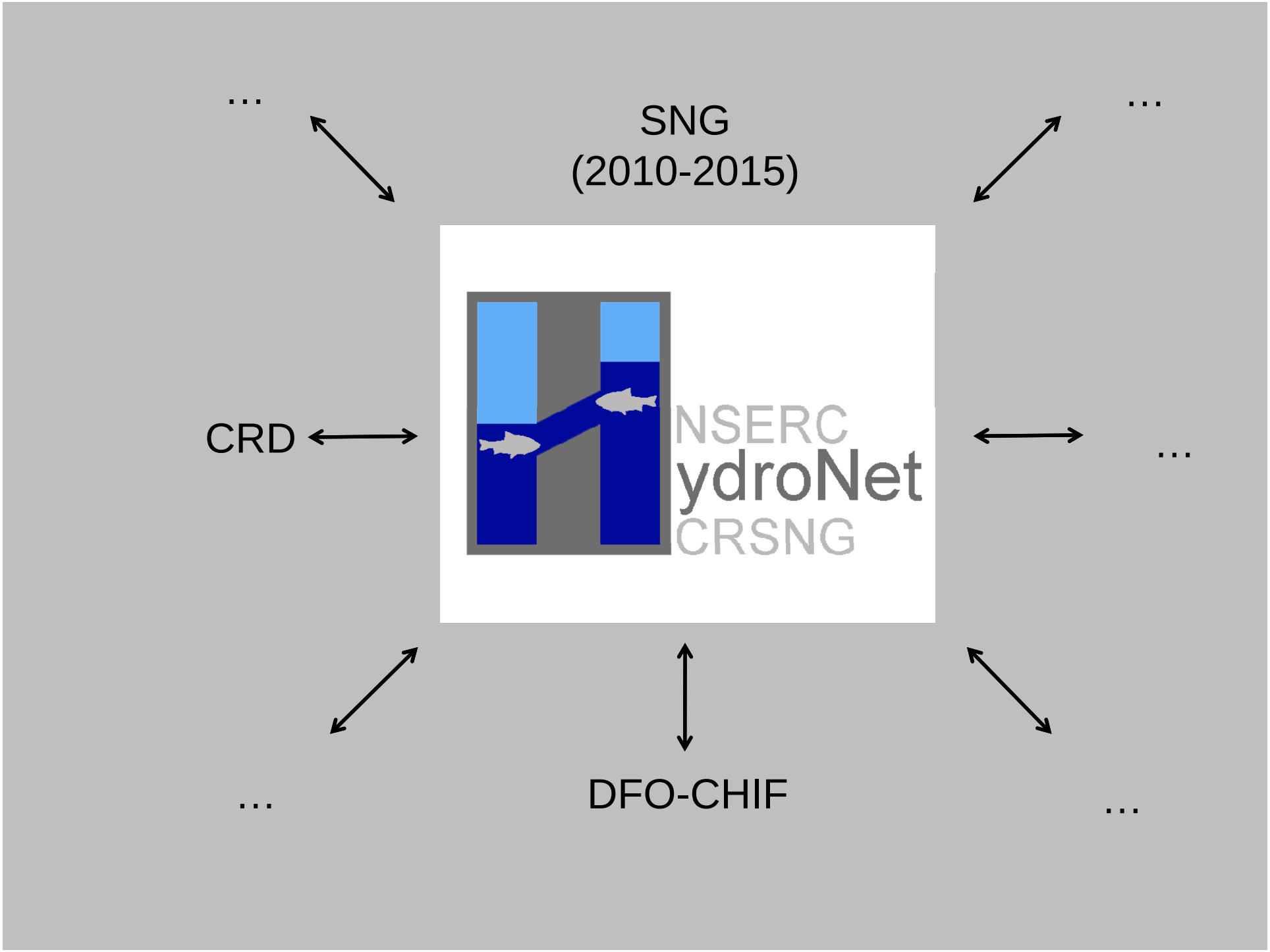
DFO-CHIF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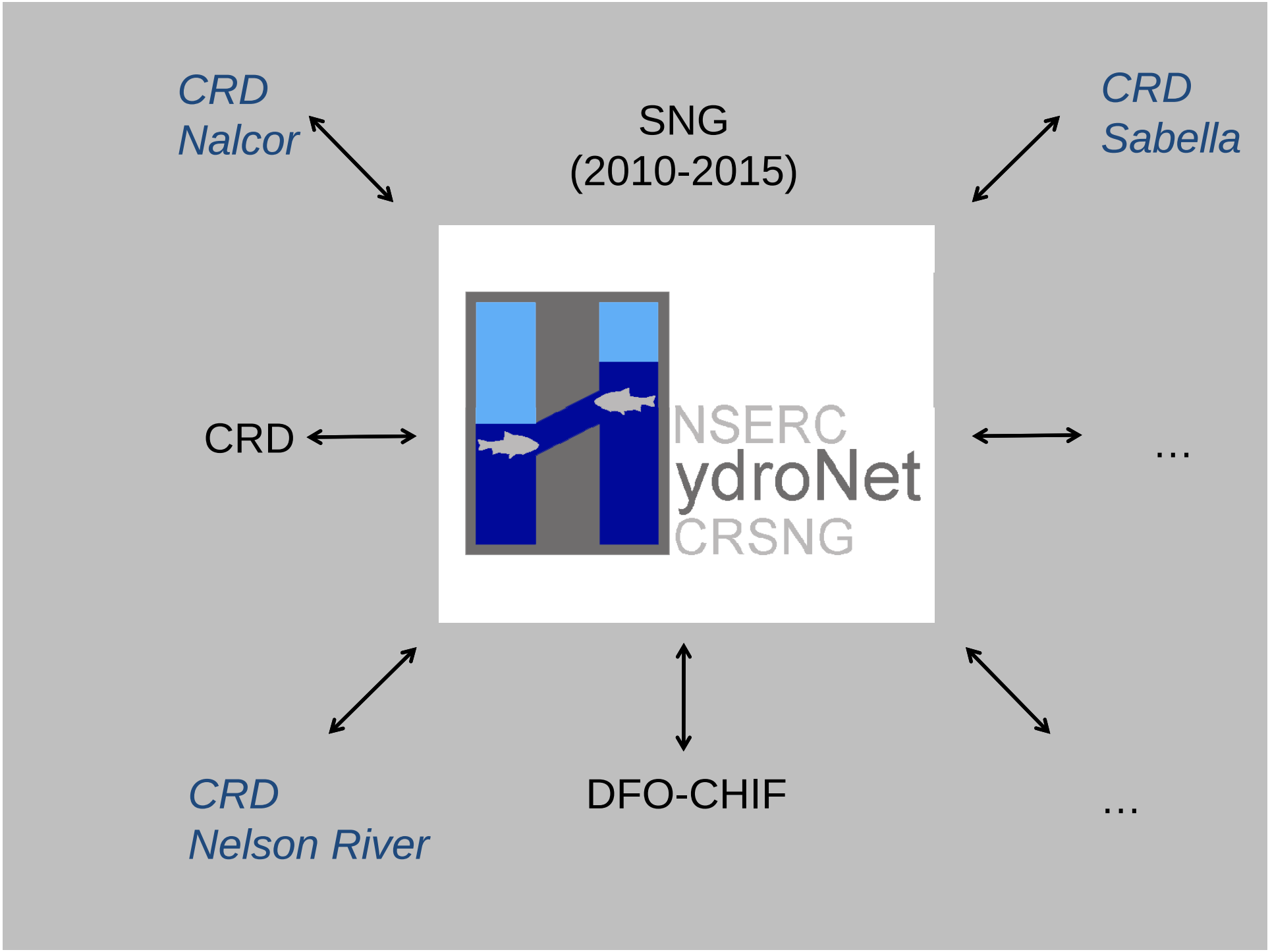
CRD
Nalcor
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CRD
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NSERC
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CRD
Nelson River
DFO-CHIF
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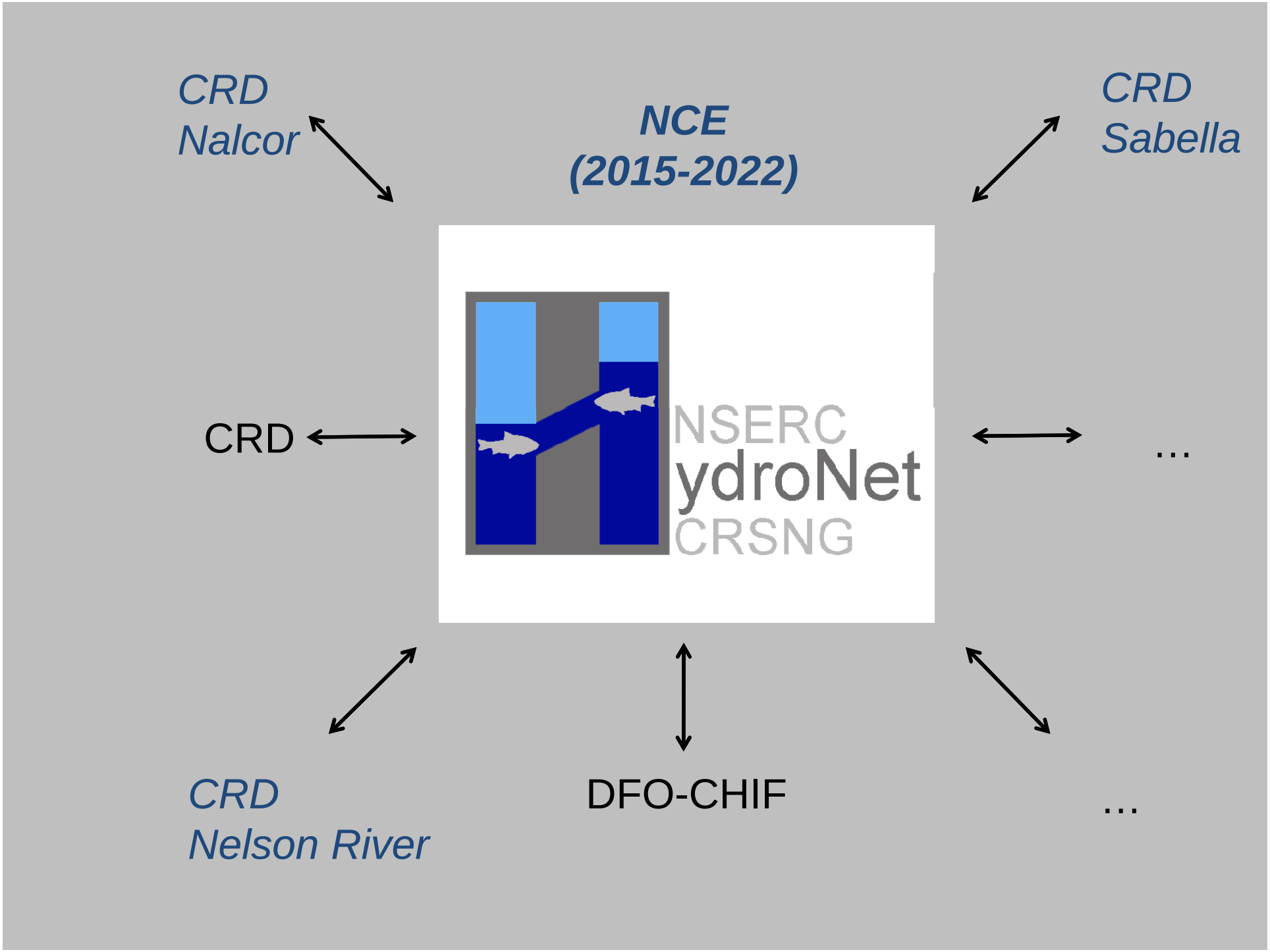
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The objectives of the 1st Symposium of NSERC HydroNet are:

1) To communicate the most recent analyses about projects that have started in 2010;

2) To present plans for 2011;

3) To receive comments/suggestions from collaborators, partners, attendees, and members of the Science Advisory Committee and Board of Directors;

4) To develop new projects, or identify new research avenues, with existing or future collaborators/partners.

Interships to graduate students 2011

- **$3K to Jason Thiem (Steven Cooke)**
Internship to Conte Anadromous Fish Research Centre
of University of Laboratory Massachusetts to conduct calibrations of archival acceleration data loggers with oxygen consumption and behaviour of captive lake sturgeon.

- **$3K to Fabien Hugue (Michel Lapointe)**
Internship in the laboratory of Jack Schmidt, Utah State University to study sediment transport processes

- **$3K to Fraser McLaughlin (Michel Lapointe)**
Intership in the laboratory of Brett Eaton UBC to develop collaborations on geomorphological processes

- **$3K to Simonne Harvey-Lavoie (Daniel Boisclair)**
Intership in the laboratory of Corey Suski, University of lllinois
to learn how to quantify the expression of heat shock protein in fish


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McGill
Canadian Rivers Institute
BC hydro
FOR GENERATIONS
UNB
University of New Brunswick
University of Alberta
Ontario
Manitoba Hydro
Brookfield
Renewable Power
Ressources naturelles et Faune
Québec
University of Lethbridge
FIAT LUX
UBC
Manitoba
Water Stewardship
Memorial University
University of Waterloo
INRS
Université d'avant-garde
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