Annual Report for Period: 03/2010 - 02/2011
Submitted on: 04/07/2011
Principal Investigator: Pierson, James J.
Award ID: 0961942
Organization: U of MD Ctr Environ Scs
Submitted By:
Pierson, James - Principal Investigator
Title:
Collaborative Research: Hypoxia in Marine Ecosystems: Implications for Neritic Copepods

Project Participants

Senior Personnel

Name: Pierson, James
Worked for more than 160 Hours: Yes
Contribution to Project:

Name: Houde, Edward
Worked for more than 160 Hours: Yes
Contribution to Project:

Name: Roman, Michael
Worked for more than 160 Hours: Yes
Contribution to Project:

Name: Stoecker, Diane
Worked for more than 160 Hours: Yes
Contribution to Project:

Post-doc

Name: Elliott, David
Worked for more than 160 Hours: Yes
Contribution to Project:
Numerical modeling of copepod life histories, copepod development time experiments, vital staining of copepods.

Graduate Student

Name: Barba, Ali
Worked for more than 160 Hours: Yes
Contribution to Project:
Collection and analysis of zooplankton samples, presented results at national conference.

Name: Liu, Katherine
Worked for more than 160 Hours: Yes
Contribution to Project:
Collection and analysis of gelatinous zooplankton samples.

Undergraduate Student

Name: Fisher, Aidan
Worked for more than 160 Hours: Yes
Contribution to Project:

Sample collection and analysis.

Technician, Programmer

Name: Jahn, Ginger
Worked for more than 160 Hours: Yes
Contribution to Project:
Sample collection and analysis

Name: Weigel, Alison
Worked for more than 160 Hours: Yes
Contribution to Project:
Shipboard and laboratory technician

Name: Guitterez, Robert
Worked for more than 160 Hours: Yes
Contribution to Project:
Shipboard and laboratory technician

Name: Seuberling, James
Worked for more than 160 Hours: Yes
Contribution to Project:
Shipboard and laboratory technician

Other Participant

Research Experience for Undergraduates

Organizational Partners

Chesapeake Bay Program Office

Chesapeake Bay Program Office deploys profiling moorings, and has invited the PIs from this project to participate in determining sites for those moorings, and to facilitate stronger direct ties between our complementary programs.

Other Collaborators or Contacts

We are coordinating field sampling and data analysis of our project with the NSF funded 'Life in the Deadzone' (LiDZ) project (OCE 0961920), which has similar research initiatives for other components of the Chesapeake Bay Ecosystem. In 2010 two of our investigators participated in the LiDZ cruise aboard the Hugh R. Sharp to collect zooplankton data in conjunction with the microbial and chemical analyses undertaken by that project.

Activities and Findings

Research and Education Activities:

In 2010 we conducted three cruises to the Chesapeake Bay to carry out the goals of this program. Those cruises were all highly successful despite a few equipment problems with the shipboard and our own scientific equipment and analysis of the samples and data that we collected is ongoing.

Two graduate students (Ali Barba and Katherine Liu) are employed for this project, and their work is ongoing. Ali Barba is studying the vertical distribution of the target copepod species, Acartia tonsa, in relation to hypoxic conditions and other environmental factors encountered. Katherine Liu is examining the gut contents and distribution of two gelatinous zooplankton species, ctenophore, Mnemiopsis leidyi, and scyphomedusan, Chrysaora quinquecirrha, in relation to the copepod and hypoxic distributions.

One postdoctoral researcher, Dr. David Elliot, is employed on the project. He is developing and enhancing an individual based model of Acartia tonsa to evaluate how hypoxic conditions might affect the population dynamics of the copepod in the Chesapeake Bay. In addition, he is conducting development rate experiments to explore the non-lethal effects of hypoxia on the copepod.

Two presentations for this project were made at the 2011 ASLO meeting in Puerto Rico:

Barba, A. P., Roman, M. R., Pierson, J. J.
Poster presentation
Title: COMPARING ZOOPLANKTON RESPONSE TO HYPOXIA IN CHESAPEAKE BAY
Abstract: Hypoxia is a common occurrence in fresh and salt water worldwide and can have negative effects on local fish and zooplankton including in the Chesapeake Bay. Copepods, specifically Acartia tonsa, are the most abundant type of zooplankton in the mesohaline reaches of the Bay. They occupy the base of the food web in many aquatic systems, including in Chesapeake Bay, and play a large role in transferring energy and material to higher trophic levels. We compared copepod behavior and fitness at both a hypoxic and an oxic site over three seasons, spring, summer and fall. It is hypothesized that low oxygen water will reduce the fitness of copepods and alter the migration behavior. To test this hypothesis, we observed copepod behavior and fitness using nets and traps, and we focused on migration patterns, population dynamics and RNA/DNA ratios.

Pierson, J. J., Roman, M., Stoecker, D., Houde, E., Decker, M., Elliott, D., Barba, A., Liu, K.
Oral Presentation
Title: DIFFERENTIATING THE IMPACTS OF HYPOXIA ON COPEPODS FROM FOOD WEB EFFECTS IN CHESAPEAKE BAY
Abstract: Hypoxia (dissolved oxygen <2 mg L -1) is prevalent in the mesohaline portion of the Chesapeake Bay each summer, with lower oxygen concentrations generally found further north. We sampled two stations, one hypoxic (treatment) and one normoxic (control), in May, August, and September 2010. We examined the fitness and behavior of copepods in varying hypoxic and environmental conditions, but under similar temperature and salinity regimes on each cruise. In May hypoxia was established at our treatment but not the control station; we found large numbers of bay anchovy eggs and Acartia tonsa copepods. By August the treatment station was anoxic and sulfidic while the control station had normoxic bottom water, and there were large numbers of gelatinous zooplankton and larger bay anchovy larvae, but A. Tonsa were scarce. In September hypoxia was retreating and both stations were well mixed and A. tonsa were abundant. Vertically stratified net tows, samples from Niskin bottles, and hydrographic data, as well as experimental data show how zooplankton populations and individuals respond to varying hypoxic conditions and pelagic communities.

Findings: (See PDF version submitted by PI at the end of the report)

Training and Development:
Our students are learning how to deploy and maintain oceanographic equipment, sort zooplankton samples, and process and analyze hydrographic and plankton data. Further teaching opportunities will arise in summer 2011 with new cruises and the upcoming outreach activities in conjunction with COSEE Coastal Trends.

Outreach Activities:
Our primary outreach activity in year 1 of this project was related to a shipboard cruise blog we published, which can be accessed here:

http://lifeinthedeadzone.org/

This site was maintained primarily by PI Pierson, but contained significant contributions from collaborators (including Byron Crump of the NSF funded LiDZ project), graduate students (Ali Barba) and others.

In addition, PI Pierson was interviewed by journalist Marc Steiner about his work in the Chesapeake related to hypoxia. That interview can be heard here:
http://www.steinershow.org/radio/the-marc-steiner-show/october-21-2010-hour-1

PI Pierson was also featured in a short article in the Chesapeake East Calendar Guide about his work on hypoxia in the Bay. That article can be viewed here, on page 40:
http://issuu.com/chesapeakeeast/docs/january2011web?showEmbed=true

Journal Publications

Books or Other One-time Publications

Web/Internet Site

Other Specific Products

Contributions

Contributions within Discipline:

Contributions to Other Disciplines:

Contributions to Human Resource Development:
Training of two graduate students, one undergraduate student, and one postdoc.

Contributions to Resources for Research and Education:

Contributions Beyond Science and Engineering:

Conference Proceedings

Special Requirements

Special reporting requirements: None
Change in Objectives or Scope: None
Animal, Human Subjects, Biohazards: None

Categories for which nothing is reported:

Any Journal
Any Book
Any Web/Internet Site
Any Product
Contributions: To Any within Discipline
Contributions: To Any Other Disciplines
Contributions: To Any Resources for Research and Education
Contributions: To Any Beyond Science and Engineering
Any Conference

We conducted three research cruises in 2010. Each cruise had an identical cruise plan, consisting of an initial survey of the hydrographic conditions of the Chesapeake Bay from the Bay Bridge in the north to the Rappahannock shoals in the south, using a Scanfish with a top mounted optical plankton counter (OPC). Then we conducted two 56 hour stations, one in the southern, less hypoxic conditions between the Rappahannock and Potomac Rivers, and one in the mid-bay near the mouth of the Little Choptank River. At each 56 hour station, we spent approximately 28 hours at anchor, where we conducted CTD casts hourly and various shipboard observations on the vertical distribution of microplankton, zooplankton trapping series to determine the vertical migration of *Acartia tonsa*, and vital rate experiments on *A. tonsa* including grazing, egg production, and percent alive.

Most of our data processing and analysis is ongoing, however we the hydrographic conditions from the Scanfish surveys have been processed.

General observations

Below are results from the three surveys, showing the development of hypoxic conditions in the Bay. In May, there is strong hypoxia in the northern part of the bay, with fully normoxic conditions in the south (Fig. 1). In August, anoxia is present in the north, with mild hypoxia in the south (Fig. 2). By September, much of the hypoxia has retreated from the south and is only present in a thin deep layer in the northern part of the Bay (Fig. 3).

In terms of our target copepod species, *Acartia tonsa*, preliminary and anecdotal evidence from examining some samples suggests that abundances were lowest in August. This was a period that also coincided with high gelatinous zooplankton and bay anchovy abundance, both of which are voracious predators of *A. tonsa*. However, this was also a period of strong hypoxia and further data analysis will help us discern the factors contributing to these observations. The highest microplankton abundance was found in May, and corresponded to very high diatom abundances at the south station and abundant diatoms and dinoflaglletes at the north station, at both stations microplankton were found throughout the water column. In August and September the microplankton was dominated by dinoflagellates and ciliates.

Further results are forthcoming.

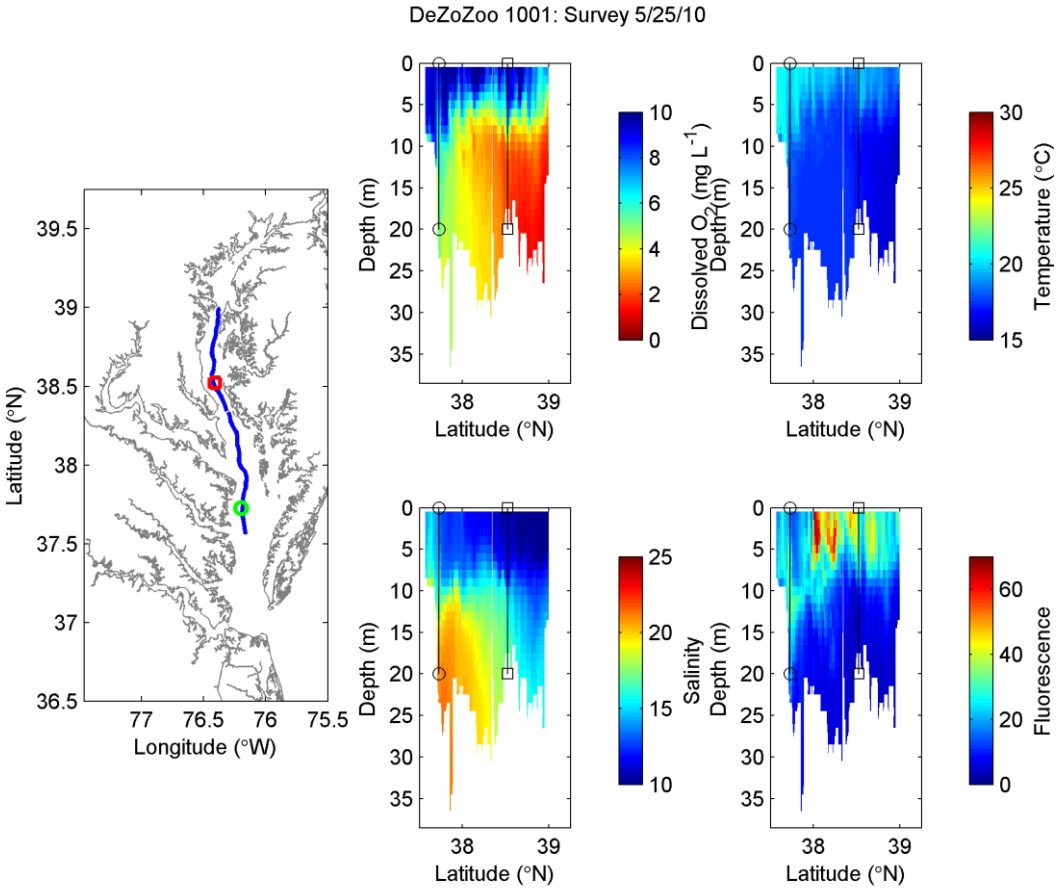

Figure 1. Hydrographic conditions from the Scanfish surveys of the mesohaline Chesapeake Bay in late May 2010.

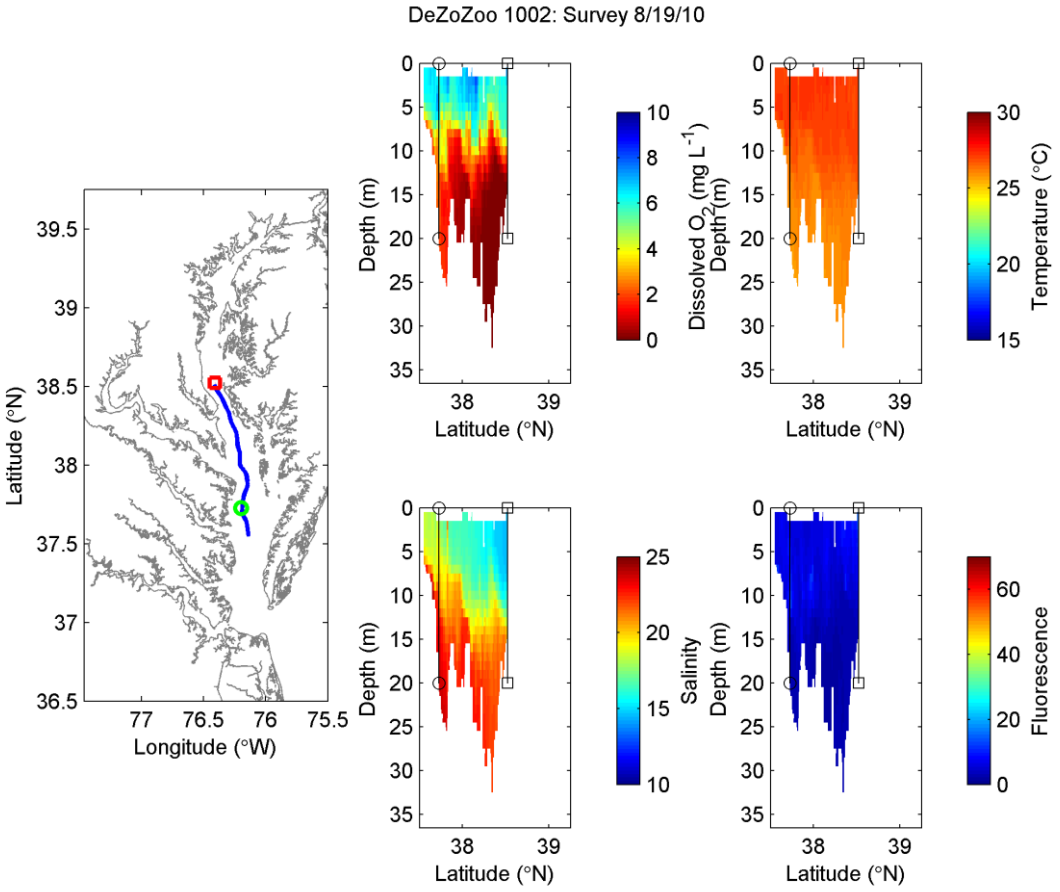

Figure 2. Hydrographic conditions from the Scanfish surveys of the mesohaline Chesapeake Bay in mid August 2010.

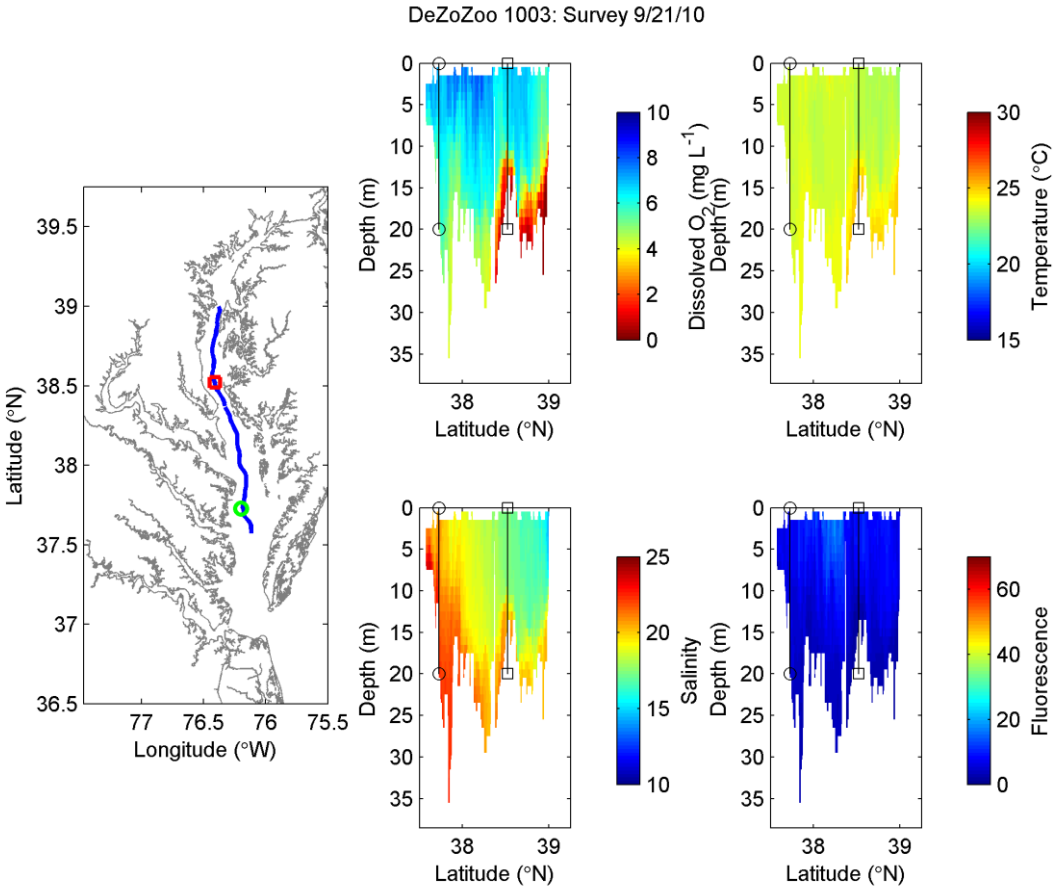

Figure 3. Hydrographic conditions from the Scanfish surveys of the mesohaline Chesapeake Bay in late September 2010.