Dynamics of Marine Ecosystems:
Biological-Physical Interactions in the Oceans (OCN 680, OCN 480)
SAMPLE SYLLABUS

Instructor:

Professor Margaret Anne McManus
Marine Sciences Building (MSB 616)
mamc@hawaii.edu

Office Hours:
Tuesday and Thursday from 1:15 – 2:30 pm

Readings:
Dynamics of Marine Ecosystems: Biological-Physical Interactions in the Oceans. Mann KH and Lazier JRN. Blackwell Scientific Publications. (2nd or 3rd edition)

Journal Articles

Exam 1: Tuesday 13 February 2018

Exam 2: Tuesday 17 April 2018

Final Exam: Thursday 10 May 12:00 – 2:00 pm

Paper Topics Due: Thursday 22 February 2018

In Class Presentations/Papers Due: Tuesday 1 May 2018

Homework:
Please pay attention to the syllabus.
(1) If we are going to have a lecture on a chapter, read the chapter before class.
(2) If we are going to have a lecture on a journal article, read the journal article before class.
(3) If you are going to present a journal article, please come to class prepared.

Class Schedule:

Week	Activity	Ch	Topic
1	Introductions Lecture	1	Overview of syllabus & project Chapter 1
	Lecture	2	Chapter 2: Biology and Boundary Layers I - Phytoplankton
2	Journal Article		*Turbulence & Phytoplankton* *Berdalet, E. and Estrada, M.: Effects of small-scale turbulence on the physiological functioning of marine algae, in: Algal Cultures, Analogues of Blooms and Applications, edited by: Subba Rao, D. V., Enfield, NH, USA, Science Publishers, Inc., 2005*
	Lecture & Journal Article	2	Chapter 2: Biology and Boundary Layers II - Zooplankton *Gradients, Zooplankton Behavior* *Woodson CB, DR Webster, MJ Weissburg and J. Yen. 2005. Response of copepods to physical gradients associated with structure in the ocean. Limnol. Oceanogr. 50(5) 1552-1564.*
3	Journal Articles		*Animals Make Turbulence* *Huntley and Zhou. 2004. Influence of animals on turbulence in the sea. Vol. 273: 65–79, 2004* *Kunze, E et al. Observations of biologically generated turbulence in a coastal inlet.*
	Lecture & Journal Article & Exercise	3	Chapter 3: Vertical Structure of the Open Ocean: Biology of the Mixed Layer *Spring Bloom* *Sverdrup HU. 1953. On Conditions for the Vernal Blooming of Phytoplankton. J. Cons. Perm. Int. Exp. Mer. 18: 287-295.*
4	Lecture	4	Chapter 4: Vertical Structure in Coastal Waters: Freshwater Runoff

	Journal Articles		<u>*Introduction to thin layers, WA/HI*</u> *Dekshenieks MM, PL Donaghay, JM Sullivan, JEB Rines, TR Osborn and MS Twardowski. 2001. Temporal and spatial occurrence of thin phytoplankton layers in relation to physical processes. Marine Ecology Progress Series. 223: 61-71* *Sevadjian JC, MA McManus, G Pawlak. 2010. Effects of physical structure and processes on thin zooplankton layers in Mamala Bay, Hawaii. Marine Ecology Progress Series. 409:95-106.* *McManus MA, JC Sevadjian, KJ Benoit-Bird, OM Cheriton, AV Timmerman, CM Waluk. 2012.* *Observations of thin layers in coastal Hawaiian waters. Estuaries and Coasts. Vol 35(4): 1119-1127*
5	Lecture	5	Chapter 5: Vertical Structure in Coastal Waters: Coastal Upwelling Regions
	Journal Articles		<u>*Upwelling shadow, thin layers, HABS*</u> *Graham WM and JL Largier. 2007. Upwelling shadows as nearshore retention sites: the example of northern Monterey Bay. Continental Shelf Research. Vol 17(5) 509-532.* *McManus MA, RM Kudela, MV Silver, GF Steward, JM Sullivan, PL Donaghay. 2008. Cryptic blooms: Are thin layers the missing connection? Estuaries and Coasts. 31: 396-401.* *Timmerman AVH, MA McManus, OM Cheriton, RK Cowen, AT Greer, RM Kudela, KC Ruttenburg and JC Sevadjian. 2014. Hidden thin layers of toxic diatoms in a coastal bay. Deep Sea Research II. Special Issue: Harmful Alglal Blooms in Stratified Systems. Raine R, E Berdalet, MA McManus, H Yamazaki (Eds). Deep-Sea Research II 101 (2014) 129–140 press.*
6	**EXAM 1**		
	NO CLASS		

7	Lecture & Journal Article	6	Chapter 6: Fronts in Coastal Waters <u>*Fronts*</u> *Owen, R. W. (1981) Fronts and eddies in the sea: mechanisms, interactions and biological effects. In The Analysis of Marine Ecosystems (ed. A. R. Longhrust), pp 233. Academic press, London.* *197-212 (PART I)*
	Journal Articles **PAPER TOPICS DUE IN CLASS**		<u>*Fronts, Phytoplankton, Zooplankton*</u> *Pingree RD, PR Pugh, PM Holligan and GR Forster. 1975. Summer phytoplankton blooms and red tides along tidal fronts in the approaches to the English Channel. Nature Vol 258: 672-677.* *Woodson CB, MA McManus, JA Tyburczy, JA Barth, L Washburn, JE Caselle, MH Carr, DP Malone, PT Raimondi, BA Menge and SR Palumbi. 2012. Coastal fronts set recruitment and connectivity patterns across multiple taxa. Limnol. Oceanogr. 57: 582-596.*
8	Journal Articles		<u>*Intro to Structure and Transport*</u> *McManus MA, OM Cheriton, PT Drake, DV Holliday, CD Storlazzi, PL Donaghay, CE Greenlaw. 2005. The effects of physical processes on the structure and transport of thin zooplankton layers in the coastal ocean. Marine Ecology Progress Series. 301: 199-215.* *Woodson CB and MA McManus. 2007. Foraging Behavior can Influence Dispersal of Marine Organisms. Limnology and Oceanography. 56(2): 2701-2709.* *McManus MA and CB Woodson. 2012. Review: Plankton distribution and oceanic dispersal. Journal of Experimental Biology Special Issue: Biophysics, Bioenergetics, and the Mechanistic Approach to Ecology. Volume 215(6): 1008-1016.*
9	Lecture	7	Chapter 7: Tides, Tidal Mixing, Surface & Internal Waves
	Journal Article		<u>*Internal Waves/Tides & Transport*</u>

			Shanks, AL. 1988. Further support for the hypothesis that internal waves can cause shoreward transport of larval invertebrates and fish. Fishery Bulletin. Vol 86(4): 708- 714. *Pineda J. 1999. Circulation and larval distribution in internal tidal bore warm fronts. Limnology and Oceanogr. 44(6): 1400-1414.*
10	Journal Articles		*<u>Internal Waves/Tides, Transport & Behavior</u>* *McManus MA, KJ Benoit-Bird, CB Woodson. 2008. Behavior exceeds physical forcing in the diel horizontal migration of a midwater sound-scattering layer in Hawaiian waters. Marine Ecology Progress Series. 365: 91-101.* *Sevadjian, JS, MA McManus, KJ Benoit-Bird, and K Selph. 2012. Shoreward advection of phytoplankton and vertical re-distribution of zooplankton by episodic near-bottom water pulses on an insular shelf: Oahu, Hawaii. Continental Shelf Research. Volumes 50-51, 1 – 15*
	Lecture & Journal Article	8	Chapter 8: Ocean Basin Circulation: The Biology of Major Currents, Gyres, Rings and Eddies *<u>Eddies, Major Currents</u>* *Owen, R. W. (1981) Fronts and eddies in the sea: mechanisms, interactions and biological effects. In The Analysis of Marine Ecosystems (ed. A. R. Longhrust), pp 233. Academic press, London.* *212-228 (PART II)*
11	Movie & Lecture		Internal Wave Generated Slicks: the Surface Lines in Coastal Kona Study (SLICKS)
	Lecture		Biological Aspects of Internal Wave Generated Slicks
12	**NO CLASS**		**SPRING BREAK**
	NO CLASS		**SPRING BREAK**
13	Journal Articles		*<u>Eddies</u>* *Bidigare, Benitez-Nelson, Leonard, Quay, Parsons, Foley, Seki. 2003. Influence of a cyclonic eddy on*

			microheterotroph biomass and carbon export in the lee of Hawaii. GRL, Vol 30(6) 1318. *Seki MP, R Lumpkin, P Flament. 2002. Hawaii cyclonic eddies and blue marlin catches: The case study of the 1995 Hawaiian International Billfish Tournament.* *Journal of Oceanography. Vol 58. 739-745.*
	Journal Articles		*<u>Eddies continued.</u>* *Shulzitskil K, S Sponaugle, M Hauffl, K Walter, EK D'Alessandro and RK Cowen. 2015. Close encounters with eddies: oceanographic features increase growth of larval reef fishes during their journey to the reef. Biol. Lett. 11: 20140746.* *http://dx.doi.org/10.1098/rsbl.2014.0746* *Storlazzi CD, MA McManus, JB Logan, BE McLaughlin. 2006. Cross-shore velocity shear, eddies and heterogeneity in water column properties over fringing coral reefs: West Maui, Hawaii. Continental Shelf Research. 26(3): 401-421.* *Polovina J, E Howell, DR Kobayashi and M Seki. 2001. The transition zone chlorophyll front, a dynamic global feature defining migration and forage habitat for marine resources. Progress in Oceanography 49 (2001) 469–* *483*
14	Journal Articles		*<u>Island Mass Effect</u>* *Doty MS and M Oguri. 1956. The Island Mass Effect. J. Cons. Int. Expl. Mer. 22:33-37* *Gove JM, MA McManus, AB Neuheimer, JS Ehses. 2016. Proximate drivers of the Island Mass Effect. Nature Communications. 7:10581 | DOI: 10.1038/ncomms10581*
	Lecture	9	Chapter 9: Variability in Ocean circulation: Its Biological Consequences
15	**EXAM 2**		
	Lecture & Journal Article		*<u>Ocean Variability and Marine Systems</u>* *Barth JA, BA Menge, J Lubchenco, F Chan, JM Bane, AR*

			Kirincich, MA McManus, KJ Nielson, SD Pierce, L Washburn. 2007. Delayed upwelling alters coastal ocean ecosystems in the northern California current. *Proceedings of the National Academy of Sciences. 104(10) 3719-3724.* *McCoy D, MA McManus, K Kotubetey, AH Kwelo, C Young, B D'Andrea, KC Ruttenberg and RA Alegado. 2017. Large-scale climatic effects on traditional Hawaiian fishpond aquaculture. PLoS ONE 12(11): e0187951. https://doi.org/10.1371/journal.pone.0187951*
16	Lecture & Acid Test Movie	10	The Oceans and Global Climate Change: Physical and Biological Aspect <u>*Ocean Acidification & Biology*</u> *Chan F, JA Barth, CA Blanchette, RH Byrne, F Chavez, O Cheriton, RA Feely, G Friederich, B Gaylord, T Gouhier, S Hacker, T. Hill, G Hofmann, MA McManus, BA Menge, KJ Nielsen, A Russell, E Sanford, J Sevadjian and L. Washburn. 2017. Persistent spatial structuring of coastal ocean acidification in the California Current System. Nature Scientific Reports | 7: 2526 | DOI:10.1038/s41598-017-02777-y*
	Lecture & Exercise	11	Fisheries exercise. The social component. Questions for the future
17	**PRESENT PAPER**		**PAPERS DUE IN CLASS**
	FINAL EXAM		**12:00-2:00 p.m.**

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Grading:

Undergraduate		
Exam 1	16 points	
Exam 2	17 points	
Final Exam	17 points	
Journal Presentations	10 points	
Participation	12 points	
Attendance	28 points	100 possible

Graduate		
Exam 1	16 points	
Exam 2	17 points	
Final Exam	17 points	
Journal Presentations	10 points	
Participation	12 points	
Attendance	28 points	
Paper/Presentation	20 points	120 possible

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Final Paper and Presentation for Graduate Students:

Due: 1 May, in class

Paper topic:

My hope is that after this class, you can go to any coastal or open ocean area and understand the physical forces that are driving circulation, and in turn understand the physical mechanisms that are affecting the marine ecosystem. For your paper, I would like you to choose one ocean area (***my advice is to chose the system that you are already working in***) describe the major physical processes driving the circulation patterns, and describe how these patterns affect the marine ecosystem (or individual planktonic populations, or chemical system). Often these papers become a fundamental piece of student's MS thesis or PhD dissertation.

Questions to answer:

(1) What are the major processes influencing the circulation patterns in your research area?
(For example: wind, wave, tide, freshwater inflow, and bathymetry/topography etc.)
(2) What do the general circulation patterns look like?
(3) How could the physical circulation affect the marine ecosystem (or individual planktonic populations, or chemical system)?

Before selecting your site here are questions to ask yourself:

(1) What historical information is available from this site? (Literature review)
(2) Is there any instrumentation currently deployed at any of these sites?
(3) Is any of this data available on the web? (Maps/charts/time series of physical data)

Specifics:

(1) Your paper should have the following sections:
- Title page
- Abstract (a brief summary of your findings)
- Introduction
- Methods (how you found your information)
- Results (a description of your study area)
- Discussion
- Acknowledgements
- References

(2) Length: no more than 10 pages including figures.

Presentation:

Students who write papers, will present their work as a scientific talk in class on 1 May.

(1) Your talk should have the following sections:

Title page
Introduction
Methods (how you found your information)
Results (a description of your study area)
Summary
Acknowledgements

(2) Length: Please allow 12 minutes for the talk, and 3 minutes for questions.

Grading:

10 points for the final paper, 10 points for the presentation. 1 point deducted for each day late.