

To Flip or to Freeze: Decision Making in Crayfish

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Reed College Biology 342

The Red Swamp Crayfish: *Procambarus clarkii*

- ★ Freshwater decapod native to Mexico and the Southern US
- ★ Currently an invasive species in many states, including the Pacific Northwest, and on other continents
- ★ May pose threat to many native species of crayfish, including those found in the Reed Canyon!
- ★ Easily obtainable from commercial providers like Carolina Biological

Hypotheses:

1. If crayfish vary their responses to predation, then different perceived threats will elicit differences in the type and duration of observable responses.
2. If satiety influences decision making, then there will be variation in the behaviors of fed and starved crayfish.

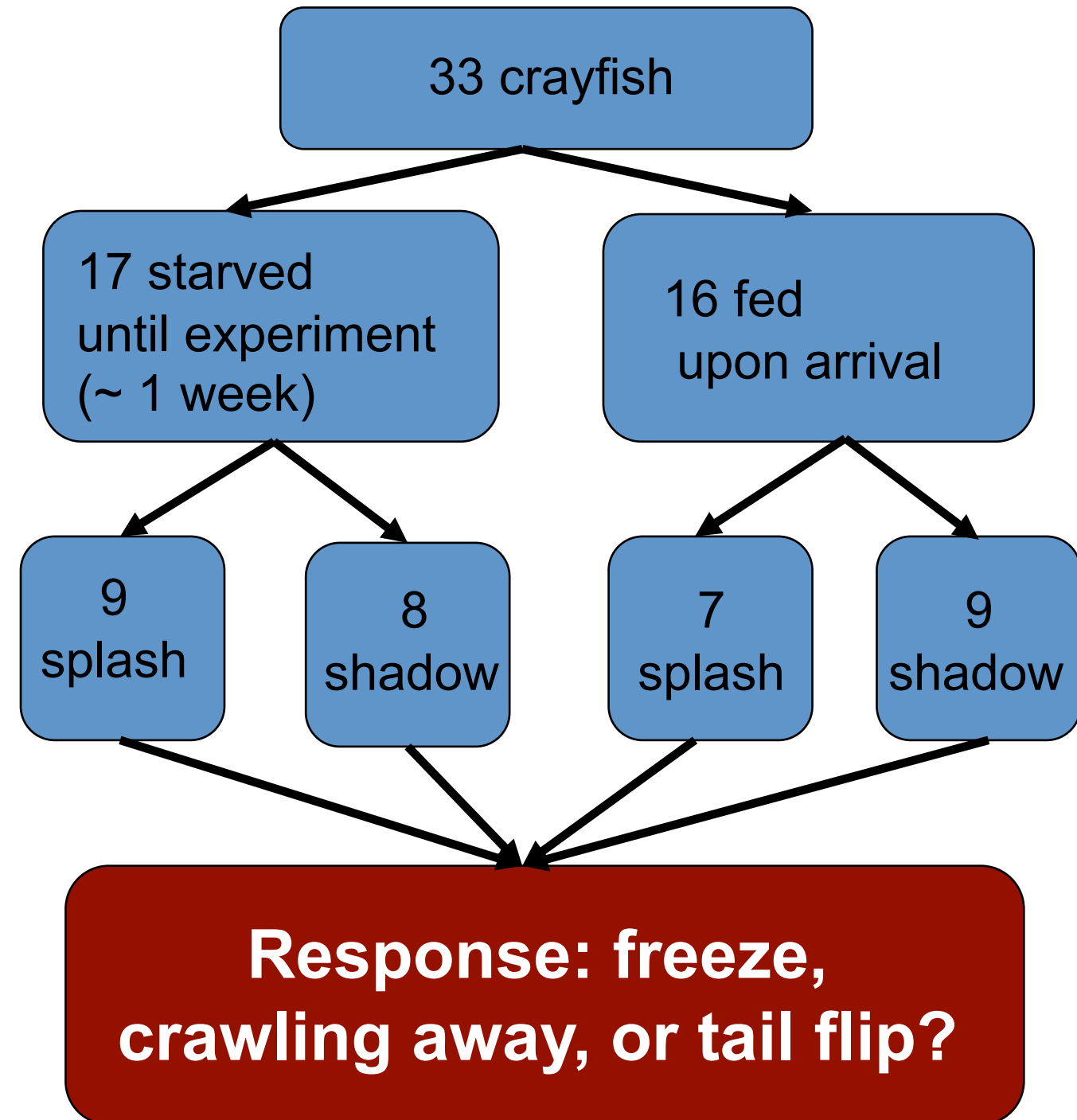
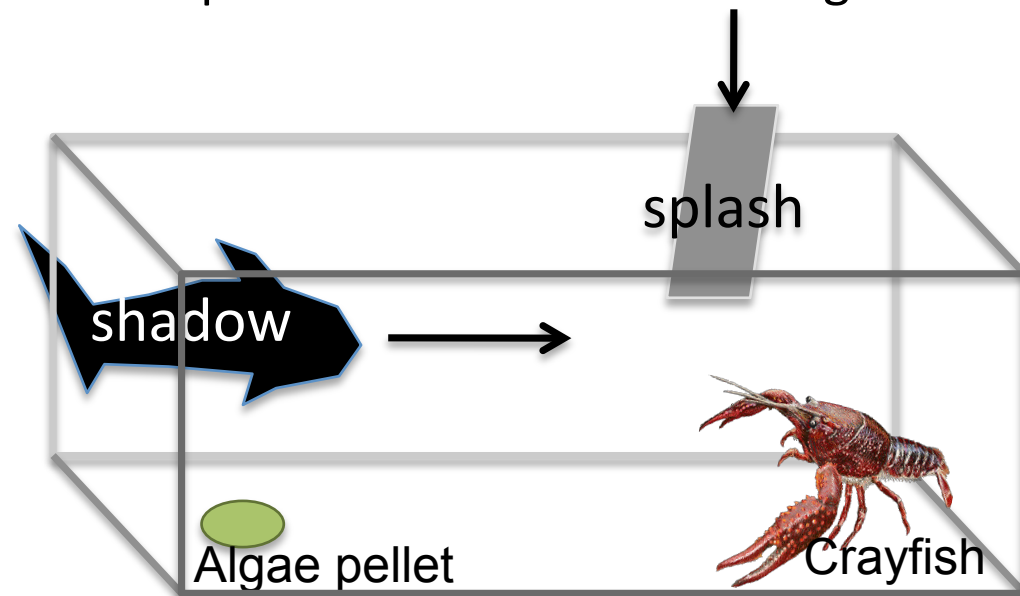


Rock On! Photo: <http://www.flickr.com/photos/trempoli/3946571207/>

How do crayfish respond to different types of predation while foraging for food? Does response depend on how hungry they are?

The Experiment

- ✦ Prior to treatment, crayfish were housed in individual permeable containers in a large communal tank
- ✦ Crayfish were placed alone in a 16 gal tank with an **algae wafer**, acclimated behind a divider for 10 minutes, then allowed to **forage**
- ✦ After 3 minutes, each was randomly presented with a **splash** (simulating a raccoon or bird) or a **shadow** (simulating a fish), then observed for another 3 minutes
- ✦ Variables measured: reaction type and duration, feeding behaviors, and any missing claws or potential other confounding factors



Crayfish image: http://animals.m-y-d-s.com/aquatic/red_swamp_crayfish/

Varied predator avoidance strategies: Crayfish exhibit different reactions to different stimuli

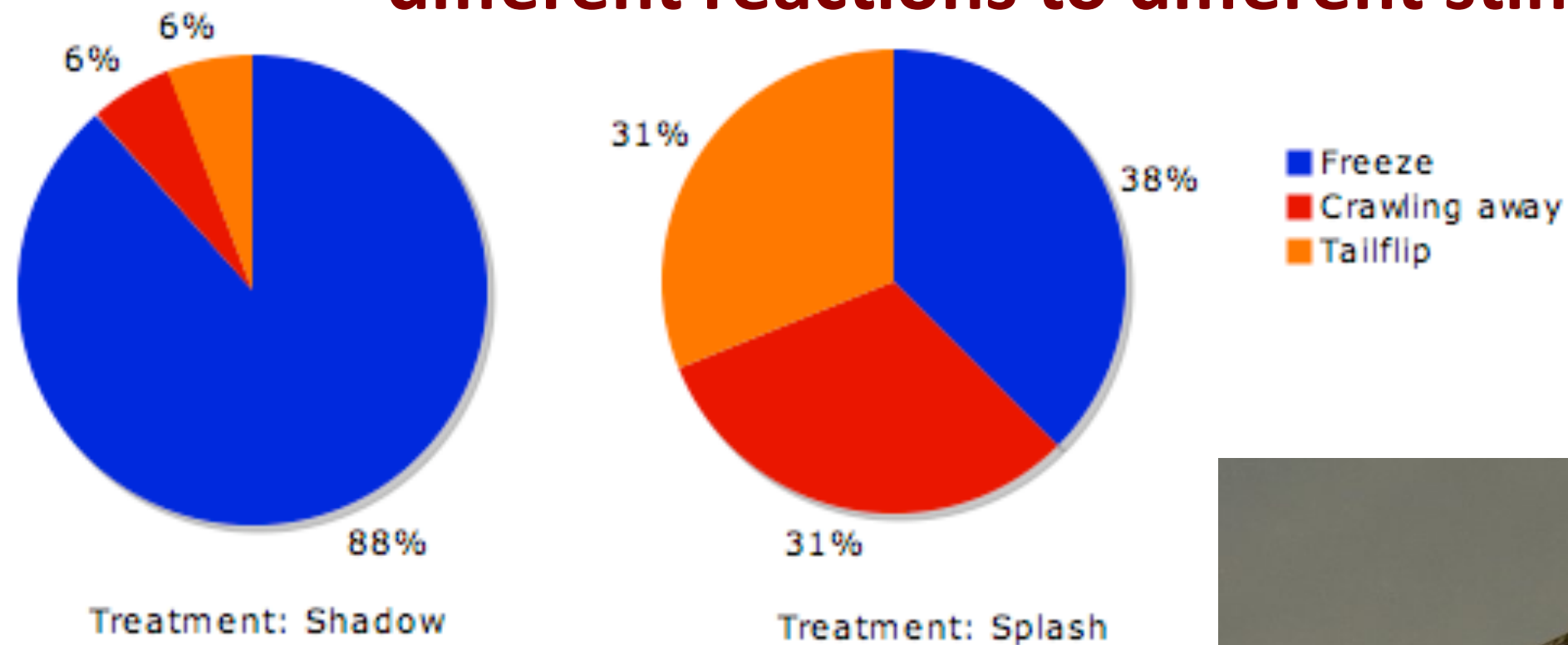


Figure 1. Proportional responses of crayfish exposed to shadow or splash stimuli while foraging (chi-square=9.25, df=2, p=0.020). The slow moving shadow was significantly more likely to elicit a freeze response, whereas the fast splash from above was more likely to trigger a mobile response.



Crayfish performing tailflip maneuver
<http://www.gizmag.com/crayfish-human-brain-decisions/15516/>

Additionally, satiety was not found to have a significant impact on response or feeding behavior before or after the stimulus. Response duration was not correlated to any of the variables measured.

Varied response could have possible adaptive value: freezing is strategic if the predator has not yet spotted the crayfish, but against a fast, targeted attack, getting out of the way is the priority. Hunger may be a less important factor in the decision-making process, contrary its significance suggested in previous findings¹.

Further Questions

- ★ Is there variation between crayfish species? Between wild and captive populations?
- ★ Are these results repeatable in wild conditions?
- ★ Water was not changed between each trial: could chemical signals have influenced response?
- ★ Is there variation in reaction time (rather than duration of reaction) across species?



Ecological Ramifications

*Pacifastacus gambelii*² was found to reside in the Reed Lake. How does its behavior compare to that of the captive *Procambarus clarkii* from Carolina Biological? Is the success of invasive *P. clarkii* related to differences in foraging behaviors and predation response?

Figure 2. Crayfish caught in Reed Canyon 11/18/10.

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1. Liden, W. H., et al. (2010) "Neural control of behavioural choice in juvenile crayfish". *Proceedings of the Royal Society Biological Sciences*, doi:10.1098/rspb.2010.1000. Published online.
 2. Fetzner, J. W. "Key to *Pacifiastacus*." 8 November, 2005. Carnegie Museum of Natural History. Accessed 18 November, 2010 <<http://iz.carnegiemnh.org/crayfish/keys/pacifastacus.htm>>.