Diel Feeding by Larval Northern Brook Lampreys in Two Northern Michigan Streams

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Introduction

Background Question: **"Do larval northern brook lampreys *Ichthyomyzon fossor* exhibit diel periodicity in feeding?"**

Larval lampreys can effectively utilize a diet or organic detritus, a low quality food resource. Life-history attributes, such as efficient digestion and assimilation of this food and a low metabolic rate, have been identified as adaptations to utilizing this food source (Sutton and Bowen 1994; Mundahl et al. 2005). This study addresses whether larval northern brook lampreys exhibit periodicity in food habits and utilization over a 24-hour period.

Objective: Determine whether larval northern brook lampreys exhibit diel periodicity in food and feeding habits.

Testable Hypotheses:

1. Larval northern brook lampreys will exhibit diel periodicity in the percentage of algae, bacteria, and organic detritus in the diet.
2. Larval northern brook lampreys will exhibit diel periodicity in the assimilation efficiency of consumed food.
3. Larval northern brook lampreys will exhibit diel periodicity in gut fullness.

Methods

Larval Lamprey Collections:

• Larvae collected at four-hour intervals over a 24-hour period from the Pike River (03-04 June 1992) and Pilgrim River (02-03 August 1992), Upper Peninsula of Michigan

Laboratory Analyses:

• Gut contents removed from anterior ¼ of intestine

• 50-µL subsample of contents examined by quantitative microscopy

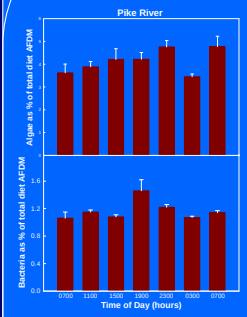
• Algal biovolume and bacterial biomass converted to AFDM eqivalent using known conversion factors from the literature

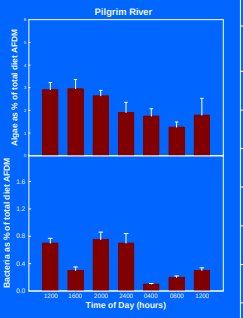
• Ash-free-dry-mass (AFDM) of organic detritus calculated as total AFDM (determined from combustion of organic material) minus microorganism (algae and bacteria) AFDM

• Percent assimilation efficiency estimated as ratio of AFDM in the anterior and poster 1/10 of the gut (diet ash was used as an unassimilated reference)

• Gut fullness measured as the mg diet AFDM · g larval lamprey^{-1}; used as an index of feeding rate

Hypothesis 1 – Diet Composition

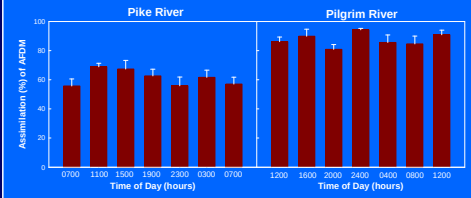




Pike River		Pilgrim River	
Time of Day (hrs)	% Detritus	Time of Day (hrs)	% Detritus
0700	95.32 (0.40)	1200	96.39 (1.01)
1100	94.96 (0.25)	1600	96.75 (0.58)
1500	94.71 (0.48)	2000	96.61 (0.57)
1900	94.32 (0.42)	2400	97.48 (0.51)
2300	94.62 (0.88)	0400	98.15 (0.38)
0300	95.48 (0.13)	0800	96.54 (0.53)
0700	94.09 (0.58)	1200	97.91 (0.91)

The percentage of diet AFDM comprised of algae by larval northern brook lampreys was low in the Pike River (3.45 to 4.77%) and Pilgrim River (1.26 to 2.95%), and followed no clear diel pattern. Similarly, the percentage of diet AFDM comprised of bacteria was also low, ranging from 1.06 to 1.46% in the Pike River and 0.10 to 0.75% in the Pilgrim River over each 24-hour period. Organic detritus comprised the majority of the utilizable portion of the diet for northern brook lampreys, regardless of sampling period, comprising between 94.02 and 95.32% in the Pike River and 96.39 and 98.54% in the Pilgrim River. There was no discernable diel trend in the consumption of organic detritus by larval northern brook lampreys in either the Pike or Pilgrim River.

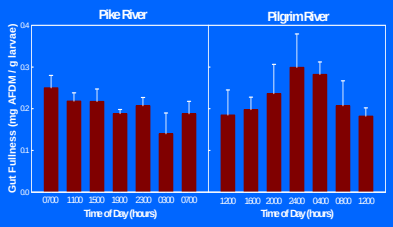
Hypothesis 2 – Assimilation Efficiency



Assimilation efficiency of larval northern brook lampreys ranged from 55.77 to 68.88% in the Pike River and 80.83 to 94.29% in the Pilgrim River over each 24-hour period. There was no discernable diel trend in the assimilation efficiency of the organic fraction of the diet by larval northern brook lampreys in either the Pike or the Pilgrim Rivers.

Hypothesis 3 –Gut Fullness

Gut fullness of larval northern brook lampreys ranged from 0.1822 to 0.2992 mg diet AFDM · g larvae^{-1} in the Pike River and 0.1396 to 0.2500 mg diet AFDM · g larvae^{-1} in the Pilgrim River. There was a diel trend in gut fullness of larval northern brook lampreys, with gut fullness values, on average, higher during early morning (Pike River) or evening (Pilgrim River) than daytime hours.



Conclusions/Ecological Implications

• There was no diel periodicity in the diet composition of larval northern brook lampreys among sampling periods, suggesting that the organic biofilm (algae, bacteria, detritus) consumed by larvae does not vary on a 24-hour basis. Yap and Bowen (2005) suggested that stream biofilm varies annually and is regulated by discharge and light availability.

• While assimilation efficiency of larval northern brook lampreys did not vary on a diel basis, gut fullness was higher during evening and early morning. Larval lampreys are burrowing suspension feeders (Moore and Beamish 1973), and this behavior may be a predator-avoidance strategy. Larval lampreys are also negatively phototactic, and higher feeding rates during periods of darkness or dim light may reflect their aversion to bright light.

• The greater percentage of organic detritus in the diet and higher assimilation efficiency of larval northern brook lampreys in the Pilgrim than the Pike River reflects seasonal variability in algal production and water temperature. These differences are similar to the seasonal variability observed for larval sea lamprey *Petromyzon marinus*, American brook lamprey *Lampetra appendix*, and northern brook lamprey (Sutton and Bowen 1994; Mundahl et al. 2005).

Literature Cited

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