Juvenile coho salmon "dine and dash" to exploit thermal heterogeneity in streams

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Rapid advancements in the ability to quantify habitat heterogeneity
How do organisms interact with habitat heterogeneity?

What about us?
Pulsed salmon subsidies
Sockeye subsidies:
- ephemeral pulse of high quality, vulnerable food
- Pulsed timing taxes processing systems
Fish require warmer temperatures to capitalize on resource pulses.
How does thermal heterogeneity mediate the ability of coho salmon to exploit sockeye salmon eggs?
Wood River system streams:
>10°C range in summer water temperature

Armstrong et al. 2010 *Ecology*
P. Lisi *in prep*
Headwaters of Bear Creek: low velocity, minimal shading = warm water, Beaver meadow complexes
Upwelling groundwater produces longitudinal variation in water temperature
0-1300 m upstream: cold water and extensive off-channel habitat: groundwater seeps preclude any downstream warming
The spatial distribution of sockeye eggs in coho diets
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% ind’s with egg in diet

Distance Upstream

Total # fish captured

- 100
- 200
- 300
- 400
- 500
- 600
The spatial distribution of sockeye eggs in coho diets

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The spatial distribution of sockeye eggs in coho diets

The graph shows the percentage of individuals with eggs in their diet across different distances upstream. The x-axis represents the distance upstream, while the y-axis shows the percentage of individuals with eggs in their diet. The data points are color-coded to represent the total number of fish captured, with different colors indicating different ranges of captures (100, 200, 300, 400, 500, 600). The graph also includes images of fish and a thermometer, suggesting a focus on the impact of temperature on fish migration and diet composition.
1. 0-930m: cold w/ sockeye
2. 930-1360m: cold w/o sockeye
3. 1360m and up: warm w/o sockeye

2008:
Deploy PIT tag
Antenna Arrays
Feeding forays into the cold downstream region

Age-1 coho salmon--
24-July: 85 mm 7.1 g
21-Aug: 108 mm 17.6 g
Fish reside in warm water for 1-4 d between feeding forays.
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Why the long pause?
Shouldn’t fish be done digesting eggs after 24 hours?

Digestion of sockeye fry (1-2)
Ration = 1-3 % body mass
Ruggerone 1988
In situ measures of gastric evacuation:
Fish can consume up to 17% of body mass in single meal

- Huge stomach capacity + slow processing of lipids explains long digestive pauses in Bear Creek coho
Successful coho don’t compromise

- Habitat coupling: Combine favorable elements of different locations
- Predator physiology makes this possible: big stomachs for moving food from one habitat patch to another
Diel movement:
ubiquitous in lakes and oceans
What about fish behavior in streams?

We need a better understanding of how fish behavior integrates across spatial and temporal variation in stream habitats.
Why should we care about whether lotic organisms exploit habitat heterogeneity in their daily behavior?

• Lotic systems are some of the most threatened worldwide
• Understanding how fish exploit heterogeneity will help us restore it
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