Marine Ecology
Three Seas XXVIII
Fall 2011

Lecture: BIOL 5515
Lab: BIO 5516

Lectures, Labs, and Discussions: Thursdays, 9:00 am to 4:30 pm.

Professor: Matt Bracken
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Office hours by appointment

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Required text:

This course is an in-depth survey of concepts in marine ecology, based on examples from the literature. Required readings for each lecture are provided in a reader (*Readings in Marine Ecology, 2011*), which can be obtained from Sal Genovese, Three Seas Coordinator, for a reasonable price.

Other necessary supplies:

(1) Water-resistant field notebook or slate (e.g., item # 101204 at http://www.benmeadows.com/).
(2) Knee-high rubber boots.
(3) Foul-weather gear, especially later in the semester.

Tide charts:

Much of our field work will involve observing and measuring processes and patterns in the intertidal zone. See http://tbone.biol.sc.edu/tide/sites_useastupper.html for the times of low tides at various locations in the Gulf of Maine.

Description:

This course is an advanced treatment of processes and interactions in ocean ecosystems. We will use both conceptual and hands-on approaches to examine the biotic and abiotic factors influencing the distributions, abundances, and interactions of marine organisms. We will also evaluate the roles that organisms play in mediating the transformation and flux of energy and matter in marine ecosystems.

Each lecture will explore a different concept in marine ecology. This approach allows us to explore general and specific concepts, comparing and contrasting the application of these concepts to different marine ecosystems. Many of the examples we will consider, in both

lecture and lab, will involve local marine habitats because we are able to go right outside and see what is going on there.

Major themes that we will consider during the course include the following:

(1) Which biotic and abiotic factors collectively structure marine ecological communities and determine community and ecosystem function?
(2) How have marine organisms adapted to the unique physical, chemical, and biological aspects of life in the sea, and what are the ramifications of these adaptations for their distributions, abundances, and interactions?
(3) What impacts have humans had on marine ecosystems?

Prerequisite:

This is an advanced course in ecology, focusing on marine ecosystems. BIOL 2311 (previously BIO U311) or an equivalent introductory ecology course must have been taken by participants.

Paper discussions

During most weeks, we will have two half-hour discussions of assigned papers. These will be arranged as lecture "breaks" during our Thursday meeting day. Students taking the course for graduate credit are required to lead a discussion, but every member of the class is welcome and encouraged to both lead a discussion. Everyone will be expected to participate.

Critiquing scientific papers

Manuscript peer review is an essential component of the publication processs. Everyone will be required to select a primary literature paper and critique it, including the hypothesis, methods, results, and context. Papers must be approved by the course instructors. More detailed information on the components of papers and the aspects that should be considered will be provided. In essence, you will evaluate the paper you are critiquing as if you were writing it, assessing the success of the author(s) in proposing a hypothesis, conducting observations and experiments to evaluate that hypothesis, reporting the results of their work, and discussing the broader context of their experiments and observations.

Group presentations on projects

The results of three of our field projects will be analyzed and evaluated in small groups (6-7 students) and presented to the entire class on December 8. These three projects (marked with * on the course schedule) will be based on data from the *Gulf Challenger* cruise (September 22), the tide-height surveys at East Point and Quoddy Head (September 28th, September 29th, and October 5th), and our measurements of nutrients and interactions between tide pool seaweeds and snails (October 27th). These presentations may take any form that you wish—be creative!—but must present the data (*i.e.*, results) and your interpretation of those data (*i.e.*, discussion) and must involve every member of the group.

Grading (percentages are approximate):

Mid-term 1:	10% (October 6)
Mid-term2:	10% (November 3)
Manuscript critique:	15% (due November 17)
Mid-term 3:	10% (December 1)
Group presentations on lab projects:	15% (December 8)
Final exam:	15% (December 15)
Discussion:	15% (throughout)
Participation:	10% (throughout)

Participation is worth 10% of your grade, and 1% will be automatically deducted for each missed class or lab session. Discussion participation (15%) will be assessed based on whether you (a) effectively lead your assigned discussion (especially in the case of graduate students) and (b) contribute substantially by asking questions and commenting effectively on all discussion papers. Be sure to read the papers, and be prepared to comment on them!

Tentative Schedule:

Dates	Lectures	Readings	Labs
09/07	(1) What is marine ecology?	None	Observations, patterns & hypotheses (14:53, +1.1')
09/15	(2) Diversity of marine organisms & habitats (3) Oceanographic drivers of biological processes	Menge et al. 2003	Introduction to oceanographic equipment (07:36, +0.7')
09/22	(4) Primary production & bottom-up processes (5) Consumers & top-down processes	Field et al. 1998 Trussell et al. 2004	Cruise on *R/V Gulf Challenger** (13:09, +1.7')
09/29	Maine Field Trip	None	Wednesday & Thursday: Quoddy Head surveys* (18:00, +0.0' & 06:24, +0.4')
10/06	(6) Competition **Mid-term exam #1**	Steneck et al. 1991 None	Nahant surveys* (13:34, +1.4')
10/13	(7) Physical stress (8) Going with the flow	Sanford 2002 Koehl et al. 2008	Biodiversity metrics (No daylight lows)

Dates	Lectures	Readings	Labs
10/20	(9) Positive interactions (10) Foundation species	Bruno 2000 Idjadi & Edmunds 2006	Trampling and recovery (11:41, +1.7')
10/27	(11) Supply-side and larval ecology (12) Marine costume party	Shanks & Roegner 2007 Mesinger & Case 1992	Snails, nutrients, and seaweeds* – collect snails & *Fucus* previous afternoon/evening (No daylight lows)
11/03	**Mid-term exam #2** (13) Spatial subsidies & connectivity	None Polis et al. 1997	Sessile and mobile diversity (12:04, 1.4')
11/10	(14) Why are there so many species? (15) Marine ecosystems	Roy et al. 1998 Grantham et al. 2004	Censusing the history of ecology (16:52, +0.2')
11/17	(16) Linking marine communities & ecosystems (17) Consequences of biodiversity change	Aquilino et al. 2009 Stachowicz et al. 2008	Group project meetings
11/24	No class – Thanksgiving recess	None	Metabolic consequences of overconsumption (Turkey Day)
12/01	**Mid-term exam #3** (18) Human impacts & marine conservation	 Halpern et al. 2008	Thursday: Group project preparation
12/08	(20) Panama, here we come! Group project presentations	Hay & Gaines 1984 None	None
12/15	**Final exam**		

Readings:

Aquilino, K. M., M. E. S. Bracken, M. N. Faubel, and J. J. Stachowicz. 2009. Local-scale nutrient regeneration facilitates seaweed growth on wave-exposed rocky shores in an upwelling system. Limnology and Oceanography **54**:309–317.

Bruno, J. F. 2000. Facilitation of cobble beach plant communities through habitat modification by *Spartina alterniflora*. Ecology **81**:1179-1192.

Field, C. B., M. J. Behrenfeld, J. T. Randerson, and P. Falkowski. 1998. Primary production of the biosphere: integrating terrestrial and oceanic components. Science **281**:237-240.

Grantham, B. A., F. Chan, K. J. Nielsen, D. S. Fox, J. A. Barth, A. Huyer, J. Lubchenco, and B. A. Menge. 2004. Upwelling-driven nearshore hypoxia signals ecosystem and oceanographic changes in the northeast Pacific. Nature **429**:749-754.

Halpern, B. S., S. Walbridge, K. A. Selkoe, C. V. Kappel, F. Micheli, C. D'Agrosa, J. F. Bruno, K. S. Casey, C. Ebert, H. E. Fox, R. Fujita, D. Heinemann, H. S. Lenihan, E. M. P. Madin, M. T. Perry, E. R. Selig, M. Spalding, R. Steneck, and R. Watson. 2008. A global map of human impact on marine ecosystems. Science **319**:948-952.

Hay, M. E. and S. D. Gaines. 1984. Geographic differences in herbivore impact: do Pacific herbivores prevent Caribbean seaweeds from colonizing via the Panama Canal? Biotropica **16**:24-30.

Idjadi, J. A. and P. J. Edmunds. 2006. Scleractinian corals as facilitators for other invertebrates on a Caribbean reef. Marine Ecology Progress Series **319**:117-127.

Koehl, M. A. R., W. K. Silk, H. Liang, and L. Mahadevan. 2008. How kelp produce blade shapes suited to different flow regimes: A new wrinkle. Integrative and Comparative Biology **48**:834-851.

Menge, B. A., J. Lubchenco, M. E. S. Bracken, F. Chan, M. M. Foley, T. L. Freidenburg, S. D. Gaines, G. Hudson, C. Krenz, H. Leslie, D. N. L. Menge, R. Russell, and M. S. Webster. 2003. Coastal oceanography sets the pace of rocky intertidal community dynamics. Proceedings of the National Academy of Sciences, USA **100**:12229-12234.

Mesinger, A. F. and J. F. Case. 1992. Dinoflagellate luminescence increases susceptibility of zooplankton to teleost predation. Marine Biology **112**:207-210.

Polis, G. A., S. D. Hurd, C. T. Jackson, and F. S. Piñero. 1997. El Niño effects on the dynamics and control of an island ecosystem in the Gulf of California. Ecology **78**:1884-1897.

Roy, K., D. Jablonski, J. W. Valentine, and G. Rosenberg. 1998. Marine latitudinal diversity gradients: tests of causal hypotheses. Proceedings of the National Academy of Sciences, USA **95**:3699-3702.

Sanford, E. 2002. Water temperature, predation, and the neglected role of physiological rate effects in rocky intertidal communities. Integrative and Comparative Biology **42**:881-891.

Shanks, A. L. and G. C. Roegner. 2007. Recruitment limitation in Dungeness crab populations is driven by variation in atmospheric forcing. Ecology **88**:1726-1737.

Stachowicz, J. J., M. Graham, M. E. S. Bracken, and A. I. Szoboszlai. 2008. Diversity enhances cover and stability of seaweed assemblages: the role of heterogeneity and time. Ecology **89**:3008-3019.

Steneck, R. S., S. D. Hacker, and M. N. Dethier. 1991. Mechanisms of competitive dominance between crustose coralline algae: an herbivore-mediated competitive reversal. Ecology **72**:938-950.

Trussell, G. C., P. J. Ewanchuk, M. D. Bertness, and B. R. Silliman. 2004. Trophic cascades in rocky shore tide pools: distinguishing lethal and nonlethal effects. Oecologia **139**:427-432.