

UNIVERSITY OF SOUTH FLORIDA -- COLLEGE OF MARINE SCIENCE
FALL SEMESTER 2009 Syllabus Version 1 (August 25)
EVOLUTION AND ECOLOGY OF REEFS

85092 OCG 6668 (614) - 3 credits

Tuesdays 4-7 pm Location: KRC 3120

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e-mail: pmuller@marine.usf.edu Office hours: by appointment

Date	Topic	Reading Assignment	Disc. Leaders
Aug. 25	Introduction to course & to coral reefs	Veron (2000) p. 19-31; Wells (1957)	PHM
Sept 1.	Physical controls on reef growth & reefs through time	Hubbard (pdf); Hallock (pdf) Veron (2000), p 33-43	PHM
Sept. 8	Coral biology	Weis et al. (2008) Houlbrèque & Ferrier-Pagès (2009)	1. 2.
	Coral –algal aymbiosis	Stat et al. (2006)	3.
	Calcification (see note below)	Allemand et al. (2004)	4.
Sept. 15	Microbes and coral reefs Guest lecture: Julie Galkiewicz	Rosenberg et al. (2007) Ritchie (2006) Thurber et al. (2009) Bourne et al. (2008)	JG JG. 1. 2.
Sept. 22	Coral classification What are species; species evolution Coral reproduction	Veron (2000) p. 47-57; VanWoesik (web) Veron (2000) p. 424-433, 437-443 Veron 416-421; Guest et al. (2005)	1. 2. 3.
Sept. 29	Diversity and biogeography of reefs Hybridization in coral evolution	Veron (2000), p. 411-416/Fukami et al (2004) Karlson (1999) p. 29-50 Willis et al. (2006)	1. 2. 3.
Abstracts/Preproposals Due			
Oct 6	Algae and primary production	Payre (website) Littler et al. (2006) Dubinsky and Berman-Frank (2001) Wooldridge (2009a)	1. 2. 3. 4.
Oct. 13	Coral predators, competitors, bioeroders	Rotjan & Lewis (2008) Fabricius (2005) Perry & Hepburn (2008)	1. 2. 3.
Oct. 20	Guest Lecture: W.C. Jaap – Reef Restoration Mesophotic reefs Deep-water corals	Jaap et al. (2006) Lesser et al. (2009) Bryan & Metaxas (2006)	WCJ 1. 2.
Oct. 27	Reef Fish: taxonomy, ecology, management	Humann, P. (1994) McManus et al. (2000) Munday et al. (2009)	1. 2. 3.
Nov. 3	Role of disturbance on coral reefs	Hughes & Connell (1999) Connell et al. (2004) McManus & Polsenberg (2004)	1. 2. 3.
Nov. 10	Pleistocene History of Reefs	Eakin and Grottooli (2006) Pandolfi (2002) Smithers et al. (2006)	1. 2. 3.
Nov. 17	Coral reefs and global change	Wooldridge (2009b) Baker et al. (2008) Guinotte & Fabry (2009)	1. 2. 3.
Nov. 24	Guest Lecture: Brian Keller Reef management in face of climate change	Keller & Causey (2005) Cooper et al. (2009) Marshall & Schuttenberg (2006)	1. 2.
Papers Due			
Dec. 1	Student Presentations		Presenters
Reviews Due			
Dec. 8	Student Presentations		Presenters
Revised Papers Due			

Course Objectives: Coral reefs worldwide are threatened by human activities ranging from local boat groundings to global change processes. The objectives of this course are to examine issues critical to coral-reef growth and preservation. Topics include what coral reefs are, how they are formed, the kinds of organisms that make up the reef community, environmental qualities required for reefs to thrive, a brief introduction to the geologic history of reefs, the importance of coral reefs to mankind, how human activities are affecting coral reefs, and an introduction to reef management.

Grading Policy: See page 6 for specific details for each assignment - late deduction 1 pt/day

Class participation (@ 10 classes x 4 points/class)	40 points	(20%)
Presenter/Discussion leader (@3 x 20 points/presentation)	60 points	(30%)
Project		
Abstract or Proposal (due 9/29)	10 points	(5%)
Paper (due for review 11/24; final version due 12/8)	40 points	(20%)
Project Presentation (12/1 or 12/8)	30 points	(15%)
Paper reviews (due 12/1)	20 points	(10%)
Total	200 points	(100%)

Discussion Leaders: Most weeks, students will be assigned as presenters/discussion leaders. Each student leader will be responsible for presenting and leading discussion on one set of the assigned readings. Recommended format is to spend 15-20 minutes summarizing key points of the reading, adjusted appropriately depending upon the number of presentations or if there is a guest lecture before the presentations. Scoring for discussion leaders will be based on an average of the score assigned by the instructor and class members, deleting the highest and lowest student scores.

Class Participation: The success of the course to enrollees depends on active and enthusiastic preparation for and participation in each class. Each student should bring at least one discussion question for each reading assignment, for discussion by the class after the summary. If you know in advance that you will miss a class, please send two questions per reading by 2 pm on class day so I can take your questions to class for discussion (this will substitute for writing a summary as noted below). Weekly scores will be based upon participation level: 4 point score for active and voluntary participation in discussion; 3 point score for thoughtful discussion when called upon; 2 points for attendance with minimal participation in the discussion.

Attendance Policy: Since 30% of the course grade will be based on weekly participation in discussion of the readings, class attendance is expected. Recognizing research and meeting commitments, students can miss up to two classes without makeup. If you must miss more than two classes, your make-up assignment is to write a one-page synthesis of each reading assigned for that class (unless you submit discussion questions in advance). If you must miss one of your scheduled presentations due to illness, change in work schedule, etc., please e-mail me as soon as possible. If you have some advanced notice to a work-schedule change, please try to arrange a presentation swap with another student. In the event of numerous absences associated with the H1N1 flu or other events, on some occasions we may need to double up on presentations to allow students to make up a missed presentation. ***Please note that students who anticipate being absent from class due to religious observance should inform the instructor by the second class meeting.***

In the event of an emergency (e.g., pandemic or major storm), it may be necessary for USF to suspend normal operations. During this time, USF may opt to continue delivery of instruction through methods that include but are not limited to: Blackboard, Elluminate, Skype, and email messaging and/or an alternate schedule. It's the responsibility of the student to monitor the Blackboard site for each class for course specific communication, and the main USF, College, and department websites, emails, and MoBull messages for important general information.

Project: The last two class meetings will serve as a mini-symposium for student projects. Each student will
a) write an approximately 300-word abstract or preproposal on the chosen topic (due September 29),

- b) write a short paper (15 text pages maximum, double-spaced) on that topic (due November 24),
- c) make a meeting-style 15-20 minute presentation (December 1 or 8, as assigned),
- d) review two papers written by other class members (received November 4, due December 1),
- d) turn in your final, corrected paper on December 8.

Advanced students with reef-related research are encouraged to present an aspect of their thesis or dissertation research, using this venue to prepare a piece of their work for a scientific meeting or for submission of a paper for publication. Beginning and special students may select to write a literature review for their possible thesis or dissertation topic. A useful reference on writing literature reviews can be found at <http://www.wisc.edu/writing/Handbook/ReviewofLiterature.html>. Students also may choose to write a research proposal in NSF or other approved format. Science educators may choose to develop a teaching exercise that presents some aspect of reef biology or geology. When you get an idea for a project, discuss it with Dr. Hallock Muller in person or by e-mail. More details on grading of abstracts, presentations and papers is explained on page 6. Oral presentations will be scored by both instructor and class members, final score will be based on an average of the score assigned by the instructor and class members, deleting the highest and lowest student scores.

Format and style: Papers should be written in the style required by the journal Coral Reefs as described in their "Instructions for Authors". Go to: <http://www.springer.com/life+sci/ecology/journal/338> and click on "Instructions for Authors" in the right-hand column under "For authors and editors". Proposals should use the Coral Reefs style for citations and references, but follow the chosen funding-agency format for proposal Title page, abstract, text, budget and budget justification.

Reading Assignments:

The syllabus, assigned readings and class presentations will be made available on Blackboard.

August 25. Introduction

Veron, J.E.N. 2000. Corals and coral reefs. In *Corals of the World, Vol. 1*. Australian Institute of Marine Science, p. 19-31.

Wells JW. 1957. Coral Reefs. Geological Society of America Memoir 67, 1:609-631, 2 figs, 9 pls.

September 1. Physical Controls and Geologic History

Hubbard, D.K. Reefs as dynamic systems. Revision of the chapter in Birkeland, C. (ed), *Life and Death of Coral Reefs*, Chapman and Hall, New York, but the 2nd edition was never published. (PDF available)

Veron, J.E.N. 2000. Geological History. In *Corals of the World, Vol. 1*. Australian Institute of Marine Science, p. 33-43.

Hallock, P. Reefs and reef limestones in Earth history. Revision of the chapter in Birkeland, C. (ed), *Life and Death of Coral Reefs*, Chapman and Hall, New York, but the 2nd edition was never published. (PDF available)

September 8. Coral Biology and Calcification

1. Weis, V.M., Davy, S.K., Hoegh-Guldberg, O., Rodriguez-Lanetty, M., Pringle, J.R. 2008. Cell biology in model systems as the key to understanding corals. *Trends in Ecology & Evolution*, 23(7): 369-376.

2. Houlbrèque, F, Ferrier-Pagès, C. 2009. Heterotrophy in tropical scleractinian corals. *Biological Reviews*, 84:1-17.

3. Stat, M., Carter, D., Hoegh-Guldberg, O. 2006. The evolutionary history of *Symbiodinium* and scleractinian hosts - Symbiosis, diversity, and the effect of climate change. *Perspectives in Plant Ecology, Evolution and Systematics*, 8 (1): 23-43 2006

4. Allemand, D., Ferrier-Pages, C., Furla, P., Houlbrèque, F., Puverel, S., Reynaud, S., Tambutte, E., Tambutte, S., Zoccola, D. 2004. Biomineralisation in reef-building corals: from molecular mechanisms to environmental control. *Comptes Rendus Palevol* 3 (6-7): 453-467.

September 15. Guest Lecture: Julie Galkiewicz -- Microbial ecology of coral reefs

- Rosenberg E, Kellogg, C.A., Rohwer F. 2007. Coral Microbiology. *Oceanography*, 20 (2):146-154.
- Ritchie, K.B. 2006. Regulation of microbial populations by coral surface mucus and mucus-associated bacteria. *Marine Ecology-Progress Series*, 322: 1-14 2006
- Thurber, R.V., Willner-Hall, D., Rodriguez-Mueller, B., Desnues, C., Edwards, R., Angly, F., Dinsdale, E., Kelly, L., Rohwer, F. 2009. Metagenomic analysis of stressed coral holobionts. *Environmental Microbiology*, 11(8):2148-2163.
- Bourne, D., Iida, Y., Uthicke, S., Smith-Keune, C. 2008. Changes in coral-associated microbial communities during a bleaching event. *ISME Journal*. 2:350-363

September 21. Classification, species concept, evolution, reproduction

- 1a. Veron, J.E.N. 2000. Structure. In *Corals of the World, Vol. 1*. Australian Institute of Marine Science, p. 47-57.
- 1b. van Woesik, R. Coral Taxonomy.
<http://my.fit.edu/~rvw/Taxonomy/Taxonomy%20Introduction.pdf>
- 2a. Veron, J.E.N. 2000. What are species? p. 424-433; and Evolution of species, p. 437-443. In *Corals of the World, Vol. 3*. Australian Institute of Marine Science.
- 3a. Veron, J.E.N. 2000. Biogeography (section on reproduction). In *Corals of the World, Vol. 3*. Australian Institute of Marine Science, p. 416-421.
- 3b. Guest, J.R., Baird, A.H., Goh, B.P.L., Chou, L.M. 2005. Seasonal reproduction in equatorial reef corals. *Invertebrate Reproduction & Development*, 48 (1-3): 207-218.

September 29. Diversity and Biogeography

- 1a. Veron, J.E.N. 2000. Biogeography (first part). In *Corals of the World, Vol. 3*. Australian Institute of Marine Science, p. 411-416.
- 1b. Fukami, H., Budd, A.F., Paulay, G., Sole-Cava, A., Chen, C.L.A., Iwao, K., Knowlton, N. 2004. Conventional taxonomy obscures deep divergence between Pacific and Atlantic corals. *Nature*, 427 (6977): 832-835.
2. Karlson, R.H. 1999. 2. Diversity. In *Dynamics of Coral Communities*, Kluwer Academic Publishers, Boston, p. 29-50.
3. Willis, B. L., van Oppen, M.J H.), Miller, D.J., Vollmer, S.V., Ayre, D.J. 2006. The role of hybridization in the evolution of reef corals. *Annual Review of Ecology, Evolution and Systematics*, 37: 489-517.

October 6. Algae and primary production

1. Payri, C. The algae in French Polynesia: generalities, form and reproduction, reef algae: <http://www.com.univ-mrs.fr/IRD/atollpol/ecorecat/ukalgues.htm>
Hawaiian Reef Algae homepage: <http://www.botany.hawaii.edu/ReefAlgae/>
Note: The student may use websites, books or other resources in preparing an introduction to marine algae associated with coral reefs.
2. Littler, M.M., Littler, D.S., Brooks, B.L. 2006. Harmful algae on tropical coral reefs: Bottom-up eutrophication and top-down herbivory. *Harmful Algae*, (5): 565-585.
3. Dubinsky, Z., and Berman-Frank, I. 2001. Uncoupling primary production from population growth in photosynthesizing organisms in aquatic ecosystems. *Aquatic Sciences*, 63:4-17.

4. Wooldridge, S.A. 2009a. Water quality and coral bleaching thresholds: Formalising the linkage for the inshore reefs of the Great Barrier Reef, Australia. *Marine Pollution Bulletin*, 58(5):745-751.

October 13. Coral-reef predators, competitors, and bioeroders

1. Rotjan, R.D., Lewis, S.M. 2008. Impact of coral predators on coral reefs. *Marine Ecology-Progress Series*, 361: 73-91.
2. Fabricius, K.E. 2005. Effects of terrestrial runoff on the ecology of corals and coral reefs: review and synthesis. *Marine Pollution Bulletin* 50 (2): 125-146.
3. Perry, C. T., Hepburn, L. J. 2008. Syn-depositional alteration of coral reef framework through bioerosion, encrustation and cementation: Taphonomic signatures of reef accretion and reef depositional events. *Earth-Science Reviews*, 86(1):106-144.

October 20. Guest lectures - Reef Restoration and Deep-Water Reefs

- Jaap, W.C., Hudson, J.H., Dodge, R.E., Gilliam, D., Shaul, R. 2006. Coral reef restoration with case studies from Florida. In Côté, I.M., Reynolds, J.D. (eds) *Coral Reef Conservation*, Cambridge University Press, London, p. 478-514.
- Lesser, M.P., Slattery, M., Leichter, J.J. 2009. Ecology of mesophotic coral reefs. *Journal of Experimental Marine Biology and Ecology*, 375(1-2):1-8.
- Bryan, T. L., Metaxas, A. 2006. Distribution of deep-water corals along the North American continental margins: Relationships with environmental factors. *Deep-Sea Research*, **53**:1865-1879.

October 27. Reef fish

1. Selected pages from Humann, P. 1994. Reef Fish Identification – Florida, Caribbean, Bahamas. New World Publications, Inc., Jacksonville, FL.
2. McManus, J.W., Menez, L.A.B., Kesner-Reyes, K.N., Vergara, S.G., and Ablan, M.C. 2000. Coral reef fishing and coral-algal phase shifts: implications for global reef status. *ICES Journal of Marine Science*, 57:572-578.
3. Munday, P.L., Leis, J.M., Lough, J.M., Paris, C. B., Kingsford, M. J., Berumen, M. L., Lambrechts, J. 2009. Climate change and coral reef connectivity. *Coral Reefs*, 28(2): **379-395**.

November 3. Role of disturbance on coral reefs

1. Hughes, T.P., and Connell, J.H. 1999. Multiple stressors on coral reefs: A long-term perspective. *Limnology and Oceanography*, 44 (3, Part 2): 932-940.
2. Connell, J.H., Hughes, T.E., Wallace, C.C., Tanner, J.E., Harms, K.E., Kerr, A.M. 2004. A long-term study of competition and diversity of corals. *Ecological Monographs*, 74 (2): 179-210.
3. McManus, J.W. and Polsenberg, J.F. 2004. Coral-algal phase shifts on coral reefs: ecological and environmental aspects. *Progress in Oceanography*, 60 (2-4): 263-279.

November 10. Pleistocene history of reefs

1. Eakin, C.M., Grotto, A.G. 2006. Coral reef records of past climate changes. In Phinney, J.T., Hoegh-Guldberg, O., Kleypas, J., Skirving, W., Strong, A. (eds.), *Coral Reefs and Climate Change: Science and Management*. American Geophysical Unions, Washington, DC, p. 33-54.
2. Pandolfi, J.M. (2002) Community Dynamics at multiple scales. *Coral Reefs*, 21:13-23.
3. Smithers, S.G., Hopley, D., Parnell, K.E. 2006. Fringing and nearshore coral reefs of the Great Barrier Reef: Episodic Holocene development and future prospects. *Journal of Coastal Research*, 22 (1): 175-187.

November 17. Coral Reefs and global change

1. Wooldridge, S.A. 2009b. A new conceptual model for the warm-water breakdown of the coral-algae endosymbiosis. *Marine and Freshwater Research*, 60(6): 483-496.
2. Baker, A.C., Glynn, P.W., Riegl, B. 2008. Climate change and coral reef bleaching: An ecological assessment of long-term impacts, recovery trends and future outlook. *Estuarine, Coastal and Shelf Science*, 80:435-471.
3. Guinotte, J.M., Fabry, V.J. 2008. Ocean acidification and its potential effects on marine ecosystems. Year in Ecology and Conservation Biology 2008, *Annals of the New York Academy of Sciences*, 1134: 320-342.

November 24. Reef Management

Guest Lecture: Brian Keller, NOAA National Marine Sanctuary Program (First half of class time)
Keller, B.D., Causey, B.D. 2005. Linkages between the Florida Keys National Marine Sanctuary and the South Florida Ecosystem Restoration Initiative. *Ocean & Coastal Management*, 48 (11-12): 869-900.

Student-led discussions (last half of class time):

1. Cooper, T.F., Gilmour, J.P., Fabricius, K.E. 2009. Bioindicators of changes in water quality on coral reefs: review and recommendations for monitoring programmes. *Coral Reefs*, 28(3): 589-606.
2. Marshall, P., Schuttenberg, H. 2006. Adapting coral reef management in the face of climate change. In Phinney, J.T., Hoegh-Guldberg, O., Kleypas, J., Skirving, W., Strong, A. (eds.), *Coral Reefs and Climate Change: Science and Management*. American Geophysical Union, Washington, DC, p. 223-242.

GRADING OF ASSIGNMENTS

Reading Assignment Discussion Leader: _____

Understanding of assignment (10 points) _____
Oral presentation (5 points) _____
(communication of key points of assignment)
Creativity in leading discussion (5 points) _____
(quality of visual aids and/or approach)

Total (20 points/assignment led) _____

Abstract or Preproposal: _____

Succinct, descriptive title (2 points) _____
Statement of purpose (2 points) _____
Methods sentence(s) (1 points) _____
Anticipated Results (1 points) _____
Significance (2 points) _____
Writing style/clarity (2 points) _____

Total (10 points possible) _____

Project Presentation: _____

Scientific content (20 points possible) _____
Oral presentation (5 points possible) _____
Creativity (5 points possible) _____
(quality of visual aids and/or approach)

Total (30 possible) _____

Final Paper: _____

Scientific content (25 points possible) _____
Organization, readability (5 points possible) _____
Citations and referencing (5 points possible) _____
Grammar, spelling (5 points possible) _____

Total (40 possible) _____

Manuscript Review (per manuscript x 2 manuscripts):

Comments on scientific content (4 points possible) _____
Comments on organization/readability (2 points) _____
Corrections of grammar/spelling, etc. (2 points) _____
Corrections of citations/referencing (2 points) _____

Total (10 possible) _____

MANUSCRIPT APPRAISAL FORM

AUTHOR:
TITLE:

REVIEWER:

INSTRUCTIONS: Please check the appropriate space, adding your comments and suggestions as required. Minor comments and corrections should be marked directly on the manuscript.

CHECK ONE:

- Acceptable without change
- Acceptable with minor changes (explain below)
- Acceptable with major revisions (explain below)
- Unacceptable (explain below)

1. How can this paper be made more appropriate or informative?
2. Is this abstract concise yet informative?
3. How can the manuscript be reorganized for better presentation?
4. How can the text be condensed?
5. Are there any errors of fact or interpretation?
6. How can the illustrations be improved?
7. Can any illustrations, tables, or appendices be omitted?
8. Does the author show adequate awareness of previous work?
9. What, if any, important reference citations were omitted?
10. Is the author diplomatic in handling the opinions of others?