Marine Zoology
MAR 226 A1, A2, A3
Fall, 2013

**Professor:** Dr. Wayne Price.  **Office/Lab:** SC 235, SC 226; 257-3639; email: wprice@ut.edu.  **Office Hours:** MWF 10-11:30; M 1:30-2:30 pm, other times by appointment.

**Class Meeting Times and Places:** Lecture (A1), MWF-9:00-9:50am, SC 233B; Lab, T 8:00-10:50 am (A2), 2:00-4:50 pm (A3) in SC225.


**Prerequisites:** BIO 203,204. Students are expected to be familiar with general biological principles covered in BIO 203 and 204, especially basic animal classification. It is the responsibility of the student to check prerequisites before enrolling in the class.

**Course Description and Learning Objectives:** This course is designed to provide an introduction to marine zoology, emphasizing ecological principles governing marine life on a worldwide basis. Ecological processes and adaptations that act to structure marine associations through time are stressed. In lecture, basic oceanographical and ecological principles and the ecology of the major marine habitats are discussed. In the laboratory, emphasis is placed on collection techniques and the natural history and taxonomy of marine organisms associated with a variety of local habitats. Special emphasis is placed on identification (using keys) of local species of crustaceans and molluscs. Specific learning objectives are given below.

1) Brief history of marine science and marine biology
2) Geological oceanography: topography of the ocean basin, basics of plate tectonics
3) Chemical oceanography: properties of water, concept of salinity, estuarine classification, dissolved gases, acidification of the oceans; major biogeographic regions, vertical profiles of salinity and temperature in the oceans
4) Physical oceanography: water masses, surface currents, upwelling, deep-water masses, thermohaline circulation
5) Major ecological principles: trophic levels, food webs, species diversity, factors regulating population size, reproductive strategies of marine benthos, major divisions of the ocean
6) The characteristics and components of the following ecosystems: seagrasses, unvegetated soft-bottoms, high energy sandy beaches, rocky shores intertidal, mangroves, oyster reefs, and coral reefs
7) Characteristics of marine zooplankton communities
8) Collection techniques, natural history, and taxonomy of organisms associated with the ecosystems and communities listed in objectives 6 and 7
9) Use of keys to identify local species of crustaceans and mollusks
10) Familiarity with marine biology primary literature.

Attendance Policy: Classes will begin on time: lectures at 9:00 am, laboratories at 8:00 am or 2:00 pm. You are expected to be in class at these times and preferably earlier. Attendance will be taken on a regular basis. Students are expected to attend all lectures and laboratories, including field trips. Several field trips will be taken; their dates are included in the syllabus; all are mandatory. More than three absences (excused & unexcused) from lecture and one lab absence will result in a 1% reduction in the final grade for each additional absence in lecture and 2% reduction for each additional absence in lab. If you miss a class, it is your responsibility to obtain missed material from other students in the class. Poor attendance is often correlated with poor academic performance. Please turn off cell phones, beepers, and other communication devices before entering class.

Academic Integrity: The University of Tampa is committed to the development of each student to become a productive and responsible citizen who embraces the values of honesty, trust, fairness, respect, and responsibility. The scholarly community at The University of Tampa strives to instill values that uphold academic integrity and promotes an ethical standard that does not condone academic misconduct. Violation of academic integrity and academic misconduct tarnish the reputation of the University and discredit the accomplishments of past and present students. Sanctions for violation of academic integrity and academic misconduct include a failing grade in an assignment or in the course, or suspension or expulsion from the University. I take integrity very seriously, including academic integrity. I will monitor all submissions and exams for violations of the academic integrity policy. Students are held responsible for knowing and observing the University’s Academic Integrity Policy posted at: http://www.ut.edu/provost. If you have any questions about the policy, please feel free to talk with me.

Students with disabilities: If there is any student who has special needs because of any disability, please go directly to the Academic Center for Excellence in North Walker Hall. You may phone 813-258-7251, or e-mail jdelvalle@ut.edu to report your needs and provide documentation of your disability for certification. Jennifer Del Valle is the associate director of the Academic Center for Excellence, Student Disability Services. Please feel free to discuss this issue with me in private if you need more information.

Disruption Policy: See last page of syllabus

Lecture Schedule

<table>
<thead>
<tr>
<th>Week</th>
<th>Topic</th>
<th>Lecture Text Chapters</th>
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</thead>
<tbody>
<tr>
<td>Aug. 26</td>
<td>Introduction; Oceanographic principles</td>
<td>1</td>
</tr>
<tr>
<td>Sept. 2</td>
<td>Oceanography and ecological principles</td>
<td>1,2: 61</td>
</tr>
<tr>
<td>Sept. 9</td>
<td>Seagrass meadows</td>
<td>5: 233-241</td>
</tr>
<tr>
<td>Sept. 16</td>
<td>Seagrass meadows; TEST I (Fri, Sept. 20)</td>
<td>5: 233-241</td>
</tr>
</tbody>
</table>
Laboratory Schedule

<table>
<thead>
<tr>
<th>Date</th>
<th>Topic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aug. 27</td>
<td>Introduction, Identification of crustacean classes</td>
</tr>
<tr>
<td>Sept. 3</td>
<td>Identification of decapod crustaceans</td>
</tr>
<tr>
<td>Sept. 7,8 (Sat., Sun. field trip) (8 am- 2-3 pm)</td>
<td>Hard substrate; seagrass meadows</td>
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<tr>
<td>Sept. 10</td>
<td>Identify hard substrate, seagrass organisms</td>
</tr>
<tr>
<td>Sept. 17 (Field Trip)</td>
<td>Gandy Bridge-subtidal soft bottom benthic community</td>
</tr>
<tr>
<td>Sept. 24</td>
<td>Sediment analysis; identification of soft bottom benthos</td>
</tr>
<tr>
<td>Sept. 28, 29 (Sat., Sun. field trip) (8 am- 2:00 pm)</td>
<td>High energy beach, Anna Maria Island</td>
</tr>
<tr>
<td>Oct. 1</td>
<td>Identify high energy beach organisms</td>
</tr>
<tr>
<td>Oct. 8</td>
<td>Review</td>
</tr>
<tr>
<td>Oct. 15</td>
<td>LAB EXAM I</td>
</tr>
<tr>
<td>Oct. 22</td>
<td>Identification of mollusks</td>
</tr>
</tbody>
</table>
Oct. 27 (Sun. field trip) (morning lab: 8am-~noon; afternoon lab: 12:45pm-~4:30pm) BIOS trawling trip; use of remote collecting gear

Oct. 29 Identification of corals, reef fishes

Nov. 2 (Sat trip; 9:45-noon) Florida Aquarium trip: coral reef fish exercise

Nov. 5 (Field trip) Gandy Bridge-mangroves, oyster reefs, salt marshes

Nov. 12 Identification of mangrove, oyster reef, salt marsh organisms

**Nov. 19 Zooplankton identification

Nov. 26 Zooplankton, Review

Dec. 3 LAB EXAM II

**Lab will be held the day before Thanksgiving Break

Examinations and Grading Policy:

<table>
<thead>
<tr>
<th>Component</th>
<th>Points</th>
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<tbody>
<tr>
<td>Three (3) lecture exams (~100 points each)</td>
<td>~300</td>
</tr>
<tr>
<td>Final exam (comprehensive)</td>
<td>~150</td>
</tr>
<tr>
<td>Two (2) laboratory exams (100-120 points each)</td>
<td>~200-240</td>
</tr>
<tr>
<td>Two (2) typed journal summaries (15 points)</td>
<td>30</td>
</tr>
<tr>
<td>Internet careers assignment</td>
<td>15</td>
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<tr>
<td>Various take-home lab assignments</td>
<td>~50-75</td>
</tr>
</tbody>
</table>

Exams will be given on the dates indicated in the schedule. Lecture exams will include all lecture material, handouts, and assigned readings. Lab exams will address all material covered in lab sessions. The final exam is comprehensive and will cover lecture aspects of the course only. All lecture exams will be kept by the instructor for purposes of outcomes assessment.

NO make-up exams in lecture or laboratory will be given. A student who misses a lecture or lab exam without a valid excuse from the Dean of Students or Dean of CLAS will receive a grade of “0” for that exam. For an exam missed with a valid excuse, the Final Exam will be weighted an additional grade. When an exam is missed, the student must notify me within 24 hours after the exam date or receive a grade of “0” for the exam.

Grading Scale:

<table>
<thead>
<tr>
<th>Grade</th>
<th>Score Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>92.0+</td>
</tr>
<tr>
<td>AB</td>
<td>88.0-91.9</td>
</tr>
<tr>
<td>B</td>
<td>82.0-87.9</td>
</tr>
<tr>
<td>BC</td>
<td>78.0-81.9</td>
</tr>
<tr>
<td>C</td>
<td>72.0-77.9</td>
</tr>
<tr>
<td>CD</td>
<td>68.0-71.9</td>
</tr>
<tr>
<td>D</td>
<td>60.0-67.9</td>
</tr>
<tr>
<td>F</td>
<td>&lt; 60.0</td>
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</table>
Journal Summary: During the course of the semester, choose two articles from the primary literature (see list of journals) and summarize them. You may not summarize articles assigned to the entire class. The first article should deal with an aspect of marine zoology covered in the first half of the semester (e.g., seagrass, soft bottom benthic communities, high energy beaches, oceanographic or ecological principles) and the second article with an aspect dealt with in the second half (intertidal ecology, mangroves, oysters, zooplankton, coral reefs, deep sea). The first summary will be due on Friday, Oct. 11, 2013 at 9:00 am and the second on Monday, Nov. 18, 2013 at 9:00 am. No credit will be given for summaries turned in later than 11 am on those days. The summaries must be 2 1/2 or more pages in length, typed, double-spaced, and in a font no larger than 12 point. The summary you submit should be a hard copy (paper), include the complete citation at the beginning, and a photocopy of the article. Use the citation format contained in the Literature Cited section of the article that is summarized. If the citation is not completely correct, one point will be deducted. Deductions will be made for errors in spelling (0.5 point/word), grammar, incomplete sentences, incoherent statements, etc... If additional authors are cited in the text of a summary e.g. "Jones (1983) found...", a complete citation of that author and article must appear in a Literature Cited section at the end of the summary. See an example in the sample article included at the end of the syllabus.

When choosing a journal article, make sure that you understand the main points of the article. This requires you to read through the paper and then the abstract (summary of paper). If the paper seems a proper choice, copy it and read it thoroughly at least twice, underlining and making notes as needed. If, at this time, you are having trouble comprehending the major points of the paper, discard it and choose another one.

Use the following guidelines when writing summaries:

1) Give full citation of paper (using format in Literature Cited of your paper) at beginning of summary. Citations may be a challenge with online articles. Check with me if you have questions.
2) Give a brief background and justification for performing the study. What was the purpose of the study? What hypothesis (es) was being tested?
3) Summarize the main procedures used (Materials and Methods). Some review articles may not have a Materials and Methods section.
4) Summarize the main results. Does the research answer the question(s) posed in # 2?
5) Discuss the significance of the findings. Compare findings with other studies, if appropriate. How do these findings fit into the broader context of marine zoology.
*6) Give a brief critique of the study. A critique is often difficult for students. Think about the following points. Was the purpose of the study accomplished satisfactorily? Was the writing clear and concise? If the study was experimental, were statistical analyses included in the results? Were sufficient replicates done? Do standard deviations/standard errors overlap? In the discussion, are methodological problems explained sufficiently; are the ramifications of the results discussed thoroughly? Just because a paper is published does not mean that it is good science. Be critical.
7) If you cite sources other than the specific article being summarized, you must list complete citations for these sources in a Literature Cited section at the end of the summary.

Careers in Marine Science-Internet Exercise: So you want to be a marine biologist? Many of you are taking this class because you are considering marine biology as a career. Others of you have an interest in the marine environment, but are setting your sights on other biologically related careers: environmental science, biomedicine, conservation, molecular biology etc… This exercise allows you to
explore the various career paths of marine science and decide which one you would most like to follow at this stage in your academic development. Many of you may simply say that you want to be marine biologists, but you must be more specific than that. Marine biology consists of many educational, research and applied subdisciplines such as aquaculture, behavior, biochemistry, botany, conservation, ecology, environmental biology and toxicology, fisheries, genetics, food technology, microbiology, molecular biology, parasitology and pathology, pharmacology, physiology and taxonomy just to name a few. You may want to work with a specific group of marine organisms such as mammals. In this case you would be a mammalogist who works with marine mammals. If you studied fish, molluscs or crustaceans, you would be an ichthyologist, malacologist or carcinologist, respectively. You might decide to study non-biological aspects of marine science-geology, physics, chemistry, engineering etc… or combine marine biology with another discipline e.g. maritime law, psychology (dolphin-assisted therapy), marine engineering.

Information for this exercise will come from the Internet, specifically web sites. I will provide the first web site, which is a comprehensive guide to careers in oceanography, marine science and marine biology from the University of California at San Diego. The URL is http://ocean.peterbrueggeman.com/career.html (see handout). Another good general site about marine biology is hosted by Dr. Jeffrey Levinton-SUNY at Stony Brook (http://life.bio.sunysb.edu/marinebio/mbweb.html; see handout). Using these sites as starting points, explore the variety of careers available in marine science, and then write a 2 1/2-3 page paper explaining the career path you have chosen. Write the paper in paragraph form and answer the following questions

1) Why have you chosen your particular field?
2) Give a general description of the duties of a person in this field.
3) How much education do you need for this career path? Bachelors, Masters, Ph.D.?
4) What sort of out-of-class experience e.g. internship, research, should you strive for while in college?
5) What non-biological skills will you need e.g. strong verbal communication, knowledge of computers, GPS, or statistics, to succeed? Be specific.
6) Where are the jobs in your chosen field - government, education, private industry, not-for-profit organizations? What are the job prospects? What is the pay range? Make sure that you answer this last question concerning salary.

You may include any other information or sources that you deem pertinent to your career choice. For instance, you may interview professors or other professionals. At the end of your paper in a section entitled, References, list from 3-6 URLs with their titles or persons interviewed, using the following formats:


Paul Anderson, Ph. D. Biologist at Florida Aquarium.

The paper is due on Friday, Sept 13 at the beginning of lecture. This gives you three weeks to complete the assignment.

Additional Reading Assignments
MAR 226, Marine Zoology
All articles are on reserve (2 hour check-out) in the library behind the circulation desk, available online OR will be handed out in class.

TEST I
Ecological principles and Oceanography


Seagrasses


TEST II
Intertidal Ecology


High Energy Beaches


TEST III
Rocky Intertidal

*Wayne, T. A. 1987. Responses of a mussel to shell-boring shells: defensive behavior in Mytilus edulis? Veliger 30: 138-147. I will try to provide a pdf of this article.

Little, C. and J. A. Kitching. 1996. The Biology of Rocky Shores

Mangroves

Odum, W.E. et. al. 1982. The ecology of the mangroves of South Florida: a community profile; Ch 1 - 1.1-1.5; Ch 2 - 2.1-2.3, 2.6-2.7; Ch 3 - 3.4; Ch 11

Oysters


Kennedy, V. S., R. I. E. Newell and A. F. Eble. 1996. The Eastern Oyster Crassostrea virginica. Ch. 9. Reproductive Processes; Ch. 10. Biology of Larvae; Ch. 13 Natural Environmental Factors; Ch. 16 Predators etc...; Ch. 17 Diseases etc...

**FINAL TEST**
Coral Reefs


Plankton

Enright, J.R., 1977, Diurnal vertical migration etc...pp. 856-859

*You are responsible for the material in these articles whether or not they are discussed in class.

**LIST OF MARINE BIOLOGY JOURNALS**

*+  Advances in Marine Biology, London and New York--review articles
Analess del Centrol de Clencias del Mar y Limnologia, Universidad Nacional Autonoma de Mexico, Mexico City
Annales Biologiques. Copenhagen
+  Aquaculture, Amsterdam
+  Aquatic Botany, Amsterdam
Aquaculture Engineering, Darking, Essex
Aquatic Toxicology, Amsterdam
Archiv fur Fis cherelwissenschaft. Hamburg
Archivio di Oceanografia e Limnologia, Venice
Atoll Reasearch Bulletin;
http://www.sil.si.edu/digitalcollections/atollresearchbulletin/ARB_About.cfm
Australian Journal of Marine and Freshwater Research. Melbourne
Beltrage zur Meereskunde, Berlin
Berichte zur Polariorschung. Bremerhaven
*B+ = Biological Bulletin; http://www.biolbull.org/
Biological Reviews of the Cambridge Philosophical Society. London
Biologiya Morya (Vladivostok). Vladivostok.
Boletin del Instituto Espanol de Oceanografia, Madrid
Bollettino de Pesca, Piscicoltura e Idrobiologia, Rome
Bollettino di Oceanografia Teorica e Applicala, Trieste
Botanica Marina. Hamburg
Bulletin. Far Seas Fisheries Research Laboratory. Shimizu
Bulletin of the Hokkaido Regional Fisheries Research Laboratory. Yoichi
Bulletin de l’Institut Oceanographique, Monaco. Monaco
Bulletin of the Japan Sea Regional Fisheries Research Laboratory.
Nigata
Bulletin of the Japanese Society of Fisheries Oceanography. Tokyo
Bulletin of the Japanese Society of Scientific Fisheries. Tokyo
*B+ = Bulletin of Marine Science. Miami, FL
Bulletins of Marine Ecology. Plymouth
Cahiers de Biologic Marine. Paris
*+ = Canadian Journal of Fisheries and Aquatic Sciences. Ottawa, Ont.
+ = Ciencias Marinas. Ensenda, Mex.
Coastal Engineering. Amsterdam
Continental Shelf Research. Oxford
Contributions in Marine Science. Port Aransas, TX
+= Copeia, New York
= Coral Reefs
+= Crustaceana, Leiden-ejournal
Cryptogamies Algologie, Paris
Cybium. Paris
Dane, Copenhagen
Deutsche Hydrographische Zeitschrift. Hamburg
Diseases of Aquatic Organisms. Amelinghausen, FDR
Dynamics of Atmosphere and Oceans. Amsterdam
*+ = Ecology. Durham, NC
= Environmental Biology of Fishes. Dordrechi
*+ = Estuaries
+= Estuarine, Coastal and Shelf Science. London etc.-ejournal
Finnish Marine Research. Helsinki
Fischerei-Forschung. Rostock
Fisheries Oceanography
Fisheries Research. Amsterdam
* Gulf and Caribbean Research. Ocean Springs, MS
Helgolander Meeresuntersuchungen. Hamburg
= Hydrobiologia
Indian Journal of Fisheries. Ernakulam
Indian Journal of Marine Sciences. New Delhi
Indo-malayan Zoology. Rotterdam
International Hydrographic Review. Monaco
Internationale Revue der Pesamten Hydrobiologie. Berlin
= Invertebrate Biology
Investigacion pesquerra (Barcelona). Barcelona
Journal of Applied Phycology
Journal of Aquaculture and Aquatic Sciences. Kansas City, MO
Journal of Coastal Research. Fort Lauderdale, FL
+= Journal of Crustacean Biology. Lawrence, KS
+= Journal of Experimental Marine Biology and Ecology
Journal of Fish Diseases
Journal of Fisheries and Aquatic Science: http://jfas.ege.edu.tr/
Journal of Fisheries of China. Shanghai
Journal of the Marine Biological Associations of India. Cochin
Journal of the Marine Biological Association of the United Kingdom, Plymouth
Journal of Marine Research. New Haven, CT
Journal of Micropalaeontology. Surrey
Journal of Northwest Atlantic Fishery Science. Dartmouth
Journal of the Oceanographical Society of Japan. Tokyo
Journal of Phycology. Columbus OH
Journal of Physical Oceanography. Boston
= Journal of Sea Research
Journal of Shellfish Research
Journal of the Tokyo University of Fisheries. Tokyo
*+ Journal of the World Aquaculture Society
Kieler Meeresforschungen. Kiel
+= Limnology and Oceanography-
Marine and Freshwater Behaviour and Physiology, London
Marine Biological Assoc of the United Kingdom
+ Marine Biology. 1997-present (behind circulation desk of library)
Marine Biology Letters. Amsterdam
= Marine Biology Research
Marine Chemistry. Amsterdam
= Marine Ecology
+= Marine Ecology - Progress Series. Hamburg; http://www.int-res.com/journals/meps/
Marine Environmental Research. Darkring, Essex.
Marine Geology. Amsterdam.
Marine Geophysical Researches. Dordrecht
Marine Geotechnology. New York
Marine Mammal Science. Lawrence, KS
Marine Micropaleontology. Amsterdam.
Marine Policy. Guildford.
Marine and Petroleum Geology. Guildford, Surrey
Marine Resource Economics. New York
Meeresforschung/report on Marine Research. Hamburg
NAFO Scientific Council studies. Dartmouth, N. S.
Nautilus
Netherlands Journal of Sea Research. Hamburg
New Zealand Journal of Marine and Freshwater Research. Wellington
North American Journal of Fisheries Management. Bethesda, MD
Ocean Management. Amsterdam
Oceanis. Paris
Oceanographic Tropicale. Paris
Oceanography and Marine Biology. London - review articles
Oceanography and Meteorology. Nagasaki
Oceanologia. Sepot
Oceanologica acia. Paris
Oceanus. Woods Hole, MA
Okeanologlya. Moscow
Ophelia. Elsimore
P.S.Z.N. 1: Marine Ecology. Berlin and Hamburg
Phycologia. London
Physis (A, B y C) (B. Aires). Buenos Aires
= Polar Biology- http://www.springerlink.com/content/100450/
= Proceedings of the Gulf and Caribbean Fisheries Institute, Miami FL
= Progressive Fish-Culturist
Progress in Oceanography. New York
Rapports et proces-verbaux des reunions. Commission internationale pour l'Exploration scientifique de la Mer Mediterranee. Monaco
Rapports et proces-verbaux des reunions. Consell international pour L'Exploration de la Mer. Copenhagen.
Revista de Biologia Marine. Vina del Mar
Revue d'hydrobiologie tropicale. Dandy
Revue Internationale d'oceanographic Medicale. Nice
Revue des travaux de Institut des Peches maritimes, Nantes. Nantes
Sarsia. Bergen
= Scientia Marina; http://www.icm.csic.es/scimar/
South African Journal of Marine Science
Tethys. Marselle

11
Thalassographica. Athens
= Transactions of the American Fisheries Society. Washington
Travaux du Centre de Recherches et d'Etudes oceanographiques, Paris.
Nouvelle serle. Paris
Trudy Vsesoyuznoga nauchno-issledovatel’skogo Institute morskogo
rybnogo khozyajstva i okeanograill. Moscow
Vie et milieu. Serie A B: Biologie marine et oceanographic.

* UT Library
+ USF Tampa Library
= available through internet

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cases may be able to download full-text articles. Go to the library web site
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Useful data bases include Aquatic Sciences and Fisheries Abstracts, Biological
Abstracts, Bioone, and JSTOR.