# Barring the way to Asian carp invasion of Quebec inland river systems

**Rémy Pouliot,** Olivier Morissette, Frédéric Lecomte

Ministère des Forêts, de la Faune et des Parcs. Direction de l'expertise sur la faune aquatique

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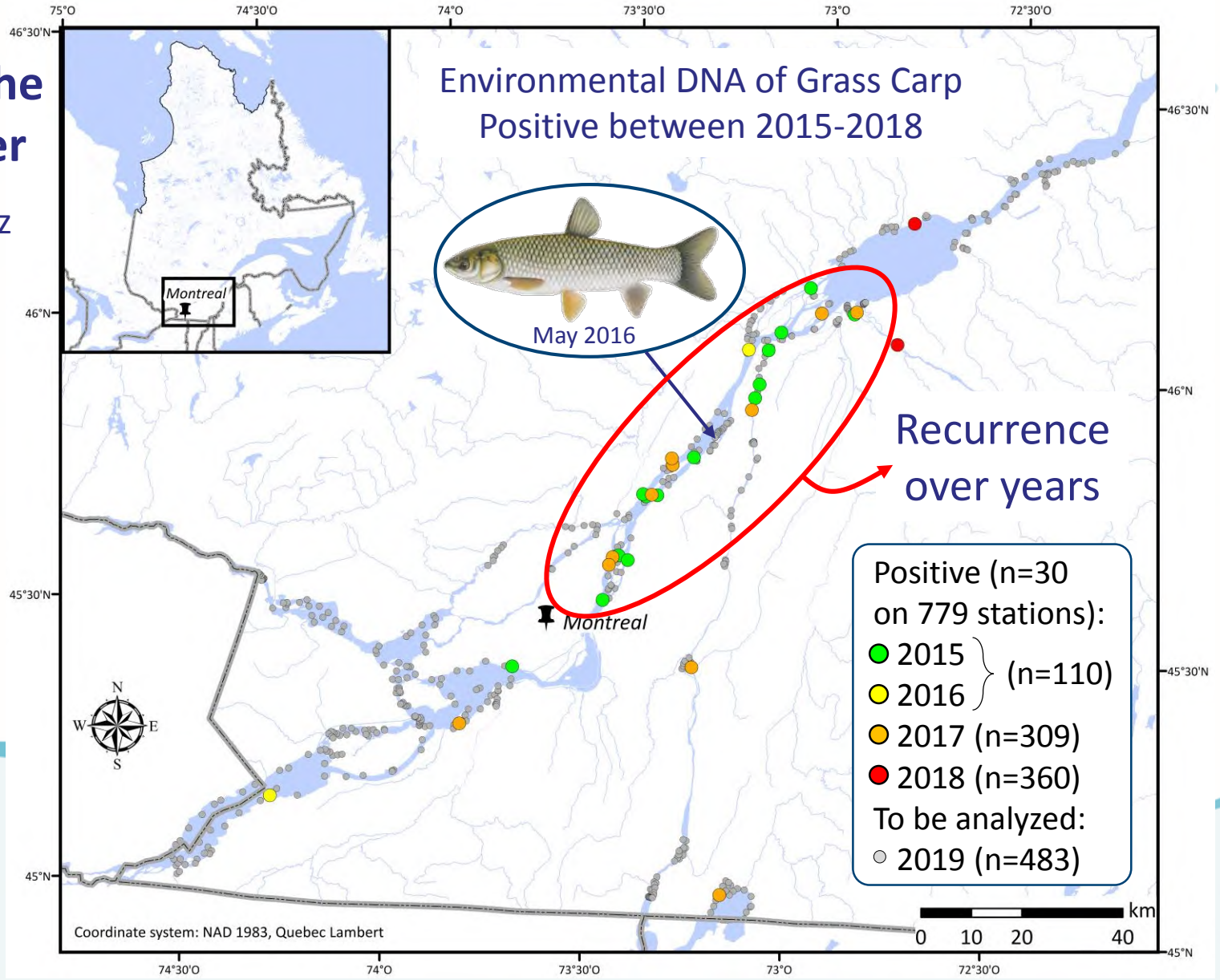
# Detection of Grass Carp in two steps in Québec waters

## Test of eDNA in the St. Lawrence River

*Collab.* Dr. L. Bernatchez
U. laval

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# Detection of Grass Carp in two steps in Québec waters

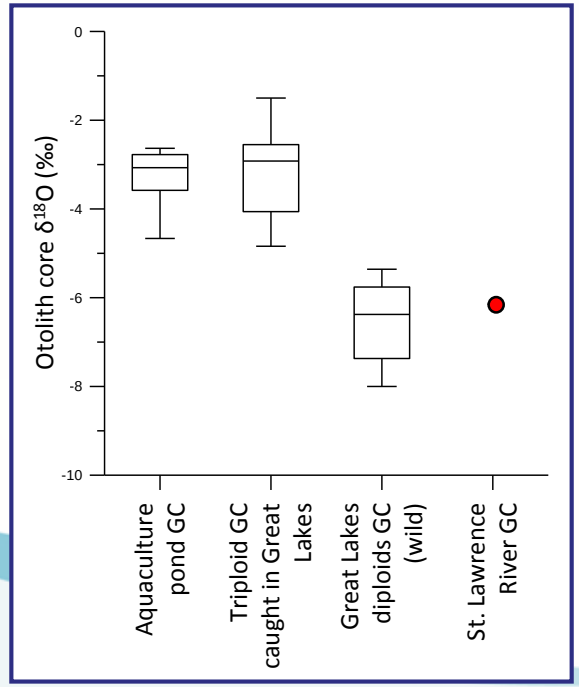
## Capture of a Grass Carp in the St. Lawrence River

Commercial fisherman from our surveillance network

- Female, diploid and bearing viable eggs
- 1,26 m TL (~49 in) and 29 kg (~64 lbs)
- Estimated as 9 years old


## Where does this carp come from?

- Otolith microchemistry and stable isotopes ($\delta^{18}O$)
- Stable isotopes on vertebrae, muscle, liver, blood and scale ($\delta^{13}C$ and $\delta^{15}N$)




(Work done by Whitledge and Cabana)

The Contrecœur GC appear to be born and lived in the Great Lakes water mass.

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# Quebec's Asian Carp Program

Initiated in 2016 (6.7 M$ until 2021, 2 phases)

**Main objective**: Increasing the capacity to react and take actions in face of AIS, notably Asian Carps, by creating this specific expertise.

- Create a concerted provincial **action plan**
- Optimize and establish **early detection** and **surveillance** focusing on Asian Carps
- Identify and analyze **options** available to **control/restrict** invasion of inland waters
- Evaluate the **options** available to **mitigate** impacts
- Develop and **adapt** the Quebec **expertise** on Asian Carps to deal with the St. Lawrence reality and create **collaborations** with agencies and experts in US & Canada

# Barrier potential in restraining fish movement project

**Objective**: Mapping and describing the natural and man-made obstacles in the St. Lawrence River tributaries to evaluate their potential in restraining fish movement and preventing Asian carp dispersal.

**Why?** Risks of dispersal from the St. Lawrence River in tributaries is now highly likely and quantifying such threat became a central objective of Quebec's Asian Carp Program.

**Where?** From tributary mouth in the St. Lawrence rivers to the upstream part of their tributaries, mainly in the fresh water part.

**When?** Under different scenario of water level.


☆ Montreal area

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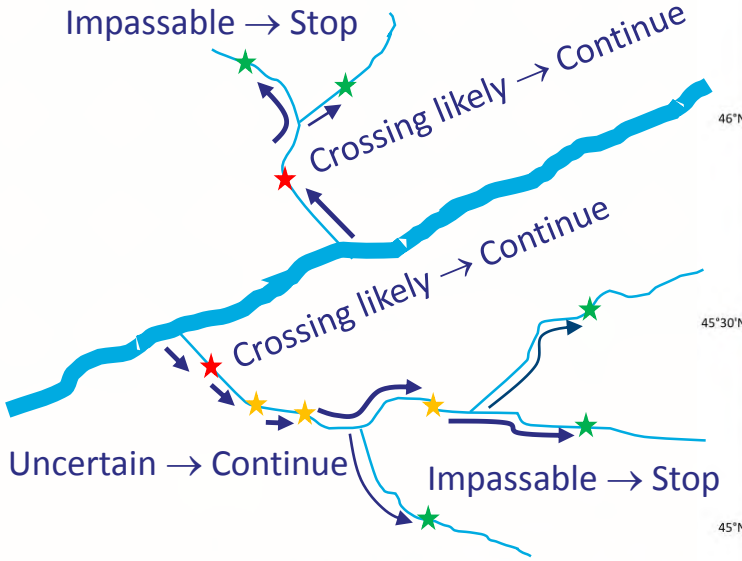
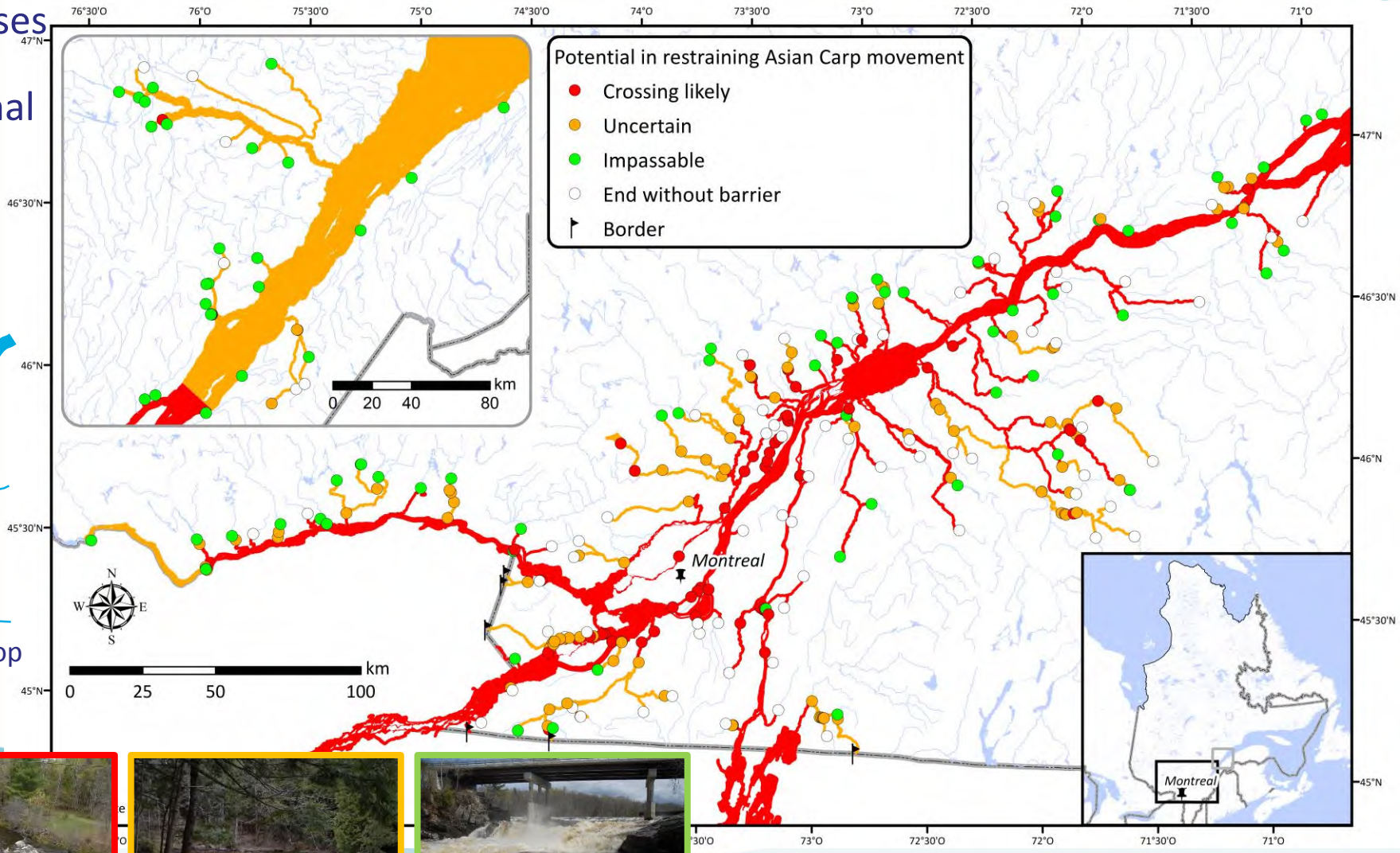
# Barrier potential in restraining fish movement project

Phase 1 : Preliminary analyses

**How?** Visually (photo), regional knowledge, biology, known barrier characteristics





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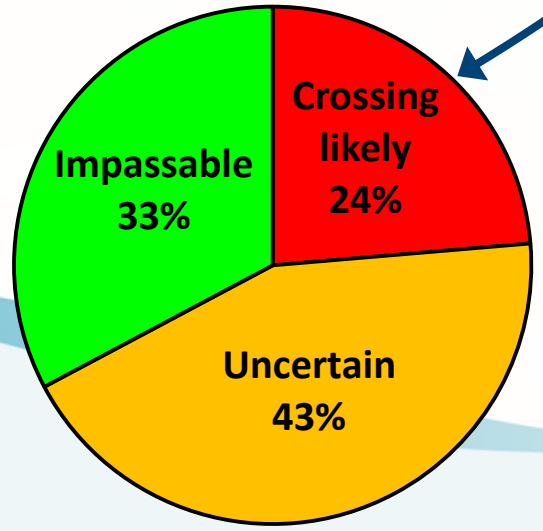
# Barrier potential in restraining fish movement project

Phase 1 : Preliminary analyses

| Barrier | Built | Natural | All |
|---|---|---|---|
| Crossing likely | 52 | 5 | 57 |
| Uncertain | 76 | 29 | 105 |
| Impassable | 53 | 26 | 79 |
| **Total** | **177** | **54** | **241** |
| End without barrier | - | 82 | 82 |
| Border | 6 | - | 6 |




- 167 tributaries ⇒ 329 sections
- The St. Lawrence River
- ~5 000 km (including the St. Lawrence)

**To keep in mind…**

- A count of existing barriers
- Only a visual evaluation
- No field visit

- Starting point
- Worst case scenario

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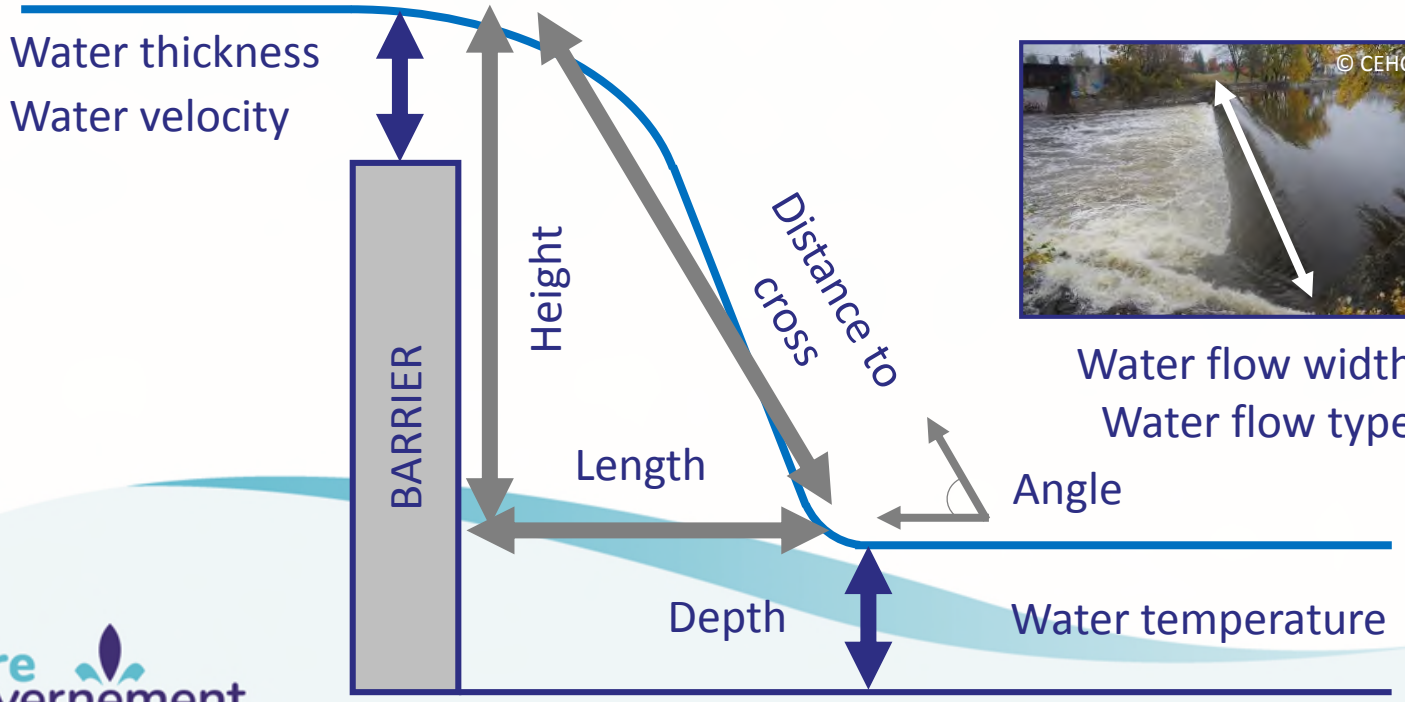
# Barrier potential in restraining fish movement project

Phase 2 : First field assessment and evaluation grid

- Field characterization of barriers (n = 102)
- Targeted periods ⇒ Flood (or high water) and low water
- Barrier characterization
  - Pictures / Descriptive schema
  - Possible ways to cross barrier
  - Complex barrier into simple barriers
- Hydrological variables

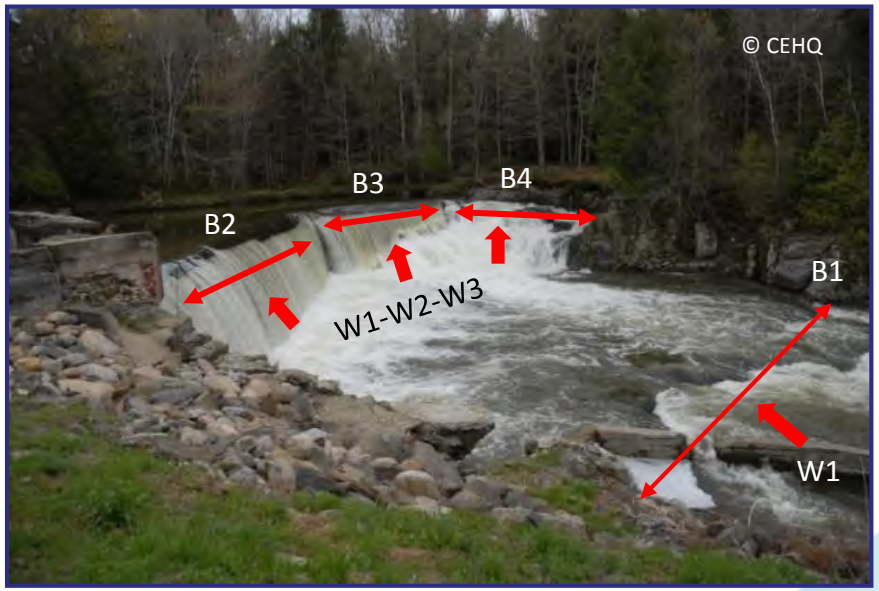






Water flow width
Water flow type

Example of complex barrier




3 ways and 4 barriers

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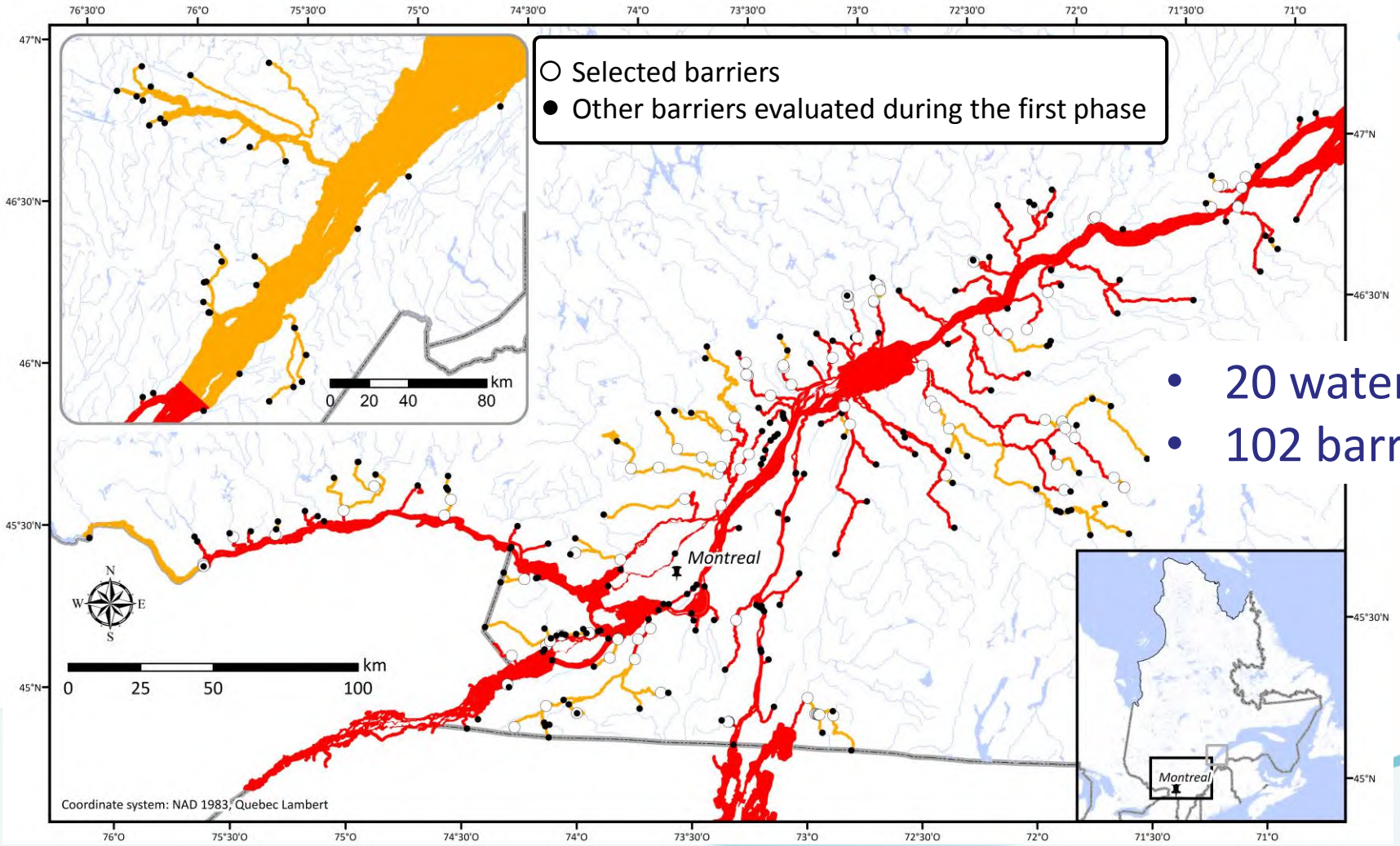
# Barrier potential in restraining fish movement project

## Phase 2 : First field assessment and evaluation grid




- 20 watershed associations
- 102 barriers

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# Barrier potential in restraining fish movement project

Phase 2 : First field assessment and evaluation grid

**Creation of a evaluation grid:**

- Variable choice
  - Easily measurable / Applicable everywhere
- Define thresholds
  - Based on Asian carp biology / swimming capacities
  - Risk management / Prudent approach ⇒ Underestimation of swimming capacity
- Variable weight
  - Interaction between variables / Influence on swimming capacity
- Categorize the risks for a given barrier
  - Missing data / Barrier complexity

# Barrier potential in restraining fish movement project

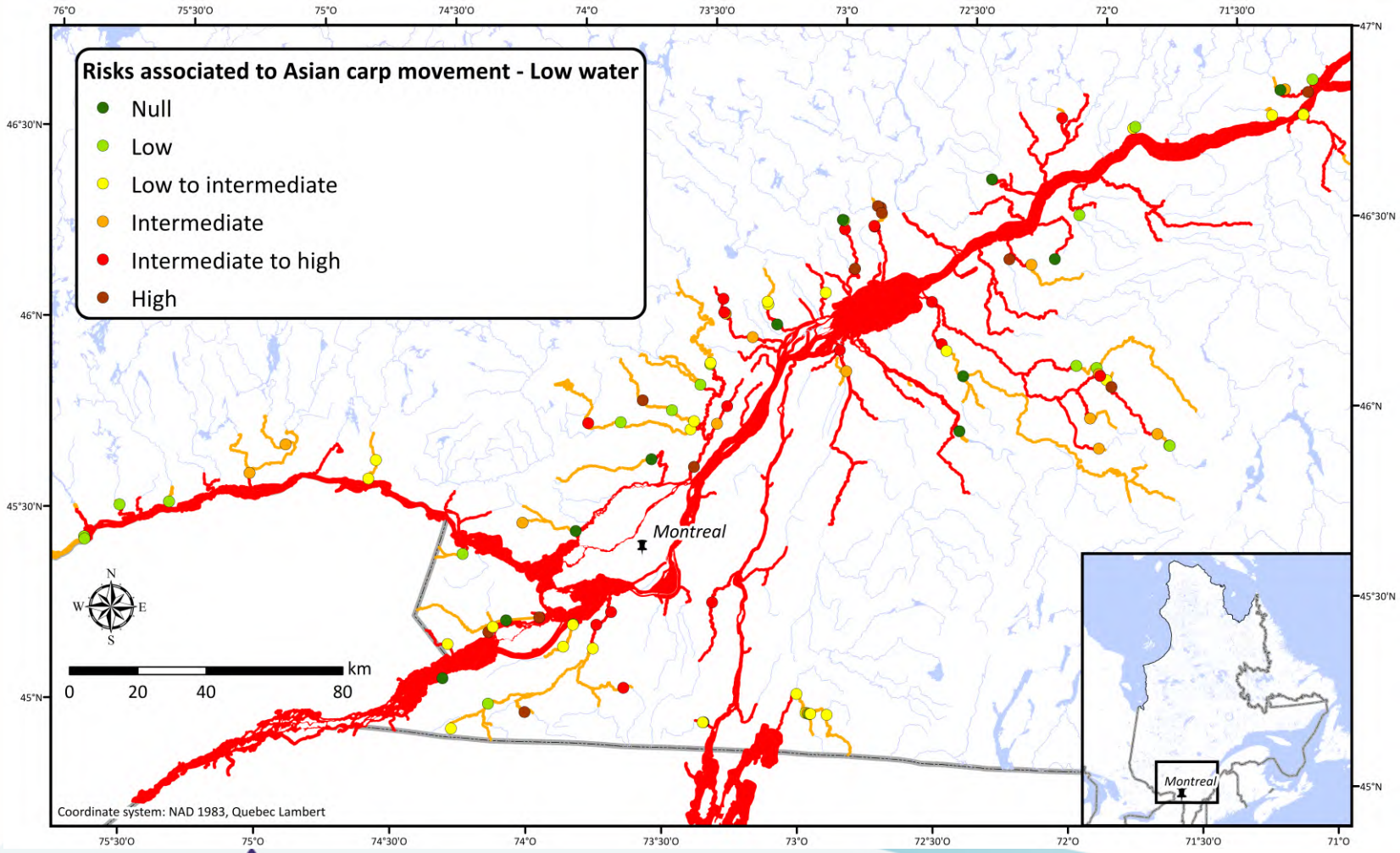
Phase 2 : First field assessment and evaluation grid

- Score transformed in ratio ⇒ Total / Total of available points (max. = 100)

| Risks | | Threshold |
|---|---|---|
| | High | Total ≥ 0.8 |
| | Intermediate to high | 0.6 ≤ Total < 0.8 |
| | Intermediate | 0.4 ≤ Total < 0.6 |
| | Low to intermediate | 0.2 ≤ Total < 0.4 |
| | Low | 0.1 ≤ Total < 0.2 |
| | Null | 0.0 ≤ Total < 0.1 |

# Barrier potential in restraining fish movement project

## Phase 2 : First field assessment and evaluation grid




| Δ LW to HW | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Risks** | **-3** | **-2** | **-1** | **0** | **1** | **2** | **3** |
| High | | 2 | 4 | 6 | | | |
| Intermediate to high | 1 | 1 | 5 | 7 | 2 | | |
| Intermediate | | 3 | 4 | 8 | | | |
| Low to intermediate | | 2 | 4 | 15 | 5 | | |
| Low | | | 5 | 12 | 5 | | |
| Null | | | | 6 | 1 | 2 | 1 |
| **TOTAL** | **31** | | | **54** | **16** | | |

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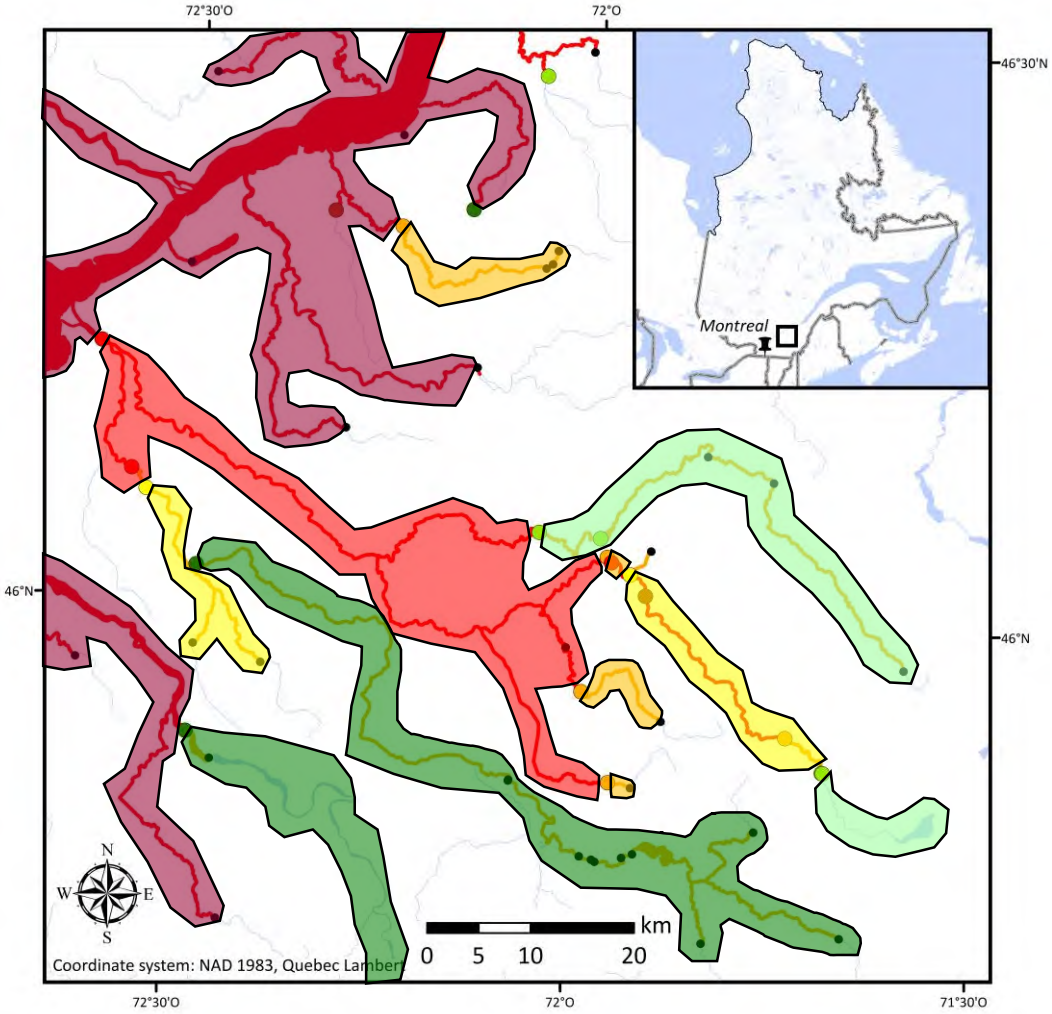
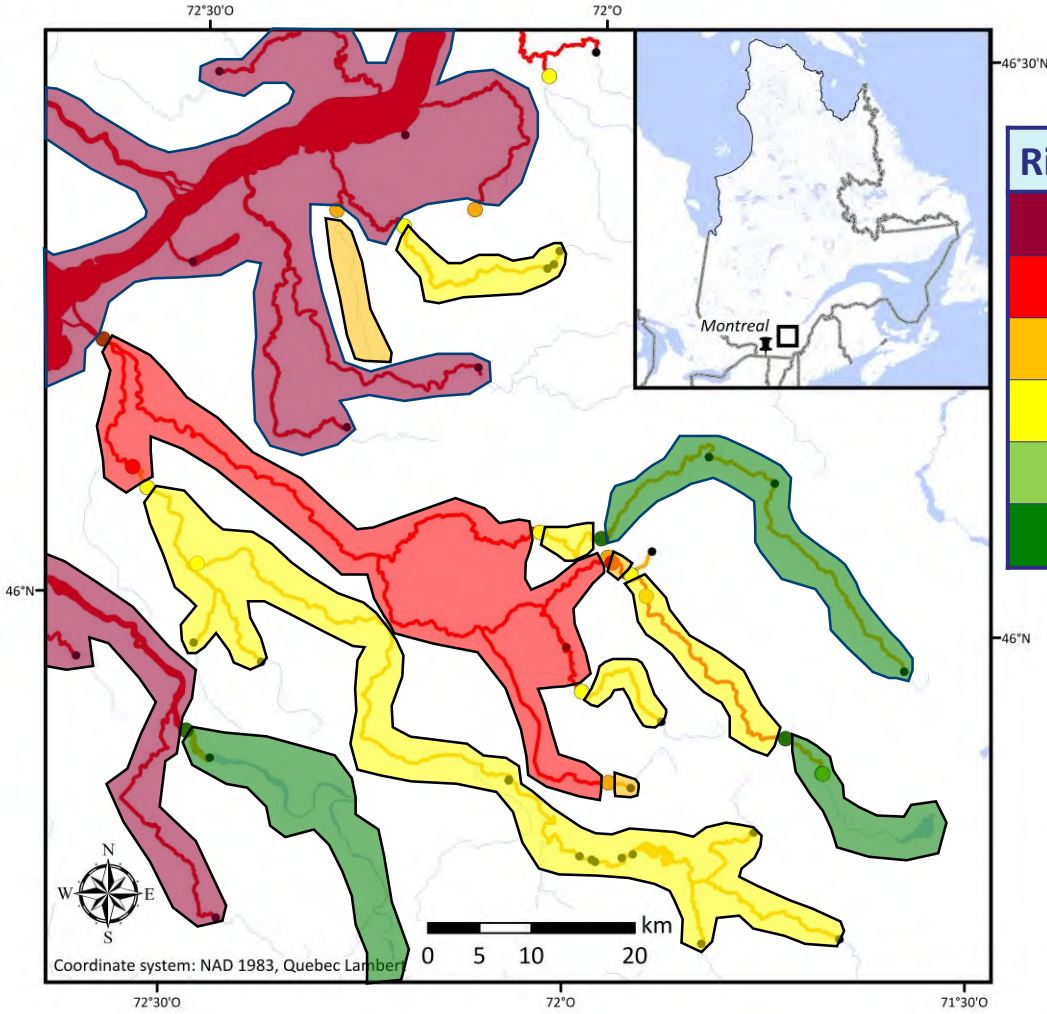
# Barrier potential in restraining fish movement project

## Phase 2 : First field assessment and evaluation grid




| Risks |
| --- |
| High |
| Intermediate to high |
| Intermediate |
| Low to intermediate |
| Low |
| Null |

**Low water** **High water**

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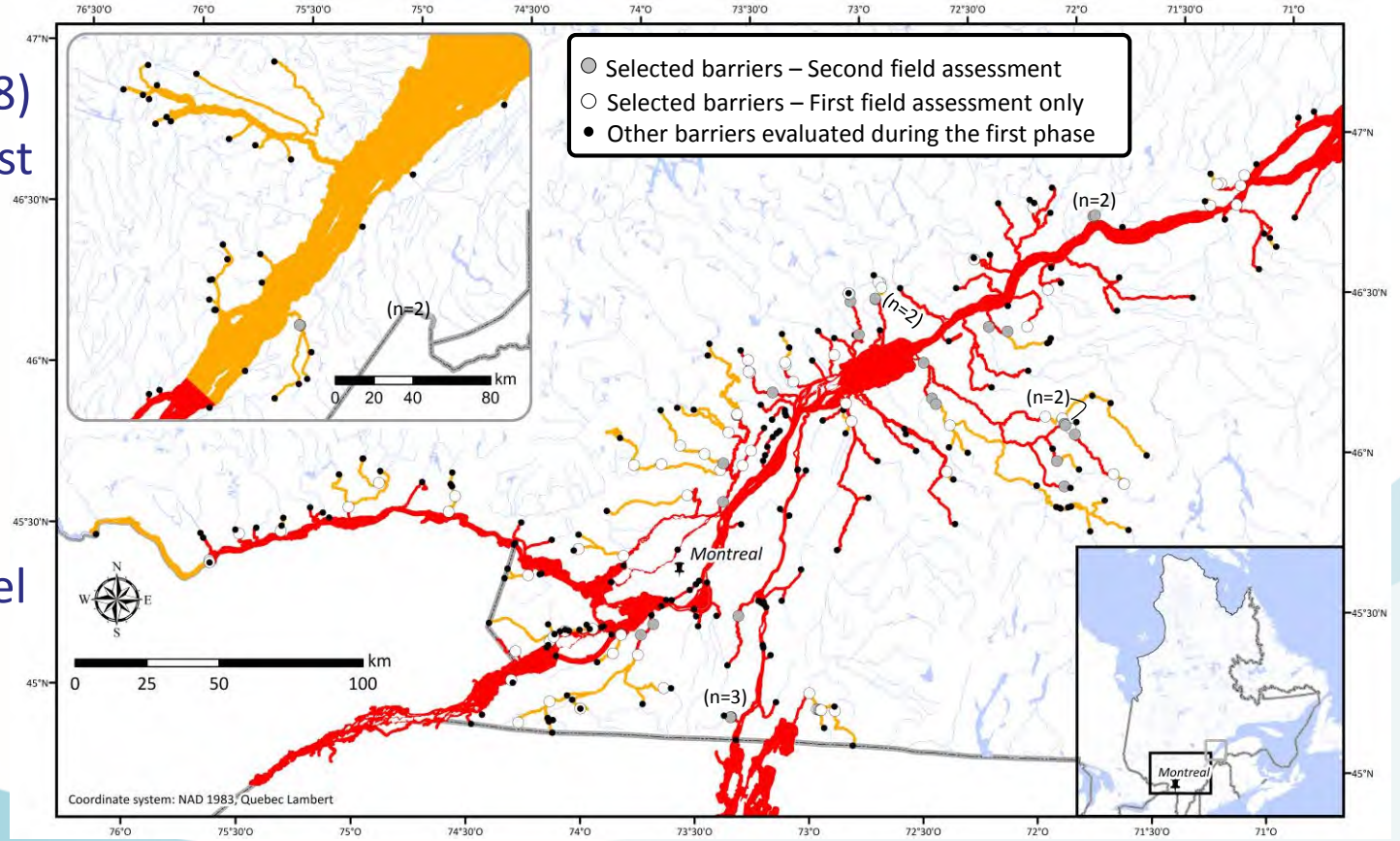
# Barrier potential in restraining fish movement project

Phase 3 : Second field assessment and evaluation grid (ongoing)

**Objective**: To determine the most at-risk time interval during the ice-free period.

- Field characterization of barriers (n = 28)
  - The most downstream barriers in the most at risk areas
  - 9 watershed associations
- Same protocol / same evaluation grid
- Six targeted periods
  - Between spring flood to higher water levels in autumn, including low water level in summer

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# Take home message

The number of potential barriers theoretically capable of blocking Asian carps invasion in inland Quebec water appears significant, **major tributaries were to some extent protected** from the species' ability to disperse through the hydrologic connectivity from the St. Lawrence River.

**Next steps:**

- Integration of second field assessment
- Utilization of evaluation grid for other species (IAS or native)
  - Impassable barriers for AIS vs. crossing likely barriers for native fishes

  ⇒ **We know the barriers to keep and those to work on**
- Risk assessments
  - River potential for Asian carp reproduction
  - River segments downstream impassable barriers

Fish images: Louis L'Hérault

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# Acknowledgement

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