

SIO 134: Introduction to Biological Oceanography

WINTER 2017

Course Instructor:

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Upper Campus Office Hours: Thursdays 11:00-12:00, York Hall 3030

Teaching Assistants:

Lillian McCormick lrnccorm@ucsd.edu Office: Wednesdays 1:00-1:50, York Hall 3030

Jessica Garwood jcarrier@ucsd.edu Office: Wednesdays 11:00-12:00, Galbraith 364

Lectures: 0930 -10:50, Tuesday and Thursday, **CENTER 113**

Lecture Notes: PDF files of PowerPoint files will be available on **TritonEd** (formerly **Ted**), <https://triton.ed.ucsd.edu>, generally 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, 9 Feb)	70 points
	Final Exam (Tuesday, 21 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 10	Overview - habitats, major themes and issues, historical perspective	pp 2-6, 10-12, 13-22
Jan 12	Why plankton “bloom” – the dynamics of ocean biology	pp 200-208
Week 2	Readings: <i>Capone et al. (1997); Hansen & Calado (1999)</i>	
Jan 17	Phytoplankton - diversity and environmental relationships	pp 141-145, 213-214
Jan 19	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 24	Grazing and secondary production processes	pp 220-222
Jan 26	Organization of pelagic food webs	pp 218-220, 225-236
Week 4	Readings: <i>Barton et al. (2013); Ballance et al. (2001)</i>	
Jan 31	Upper ocean circulation, biogeography, biomes (Dr. Andrew Barton)	pp 22-24
Feb 2	Seabird ecology of the oceanic tropical Pacific (Dr. Lisa Ballance)	pp 185-194
Week 5	Readings: <i>Frank et al. (2005); Condon et al. (2011); Giovannoni (2012)</i>	
Feb 7	Bottom-up vs top-down controls of marine ecosystems	pp 52-60
Feb 9	Mid-term Exam	
Week 6	Readings: <i>Benoit-Bird (2004); Smith et al. (1989); Danovaro et al. (2014)</i>	
Feb 14	Vertical migrations and life in the twilight zone	pp 154-158, 175-177
Feb 16	Ecology of deep sea organisms and habitats	pp 410-428
Week 7	Readings: <i>Doney et al. (2009); Jiao et al. (2010); Buesseler et al. (2008)</i>	
Feb 21	New production, elemental cycles and global ocean biogeochemistry	pp 27-33, 208-211, 237-240
Feb 23	Iron limitation and carbon sequestration	pp 211-212
Week 8	Readings: <i>Knowlton (2001); Sandin et al. (2010), Levin et al. (2001)</i>	
Feb 28	Coral reef ecology (Dr. Jennifer Smith)	pp 378-401
Mar 2	Wetlands and soft-bottom coastal ecology (Dr. Lisa Levin)	pp 327-359
Week 9	Readings: <i>Ducklow et al. (2013); Fritz et al. (2017); Jackson et al. (2001)</i>	
Mar 7	Sea ice, global warming and the ecology of polar regions	pp 428-432
Mar 9	The ups and downs of ocean fisheries	pp 461-478
Week 10	Readings: <i>Chavez et al. (2003); Gargett (1997); Pershing et al. (2015)</i>	
Mar 14	Larval ecology and recruitment of ocean fishes	
Mar 16	Human and climate influences, decadal variability	pp 513-515
Mar 21	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., et al. 2007. The microbial loop. *Oceanography*, 20: 28-33.

Week 4

- Frank, K.T., et al. 2005. Trophic cascades in a formerly cod-dominated ecosystem. *Science*, 308: 1621-1623.
- Condon, R.H., et al. 2011. Jellyfish blooms result in major microbial respiratory sink of carbon in marine systems. *Proc. Nat. Acad. Sci.*, 108: 10225-10230.
- Giovannoni, S.J. 2012. Vitamins in the sea. *Proc. Nat. Acad. Sci.*, 35: 13,888-13,889.

Week 5

- Barton A.D., et al. 2013. The biogeography of marine plankton traits. *Ecol. Lett.*, 16:522-534.
- Ballance L.T., et al. 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. *Mar. Biol.*, 145: 435-444.
- Smith C.R. et al. 1989. Vent fauna on whale remains. *Nature*, 341: 27-28.
- Danovaro R. et al. 2014. Challenging the paradigms of deep-sea ecology. *TREE*, 29: 465-475.

Week 7

- Doney, S.C., et al. 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.
- Fritz, M., et al. 2017. Collapsing Arctic coastlines. *Nature Climate Change*, 7: 6-7.
- 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.
- Pershing, A.J., et al. 2015. Slow adaptation in the face of rapid warming leads to collapse of the Gulf of Maine cod fishery. *Science*, 350: 809-813.