

2019 State of the Coast Poster Exhibition First Place

Author: Steven Manos

Title: Juvenile Dungeness crab try to avoid low pH seawater, but when forced into such unfavorable conditions, they may take longer to find their prey.

Abstract: Recent studies have shown that the large increase of anthropogenic carbon is contributing to low pH in the ocean, referred to as ocean acidification, which in turn affects the calcification of crustaceans. Ocean acidification is also known to affect behavior and sensory systems of organisms. Metacarcinus magister (Dungeness crab) are a major contributor to the Oregon fishing communities, and coastal culture of the region. There has been relatively little research on the effects of ocean acidification on post-settlement juvenile life history stage in Dungeness crab. Here, we tested how exposing juvenile Dungeness crab to an ambient pH and a more acidic pH alters their foraging behavior and if they are able to sense and move away from a reduced pH. We captured megalopae using a light trap and settled juvenile crab into ambient lab conditions. We measured crab prey discovery time and handling time in the controlled pH and more acidic pH. We hypothesized that the juveniles in the low pH water would take a longer amount of time to find their food or would not be able to find it. We used a two-current flume with an ambient pH and a reduced pH, providing a choice between the two, and measured the amount of time individuals spent in each pH in 300 second trials. We found that while behavior is highly variable, juvenile Dungeness try to avoid low pH water, and when they are forced into such unfavorable conditions, they may take longer to find their prey.

Introduction

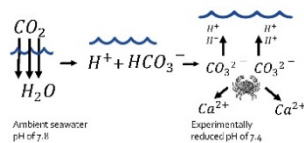
Increased atmospheric CO₂ is reducing the pH levels of the ocean; this is causing a range of complex responses from marine species¹. A lower pH can be harmful to organisms that make CaCO₃ shells and exoskeletons, such as crustaceans². (Fig. 1)

In East coast blue crab, elevated CO₂ reduced crab feeding and survival with a pH drop of 0.3 units³. If these types of harmful responses of ocean acidification are observed in Dungeness crab, it may influence the fishery, which is Oregon's most commercially valuable fishery (\$5-74 million a year⁴).

In this study we investigated:

- 1) the ability of juvenile Dungeness crab to avoid sea water with a lowered pH.
- 2) how a reduced pH affects the ability of individual juvenile Dungeness crab to find food.

Fig. 1 Diagram showing how CO₂ enters seawater and affects carbonate chemistry, increasing carbonate concentration of H₂CO₃ and decreasing ambient pH from 7.8 to over pH 7.4, used in this experiment.



Methods

Experiment 1: Juvenile Dungeness crabs were placed in the center of a two-current flume flowing both pH 7.8 and pH 7.4 seawater. We recorded crab movement and time spent within the 2 pH levels for 300 seconds in 30 replicate trials. (dyed water showing flume test prior to trial)



Experiment 2: Juvenile Dungeness crabs were placed in a behavior arena (Fig. 3) in pH 7.8 or pH 7.4 in a 5 minute trial with a caged piece of food up-current. Time taken to reach food was recorded.



Thank you!

The National Science Foundation (OCE 1509943, Oregon Scientific Center award 18-0115) # NA43CAPL20022 (CFDA No. 11.447), Mike Johnson, James Johnson, Heejun Kim, Sam Whipple, Matt Johnson, Natalie Thompson, Maya Watts, Richard Ennes, Nicole Nakano, Eddie Schmitt, and Mike Thomas.



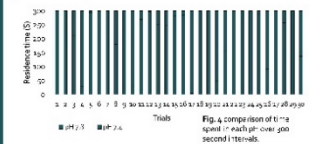
Juvenile Dungeness crabs try to avoid low pH seawater, but when forced into such unfavorable conditions, they may take longer to find their prey.

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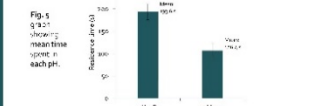


Results

Experiment 1:

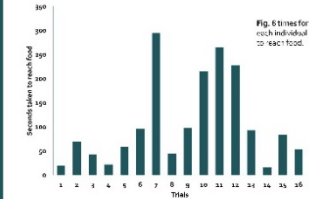


Crabs spent a mean of 65% of their time in pH 7.8 and 35% of their time in pH 7.4.



Crabs spent significantly more time in water with a higher pH (Fig. 2; t=2.46, df=29, p=0.02).

Experiment 2:



76.2% of crabs found the food (Fig. 6)
There was no statistical difference in foraging times between the crabs placed in 7.4 pH (mean of 131 seconds) and 7.8 pH (mean of 81 seconds) water (two sample t-test, t=1.12, df=14, p=0.2827).

Discussion

Crabs were able to differentiate pH changes in sea water and show preference for the control pH 7.8. Avoidance of a lower pH may indicate changes in settlement location for juveniles with a global reduction in pH due to ocean acidification. While crabs didn't spend significantly more time to reach the food in a reduced pH they did have a difference in average times taken to get the food. We believe that with an increased sample size, crabs in a reduced pH would take significantly more time to find the food. This may indicate that a reduced pH could impair their ability to find prey or bait in crab traps, potentially affecting crab fisheries.


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2019 State of the Coast Poster Exhibition Runner Up

Author: Britta Baechler



Title: Microplastic Concentrations in Two Oregon Bivalve Species: Spatial, Temporal, and Species Variability

Abstract: Microplastics are an ecological stressor with implications for ecosystem and human health when found in seafood. We quantified microplastic types, concentrations, anatomical loadings, geographic distribution, and temporal differences in Pacific oysters (*Crassostrea gigas*) and Pacific razor clams (*Siliqua patula*) collected from 15 Oregon coast sites. Organisms were chemically digested and visually analyzed for microplastics, and material type was determined in a subset of particles using Fourier Transform Infrared Spectroscopy (FTIR). Microplastics were present in organisms from all sites sampled. On average, whole Pacific oysters and Pacific razor clams contained 10.95 ± 0.77 and 8.84 ± 0.45 microplastics per individual, respectively. Contamination was quantified but not subtracted from averages. Over 99% of identified particles were microfibrers. Spring samples contained more anthropogenic debris than summer samples in oysters but not razor clams. This study provides a baseline of microplastics in Oregon bivalves and is the first to determine Pacific razor clam concentrations.




MICROPLASTICS IN TWO OREGON BIVALVE SPECIES


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SPECIES STUDIED



Pacific oyster
Crassostrea gigas
HABITAT: ESTUARIES



Pacific razor clam
Siliqua patula
HABITAT: SANDY BEACHES

BACKGROUND

What are microplastics?


- Plastics <5mm manufactured for cosmetics or cleaners, broken down from larger plastics, or synthetic fibers released from washing clothes^{1,2,3}

Why are they a problem?


- Marine plankton, bivalves, fish, marine mammals, sea turtles, sharks, and seabirds mistake them for food^{4,5,6,7}
- Ingested particles carry harmful chemical contaminants, and both plastics and contaminants can accumulate in marine predators and humans^{8,9,10}
- Microplastics disrupt metabolism, reproduction, growth, and health of marine and freshwater organisms¹¹
- Trophic transfer of microplastics has been demonstrated¹²

RELEVANCE


Why study microplastics in Oregon bivalves?



Important for fisheries/aquaculture



Oregon lacks microplastic data




Known to impact bivalve health

OBJECTIVES


- Quantify the **number & type** of plastic pieces in each species.
- Examine the **geographical gradient & temporal variability** of microplastics in bivalves across locations and species.
- Count & categorize microplastics in organism **gut vs. non-gut** tissues.

METHODS


COLLECTION



PROCESSING




ANALYSIS



SITES

Collected April and July 2017



Samples

- 15 sites
- 142 razor clams
- 141 Pacific oysters

RESULTS

Table 1. Average microplastic concentrations ± Standard Error

| | Pacific oysters | Razor clams |
|-----------------------|-----------------|-------------|
| # plastics/g tissue | 0.35 ± 0.04 | 0.16 ± 0.02 |
| # plastics/individual | 10.95 ± 0.77 | 8.84 ± 0.45 |
| | * p < 0.0001 | |

- Both species contained plastic at all 15 sites
- 3,053 microplastics** found in 320 samples (whole, gut, tissue)
- >99% of particles were fibers (82% colorless)
- Material types identified: **PET, acrylic, aramid, zein, cellophane**
- Significant **seasonal differences** in oysters (spring higher)
- Few geographic differences (2 oyster site pairs, 1 clam site pair)
- No differences between gut and non-gut tissue concentrations

Figure 1. Microplastic concentrations by species & season

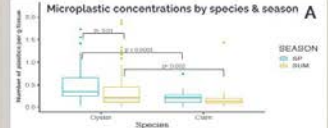


Figure 2. Microplastic concentrations by sample site

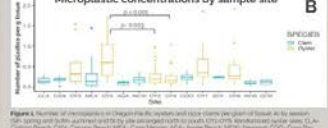


Figure 1. Number of microplastics per individual by species and season. Box plots show median, mean, and standard deviation. Significance levels are indicated by asterisks (* p < 0.05, ** p < 0.01, *** p < 0.001).
Figure 2. Number of microplastics per individual by site. Box plots show median, mean, and standard deviation. Significance levels are indicated by asterisks (* p < 0.05, ** p < 0.01, *** p < 0.001).

ACKNOWLEDGMENTS

Thanks to Dr. K. Hesse for providing the FTIR instrument for use at the University of Oregon. We also thank Dr. J. Hesse for providing the FTIR instrument for use at the University of Oregon. We also thank Dr. J. Hesse for providing the FTIR instrument for use at the University of Oregon. We also thank Dr. J. Hesse for providing the FTIR instrument for use at the University of Oregon.

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2019 State of the Coast Poster Exhibition People's Choice Award

Author: Keala Pelekai

Title: Evaluation of Pacific Lamprey statoliths and eye lenses as records of age, natal origin, and trophic history patterns

Abstract: The Pacific Lamprey (*Entosphenus tridentatus*) is an anadromous species native to the North Pacific Ocean and its adjacent freshwater tributaries. Pacific Lamprey are both ecologically and culturally important to the Pacific Northwest of the United States. In that last 50 years, Pacific Lamprey have experienced declines in abundance throughout the Columbia River Basin, USA. More information on the biology and ecology of this species is needed for conservation and management. Anatomical structures have been widely used in fisheries science for biological inference. The Pacific Lamprey is a cartilaginous fish that lacks the common hard structures used in teleosts to elucidate age and life history patterns. Statoliths, analogous to otoliths in function, are calcium-fluorapatite concretions found in the auditory capsules of lampreys. Statoliths have potential for aging and microchemical analysis but require further validation that bands represent annual deposition and are chemically reflective of the individual's environment. Eye lenses are another structure with potential for trace element and stable isotope analysis but remain relatively unexplored for lamprey. The goal of this project is to broaden our understanding of lamprey by evaluating the efficacy of different structures for determining age, natal origin, and trophic history patterns. These objectives will be achieved by evaluating lamprey statoliths and eye lenses taken from known age and origin specimens.

