

Marine Ecology

Professor Mark E. Hay

(Tu, Th 1335-1455h in U A Whitaker Biomedical Engr)

Office is 2102 in the Ford Env. Science and Eng. Building

Office phone – 404-894-8429

mark.hay@biology.gatech.edu

Class Requirements and Grading - Tests will consist of a mix of short answer (a few sentences to a paragraph) questions mandating that you understand and be able to work with the concepts we have covered and multiple choice questions. There are three exams – each covers only the material presented since the previous test. **I EXPECT YOU TO READ THE ASSIGNED PAPERS BEFORE COMING TO EACH CLASS.** I will give pop quizzes designed to see if you read the papers as assigned (i.e., to punish you for not reading the papers and not being prepared to participate – there will be no make-ups for missed pop-quizzes, but you can drop ONE. Thus don't miss class and don't be late). Additionally, I am not reluctant to ask questions on the tests that have been addressed directly by the papers, but little, if at all, in class.

Before 21 February, you are to find, read, and summarize in one page or less (12 pt font, double spaced, 1 inch margins all round) a primary research paper about any topic on our schedule; **before 4 April**, do this a second time. These papers cannot be ones assigned for reading. Include the following in each summary: 1) a quick summary of the hypotheses tested, methods used, and findings, 2) strengths of the study (what makes it interesting, novel, substantial and rigorous, etc.), 3) limitations of the study (are the methods suitable for the questions addressed? Do the author's conclusions exceed the foundations of their data, etc.), and 4) a short statement on the overall value of the paper given its relative strengths and limitations.

Grading –

Pop Quizzes	5%
Exam 1	25%
Exam 2	30%
Exam 3	30%
Two summary papers	10%
Class participation/discussion	3% extra credit

Job Opportunities, Summer courses, etc. - Many of you will be interested in summer jobs involving marine ecology, summer classes, etc. Information I get regarding these will be sent to you via email, or possibly announced in class. Doing well, preferably very well, in this class obviously enhances my ability to promote you for such opportunities. I also may hire assistants for the summer, and I work in Fiji, so.....

Schedule of Topics and Readings

January:

- 8** - Introduction to the course – This is about marine ecology, but also about **SCIENCE** – Read the one page essay attached to this outline and get comfortable with asking “stupid” questions. If we don’t ask these questions, we stay stupid – so speak up; doing so also will help you and those around you, and the “stupid” questions are often some of the most critical ones....

GLOBAL CHANGE AND OTHER LARGE-SCALE STRESSORS

- 10** - Overview of the ecological state of the ocean
READ – Jackson JBC. 2008. Ecological extinction and evolution in a brave new ocean. Proc. Nat Acad. Sci. 105: 11458-11465.
- 15** - Rigor, experimental design, and science as a “way” of knowing, not just what is known
READ – Chamberlin, T.C. 1965. The method of multiple working hypotheses. Science 148: 754-759.
AND
Hurlbert, S.H. 1984. Pseudoreplication and the design of ecological field experiments. Ecological Monographs 54:187-211.
Sorry about the length of today’s reading assignment, but it is a critical topic that will allow you better insight into the validity of many of the other papers you will read.
- 17** - Climate change, global warming, and effects on marine systems
READ - Hoegh-Guldberg, O and JF Bruno 2010. The impact of climate change on the world’s marine ecosystems. SCIENCE, 328: 1523-1528.
- 22** - Ocean acidification and effects on marine ecosystems
READ - Doney SC, VJ Fabry, RA Feely, JA Kleypas. 2009. Ocean Acidification: The Other CO2 Problem. Annu. Rev. Mar. Sci. 1: 169-192.
- 24** - Disease and impacts on marine communities
READ – Harvell CD, et al. 1999. Emerging marine diseases: Climate links and anthropogenic factors. Science 285:1505-1510

FUNDAMENTALS OF MARINE ECOLOGY

- 29** - Sex in the sea I: fertilization

READ - Clifton, K.E. 1997. Mass spawning by green algae on coral reefs. *Science* 275:1116-1118.

AND

Yund PO. 2002. How severe is sperm limitation in natural populations of marine free-spawners? *Trends in Ecology and Evolution* 15: 10-13

31 - Sex in the sea II: Sex change

READ – Warner RR 1984. Mating-behavior and hermaphroditism in coral reef fishes. *American Scientist* 72:128-136.

February:

5 - Zygote/Larval behavior (now what do the babies do?)

READ - Strathmann, R.R. 1980. Why does a larvae swim so long? *Paleobiology* 6:373-376

AND

Doropoulos c. et al. 2012. Ocean acidification reduces recruitment by disrupting intimate larval-algal settlement interactions. *Ecology Letters* 15: 338-346.

7 - Dispersal and open vs closed populations (can populations be locally adapted?):

READ – Marshall, DJ, K Monro, M Bode, MJ Keough, and S Swearer. 2010. Phenotype-environment mismatches reduce connectivity in the sea. *Ecology Letters* 13:128-140.

12 - EXAM #1

14 - Local recruitment despite pelagic dispersal – how might it be achieved?

READ – Almay GR, Berumen ML, Thorrold SR, Planes S, and Jones GP. 2007. Local replenishment of coral reef fish populations in a marine reserve. *Science* 316: 742-744.

AND

Dixson DL, GP Jones, PL Munday, S Planes, MS Pratchett, M Srinivasan, C Syms and SR Thorrold 2008. Coral reef fish smell leaves to find island homes. *Proc. R. Soc. B* **275**, 2831-2839

19 - The emerging recognition of larval behavior – effects on ecosystems

READ – NO READING...at present. This lecture will be on emerging findings that have not yet been written or published. If a preliminary paper is ready by mid-February, I'll add a reading, but at present, none exist.

21 - Competition and the structure of marine communities

READ – Litchman E. et al. 2007. The role of functional traits and trade-offs in structuring phytoplankton communities: scaling from cellular to ecosystem levels. *Ecology Letters*. 10: 1170-1181.

- 26 - **Allelopathy and its role in benthic community structure**
 READ - Rasher DB, S Engel, EP Stout, J Kubanek and ME Hay. 2011. Macroalgal terpenes function as allelopathic agents against reef corals. *Proceedings of the National Academy of Sciences* 108: 17726-17731
 AND
 Dixson DL and ME Hay. 2012. Corals chemically cue mutualistic fishes to remove competing seaweeds *Science* 338: 804-807
- 28 - **Competition – Most critical among similar or dis-similar species?**
 READ - Burkepile, DE, JD Parker, CB Woodson, HJ Mills, J Kubanek, PA Sobecky, and ME Hay 2006. Chemically-mediated competition between microbes and animals: microbes as consumers in food webs. *Ecology* 87:2821-2831.
- March:**
- 5 - **Consumer-Prey interactions I**
 READ – Estes JA et al. 2011. Trophic downgrading of planet Earth. *Science* 333: 301-306
 AND
 Duffy, J.E. and M.E. Hay. 2001. Ecology and evolution of marine consumer-prey interactions. Pages 131-157, In Bertness, M, M.E. Hay and S.D. Gaines (eds.) *Marine Community Ecology*, Sinauer Press, Sunderland, Massachusetts
- 7 - **Consumer-Prey interactions II (Chemical defenses: examples of using mechanisms to scale up to ecological and evolutionary consequences)**
 READ – Hay ME. 2009. Marine chemical ecology: Chemical signals and cues structure marine populations, communities, and ecosystems. *Annual Review of Marine Sciences* 1: 193-212.
- 12 - **guest lecture - Chemical signals in the plankton**
 READ Pohnert G, Steinke M, and Tollrian R. 2007. Chemical cues, defense metabolites and the shaping of pelagic interspecific interactions. *Trends in Ecology and Evolution* 22:198-204.-
- 14 **EXAM #2**
- 19 **Spring Break**
- 21 **Spring Break**
- 26 – **Top-down vs bottom up effects on community structure**
 READ - Burkepile, DE and Hay ME. 2006. Herbivore versus nutrient control of marine primary producers: Context-dependent effects. *Ecology* 87: 3128-3139.
- 28 - **Trophic Cascades**

READ – Myers RA, et al. 2007. Cascading effects of the loss of apex predatory sharks from a coastal ocean. *Science* 315:1846-1850.

AND

Springer AM, et al. 2003. Sequential megafauna collapse in the North Pacific Ocean: an ongoing legacy of industrial whaling? *PNAS* 100: 12223-12228

April:

2 - Trait mediated interactions: The ecology of fear.

READ – Peckarsky BL, et al. 2008. Revisiting the classics: considering nonconsumptive effects in textbook examples of predator-prey interactions. *Ecology* 89:2416-2425.

4 - Facilitation/positive interactions and the structure of marine communities

READ – Bruno JF, Stachowicz JJ, and Bertness MD. 2003. Inclusion of facilitation into ecological theory. *Trends in Ecology and Evolution* 18: 119-125

9 - Marine migrations: Meeting needs and causing cross-system transport

READ – Costa, DP, Breed GA, and Robinson PW. 2012. New insights into pelagic migrations: Implications for ecology and conservation. *Annual Review of Ecology, Evolution, and Systematics* 43: 73-96.

11 - Biogeography of marine processes – tropicalization due to climate change?

Read – Pennings SC and Silliman BR. 2005. Linking biogeography and community ecology: latitudinal variation in plant-herbivore interaction strength. *Ecology* 86: 2310-2319

CAN ECOLOGICAL INSIGHTS ENHANCE MANAGEMENT? (I.E., SO NOW WHAT DO WE DO?)

16 - Fishing and effects on marine ecosystems

READ – Erlandson JM and Ricks TC. 2010. Archeology meets marine ecology: the antiquity of maritime cultures and human impacts on marine fisheries and ecosystems. *Annual Review of Marine Science* 2: 231-251.

18 guest lecture

23 - Coral reefs as an example of the synergistic effects of multiple stressors

READ - Hughes TP, NAJ Graham, JBC Jackson, PJ Mumby, RS Steneck. 2010. Rising to the challenge of sustaining coral reef resilience. *Trends in Ecology and Evolution* 25:633-642.

25 - Eco-Engineering sustainable ecosystems (an example)

READ - Burkepile DE and ME Hay. 2008. Herbivore species richness and feeding complementarity affect community structure and function: the case for Caribbean reefs. *Proc. Nat. Acad. Sci.* 105:162021-16206.

May:

2 Final Exam 2:50 – 5:40