Investigating the effects of rainbow smelt (*Osmerus mordax*) invasion on lake trout (*Salvelinus namaycush*) restoration in the Sudbury Basin

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Introduction

- Only ~30% of lake trout reintroduction programs have resulted in self-sustaining populations[1]
- Replacement of native forage base with rainbow smelt may affect reintroduction success[2]
- Smelt contain higher levels of dietary thiaminase (up to 100x) than native prey fishes[3] and consumption of smelt has been associated with thiamine deficiency complex (TDC)[3,4]
- TDC may hinder reintroduction efforts for lake trout in smelt-invaded lakes, but current data are insufficient to assess this[2,4]
- The restoration of lake trout in acid-affected lakes in the Sudbury Basin provides an opportunity to assess the effects of smelt on lake trout restoration

Figure 1. Sudbury angler with a net full of exotic rainbow smelt

Rainbow smelt, Edmonson and Crisp

Objectives and Hypotheses

O1. Compare prevalence of TDC in lake trout between lakes that do and do not contain smelt

O2. Determine if individual and population metrics differ between lakes that do and no not contain smelt

O3. Determine the relationship between dietary niche and tissue thiamine levels

H1. Prevalence of TDC will be greater in lakes with rainbow smelt

H2. Individual and population metrics will differ between lakes with and without smelt

H3. Lake trout dietary niche will influence tissue thiamine levels

Table 1. Individual performance and population metrics to be compared between lakes with and without smelt

Individual metrics	Population metrics
Condition	Length-at-age
Colouration	Catch per unit effort
Morphology	Mortality rate
Tissue thiamine concentration	Growth rate

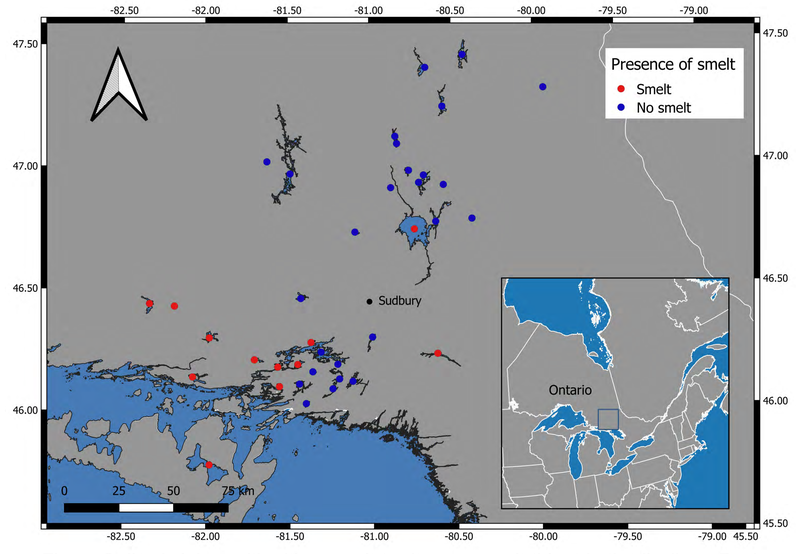

Figure 2. Study lakes with either smelt (red) or no smelt (blue) in the Sudbury Basin

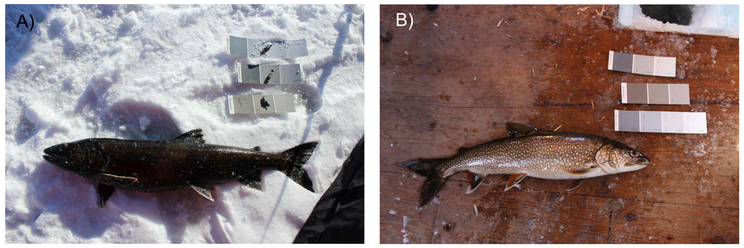

Figure 3. Lake trout captured from A) Wanapitei Lake (smelt) and B) Panache lake (no smelt)

Methods

- Broadscale monitoring survey data were collected from 2009–2019 for lake trout lakes with smelt (n = 12) and without smelt (n = 27)
- Population metrics, such as length-at-age and catch per unit effort, will be compared between lakes with and without smelt
- In summer 2021, n = 20 lake trout and prey items will be collected from a sample of lakes with (n = 6) and without (n = 6) smelt using summer profundal index sampling[5] and angling.
- Individual metrics will be collected for each lake trout
- Thiaminase activity will be measured for captured prey fishes[6] and compared between prey fishes within and between lakes
- Fatty acid signature analyses and stable isotope ($\delta^{13}C$ and $\delta^{15}N$) analyses will be used to elucidate prey contributions to diet and to quantify dietary niches[7,8]
- Liver and muscle total thiamine concentration will be determined using High Performance Liquid Chromatography[9]. Fish are considered to have TDC if thiamine levels are below ≤0.65 nmol • g^{-1}, [10] . Prevalence of TDC will be measured as a proportion.
- Using glmms, individual metrics, population metrics, and prevalence of TDC will be compared between lakes with and without smelt
- The relationship between dietary niches and tissue thiamine levels of individual lake trout will be quantified using regression analyses

Significance

- Thiamine deficiency is identified as a factor causing population declines in several species[11]
- Lake trout are currently the focus of multiple multi-million dollar reintroduction programs[12]
- Results will contribute to the knowledge of best practices for species reintroductions and may identify factors influencing success of reintroduction programs for lake trout
- Findings will provide information for more effective and efficient restoration, management, and conservation.

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More information available at

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