The complex interaction of ecology and hydrology in a small catchment: 
a salmon’s perspective

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![Map of study area](image)
Streamflow characteristics of Catamaran Brook (1990-2010)

Wild Atlantic salmon
*a wondrous life cycle*
Objectives for our North-Watch paper

to investigate the inter-relationship of Atlantic salmon, *Salmo salar*, and hydrologic factors inherent to the Miramichi basin and the boreal-temperate Canadian climate. Specifically,

- how natural hydrologic variability in different seasons can influence the population dynamics of wild salmon
- predict changes in habitat suitability and salmon populations in relation to climate change
Annual estimates of adult Atlantic salmon entering Catamaran Brook as a function of maximum stream discharge during upstream migration (Sept-Nov).

from Mitchell & Cunjak (2007)

Ecological significance of autumn streamflows
Fig. 6. Mean total fish production of four dominant species combined (a) and percentage of total production by species (b) by habitat type and reach in Catamaran Brook, 1990–2004. Error bars are standard error.

(from Mitchell & Cunjak 2007, JAE)
salmon egg survival, 1990-2000

% change in autumn-to-summer density of juvenile salmon, 1990 – 2002

estimated smolt totals, 1990-2008
Water Temperature and Salmon

- **Upper lethal limit:** 29°C
- **Physiological Stress:** 23°C – abandon territories
- **Optimal:** 15-18°C – Growth, survival
Number of days per year when max daily water temp ($T_{\text{max}}$) exceeded 23°C in the Little Southwest Miramichi River (1992-2011).

* indicates a year with incomplete summer data.

Number of days when $T_{\text{max}}$ exceeded 23°C as a function of river discharge (m$^3$/s)
CONCLUSIONS

• response of spawning adults to ascend small streams in response to high autumn flows, or the density-dependent relationship of salmon eggs/parr and winter streamflows, are suggestive of evolutionarily adaptive traits.

• some evidence for markedly negative impacts of atypical, extreme flow events
  1. destructive consequences of mid-winter mechanical ice break-up on the survival of juvenile salmon and other fishes is highly unpredictable but has significant implications on fish community dynamics.
  2. summer low flows directly increase the probability of high temperature stress events with major implications for growth and survival of coolwater fishes.

• these ‘rare’, or extreme, flow events may increase in frequency in the future as predicted under various climate-warming scenarios