The scent of a predator: the effects of chemical threats on shell selection in the hermit crabs, \textit{Pagurus samuelis} and \textit{Pagurus hirsutiusculus}

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### Overview

- Predators can affect prey by: 1) reducing the prey population through consumption and 2) inducing phenotypic changes in their prey.
- Changes arising in prey populations from chemical predator threats can be morphological, physiological, behavioral or life-historical.
- Indirect or chemically signaled trait-mediated impacts have been studied less. However, their implications are all-encompassing within ecological communities because their effects are transferred across other species which come into contact with the prey.
- Hermit crabs, because they exhibit complex behaviors and respond to chemical cues, are an ideal model to study trait-mediated behavioral plasticity. Shell selection in hermit crabs is a compromise between shell traits and different aspects of fitness. For example, hermit crab growth, survival, and brood size depend on the characteristics of chosen shell species. In Horseshoe Cove, two Pagurid species occupy up to 12 different species of gastropod shells.

### Methods

In each laboratory trial, individual hermit crabs were given a choice of two species of gastropod shells matched as closely as possible in internal volume. Hermit crabs were exposed to predator effluent (n=6), either \textit{C. antennarius} (Cancer crab) or \textit{P. helianthoides} (sea star), or a no-effluent control (n=6). Naked hermit crabs were placed in a culture dish halfway between the two shells, observations were taken for the first five minutes, and time to first shell choice was noted (latency). Shell selection was recorded at fifteen minutes, two and six hours.

### Results

- **Pagurus samuelis** responded to Cancer effluent and took longer to make the first shell choice. Individuals exposed to the sea star \textit{Pycnopodia} selected shells faster, although this trend was not significant.
- **Pagurus hirsutiusculus’** time to first shell choice did not differ between individuals exposed to predator effluent and control water in either predator treatment.

### Discussion

1) Only \textit{Pagurus samuelis} showed sensitivity to Cancer effluent. Still, they did not select the thicker \textit{Nucella lamellosa} shell that may offer more crab protection.

- Activity level or frequency of shell switching may better indicate sensitivity to predator cues.
- Alternatively, hermit crab species may differ in their ability to detect predators.

2) Although there was a trend in \textit{P. samuelis} response to \textit{Pycnopodia} cues, it was not statistically significant. This suggests that hermit crabs may be unable to detect some predators.

3) Shell preference was species-specific: 100% of \textit{P. samuelis} picked \textit{P. hirsutiusculus} regardless of other shell options or presence of predator cues.

### Conclusion

Although hermit crabs appear to respond to predator cues in some cases (by changing speed of shell selection), they appear remarkably consistent in their shell preferences. These choices may reflect the optimal balance of multiple costs and benefits conferred by different shell types.