Are Hydroelectric Reservoirs interesting for Waterfowl : a Case Study

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Senechal et *al.* 2022. Pre and Post-Impoundment Study of Breeding Waterfowl Use of a Hydroelectric Reservoir in the Eastern Canadian Boreal Forest. Waterbirds 45(4): 407-420

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Study overview and findings

In this study, we will :

- Tried to differentiate between real impacts and natural variations in duck populations after creating a reservoir
- See that, after impoundment, the density of :
  - breeding pairs remained stable
  - density of broods significantly increased (x6)
- How duck species react differently to this new modified habitat

Introduction

Many countries (Brazil, Canada, China, Finland, USA,...) rely on hydroelectricity as a renewable source of energy

Reservoirs can have large scale impacts by flooding land and transforming rivers and ponds into large bodies of water

The impacts on breeding waterfowl, a group of aquatic birds associated with wetlands, is poorly understood

Introduction

Few long term follow-ups are available on the subject

Most of the studies don’t have control plots to differentiate real impacts from annual variations in duck populations

Finally, accurate impact assessments and good mitigation measures are necessary for better environmental conservation

Objectives

To compare breeding pairs and broods numbers before and after the creation of a reservoir (over a ten year period)

Hypothesis : the creation of the reservoir will reduce the number of wetlands available and be detrimental to duck numbers

Study area

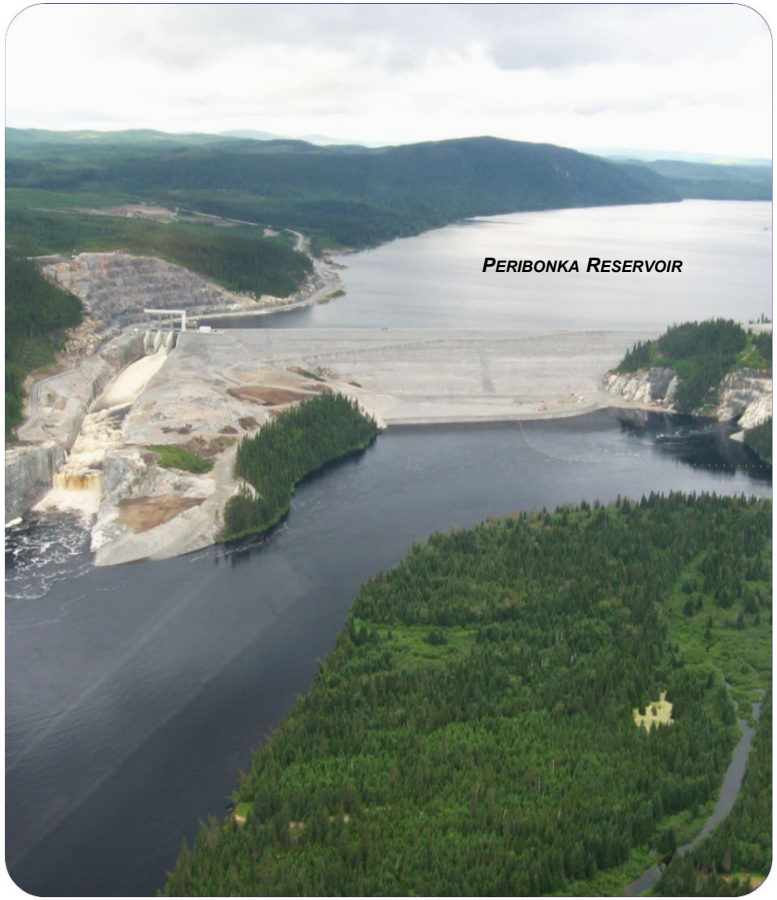
Located in the eastern boreal forest of Canada

- Mostly balsam fir/black spruce (coniferous)
- Logging operations in many areas

Study area

- A 32 km^2 reservoir

- **Run-of-river type powerhouse**
  (water level fluctuations : 1,5 m)



Study area

Impounded in September 2007

Mitigation measures for waterfowl :

- 40 ha of wetlands created
- 59 nest boxes installed around the reservoir and the wetlands (2006-2009)

Surveys

Helicopter surveys were conducted before and after impoundment :

- Before : 2004 and 2005
- After : 2008, 2010, 2012, 2015 and 2018

Surveys

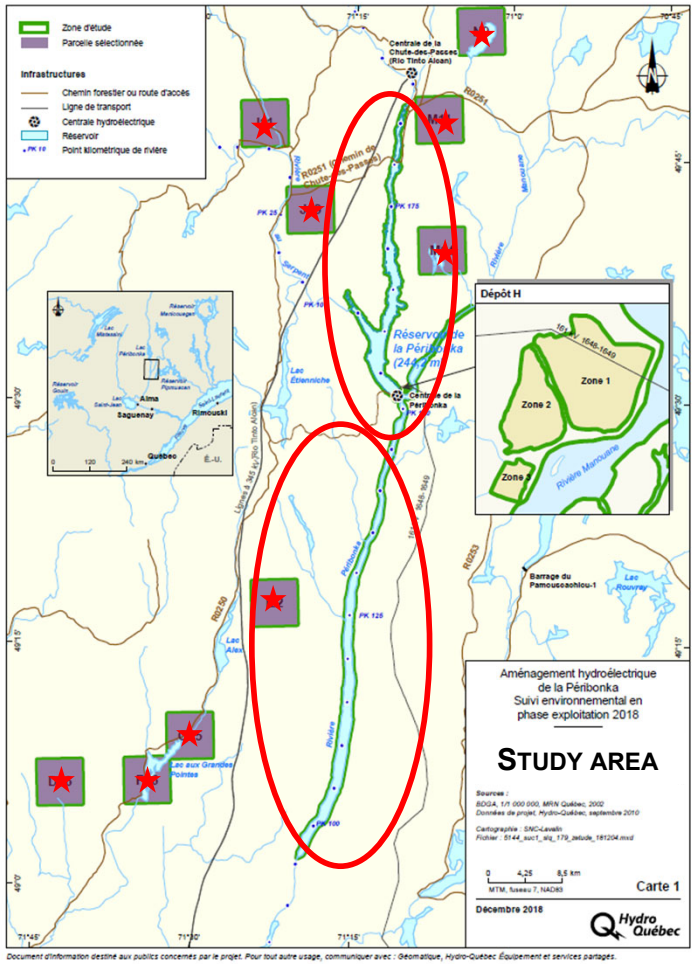
Surveys were done :

- Impact site : Reservoir

- Control sites : 9 random 5x5 km plots

  Downstream portion of the river

Surveys for breeding pairs (spring) and broods (summer)



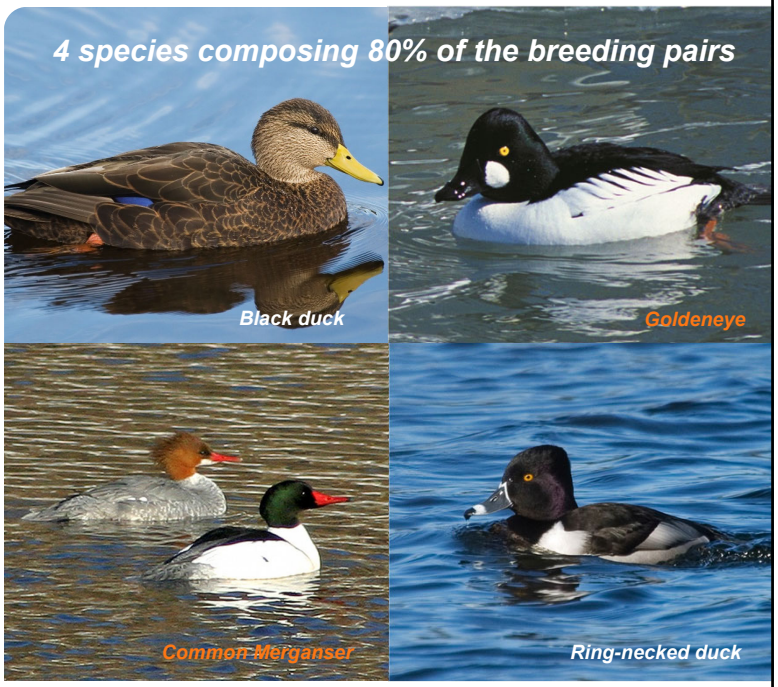
Results – Species composition

Species richness similar before and after impoundment
(9,0±1,4 compared 7,6±2,6 species)

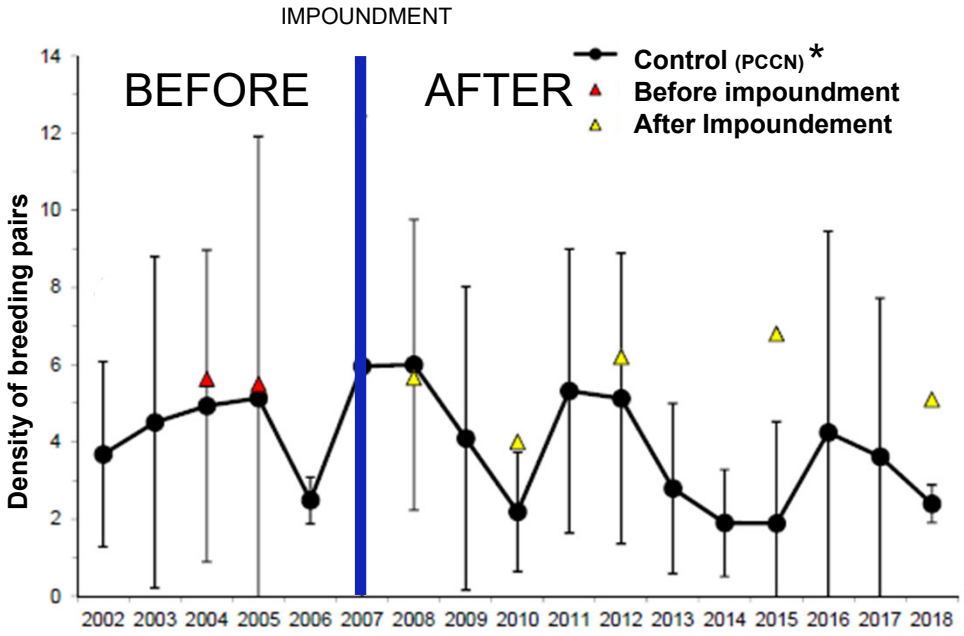
Common Goldeneye and Black Duck: observed every year

Ring-necked duck (small ponds): not seen 3 years after impoundment

Merganser (fish-eater): abundant pre-impoundment, declined and was not detected the 10th year



Results – Variations in breeding pairs



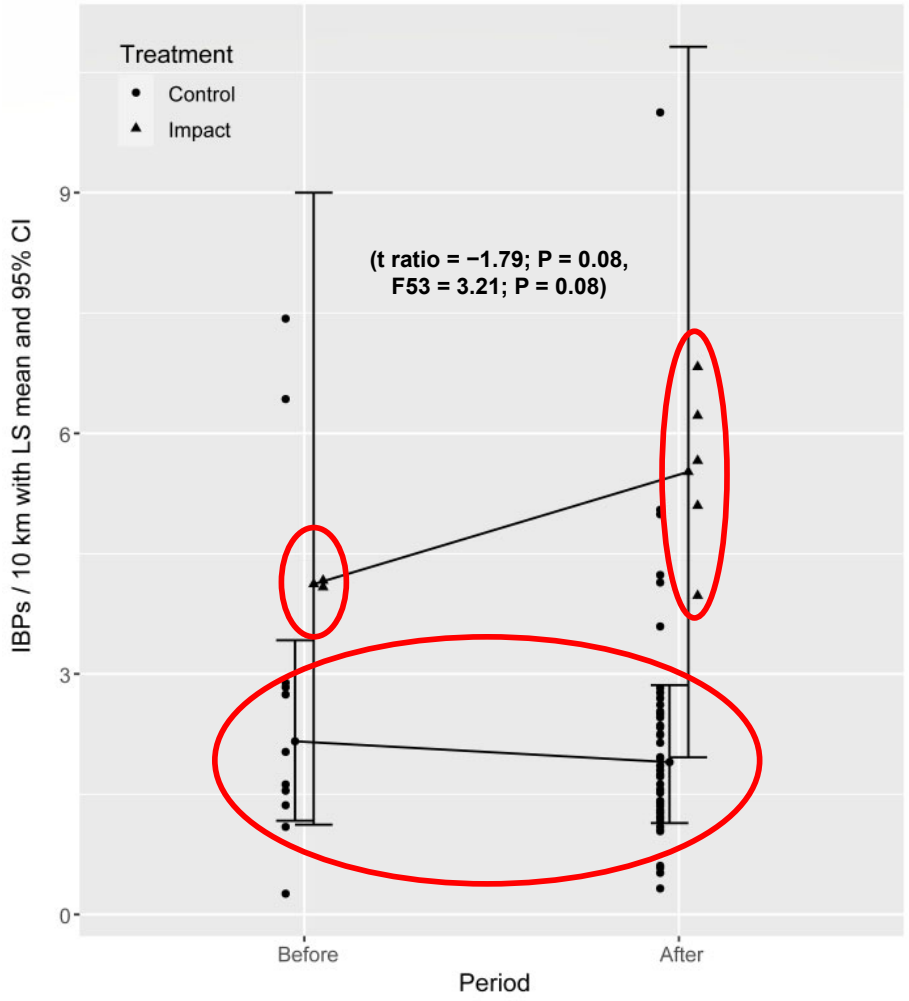
- Breeding pair numbers were converted to densities
- Density in breeding pairs varies after impoundment and is sometimes different than the density in control plots
- Are those variations significant ?

*** Control plots in this graph do not include pairs observed on the downstream river**

Impact on breeding pairs

BACI test : densities of breeding pairs, **before** and **after** the impoundement (▲), are compared, taking in consideration the natural variations in duck populations (control •) and time

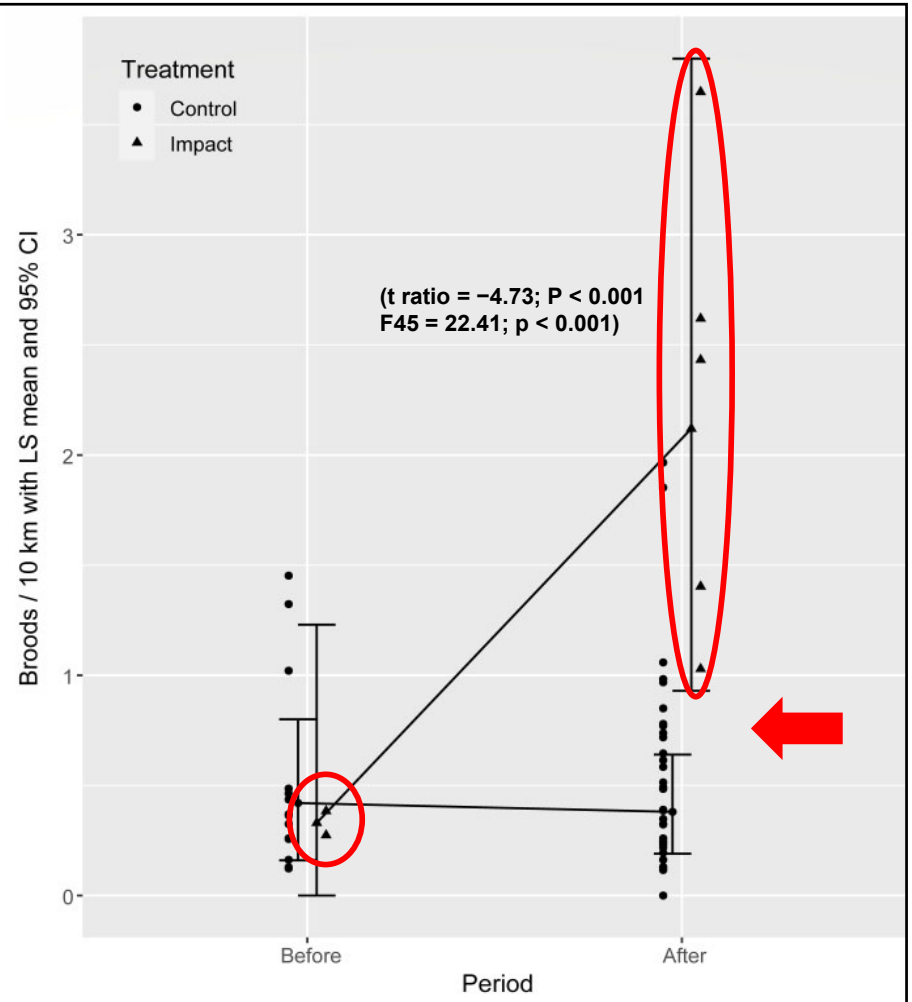
The density of breeding pairs was similar before and after the creation of the reservoir



Impacts on broods

The density of broods after impoundment is significantly greater (▲)

Broods are x6 more abundant on the reservoir



Discussion

Contrary to our predictions, the creation of the reservoir did not lead to a decrease in density of breeding pairs or broods

The density of breeding pairs was stable and broods significantly increased (sixfold)

Discussion

Positive results are probably due to the fact that water level fluctuations on the Peribonka reservoir are low
(max ±1,5 m)

Fluctuations are similar to the variations found on natural water bodies

Small variations in water levels promote the growth of aquatic plants and waterfowl habitat

Large bodies of water also offer protection from predators (mammalian) during brood rearing

Peribonka river : « The river that dig through sand in native language »

Discussion

Of course, mitigations measures also contributed reducing impacts on waterfowl

However, we estimated that nest boxes contributed to only ≈30% of the brood numbers and that only 15% of the broods observed were seen of the wetlands created as mitigation measures

Reservoirs are interesting for waterfowl but duck species reacted differently to this new modified habitat

Peribonka river : « The river that dig through sand in native language »

Discussion

Studies also reported that nest box efficiency drops after time if they are not regularly cleaned and repaired

Also, wetland creation can be efficient measures of mitigation but are costly

Further studies could be needed to better understand the impact of reservoirs over the longer term (>10 years)

Peribonka river : « The river that dig through sand in native language »