



## Program Description

Moss Landing Marine Laboratories (MLML) at Moss Landing, California, is operated year round by the California State University. This marine facility functions as an extension of seven participating State Universities (Fresno, Hayward, Monterey Bay, Sacramento, San Francisco, San Jose, Stanislaus) and offers full-time course work in marine biology, oceanography, marine geology, and other marine sciences.

Enrollment is open to properly qualified upper division and graduate students from each of the participating colleges. New students may qualify through normal matriculation procedures at one of the home campuses. With approval of academic advisors, students may satisfy a part of their requirements in Biological Sciences through courses offered at the Moss Landing Laboratories. The Master of Science degree in Marine Science is offered as an interdepartmental degree through Biological Sciences in cooperation with Moss Landing Marine Laboratories.

## Special Features

- Most courses are field-oriented, taking advantage of a diversity of nearby coastal and marine habitats, including Monterey Submarine Canyon, subtidal kelp forests, Elkhorn Slough and rocky and sandy intertidal zones.
- Field activities are facilitated by the MLML fleet, the 135' R/V POINT SUR, the 35' R/V ED RICKETTS, two Boston Whalers and a number of inflatable rafts.
- Ongoing research by faculty and graduate students further enhances the MLML learning experience.

## Contact Information

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## Graduate Program

### *Admission Requirements*

The Master of Science degree in Marine Science program is administered through MLML and the Biological Sciences Department. The prospective student must meet the entrance requirements for the program and will be accepted into unclassified or conditionally classified graduate status by normal procedures. The student will become classified upon completion of MLML's requirements.

A conditionally classified student may become fully classified in the Marine Science program as follows:

- obtain an advisor at MLML and one from the department of the student's choice at the home campus. Each new student in the MS program at MLML will be assigned an advisor who may or may not be the final thesis advisor.
- make up any course work deficiencies at either the home campus department (see their regulations) and/or MLML. MSCI 104, and three of the following five courses are prerequisites for classified graduate standing: MSCI 103, MSCI 141, MSCI 142, MSCI 143, and MSCI 144. These courses may be waived by the graduate committee upon certification that equivalent courses have been satisfactorily completed. MSCI 104 is a prerequisite and cannot be counted toward the 30-unit degree requirement.
- students who do not receive a GPA of 3.0 or better in the courses listed above taken at MLML, or who wish to substitute equivalent courses taken elsewhere regardless of the grade(s) received, must pass a written qualifying examination given by the faculty at MLML. Contact MLML for further information.

### *Advancement to Candidacy*

To be advanced to candidacy, the student must have:

- attained classified standing;
- selected a thesis problem and a thesis advisory committee. The thesis committee will be composed of at least three members, including one faculty member from MLML (who is ordinarily the thesis advisor) and, at the discretion of the home campus, a

representative from that campus. The other member or members of the thesis committee may also be from MLML, or from the home campus, or elsewhere, with the approval of the thesis advisor; and passed the Writing Proficiency Examination (WPE) or secured approval for a WPE waiver.

## Requirements ■ Master of Science Degree

A student becomes eligible for the MS degree in Marine Science after satisfying the following requirements:

- the student has been advanced to candidacy;
- the student has satisfied MLML's requirements for the degree; and
- the student has completed the following 30-unit curriculum requirements.

### A. Required Courses (6 units)

- (2) Select one of the following:
- |          |                           |
|----------|---------------------------|
| MSCI 285 | Seminar in Marine Biology |
| MSCI 286 | Seminar in Marine Geology |
| MSCI 287 | Seminar in Oceanography   |
- (4) MSCI 299 Master's Thesis

### B. Electives\* (24 units)

- (9) Electives from MSCI 200-level courses
- (15) Electives from MSCI 100-level or above courses as approved by the thesis committee. The following courses may be used:
- |            |  |
|------------|--|
| MSCI 112   | Marine Birds and Mammals (Upper division college vertebrate zoology; or instructor permission) |
| MSCI 113   | Marine Ichthyology (College zoology or equivalent or instructor permission)                    |
| MSCI 124   | Marine Invertebrate Zoology I (College zoology or instructor permission)                       |
| MSCI 125   | Marine Invertebrate Zoology II (College zoology or instructor permission; MSCI 103)            |
| MSCI 131   | Marine Botany  |
| MSCI 161   | Marine Fisheries (College mathematics, MSCI 104 or instructor permission)                      |
| MSCI 173   | Topics in Marine Biology   |
| MSCI 174   | Topics in Oceanography   |
| MSCI 175   | Topics in Marine Sciences  |
| MSCI 177   | Microscopic Techniques (One semester college physics)  |
| MSCI 202   | Oceanographic Instrumentation (MSCI 141, MSCI 142)   |
| MSCI 211   | Ecology of Marine Birds and Mammals (MSCI 103, MSCI 104, MSCI 112)                             |
| MSCI 212** | Advanced Topics in Marine Vertebrates (MSCI 112 or MSCI 113)                                   |
| MSCI 221   | Advanced Topics in Marine Invertebrates (MSCI 124 and instructor permission)                   |
| MSCI 222   | Biology of the Mollusca (MSCI 124)   |
| MSCI 231   | Biology of Seaweeds (MSCI 131 or instructor permission)  |
| MSCI 233** | Advanced Topics in Marine Ecology (MSCI 103)   |
| MSCI 234   | Advanced Biological Oceanography (MSCI 144)  |
| MSCI 242   | Plate Tectonics (MSCI 141 or instructor permission)  |
| MSCI 244   | Paleoceanography (MSCI 141 or instructor permission.)  |
| MSCI 245   | Deep-Sea Sedimentation (MSCI 141)  |

MSCI 251**	Marine Geochemistry (MSCI 143, one year calculus)
MSCI 261	Ocean Circulation and Mixing (MSCI 142; college physics strongly recommended)
MSCI 271**	Population Biology (MSCI 103, MSCI 104)
MSCI 272	Subtidal Ecology (MLML diver certification and marine ecology; knowledge of marine algae, invertebrates, and statistics recommended)
MSCI 274	Advanced Topics in Oceanography
MSCI 280**	Scientific Writing (Graduate status)
MSCI 298**	Research in Marine Sciences

\* Other electives, including courses from home campus departments, may be included after consultation with the thesis advisory committee. See course descriptions for prerequisites.

\*\* **Prerequisite:** Instructor permission

### Notes:

- The student must have submitted a thesis approved by the thesis advisory committee. The thesis must conform to the rules set forth by the home campus.
- The student must successfully give an oral thesis defense in the form of a seminar open to the general public. The thesis advisory committee must be present, may require further oral questioning after the seminar, and will evaluate the success of the presentation.

## Upper Division Courses

**MSCI 103. Marine Ecology.** Field-oriented introduction to the interrelationships between marine and estuarine organisms and their environment with emphasis on quantitative data collection and analysis. Lecture two hours; laboratory six hours. **Prerequisite:** Ecology, statistics; or concurrent registration in MSCI 104. Fall only. 4 units.

**MSCI 104. Quantitative Marine Science.** Mathematical methods for the analysis of biological, chemical and physical data from the marine environment; experimental design, parametric and nonparametric statistics. Lecture three hours; laboratory three hours. **Note:** Not for major credit. **Prerequisite:** College mathematics. Fall only. 4 units.

**MSCI 105. Marine Science Diving.** Skin SCUBA diving course, pool-training culminates in ten ocean dives. Topics covered included diving physics, physiology, diving environments, night diving and research diving. Successful completion gives NAUI and MLML certification. Lecture one hour; laboratory six hours. **Note:** Not for major credit. **Prerequisite:** Upper division science major status, thorough physical examination, ability to pass swimming test. 3 units.

**MSCI 110. Introduction to Marine Animal Behavior.** Basic theoretical concepts of animal behavior, stressing the causation, development, and evolution of behavior. Emphasis is on the marine environment. Lecture three hours; laboratory three hours. **Prerequisite:** MSCI 103. 4 units.

**MSCI 112. Marine Birds and Mammals.** Systematics, morphology, ecology and biology of marine birds and mammals. Lecture two hours; laboratory six hours. **Prerequisite:** Upper division college vertebrate zoology or instructor permission; MSCI 103 recommended. Alternate years in spring. 4 units.

**MSCI 113. Marine Ichthyology.** Description of the taxonomy, morphology, and ecology of marine fishes. Both field and laboratory work concentrate on the structure, function and habits of marine fishes and the ecological interactions of these fishes with their biotic and abiotic surroundings. Lecture two hours; laboratory six hours.

**Prerequisite:** College zoology or equivalent or instructor permission; MSCI 103 recommended. Spring only. 4 units.

**MSCI 124. Marine Invertebrate Zoology I.** Field oriented introduction to the structure, systematics, evolution, and life histories of the major and minor marine phyla. Lecture two hours; laboratory and six hours. **Prerequisite:** College zoology or instructor permission; MSCI 103 recommended. Spring only. 4 units.

**MSCI 125. Marine Invertebrate Zoology II.** Field oriented introduction to the structure, systematics, evolution and life histories of the minor marine invertebrate phyla. Lecture one hour; laboratory and field six hours. **Prerequisite:** College zoology or instructor permission; MSCI 103 and MSCI 124 recommended. Spring only. 3 units.

**MSCI 131. Marine Botany.** Introduction to the plants of the sea, marshes, and dunes, with emphasis on the morphology, taxonomy and natural history of seaweeds and vascular plants. Lecture two hours; laboratory six hours. **Prerequisite:** MSCI 103 recommended. Fall only. 4 units.

**MSCI 135. Physiology of Marine Algae.** Physiological basis for understanding the adaptation of marine algae to their environment. Topics include respiration, enzyme activity, and biochemical composition. Hands-on experience in basic electronic instrumentation, chemical separations, optical measurements, culturing methods, and radioisotope techniques. **Prerequisite:** MSCI 103, MSCI 131, and MSCI 144. Lecture two hours; laboratory six hours. 4 units.

**MSCI 141. Geological Oceanography.** Study of the structures, physiography and sediments of the sea bottom and shoreline. Lecture two hours; laboratory and field six hours. **Prerequisite:** MSCI 142, MSCI 143; may be taken concurrently. Fall only. 4 units.

**MSCI 142. Physical Oceanography.** Introduction to the nature and causes of various oceanic motions including currents, waves, tides, and mixing and the Physical properties of seawater. Limited use of calculus. Lecture three hours; laboratory three hours. **Prerequisite:** College algebra, college physics recommended. Fall only. 4 units.

**MSCI 143. Chemical Oceanography.** Introduction to the theoretical and practical aspects of the chemistry of the oceans, including major salts, dissolved gases, nutrient ions, carbonate system, transient tracers, and shipboard sampling techniques. Lecture two hours; laboratory six hours. **Prerequisite:** One year of college chemistry. Spring only. 4 units.

**MSCI 144. Biological Oceanography.** Ocean as an ecological system. Emphasis will be on the complexity of organismal-environmental interaction of the plankton, the transfer of organic matter between trophic levels and nutrient cycles. Laboratory sessions will include methods in sampling, shipboard techniques, identification of the plankton, and current analytical techniques. Lecture two hours; laboratory six hours. **Prerequisite:** General biology, general chemistry. Spring only. 4 units.

**MSCI 161. Marine Fisheries.** Introduction to fishery biology, including the concepts stock, recruitment, and yield, emphasizing the parameters abundance, age, growth, and mortality. Discussion of hydrography and fishery ecology, management problems, world fisheries and mariculture, and collection and analysis of fishery data. Lecture two hours; laboratory six hours. **Prerequisite:** College mathematics, MSCI 104 or instructor permission; MSCI 103 recommended. 4 units.

**MSCI 173. Topics in Marine Biology.** Study of a selected area in marine biology (morphology, physiology, ecology, etc.). Subjects will vary depending on student demand and availability of instructors. Offered on demand. 1-4 units.

**MSCI 174. Topics in Oceanography.** Study of a selected area in oceanography. The subjects will vary depending on student demand and availability of instructors. 1-4 units.

**MSCI 174D. Coastal Processes of the Monterey Bay Region.** Introduction to the principles of coastal morphology and sediment dynamics; effects of coastal erosion and cliff retreat along the northern margin of the bay; longshore drift near Moss Landing, the differences between summer and winter (storm) beaches with special emphasis on El Nino impacts; hazards to development produced by rapidly increasing population along the coastal margin and the role that tectonics and submarine canyons (Monterey Canyon) play in coastal processes. Graded Credit/No Credit. 1 unit.

**MSCI 175. Topics in Marine Sciences.** Advanced undergraduate course in a special subject area; lecture, discussion, laboratory and field components; topics change each semester. **Prerequisite:** May be repeated for credit. 1-4 units.

**MSCI 177. Microscopic Techniques.** Principles and techniques of light and electron microscopy. Consideration of brightfield, darkfield, phase contrast and interference contrast light microscopy; episcopic and diasopic illumination systems; photomicrography; preparation of materials for and operation of the scanning electron microscope. Lecture two hours; laboratory three hours. **Prerequisite:** One semester college physics. 3 units.

**MSCI 180. Independent Study.** Faculty-directed study of selected research problems; open to undergraduate students with adequate preparation. Three hours work per unit. **Prerequisite:** Instructor permission. 1-4 units.

## Graduate Courses

**MSCI 202. Oceanographic Instrumentation.** Principles of instruments used in oceanographic research, introduction to electronics, and applications of instrument measurements. Emphasis will vary from CTD profilers, current meters, radiometry and chemical measurement. Lecture two hours; laboratory six hours. **Prerequisite:** MSCI 142, MSCI 142 and instructor permission. Alternate years in spring. 4 units.

**MSCI 204. Sampling and Experimental Design.** Discussion of random sampling, systematic sampling, subsampling, survey techniques, and design of single and multifactorial experiments using randomized and block experimental designs: basic design of experiments and field sampling will be covered. Biases and problems of sampling marine biota will be presented and discussed by critiquing relevant literature. Lecture four hours. **Prerequisite:** MSCI 103, MSCI 104. 4 units.

**MSCI 208. Molecular Ecology: Concepts and Methods.** Use of genetic information affecting interactions of organisms with environment. Lectures on molecular markers used to assess diversity in communities, characterize spatial/temporal variation in species composition, assess genetic variability in populations, discriminate/reveal kinship among individuals, and detect/quantify gene expression important in organismal responses to environmental fluctuation. Basic molecular methods (DNA and RNA isolation/amplification/cloning/sequencing) taught. Students projects as budget permits. Enrollment limited. Lecture 2 hours; laboratory 6 hours. **Prerequisite:** Basic cellular/molecular biology course; consent of instructor. 4 units.

**MSCI 211. Ecology of Marine Birds and Mammals.** Community approach to the ecology of marine birds and mammals using experimental and sampling methodology; examine the distribution, abundance, trophic ecology, and behaviors of birds and mammals in Elkhorn Slough and Monterey Bay. Lecture two hours; laboratory six hours. **Prerequisite:** MSCI 103, MSCI 104, MSCI 112. 4 units.

**MSCI 212. Advanced Topics in Marine Vertebrates.** Advanced consideration of the ecology, physiology and phylogeny of fishes, birds, reptiles or mammals, emphasizing current literature and research. Topics and emphasis will vary with term and instructor. Lecture two hours; laboratory six hours. **Note:** May be repeated once for credit. **Prerequisite:** MSCI 112 or MSCI 113 and instructor permission. Alternate years in fall. 1-4 units.

**MSCI 221. Advanced Topics in Marine Invertebrates.** Advanced considerations of the ecology, physiology and phylogeny of the various invertebrate phyla emphasizing current literature and research. Topics will vary from term to term. Lecture two hours; laboratory six hours. **Note:** May be repeated for credit when topics change. **Prerequisite:** MSCI 124 and instructor permission. Offered on demand. 1-4 units.

**MSCI 222. Biology of the Mollusca.** Systematics, functional morphology, ecology and physiology of the mollusca with emphasis on the marine forms. Lecture two hours; laboratory six hours. **Prerequisite:** MSCI 124. 4 units.

**MSCI 231. Biology of Seaweeds.** Lecture-discussions in algal development, reproduction, and ecology. Extensive reading of original literature. Ecologically oriented individual research projects involving laboratory culture and field experimentation. Lecture two hours; laboratory six hours. **Prerequisite:** MSCI 131 or instructor permission. 4 units.

**MSCI 233. Advanced Topics in Marine Ecology.** Selected topics and current issues in marine ecology. The subjects will vary depending on student demand and availability of instructors. **Note:** May be repeated for credit when topics change. **Prerequisite:** MSCI 103 and instructor permission. Offered on demand. 1-4 units.

**MSCI 233C. Coastal Ecology-Gulf of California.** Field-oriented examination of the interrelationships between intertidal and shallow subtidal organisms and their environment in the Gulf of California, Mexico. Information from lectures and review of primary literature on the ecology of the region will be used to write a research proposal. 1 hour lecture, 6 hours laboratory. **Prerequisite:** MSCI 103, MSCI 104, MLML SCUBA certified, graduate status, instructor permission. 3 units.

**MSCI 234. Advanced Biological Oceanography.** Experimental techniques in biological oceanography with emphasis on problems important to plankton ecology. Includes lectures, labs, and discussions of current research problems. An individual research project involving analytical tools will be required. Lecture two hours; laboratory six hours. **Prerequisite:** MSCI 144. 4 units.

**MSCI 242. Plate Tectonics.** Historical background, modern theory, and geo-physical evidence of continental drift sea floor spreading and plate tectonics. Examinations of the impact of the recent revolution in historical geology. Lecture three hours. **Prerequisite:** MSCI 141 or instructor permission. 3 units.

**MSCI 244. Paleoceanography.** Interdisciplinary studies of the provenance, biologic and geologic composition of marine sediments and of the organisms contributing to their formation; sedimentary processes affecting these sediments. Lecture two hours; laboratory six hours. **Prerequisite:** MSCI 141 or instructor permission. 4 units.

**MSCI 245. Deep-Sea Sedimentation.** Study of the types of marine sediment found in the deepest part of all oceans; the sedimentary processes responsible for the deposition, preservation and re-deposition of these sediments. Lecture two hours; laboratory six hours. **Prerequisite:** MSCI 141. 4 units.

**MSCI 251. Marine Geochemistry.** Geochemical processes in the oceans: thermodynamics of low temperature aqueous reactions, processes occurring at the sea floor and air-sea interface. Lecture two

hours; laboratory six hours. **Prerequisite:** MSCI 143, quantitative analysis, one year calculus or instructor permission. 4 units.

**MSCI 261. Ocean Circulation and Mixing.** Mathematical description of the distribution of properties (salinity density, etc.) in the oceans relating to physical and biochemical processes. Equations of motion, geotropic method, and theory of distribution of variables. Lecture two hours; laboratory six hours. **Prerequisite:** MSCI 142; college physics strongly recommended or instructor permission. 4 units.

**MSCI 262. Satellite Oceanography.** Physical principles of remote sensing with application to the oceans including satellite image processing methods. Labs involve use of PC and Unix workstation. Lecture two hours; laboratory six hours. **Prerequisite:** MSCI 142, MSCI 144, or instructor permission. MSCI 263 strongly recommended. 4 units.

**MSCI 263. Application of Computers in Oceanography.** Lecture, discussion and technical programming with MATLAB for computation and visualization with applications in marine sciences. Use of existing program libraries for data I/O and analysis. Semester project required. Lecture two hours; laboratory six hours. **Prerequisite:** College math and instructor permission. Fall only. 4 units.

**MSCI 271. Population Biology.** Principles of the interaction among marine organisms that result in the alteration of population structures. Techniques for assessment and management of populations. Lecture two hours; laboratory three hours. **Prerequisite:** MSCI 103, MSCI 104; or instructor permission. Spring only. 3 units.

**MSCI 272. Subtidal Ecology.** Ecology of nearshore rocky subtidal populations and communities with emphasis on kelp forests. Lectures and discussions of original literature. Field work with SCUBA including group projects on underwater research techniques and community analysis, and individual research on ecological questions chosen by the student. Lecture two hours; laboratory six hours. **Prerequisite:** MLML diver certification and marine ecology (knowledge of marine algae, invertebrates, and statistics recommended). 4 units.

**MSCI 274. Advanced Topics in Oceanography.** Study of a selected area in oceanography. The subjects will vary depending on student demand and availability of instructors. 1-4 units.

**MSCI 280. Scientific Writing.** Techniques and strategies of scientific writing used for proposals, journal submissions, and abstracts for meetings. Students will develop their writing skills by preparing, editing, and rewriting manuscripts. Lecture three hours. **Prerequisite:** Graduate status and instructor permission. 3 units.

**MSCI 285. Seminar in Marine Biology.** Seminar will be held on topics changing each semester. Each student will be required to give at least one seminar. Lecture two hours. **Note:** May be repeated once for credit. **Prerequisite:** Instructor permission. 2 units.

**MSCI 286. Seminar in Marine Geology.** Seminar will be held on topics changing each semester. Each student will be required to give at least one seminar. **Note:** May be repeated once for credit. 2 units.

**MSCI 287. Seminar in Oceanography.** Seminar will be held on topics changing each semester. Each student will be required to give at least one seminar. **Note:** May be repeated once for credit. 2 units.

**MSCI 298. Research in the Marine Sciences.** Independent investigations of an advanced nature for the graduate student with adequate preparation. **Prerequisite:** Instructor permission. 1-4 units.

**MSCI 299. Master's Thesis.** 1-4 units.