Insight of the Deepwater Sculpin Reproduction in Lake Ontario

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INTRODUCTION

- Deepwater sculpin *Myoxecephalus thompsonii*, abundant in Lake Ontario until the 1940s, were thought to be extirpated until the late 1990s (Lantry *et al.* 2007, Figure 1). Since then, they appear to have recovered as their population increased 59% per year from 1996 to 2016 (Weidel et al. 2017).
- Negative interactions with alewife and slimy sculpin were implicated in their decline in Lake Michigan (Madenjian *et al.* 2002). Their recovery has been associated with declining alewife and rainbow smelt abundance, as well as reduced nutrient inputs in Lake Ontario (Weidel et al. 2017).
- Juvenile deepwater sculpin are bottom dwellers and are preyed upon by burbot and lake trout, helping to cycle energy from benthic zones to surface waters through their diet of invertebrates such as *Diporeia* and *Mysis* (Brandt 1986).
- Spawning of deepwater sculpin takes place in the winter and the peak hatching period is in March (Nash and Geffen 1991); however, little is known about their reproduction.
- Their size at first maturation in Lake Ontario is 116 and 110 mm for females and males, respectively (Weidel et al. 2017). Females gonadosomatic index (GSI) reached up to 25%, whereas males GSI were up to 3.3% (Weidel et al. 2017).

OBJECTIVES

- Determine health of deepwater sculpin using their condition factor (K).
- Evaluate deepwater sculpin reproductive potential using gonadosomatic index (GSI) and batch fecundity.
- Assess deepwater sculpin oocyte development to test the hypothesis that deepwater sculpin undergo multiple spawning events.

Figure 1: Deepwater sculpin

Figure 2: Oocyte diameter measurement.

MATERIALS AND METHODS

- Deepwater sculpin were collected from Lake Ontario by NYSDEC and USGS in Fall 2018 and 2019 using bottom trawls.
- Fish were weighed (W in g) and measured for total length (L in cm).
- Gonad was excised and weighed (W_g in g). Ovaries were subsampled for batch fecundity estimate.
- K was calculated as $(Wx100)/L^3$ and GSI as $(W_g x100)/W$.
- Absolute batch fecundity was determined by counting the total number of the largest oocytes present in the ovary subsample and the number counted raised to the whole ovary weight.
- Relative batch fecundity was calculated as the absolute batch fecundity divided by the fish weight.
- Oocyte development was accessed using histological procedures. Gonads were fixed in formalin or Bouin's solution, embedded in paraplast, cut at 6 µm sections, and stained with Mayer's hematoxylin and eosin according to Rinchard and Kestemont (1996).
- The diameter of twenty mature oocytes for each mature female was measured under a binocular microscope using Celestron Imaging software (Figure 2).

RESULTS AND DISCUSSION

- The average condition factor (K) was 1.09 and 1.08 for females and males, respectively.
- Total length and body weight relationship is presented in Figure 3. Growth of deepwater sculpin was positively allometric (b > 3) on pooled data.
- GSI reached 1.3 ± 0.7% and 7.9 ± 6.2% in males and females, respectively. Female ovaries were in different stages of maturity, confirming a prolonged spawning period.

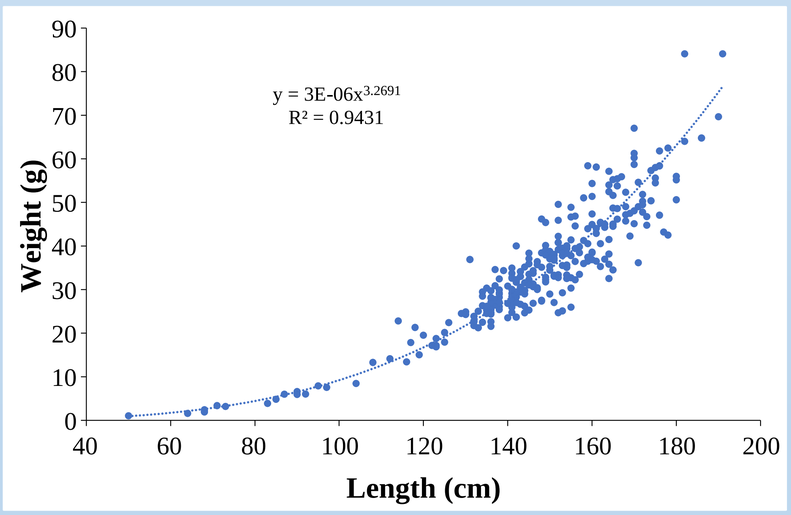

Figure 3. Length / weight relationship of deepwater sculpin collected in Lake Ontario in Fall 2018 and 2019 (n = 167).

- Preliminary histological data revealed the presence of oocytes at different stage of maturity inside the ovary indicating that deepwater sculpin are able to spawn multiple times during its spawning season (Figure 4).
- Absolute batch fecundity averaged 723 ± 196 and 840 ± 268 eggs in 2018 (n = 30) and 2019 (n = 22) and relative batch fecundity ranged from 9 to 27 eggs/g of fish.

Figure 4. Cross sectional view of stained deepwater ovary. Maturity stages also shown. Previtellogenic (pr), endogenous vitellogenesis (ed), exogenous vitellogenesis (ex).

- The diameter of the largest oocytes averaged 1.30 ± 0.23 mm and 1.37 ± 0.20 mm in Fall 2018 and 2019, respectively (Figure 5).
- These results provide new insights about the reproduction of deepwater sculpin in Lake Ontario.

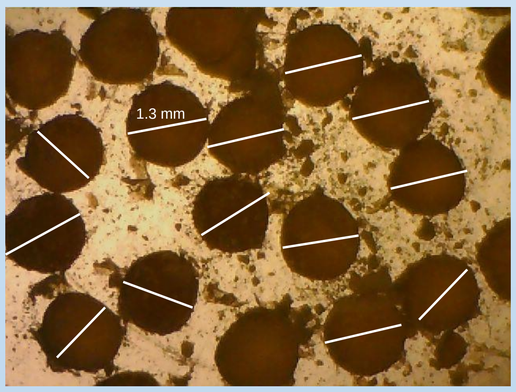

Figure 5. Measurement of the largest oocytes.

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