

## MARINE ECOLOGY

Biology 313 Fall 2010

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Lecture: Tuesday/Thursday 0930-1050, Carnegie 429  
Lab: Tue. 1300-?; Carnegie 444

### Course Description

This course provides an in-depth examination of the ecology of marine and brackish water systems based on the principles of population biology and community ecology. The course begins with an overview of isotope chemistry, ecology, and larval biology as background for the remainder of the course. We will then study the ecology of the major marine communities: intertidal and subtidal hard substrate, kelp, soft substrate, estuarine, plankton, coral reef, and deep sea. Throughout the semester, emphasis is placed on current hypotheses concerning the processes controlling the structure and function of these communities and the potential impact of climate change on these processes. We will also emphasize written and oral critical evaluation of the primary scientific literature. Laboratories are designed to demonstrate some of the principles discussed in class and to provide an opportunity to collect, analyze, interpret and report on scientific data. The last half of the course you will be conducting your own independent project in laboratory.

### Reading:

**Textbook** : Nybakken, J.W. 2001. *Marine Biology an Ecological Approach* 6<sup>th</sup> Edition, Harper Collins College Publishers

**Articles**: Readings from the primary literature for the bulk of reading in Marine Ecology. Articles are listed by author's last name in the syllabus are accessible through the library in lyceum (<http://lyceum.bates.edu>) in the Articles folder (in the files folder). Most are also available on line. Class will focus on the discussion of articles, so it is essential that you do the reading faithfully and prior to coming to class. Each class, one of you will be selected at random to lead the discussion on an article. I suggest you print out articles to read and bring to class.

### **Optional reading** (on reserve, Ladd Library):

Bertness, M.D. 1999. *The Ecology of Atlantic Shorelines*. Sinauer Associates, Inc. 417 pp.

Bertness, M.D. 2007. *Atlantic Seashore: Natural History and Ecology*, Princeton University Press, 431pp.

Bertness, M.D., S.D. Gaines, M.E. Hay (eds.) 2001. *Marine Community Ecology*, Sinauer Associates, Inc. 550 pp.

Day, RA, B. Gastel 2006. *How to Write and Publish a Scientific Paper*, 6<sup>th</sup> ed. Greenwood Press 302 pp. [reserve for B474]

Gillen, C.M. *Reading Primary Literature: A Practical Guide to Evaluating Research Articles in Biology*, Pearson Benjamin Cummings Press, New York, 44 pp.

Grading:

Grades are based largely on written work (biweekly papers, final paper, lab report, project report) and class and lab participation. All work must be submitted to pass the class. The final exam is a 10-15 minute oral exam.

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|--|-----|
| Biweekly papers (4)                    | 32% |
| Final paper                            | 10% |
| <b>Oral</b> exam & class participation | 10% |
| Lab Reports (1)                        | 18% |
| Final Research Project                 | 30% |

Papers: Approximately, every other week you will write a 2-page paper on a topic selected by me. These papers are due in class on Thursday (except during the week of fall break when they are due on the following Tuesday). Papers **must** be submitted as hard copy **and** as an electronic copy as a word attachment to an e-mail. The text of these papers **must not** exceed **2 pages**. References, figures, and diagrams are not included in the 2- page limit. The final paper can be on a topic of your choosing and **may not exceed 5 pages** in length. I will **not accept**, and if they slip by not read, papers that exceed these length limits nor will I accept late papers. NO exceptions.

Office Hours: I have no official office hours. My office is almost always open and I am generally available for students anytime I am on campus from **Monday-Thursday**. It is best to make an appointment if you want to be sure to see me. Please do not try and meet with me the hour or so before class or if my office door is closed. I reserve Fridays for my thesis students and my research. I am most easily reached by e-mail, but do not expect an immediate response.

Communication: The easiest way to reach me may be by e-mail (wambrose). If you want to address your question to the entire class, use the class list serve (Fbio313a@lists.bates.edu). I will use the list serve to get messages to you between classes, so it is your responsibility to check e-mail. You may want to use it to set up study groups etc. Be aware that if you respond to a message on the list serve, everyone will see it. I respond to e-mail in a timely manner, not necessarily immediately.

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**LECTURE SCHEDULE**  
(Subject to change<sup>1</sup>)

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| Date           | Topic   | Reading  |
|----------------|---|--|
| <u>Week 1</u>  |   |  |
| Thur. 9 Sept.  | Course Introduction<br>Structure of Marine Communities<br>Isotope Chemistry | Ch 1(1-25; 31-41)<br>Buss 1979<br>Peterson 1977<br>Hobson <i>et al.</i> 1995<br>Riera <i>et al.</i> 1999           |
| <u>Week 2</u>  |   |  |
| Tue. 14 Sept.  | Lab-Sprague Marsh   |  |
| Thur. 16 Sept. | Larval Ecology  | Ch 1 (25-31)<br>Farrell <i>et al.</i> 1991<br>Grosberg 1981<br>Pawlick <i>et al.</i> 1991<br>Shanks & Pfister 2009 |

| Date           | Topic  | Reading  |
|----------------|--|--|
| <u>Week 3</u>  |  |  |
| Tue. 21 Sept.  | Rocky Intertidal I: Competition  | Ch 6 (266-308)<br>Jenkins <i>et al.</i> 1999<br>Paine 1966<br>Lubchenco 1978   |
| Thur. 23 Sept. | Rocky Intertidal II: Disturbance<br>and larval supply<br><b>PAPER #1 DUE</b> | Bertness <i>et al.</i> 2004a<br>Gaines <i>et al.</i> 1985<br>Jenkins 2005  |
| <u>Week 4</u>  |  |  |
| Tue 28 Sept.   | Dr. Kim Holzer: Sea Grass Ecology  | Ch 5 (233-241)<br>Heck & Valentine 2006<br>Moren & Björndal 2005<br>Schanz <i>et al.</i> 2002  |
| Thur. 30 Sept. | Rocky Intertidal III: Bottom-up<br>Organization                              | Menge <i>et al.</i> 1997<br>Menge 2000<br>Pfister 2007   |
| <u>Week 5</u>  |  |  |
| Tue. 5 Oct.    | Rock Intertidal: multiple stable states                                      | Bertness <i>et al.</i> 2004b<br>Connell & Sousa 1983<br>Petraitis & Dudgeon 2004<br>Petraitis <i>et al.</i> 2009                         |
| Thur. 7 Oct.   | Kelp Beds: Sea otters and urchins<br><b>PAPER #2 DUE</b>                     | Ch 5 (221-233)<br>Anthony <i>et al.</i> 2008<br>Estes <i>et al.</i> 1998<br>Reisewitz <i>et al.</i> 2006<br>Simenstad <i>et al.</i> 1978 |
| <u>Week 6</u>  |  |  |
| Tue. 12 Oct.   | Estuaries: Productivity  | Ch 8 (361-381)<br>Haines 1977<br>Teichberg <i>et al.</i> 2010<br>Wolver and Spurrier 1988  |
| Tue 14 Oct.    | Estuaries: Salt Marshes  | Ch 8 (381-406)<br>Alberti <i>et al.</i> 2010<br>Bertness 1991<br>Sala <i>et al.</i> 2008<br>Silliman <i>et al.</i> 2005                  |

| Date           | Topic  | Reading   |
|----------------|--|---|
| <u>Week 7</u>  |  |   |
| Tue. 19 Oct.   | Soft-substrate I: Physical and Biological Factors                              | Ch 6 (308-341)<br>Lenihan & Micheli 2000<br>Rhodes & Young 1970<br>Thrush <i>et al.</i> 2006<br>Whomersley <i>et al.</i> 2010         |
| Thur. 21 Oct.  | <b>FALL BREAK</b>  |   |
| <u>Week 8</u>  |  |   |
| Tue. 26 Oct.   | Soft-substrate II: Top-down and bottom-up organization<br><b>PAPER # 3 DUE</b> | Ambrose 1984<br>Beukema <i>et al.</i> 2002<br>Cartes <i>et al.</i> 2009<br>Quizon <i>et al.</i> 2008<br>Posey <i>et al.</i> 1995      |
| Tue. 28 Oct.   | Plankton I: 1° Productivity & Food Chain Structure                             | Ch 2<br>Azam 1998<br>Berger <i>et al.</i> 2007<br>Blackburn <i>et al.</i> 1998<br>Boyd <i>et al.</i> 2001<br>Pauly & Christensen 1995 |
| <u>Week 9</u>  |  |   |
| Thur. 2 Nov.   | Plankton II: Long-Term Change  | Borkman & Smyda 2009<br>Boyce <i>et al.</i> 2010<br>Edwards & Richardson 2004<br>Gregg <i>et al.</i> 2005<br>Karl <i>et al.</i> 2001  |
| Thur. 4 Nov.   | Plankton III: Top-down Control   | Frederiksen <i>et al.</i> 2006<br>Fulton 1984<br>Myers <i>et al.</i> 2007<br>Olsen <i>et al.</i> 1007<br>Strom <i>et al.</i> 2001     |
| <u>Week 10</u> |  |   |
| Tue. 9 Nov.    | Pelagic-Benthic Coupling   | Ambrose & Renaud 1995<br>Fulweiler & Nixon 2009<br>Graf 1989<br>Wittbard <i>et al.</i> 2000<br>Smith <i>et al.</i> 1999               |
| Thur. 11 Nov.  | Coral Reef I: Coral-coral interaction<br>Net works<br><b>PAPER # 4 DUE</b>     | Ch 9 (407-436)<br>Chornesky 1989<br>Labid & Chadwick 2006<br>Maida <i>et al.</i> 1995   |

| Date           | Topic   | Reading  |
|----------------|---|--|
| <u>Week 11</u> |   |  |
| Tue. 16 Nov.   | Coral Reefs II: Bleaching and Fishes                      | Ch 9 (436-453)<br>Almany & Webster 2004<br>Aronson <i>et al.</i> 2002<br>Doherty & Fowler 1994<br>Gardner <i>et al.</i> 2003<br>Geanger & Stier 2009<br>McCleod <i>et al.</i> 2010 |
| Thur. 18 Nov.  | Deep Sea I: Diversity                                     | Ch 4<br>Gray 2002<br>Poore & Wilson 1993<br>Snelgrove <i>et al.</i> 1992   |
| <u>Week 12</u> | <b>THANKSGIVING BREAK</b>                                 |  |
| <u>Week 13</u> |   |  |
| Tue. 30 Nov.   | Deep Sea II: Hydrothermal Vents<br><b>FINAL PAPER DUE</b> | Demopoulos <i>et al.</i> 2010<br>Goffredi <i>et al.</i> 2004<br>Marsh <i>et al.</i> 2001<br>Mullineux <i>et al.</i> 2009<br>Tunnicliffe 1992                                       |
| Tue. 2 Dec.    | Fisheries I: Patterns                                     | Ch 11 (500-520)<br>Botsford <i>et al.</i> 1997<br>Finney <i>et al.</i> 2010<br>Myers & Worm 2003<br>Steele & Hoagland 2003<br>Watling & Norse 1998                                 |
| <u>Week 14</u> |   |  |
| Tue. 7 Dec.    | Fisheries II: Consequences & Solutions                    | Pauly <i>et al.</i> 2005<br>Myers <i>et al.</i> 2007<br>Jackson <i>et al.</i> 2001<br>Steele 2004<br>Zeller & Russ 2004  |
| Thur. 9 Dec.   | Climate Change  | Comeau <i>et al.</i> 2009<br>Grebmeier <i>et al.</i> 2006<br>Greene & Pershing 2007<br>Hoegh-Guldberg & Bruno 2010<br>Riebessel <i>et al.</i> 2007<br>Schmittner 2005              |
| Fri. 10 Dec    | <b>FINAL PROJECT PAPER</b>                                |  |
| <u>Week 15</u> | <b>Final Exam: Oral<br/>1030 and TBA</b>                  |  |

**LABORATORY SCHEDULE**

(Subject to change<sup>1</sup>)

The purpose of the laboratories is to introduce you to local marine communities, to allow you to observe some of the patterns of species distribution and abundance, and to test some of the principles discussed in class. The laboratories are also designed to expose you to some of the methods (field, laboratory, and statistical) used in marine ecology and to give you the opportunity to develop your skills in scientific writing and critical analysis.

Many labs are dependent on low tides, and will therefore sometimes begin earlier and will almost always run later than scheduled. We will rarely return from field work before 1630 (4:30pm) and often we will be much later. Students who anticipate difficulties with scheduling should see me as soon as possible.

Labs will run as scheduled regardless of weather unless the conditions are hazardous. Dress appropriately. Be prepared to get wet and cold. Wear waterproof foot ware (we have some wet suit booties and rubber boots you can borrow) and bring a hat, gloves, and a change of clothes.

The results of one laboratory must be reported in the form of a scientific paper and is **due 2 November**. The latter part of the semester is devoted to an independent project and a scientific-format report **due 10 December**. Your independent project may be an expansion, with significantly more data collection and a slightly different question, of a lab we have done. I will also provide a list of possible topics. Or, you may choose your own research question. Statistical analysis beyond what we do in the formal laboratory period will be necessary for the lab you chose to write and for your independent project. .

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| Date          | Lab   | Reading   |
|---------------|---|---|
| <u>Week 1</u> |   |   |
| Thur. Sept 9  | <b>Wiscasset Long-Term Sampling (Optional)</b><br>(L: 1800, -1.5 ft; lv. 1430)                        |   |
| <u>Week 2</u> |   |   |
| Tue. 14 Sept. | <b>Salt Marsh Food Web</b><br>(L: 1106, 0.2 ft; lv. 0930.)  | Hampel et al. 2005<br>McMahon <i>et al.</i> 2006<br>Schindler & Lubetkin 2004 |
| <u>Week 3</u> |   |   |
| Tue. 21 Sept. | <b>Tide Pool Structure</b><br>(L:1647, 0.7 ft): Giant Stairs  | Methratta, 2004<br>Metaxas <i>et al.</i> 1994<br>Trussell <i>et al.</i> 2004  |
| <u>Week 4</u> |   |   |
| Tue. 28 Sept. | <b>Food Web &amp; Tide Pool Analysis</b>  |   |
| <u>Week 5</u> |   |   |
| Tue. 5 Oct.   | <b>Soft-Bottom Community Structure</b><br>(L: 1523, -0.3 ft): Maquoit Bay                             | Peterson & Black 1987<br>Peterson 1987  |
| <u>Week 6</u> |   |   |
| Tue. 12 Oct.  | <b>Soft-bottom Analysis</b><br><b>Project Outline Due &amp; Oral Presentation of Project Proposal</b> |   |

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| Date           | Lab   | Reading  |
|----------------|---|--|
| <u>Week 7</u>  |   |  |
| Tue. 19 Oct.   | <b>Remineralization</b><br>(L: 1535, 1.0 ft.)                             | Ståhl, H. <i>et al.</i> 2004<br>Williams & Heck 2001 |
| <u>Week 8</u>  |   |  |
| Tue. 26 Oct.   | <b>Remineralization Analysis</b>  |  |
| <u>Week 9</u>  |   |  |
| Tue. 2 Nov.    | <b>Project work: field</b><br>(L: 1412, 0.1 ft.)<br><b>Lab Report Due</b> |  |
| <u>Week 10</u> |   |  |
| Tue. 9 Nov.    | <b>Project Work: lab</b><br>(L: 1919, -0.6 ft.)                           |  |
| <u>Week 11</u> |   |  |
| Tue. 16 Nov.   | <b>Project Work: field/lab</b><br>(L: 1307, 1.5 ft.)                      |  |
| <u>Week 12</u> |   |  |
| Tue. 23 Nov.   | <b>THANKSGIVING BREAK</b>   |  |
| <u>Week 13</u> |   |  |
| Tue 30 Nov.    | <b>Project Work: data analysis</b>  |  |
| <u>Week 14</u> |   |  |
| Tue. 7 Dec.    | <b>Presentations</b>  |  |
| Fri. 10 Dec.   | <b>Project Due</b>  |  |

<sup>1</sup> Lecture and Laboratory schedules are subject to change. Changes will be announced in class or on the class e-mail list. It is your responsibility to keep informed.

*"Science is facts. Just as houses are made of stones, so is science made of facts. But a pile of stones is not a house and a collection of facts is not necessarily science."* Henri Poincare (French Mathematician)