

SIO 134: Introduction to Biological Oceanography

WINTER 2015

Course Instructor:

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Scheduled Upper Campus Office Hours: Thursdays 1100-1200, York Hall 3030

Teaching Assistants:

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Lectures: 0930 - 1050, Tuesday and Thursday, **CENTER 212**

Lecture Notes: PDF files of PowerPoint files will be available on **Ted**, <http://ted.ucsd.edu>, typically on the afternoon prior to lecture. The purpose of the notes is to facilitate, not substitute for, note taking and lecture attendance. Access is by your personal UCSD Academic Computing **username** and **password**.

Assigned readings: These short journal articles, available as PDF files on the course website, are meant to complement the lectures on important ecological topics or issues of contemporary concern for the marine ecosystem. Details in these readings may go beyond what is necessary for the course, but the general concepts are “fair game” for exams. Readings are assigned by lecture week and are best completed before the relevant lecture or weekly Discussion Section.

Additional background reading: If you desire more background reading and already have a copy of the **Marine Biology** textbook (J.S. Levinton. 2013. 4th ed., Oxford Univ. Press) used in the SIO 132, Marine Biology course, relevant pages are noted to the right of each date on the Lecture Schedule. However, you need not read that material to do well in this course.

Interested students may also find additional information on concepts in the following books on library reserve:

Biological Oceanography, C.B. Miller & P.A. Wheeler, Wiley Blackwell Publ., 2nd ed., 2013.

Biological Oceanography: An Introduction, C.M. Lalli and T.R. Parsons, Open Univ., 2nd ed., 1997.

Discussion Sections (not mandatory): TA-led sections and review sessions are primarily for the clarification of lecture material and readings, and preparation for exams.

<u>Grading:</u>	Midterm Exam (Thursday, 5 Feb)	70 points
	Final Exam (Tuesday, 17 March)	130 points
	TOTAL	200 points

Evaluation is by letter grade based on two exams. There will be a short non-graded quiz in Discussion Sections during week 4 (before the midterm) to familiarize students with exam question style and content. The final exam will cover the material not included on the midterm (i.e., non-comprehensive).

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Course content: The course presents the basics for understanding the ecology of marine communities in a dynamic and changing ocean environment. In the first part of the course, we will take a process approach, focusing on major functional groups of marine organisms, how they interact in ocean food webs, and how the resulting communities respond to their environment. In the second half, we use this foundation as a basis for considering contemporary issues in ocean ecology, including human and climate influences.

LECTURE SCHEDULE

Date	Topic	Levinton Text
Week 1 Readings: <i>Anderson & Rice (2006); Miller (2004)</i>		
Jan 6	Overview - habitats, major themes and issues, historical perspective	pp 2-6, 10-12, 13-22
Jan 8	Why plankton “bloom” – the dynamics of ocean biology	pp 200-208
Week 2 Readings: <i>Capone et al. (1997); Hansen & Calado (1999)</i>		
Jan 13	Phytoplankton - diversity and environmental relationships	pp 141-145, 213-214
Jan 15	Zooplankton - diversity and adaptations of planktonic consumers	pp 91-93, 145-154
Week 3 Readings: <i>Koehl & Strickler (1981); Alldredge & Madin (1982); Pomeroy et al. (2007)</i>		
Jan 20	Grazing and secondary production processes	pp 220-222
Jan 22	Organization of pelagic food webs	pp 218-220, 225-236
Week 4 Readings: <i>Frank et al. (2005); Condon et al. (2011); Giovannoni (2012)</i>		
Jan 27	Upper ocean circulation, biogeography and ocean biomes	pp 22-24
Jan 29	Bottom-up vs top-down controls of marine ecosystems	pp 52-60
Week 5 Readings: <i>Ballance et al. (2001)</i>		
Feb 3	Seabird ecology of the oceanic tropical Pacific (Dr. Lisa Ballance)	pp 185-194
Feb 5	Mid-term Exam	
Week 6 Readings: <i>Benoit-Bird (2004); Smith et al. (1989); Van Dover et al. (2002)</i>		
Feb 10	Vertical migrations and life in the twilight zone	pp 154-158, 175-177
Feb 12	Ecology of deep sea organisms and habitats (Kirk Sato)	pp 410-428
Week 7 Readings: <i>Doney et al. (2009); Jiao et al. (2010); Buesseler et al. (2008)</i>		
Feb 17	New production, elemental cycles and global ocean biogeochemistry	pp 27-33, 208-211, 237-240
Feb 19	Iron limitation and carbon sequestration	pp 211-212
Week 8 Readings: <i>Knowlton (2001); Sandin et al. (2010); Levin et al. (2001)</i>		
Feb 24	Coral reef ecology (Dr. Stuart Sandin)	pp 378-401
Feb 26	Ecology of soft-bottom benthic habitats (Dr. Lisa Levin)	pp 327-359
Week 9 Readings: <i>Ducklow et al. (2013); Jackson (2001)</i>		
Mar 3	Sea ice, global warming and the ecology of polar regions	pp 428-432
Mar 5	The ups and downs of ocean fisheries	pp 461-478
Week 10 Readings: <i>Chavez et al. (2003); Gargett (1997)</i>		
Mar 10	Larval ecology and recruitment of ocean fishes	
Mar 12	Human and climate influences, decadal variability	pp 513-515
Mar 17	Final Exam (Tuesday, 0800 – 1100)	

WEEKLY READING ASSIGNMENTS

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Week 1

- Anderson, T.R. & T. Rice. 2006. Deserts on the sea floor: Edward Forbes and his azoic hypothesis for a lifeless deep ocean. *Endeavour* 30: 131-136.
- Miller, C.B. 2004. The spring phytoplankton bloom. Chapter 1 (pp 1-19) in Miller, C.B. *Biological Oceanography*, Blackwell Science Ltd., Oxford.

Week 2

- Capone, D.G. et al. 1997. *Trichodesmium*, a globally significant marine cyanobacterium. *Science*, 276: 1221-1229.
- Hansen, P.J. & A.J. Calado. 1999. Phagotrophic mechanisms and prey selection in free-living dinoflagellates. *J. Eukary. Microbiol.* 46: 382-389.

Week 3

- Koehl, M.A.R. & J.R. Strickler. 1981. Copepod feeding currents: Food capture at low Reynolds Number. *Limnol. Oceanogr.*, 26: 1062-1073.
- Allredge, A.L. & L.P. Madin. 1982. Pelagic tunicates: unique herbivores in the marine plankton. *BioScience*, 32: 655-663.
- Pomeroy, L.R., P.J. leB. Williams, F. Azam & J.E. Hobbie. 2007. The microbial loop. *Oceanography*, 20: 28-33.

Week 4

- Frank, K.T., B. Petrie, J.S. Choi & W.C. Leggett. 2005. Trophic cascades in a formerly cod-dominated ecosystem. *Science*, 308 (5728): 1621-1623.
- Condon, R.H., D.K. Steinberg, P.A. del Giorgio, T.C. Bouvier, D.A. Bronk, W.H. Graham & H.W. Ducklow. 2011. Jellyfish blooms result in major microbial respiratory sink of carbon in marine systems. *PNAS*, 108: 10225-10230.
- Giovannoni, S.J. 2012. Vitamins in the sea. *PNAS*, 35: 13,888-13,889.

Week 5

- Ballance L.T., D.G. Ainley & G.L. Hunt. 2001. Seabird foraging ecology. Pages 2636-2644 In: Steele, J.H., S.K. Thorpe and K.K. Turekian (eds.), *Encyclopedia of Ocean Science*, Academic Press.

Week 6

- Benoit-Bird, K.J. 2004. Prey caloric value and predator energy needs: Foraging predictions for wild spinner dolphins. *Marine Biology*, 145: 435-444.
- Smith C.R. et al. 1989. Vent fauna on whale remains. *Nature* 341: 27-28.
- Van Dover C.L. et al. 2002. Evolution and biogeography of deep-sea vent and seep invertebrates. *Science* 295: 1253-1257.

Week 7

- Doney, S.C., V.J. Fabry, R.A. Feeley & J.A. Kleypas. 2009. Ocean acidification: the other CO₂ problem. *Annu. Rev. Mar. Sci.* 1: 169-192.
- Jiao, N. et al. 2010. Microbial production of recalcitrant dissolved organic matter: long-term carbon storage in the global ocean. *Nature Rev., Microbiol.* 8: 593-599.
- Buesseler et al. 2008. Ocean iron fertilization – Moving forward in a sea of uncertainty. *Science* 319: 162.

Week 8

- Knowlton, N. 2001. The future of coral reefs. *Proc. Nat. Acad. Sci.* 98: 5419-5425.
- Sandin, S.A., S.M. Walsh & J.B.C. Jackson. 2010. Prey release, trophic cascades, and phase shifts in tropical nearshore marine ecosystems, Pp. 71-90 in J. Terborgh & J.A. Estes, eds. *Trophic cascades: predators, prey, and the changing dynamics of nature.* Island Press.
- Levin, L.A. et al. 2001. The function of marine critical transition zones and the importance of sediment biodiversity. *Ecosystems* 4: 430-451.

Week 9

- Ducklow, H.W. et al. 2013. West Antarctic Peninsula: An ice-dependent coastal marine ecosystem in transition. *Oceanography* 26: 190-203.
- Jackson, J.B.C. et al. 2001. Historical overfishing and the recent collapse of coastal ecosystems. *Science*, 293: 629-638.

Week 10

- Chavez, F.P. et al. 2003. From anchovies to sardines and back: Multidecadal change in the Pacific Ocean. *Science*, 299: 217-221.
- Gargett, A.E. 1997. Physics to fish: Interactions between physics and biology on a variety of scales. *Oceanography* 10: 128-131.