Ocean Acidification and Predator-Prey Relations: Correlating Disruption of Predator Avoidance with Chemosensory Deficits

Alexandra FW Sidun
*Chapman University*, sidun100@mail.chapman.edu

William G. Wright
*Chapman University*, wwright@chapman.edu

Follow this and additional works at: [https://digitalcommons.chapman.edu/cusrd_abstracts](https://digitalcommons.chapman.edu/cusrd_abstracts)

Part of the Integrative Biology Commons, Laboratory and Basic Science Research Commons, Marine Biology Commons, Other Ecology and Evolutionary Biology Commons, Other Life Sciences Commons, and the Systems Biology Commons

**Recommended Citation**
[https://digitalcommons.chapman.edu/cusrd_abstracts/190](https://digitalcommons.chapman.edu/cusrd_abstracts/190)

This Poster is brought to you for free and open access by the Center for Undergraduate Excellence at Chapman University Digital Commons. It has been accepted for inclusion in Student Scholar Symposium Abstracts and Posters by an authorized administrator of Chapman University Digital Commons. For more information, please contact laughtin@chapman.edu.
Ocean acidification and predator-prey relations: Correlating disruption of predator avoidance with chemosensory deficits

Sidun, A.F.W., Wright, W. G.
Schmid College of Science and Technology, Chapman University, Orange, CA

Introduction

One of the most disturbing effects of global climate change is the increased carbon dioxide sequestering and atmospheric acidification of our oceanic systems (Figure 1).

Figure 1. Atmospheric CO2, modifies the ocean. Chemical reactions that occur when atmospheric carbon dioxide is dissolved in the ocean (NOAA Ocean Acidification Program, 2015).

The dissolved CO2 in seawater increases acidity (hydrogen ions) of the ocean and thus, the pH.

The impacts of ocean acidification on specific ecosystems are still relatively unknown, especially effects on behavioral ecology of the organisms in these ecosystems. Risk of predation is a critical aspect of chemistry and acidification effects on organisms' behavior. In addition, the increased acidity of seawater leads to increased behavioral responses to chemical signals from their predators in a wide array of antipredator behaviors. Recent research suggests such behaviors may be unprecedented by modern increases in acidity (Schmid et al., 2018, Munday et al., 2011, Nilsen et al., 2012). We investigated whether slightly acidic water reduces antipredator behavior in our study species (see Figure 2).

The blue-banded hermit crab, Dardanus megistos, is a small invertebrate of local biodiversity and is a model organism for studying all aspects of chemical communication (Greggor et al., 2010). We are currently exploring the use of odors of other predators to further explore how acidity abolishes predator-prey behavioral responses to chemical signals from predators (Stamper et al., 2011). The solutions were constantly stirred until pH was reduced to 7.00 (+/- 0.05). We tested the feeding rates of hermit crabs in the following treatments:

1. Ambient artificial seawater
2. Acidic artificial seawater
3. Acidic artificial seawater + predator odor
4. Ambient artificial seawater + predator odor

We hypothesize:

- that predation presence will significantly reduce feeding rates in seawater at ambient pH
- that predation presence will significantly reduce feeding rates in seawater at ambient pH
- increased feeding to predator-free levels.

Figure 3. Equipment used for acidification treatments including a 5-litre capacity 150 mL/gauge, a regulated valve, separate bubble flow for acidification treatments, a pH probe, and bubble counter.

Figure 4. Results are the four treatments with similar subject and experimental manipulations.

Figure 5. Shown is the mean consumption of the four treatments with their corresponding standard error bars. These data reflect three separate experiments (Figure 6) arranged to show the overall effect of acidic treatments in comparison to ambient treatments; Acidic and Predator-scented ASW. Images of hermit crab, Dardanus megistos, on left side of each treatment. Shown is the mean consumption of the four treatments with their corresponding standard error bars. These data reflect three separate experiments (Figure 6) arranged to show the overall effect of acidic treatments in comparison to ambient treatments; Acidic and Predator-scented ASW. Images of hermit crab, Dardanus megistos, on left side of each treatment.

Figure 6. Atmospheric CO2, modifies the ocean. Chemical reactions that occur when atmospheric carbon dioxide is dissolved in the ocean (NOAA Ocean Acidification Program, 2015).

Discussion

Unfortunately, no correlation between pH and behavioral responses has been found due to the lack of observed behavioral changes. At the present study stage, we tested whether acidic water would similarly eliminate the third behavioral response, predator-induced inhibition of feeding.

Acknowledgements

Thank you to previous Wright lab researchers for a foundation to build our research upon, including Courtney Jones, Kim Takagi, and Alex Hall.

References


Thank you to current lab members Ari Bichlar and Anaraat Katta for assistance in aquarium tank care, feeding assay demonstrations, and gene brainwashing.

Figure 7. Conclusion

Methods

Hermit crabs were collected from Little Corona, Newport Beach, CA (33°55’26.8”N 117°29’18.0”W). We tested the feeding rates of hermit crabs in the following treatments:

1. Ambient artificial seawater
2. Acidic artificial seawater
3. Acidic artificial seawater + predator odor
4. Ambient artificial seawater + predator odor

Water Acidification:

We used a 5-litre capacity 150 mL/gauge, a regulated valve, separate bubble flow for acidification treatments, a pH probe, and bubble counter.

Figure 7. Conclusion

1.18
Ambient ASW
Avg pH 8.2
Ambient Predator-scented ASW
Avg pH 8.2
Acidic ASW
Avg pH 7.2
Acidic Predator-scented ASW
Avg pH 7.2

Water Acidity:

1. We used a 5-litre capacity 150 mL/gauge, a regulated valve, separate bubble flow for acidification treatments, a pH probe, and bubble counter.
2. We tested hermit crabs for feeding readiness before each experimental trial.
3. We used a 5-litre capacity 150 mL/gauge, a regulated valve, separate bubble flow for acidification treatments, a pH probe, and bubble counter.

Figure 7. Conclusion

1.18
Ambient ASW
Avg pH 8.2
Ambient Predator-scented ASW
Avg pH 8.2
Acidic ASW
Avg pH 7.2
Acidic Predator-scented ASW
Avg pH 7.2

Water Acidification:

We used a 5-litre capacity 150 mL/gauge, a regulated valve, separate bubble flow for acidification treatments, a pH probe, and bubble counter.

Figure 7. Conclusion

1.18
Ambient ASW
Avg pH 8.2
Ambient Predator-scented ASW
Avg pH 8.2
Acidic ASW
Avg pH 7.2
Acidic Predator-scented ASW
Avg pH 7.2

Water Acidification:

We used a 5-litre capacity 150 mL/gauge, a regulated valve, separate bubble flow for acidification treatments, a pH probe, and bubble counter.

Figure 7. Conclusion

1.18
Ambient ASW
Avg pH 8.2
Ambient Predator-scented ASW
Avg pH 8.2
Acidic ASW
Avg pH 7.2
Acidic Predator-scented ASW
Avg pH 7.2

Water Acidification:

We used a 5-litre capacity 150 mL/gauge, a regulated valve, separate bubble flow for acidification treatments, a pH probe, and bubble counter.

Figure 7. Conclusion

1.18
Ambient ASW
Avg pH 8.2
Ambient Predator-scented ASW
Avg pH 8.2
Acidic ASW
Avg pH 7.2
Acidic Predator-scented ASW
Avg pH 7.2

Water Acidification:

We used a 5-litre capacity 150 mL/gauge, a regulated valve, separate bubble flow for acidification treatments, a pH probe, and bubble counter.