

SIO 134: Introduction to Biological Oceanography

WINTER 2016

Course Instructor:

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Lectures: 0800 - 0920, Tuesday and Thursday, **CENTER 119**

Lecture Notes: PDF files of PowerPoint files will be available on **Ted**, <http://ted.ucsd.edu>, typically on the afternoon prior to lecture. Their purpose is to facilitate note taking and study, not to substitute for 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 to understand for the course, so they need not be studied in detail. However, 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 want or need 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.

Grading:	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 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 5	Overview - habitats, major themes and issues, historical perspective	<i>pp 2-6, 10-12, 13-22</i>
Jan 7	Why plankton “bloom” – the dynamics of ocean biology	<i>pp 200-208</i>
Week 2	Readings: <i>Capone et al. (1997); Hansen & Calado (1999)</i>	
Jan 12	Phytoplankton - diversity and environmental relationships	<i>pp 141-145, 213-214</i>
Jan 14	Zooplankton - diversity and adaptations of planktonic consumers	<i>pp 91-93, 145-154</i>
Week 3	Readings: <i>Koehl & Strickler (1981); Alldredge & Madin (1982); Pomeroy et al. (2007)</i>	
Jan 19	Grazing and secondary production processes	<i>pp 220-222</i>
Jan 21	Organization of pelagic food webs	<i>pp 218-220, 225-236</i>
Week 4	Readings: <i>Frank et al. (2005); Condon et al. (2011); Giovannoni (2012)</i>	
Jan 26	Bottom-up vs top-down controls of marine ecosystems	<i>pp 52-60</i>
Jan 28	Upper ocean circulation, biogeography and ocean biomes	<i>pp 22-24</i>
Week 5	Readings: <i>Ballance et al. (2001)</i>	
Feb 2	Seabird ecology of the oceanic tropical Pacific (Dr. Lisa Ballance)	<i>pp 185-194</i>
Feb 4	Mid-term Exam	
Week 6	Readings: <i>Benoit-Bird (2004); Smith et al. (1989); Van Dover et al. (2002)</i>	
Feb 9	Vertical migrations and life in the twilight zone	<i>pp 154-158, 175-177</i>
Feb 11	Ecology of deep sea organisms and habitats (Dr. Lisa Levin)	<i>pp 410-428</i>
Week 7	Readings: <i>Doney et al. (2009); Jiao et al. (2010); Buesseler et al. (2008)</i>	
Feb 16	New production, elemental cycles and global ocean biogeochemistry	<i>pp 27-33, 208-211, 237-240</i>
Feb 18	Iron limitation and carbon sequestration	<i>pp 211-212</i>
Week 8	Readings: <i>Knowlton (2001); Sandin et al. (2010), Aburto-Oropeza et al. (2008, 2009)</i>	
Feb 23	Coral reef ecology (Dr. Stuart Sandin)	<i>pp 378-401</i>
Feb 25	Mangrove ecology and ecosystem services (Dr. Octavio Aburto)	<i>pp 327-359</i>
Week 9	Readings: <i>Ducklow et al. (2013); Jackson (2001)</i>	
Mar 1	Sea ice, global warming and the ecology of polar regions	<i>pp 428-432</i>
Mar 3	The ups and downs of ocean fisheries	<i>pp 461-478</i>
Week 10	Readings: <i>Chavez et al. (2003); Gargett (1997)</i>	
Mar 8	Larval ecology and recruitment of ocean fishes	
Mar 10	Human and climate influences, decadal variability	<i>pp 513-515</i>
Mar 17	Final Exam (Thursday, 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.
- Alldredge, 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.
- Aburto-Oropeza, O., et al. 2008. Mangroves in the Gulf of California increase fishery yields. *Proc. Natl. Acad. Sci. USA* 105: 10,456–10,459.
- Aburto-Oropeza, O., et al. 2009. Recruitment and ontogenetic habitat shifts of the yellow snapper (*Lutjanus argentiventris*) in the Gulf of California. *Mar. Biol.* 156: 2461–2472.

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.