



EXPLORING TEMPORAL DYNAMICS AND REGULATORY BEHAVIORS OF FORAGING GROUPS OF JUVENILE COHO SALMON

Christopher J. Naus, Matthew J. Jacobson, and Dr. David Lonzarich, University of Wisconsin–Eau Claire

BACKGROUND

Many animals forage in groups, groups offer:

- Advantages
 - Decreased risk of predation
 - Increased feeding rate
- Disadvantages
 - Intraspecific competition
 - Aggression

As group size increases, disadvantages begin to decrease individual fitness. However, there are still fitness benefits to living in large groups for lone foragers.

Group Size Paradox (Figure 1)

- Optimal Group Size
 - Group size at which individual fitness is highest.
- Equilibrium Group Size
 - Group size at which fitness for a group member and an individual forager are equal.

Paradox: Group size should increase until equilibrium group size is reached. Previous research has shown that group sizes are maintained at an optimal level.

(Beauchamp G, and Fernández-Juricic E. 2004. The group-size paradox: effects of learning and patch departure rules. *Behav. Ecol* 16:2: 352-357.)

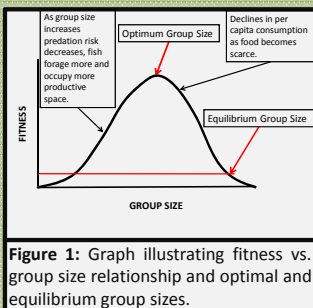


Figure 1: Graph illustrating fitness vs. group size relationship and optimal and equilibrium group sizes.

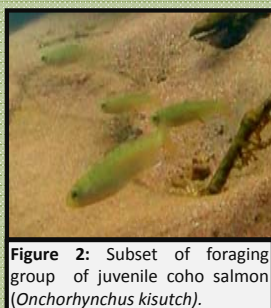


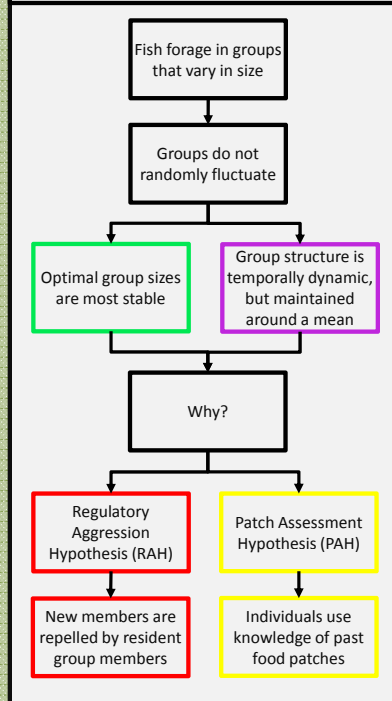
Figure 2: Subset of foraging group of juvenile coho salmon (*Onchorhynchus kisutch*).

METHODS

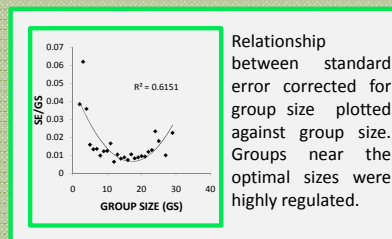
Study conducted in the Onion River, Bayfield County, WI. from May-August 2008

- Field Methods
 - Bank shore counts of groups of juvenile coho salmon (Figure 2)
 - Counted 126 foraging groups
 - Group counts made every 30 seconds for 15 minutes
 - Group sizes were distributed equally into categories: 1-3, 4-6, 7-9, 10-12, 13-15, 16-18, 19-21, and 22+
 - Underwater Video recording
 - Recorded 69 groups for 15 minutes
- Video Analysis
 - Four videos from each category were analyzed for as many visible fish as possible in a random five minute video segment.
 - Foraging
 - Aggression (Perpetrator and Victim)
 - Departure time

STUDY OBJECTIVES



TEMPORAL DYNAMIC RESULTS



Relationship between standard error corrected for group size plotted against group size. Groups near the optimal sizes were highly regulated.

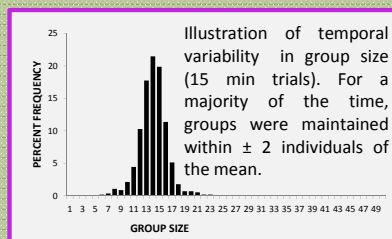
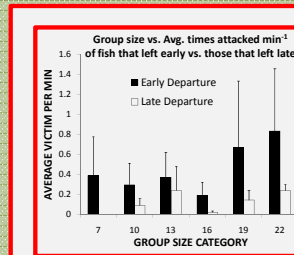


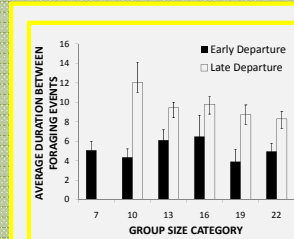
Illustration of temporal variability in group size (15 min trials). For a majority of the time, groups were maintained within ± 2 individuals of the mean.

REGULATORY BEHAVIOR RESULTS



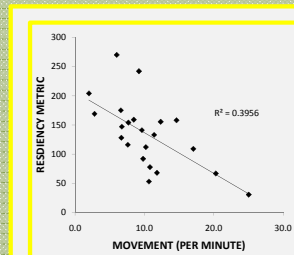
RAH

- Individuals that left the group early (Departure time ≤ 100 sec) were victimized significantly more times per minute than individuals that stayed the longest (Departure time ≥ 200 sec) ($p=0.05$, $df=17$).
- This supported the Regulatory Aggression Hypothesis.



PAH

- Individuals that left early had significantly shorter durations between foraging events than individuals that stayed the longest ($p<0.001$, $df=17$).
- This is opposite of what the patch assessment hypothesis predicts.
- We propose two alternative explanations to further examine the patch assessment hypothesis.



ALTERNATE EXPLANATIONS

- Transient Fish
 - Some fish move from group to group feeding opportunistically until aggression and energy expenditure become high.
- Energy Expenditure
 - Preliminary evidence showed that fish that left early (transients) moved around more to acquire food. This suggests a lower net energy gain ($p<0.001$, $r^2=0.40$).

CONCLUSIONS

- Foraging groups of juvenile coho salmon are maintained around a mean and highly regulated near an optimal size. Aggression appeared to be an important mechanism of group regulation.
- Our research suggests tests of the patch assessment hypothesis require more than measuring foraging gains. It is important to consider energy costs and alternative feeding strategies.

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