

MSL 412: Early Life Histories of Marine Invertebrates (3 credits)

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Meetings: T/Th 11:30 – 1:00
Location: 214 O'Neil
Office hours: by appointment

Course Description

This course will provide advanced students in marine science with an in-depth look at the reproductive biology and ecology of marine organisms, focusing on the invertebrate phyla. We will investigate the biology of invertebrate reproduction, from the production of eggs and sperm to the successful transformation into the juvenile form, and all steps in between. Throughout this course, we will consider environmental constraints on reproduction and larval ecology, and their effects on the evolution of early life-history strategies in the marine environment. The production, movement, and survival of larval forms is a central theme in many current issues in marine ecology, including invasive species, establishment of marine reserves, and impacts of climate change on marine communities. This course thus aims to provide students with a solid understanding of reproductive processes, and an opportunity to critically examine current research in the field.

Learning Objectives

1. Identify some of the most frequently encountered larval forms of invertebrate taxa, and understand the classification schemes for larvae and life-history modes.
2. Understand the role of larval forms in defining invertebrate taxonomic relationships.
3. Become familiar with the basic biological processes of gamete production, fertilization, embryogenesis, and larval development in marine invertebrates.
4. Explore the effects of environmental variables on reproduction, larval development, dispersal and recruitment.
5. Understand how survival and mortality of early life stages affect population dynamics of marine invertebrates.
6. Develop skills in reading and discussing the current scientific literature.

Course Format and Requirements

This course is lecture-based, but will also include group discussions of the scientific literature. Handouts of all slides will be distributed to assist with note-taking.

Readings

There is no required text book for this course. For each lecture / topic, you will be assigned **supporting readings** that will include review papers from scientific journals and/or book chapters. Readings will be distributed as pdf files via email, or posted in a Google Drive folder.

A **reference list** is provided, and will be updated throughout the semester. This list contains full citations for all references cited in lectures, as well as additional relevant articles. *You are not expected to read all the papers on this list!* It is merely provided as a resource.

A NOTE ABOUT READINGS: Undergraduate students may find the reading requirements for this course to be challenging. Extracting key information from scientific papers is a skill that takes time to develop,

so don't get discouraged! Here are some guidelines to help you determine how best to spend your time on readings:

- Review papers and book chapters that accompany the lectures are intended to give you something to refer to when reviewing important concepts for exams. In reading these materials, pay particular attention to topics emphasized in lectures.
- Group discussions of the scientific literature will be held during class, as described below. You are expected to come to discussion having read the assigned articles carefully. *However*, you will not be tested on specific details from the discussion readings. These sessions are meant to help you hone your critical thinking skills, and explore topics more deeply. Do your best to identify the central message of each paper, and don't be afraid to ask questions during the discussion.

Group Discussions (20 pts each)

We will discuss as many as three readings from the primary literature at each discussion session. Most readings will be selected by the instructor, but students may also be asked to select papers on occasion. Readings will be distributed at least one week in advance. *All students are expected to be prepared, and to participate in discussions.* Points will be awarded according to the following rubric:

| Score | Criteria |
|--------|---|
| 20 pts | Actively engaged, asking questions and speaking multiple times during discussions, demonstrating thorough reading of the material |
| 18 pts | Engaged, speaking during discussion, demonstrating some familiarity with the reading materials |
| 15 pts | Somewhat engaged, speaks only when called upon during discussion, demonstrates only cursory reading of the material |
| 10 pts | Not engaged, mostly silent, difficulty answering questions when called upon, has not read all material |
| 5 pts | Present, but silent during discussion; unprepared |
| 0% | Absent |

To help you to prepare for discussions, ask yourself the following questions:

- Why was this reading assigned? What is the relevance to the recent lecture topics? Does this paper add any new information not covered in lectures?
- What is the purpose of the paper? Is the purpose clearly stated? Justified?
- Are the methods sound? Are they appropriate to the hypothesis stated? What would you do differently? What assumptions are inherent in the methods? Are these assumptions reasonable/acceptable/justified?
- What are the key results? Do they address the stated hypothesis and/or objectives? Was the hypothesis accepted/rejected? Do the figures present the results clearly? Identify figures that are especially useful in conveying the important findings—What do they tell you?
- Do the conclusions follow from the results? How do they fit into the broader context of other work done in the field? Are there broader implications for the field of marine science/biology/fisheries? Are there any major questions suggested by the findings?

- Was the paper easy to follow? Why or why not? Was there information missing that would have helped clarify any aspect of the study?

Study Questions (30 pts each)

Two sets of study questions will be assigned during the semester. Each assignment will consist of 2 or 3 essay questions, and you will be expected to write a short (~1/2 page) answer to each question. Questions will provide an opportunity for you to synthesize material covered in lectures, and working through them will help you prepare for exams. Due dates are listed on the lecture schedule, and additional instructions and grading criteria will be provided in class. You will have approximately one week to answer each set of questions. You will receive feedback on these assignments prior to the exams. For this reason, **LATE PAPERS WILL NOT BE ACCEPTED** unless prior arrangements are made with the instructor (e.g., for students who will be out of email contact for field work, etc.).

Exams

Two **midterms (100 pts)** and one **final exam (125 pts)** will be given during the course. These exams will be written, closed-book, multiple choice /short-answer /essay exams that must be completed during the normal class period. The final exam will include material presented throughout the semester, but will be weighted more heavily toward material covered after the second midterm.

Class Project

All students will collaborate and contribute toward a synthesis of literature on a topic that will be defined by the instructor, and refined by the students through in-class discussion. Each student will be responsible for giving an oral presentation summarizing the findings of their own literature review, and preparing an annotated bibliography for submission to the instructor. Students will be invited (but not required) to participate as co-authors in combining results of the class project into a Review and Synthesis article to be submitted to a peer-reviewed journal. More details will be provided in class.

Grading

Final semester grades will be assigned according to the following scale (fractions will be rounded up to the nearest whole number):

| | | | |
|------------|----------|-----------|--------|
| A+ 98-100% | A 93-97% | A- 90-92% | |
| B+ 87-89% | B 83-86% | B- 80-82% | |
| C+ 77-79% | C 73-76% | C- 70-72% | |
| D+ 67-69% | D 63-66% | D- 60-62% | F <60% |

Course Policies

(1) Attendance: Students will not be penalized for poor attendance; however, students are expected to attend all scheduled classes and will be held responsible for all material presented in lecture, discussion, and assigned readings. Students who miss class should work with classmates to obtain missed material; the instructor will not be responsible for providing lecture notes. Lectures will be presented using PowerPoint and copies of slides will be made available after lecture. However, these slides contain only an outline of the material covered; you are unlikely to be successful in this course if you fail to attend class and take notes.

Please note that in-class activities such as discussions can't be made up, regardless of the reason for missing class. In the case of excused absences, the instructor may provide an alternative assignment in place of discussion, or provide an exemption for that discussion.

(2) Support and Disability Services: The Office of Disability Services can be reached by phone- (907) 474-5655, or email- fydso@uaf.edu, and can be located in WHIT 203 on the UAF campus. The Office of Disability Services is available for students with physical or learning disabilities. If you feel that you are differently abled and need these services, please contact the office or ask the instructor to make arrangements.

(3) Courtesy: Please turn off all audible sounds to any electronic devices (phones, laptops, tablets etc.) while in lecture. Refrain from using your laptops for activities not related to lecture during class time, e.g. emailing or browsing the web. Use of these items is strictly prohibited during exams. Students are free to record lectures. You may bring food or drink in the classroom unless otherwise instructed, for example when shared computers are in use.

(4) Plagiarism and academic integrity: Plagiarism will not be tolerated in any way during this course. All assignments are expected to consist of students' original ideas and/or information from properly cited published sources. Students may seek assistance with proper referencing of scientific literature from the instructor as needed. Students are expected to conduct themselves according to the UAF Student Code of Conduct, which can be found in the course catalog. Failure to comply with these guidelines will result in a failing grade, and the student may face consequences at the university level, depending on the severity of the offense.

(5) Student protections and services statement: Every qualified student is welcome in our classroom. As needed, we are happy to work with you, disability services, veterans' services, rural student services, etc. to find reasonable accommodations to support your learning and participation. Students at this university are protected against sexual harassment and discrimination (Title IX), and minors have additional protections. As required, if we notice or are informed of certain types of misconduct, we are required to report it to the appropriate authorities. For more information on your rights as a student and the resources available to you to resolve problems, please go to the following site: www.uaf.edu/handbook/.

(6) UA is an AA/EO employer and educational institution and prohibits illegal discrimination against any individual: alaska.edu/nondiscrimination.

(7) Effective communication: Students who have difficulties with oral presentations and/or writing are strongly encouraged to get help from the UAF Department of Communication's Speaking Center (907-474-5470, speak@uaf.edu) and the UAF English's Department's Writing Center (907-474-5314, Gruening 8th floor), and/or CTC's Learning Center (604 Barnette st, 907-455- 2860).

(8) Students should keep up-to-date on the university's policies, practices, and mandates related to COVID-19 by regularly checking this website: <https://sites.google.com/alaska.edu/coronavirus/uaf/uaf-students?authuser=0>
Further, students are expected to adhere to the university's policies, practices, and mandates and are subject to disciplinary actions if they do not comply.

Course Topics and Schedule

| Week | Lecture Topic | Assignments |
|------|---|--|
| 1 | Course overview; Classification of life history modes | Levin & Bridges 1995 |
| | Embryology and metazoan phylogeny | Brusca & Brusca Ch. 4 |
| 2 | Porifera, Cnidaria, Annelids and other worms | <i>Consult Invert Zoo text as needed</i> |
| | Mollusca, Echinodermata, Crustacea | |
| 3 | Origins and evolutionary transitions in complex life cycles | Havenhand 1995; Nielsen 2013 |
| | Macroalgal Life Cycles | Schiel & Foster 2006 |
| 4 | DISCUSSION: Plasticity of life history traits | |
| | <i>Guest Lecture</i> | Study question 1 due |
| 5 | Egg size and maternal investment | Moran & McAlister 2009 |
| | Gametogenesis and spawning | Morgan 1995 |
| 6 | Midterm #1 | |
| | Fertilization & Sexual Selection | Levitan 2006 |
| 7 | <i>Guest Lecture</i> | |
| | DISCUSSION | |
| 8 | Larval feeding and nutrition | Boidron-Metairon 1995 |
| | Swimming & behavior | Koehl & Hadfield 2010 |
| 9 | DISCUSSION | |
| | Mortality & Defense | Vaughn & Allen 2010 |
| 10 | Larval dispersal and connectivity | Levin 2006; Study Question 2 due |
| | | |
| 11 | Midterm #2 | |
| | Settlement and recruitment processes | Pineda et al. 2009 |
| 12 | Settlement and recruitment (continued) | |
| | DISCUSSION | |
| 13 | Reproduction in the Deep Sea | Young 2004 |
| | Current topics: Climate change, ocean acidification | |
| 14 | Student Presentations | |

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|----|------------------------------|--|
| | NO CLASS: Thanksgiving | |
| 15 | Student Presentations | |
| | DISCUSSION | |
| 17 | FINAL EXAM | |