GLOBAL KELP SYSTEMS

COURSE TITLE: MS 233 – Advanced Topics in Marine Ecology: Global Kelps Systems

SPRING – AUSTRAL SUMMER 2019

LOCATION
Estación Costera de Investigaciones Marinas (ECIM), P. Universidad Catolica de Chile PUC.

DATES
15th -23rd of January, 2019

INSTRUCTORS:

Dr. Michael Graham (Moss Landing Marine Labs, email: mgraham@mlml.calstate.edu)
Dr. Alejandro Buschmann (Universidad de Los Lagos, email: abuschma@ulagos.cl)
Dr. Scott Hamilton (Moss Landing Marine Labs, email: shamilton@mlml.calstate.edu)
Dr. Sylvain Faugeron (P. Universidad Católica de Chile, email: sfaugeron@bio.puc.cl)
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Dr. Myriam Valero (Station Biologique de Roscoff, email: myriam.valero@sb-roscoff.fr)

WHAT THIS COURSE IS ABOUT: Kelp forests represent some of the most diverse, productive, and dynamic ecosystems on the planet, and the distributions of many organisms are known to be linked tightly to the presence of kelp due to a variety of trophic and habitat associations. The presence of kelp populations in nearshore regions also significantly enhances the diversity and productivity of coastal ecosystems. Despite early interest in how kelp forests function, however, little is known about the temporal and spatial scales at which kelp forest communities respond to variability in kelp distribution and abundance. Such information is not only vital to basic studies of community assembly but also to more applied questions of societal concern, for example the prediction of ecosystem consequences due to global climate change, habitat modification, and human exploitation of kelp forest resources.

This course will touch on three themes that can be summed up by the following questions:
(1) What is the role of kelps in nearshore systems? (2) Can kelp trophic and habitat associations be untangled? (3) What are the ecosystem consequences of kelp addition to a system? How susceptible are kelp forests to current global warming?
 These research questions are challenging and the global scientific community studying kelp ecology is divided into provincial research programs demarcated by political, social, and economic boundaries. Kelp forests, however, are structured by processes that are ignorant of these sorts of boundaries. As such, scientific provincialism can impede the study and understanding of kelp ecosystem functioning at regional to global scales … the scales at which such functioning is ultimately expressed. **The goal of this course is to develop an integrated education-research curriculum that addresses the functioning of global kelp systems.**

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COURSE STRUCTURE: The course is organized around morning "challenge" lectures in which the instructors present a brief background (2 hours) on ecological concepts in order to stimulate student discussion. The lectures are complimented by extensive reading of the primary literature and round-table discussions of key concepts, methodologies, and research directions. Intensive laboratory will follow each lecture, so that students can immediately apply their new concepts and skills. All exercises will utilize real data resulting from a field experiment to be conducted by the students. Understanding of the role of kelp abundance in regulating the structure and functioning of global kelp systems requires knowledge of processes spanning various fields, and spatial, temporal, and taxonomic scales. As such, we have compiled a group of US, Chilean and UK instructors with expertise in: (1) physiology, ecology, molecular biology, and experimental design; (2) organisms, populations, and communities; and (3) algae, invertebrates, and vertebrates.

CLASS EXPERIMENT: In addition to lectures and laboratories, and guest invited presentations, students will conduct a field experiment in southern Chile to test the population and community-level associations of organisms to kelp in natural systems. We will be sampling areas near Las Cruces (ECIM, http://ecim.bio.puc.cl/en/) to study these associations in both the rocky intertidal and shallow subtidal. This site is part of a larger project to study the ecology of annual populations of giant kelp where unique interactions take place. We will be sampling (1) natural kelp populations, (2) evaluation of kelp and mollusk exclusion experiments, (3) and patterns of kelp herbivore interactions. The sampling will be conducted by the students and instructors to estimate (a) the abundance of algae, invertebrates, and fishes, (b) the effect of exclusion treatments on algal recruitment and abundance, and (c) the impact of grazers on kelp abundance, among other issues. The following are some of the hypotheses that will be tested during this course:

- Grazers affect kelp recruitment
- Secondary substrata may affect indirectly kelp recruitment
- Predators are more abundant when kelps are present
- Herbivore and predator diets are more diverse when kelps are present
- Herbivores and predators are larger when kelps are present
- Species richness and diversity are correlated with kelp's abundance and genetic diversity

EXAMS & GRADING:
Final exam:	25%
Assignments:	25%
Research paper (MLML students):	25%
Class participation:	25%

Final exam: A written exam will be handed out after the last laboratory exercise to be completed in 24 hours. All students must turn in the exam in order to receive a grade. Students *may not* work together on the exam.

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Assignments: Three laboratory assignments will be due the morning after they are assigned. All students must turn in the assignments in order to receive a grade. Students *can* work together on the assignments.

Research paper: A research paper on the field study data is due on April, 2018.

Class participation: This includes discussions in class and helping with laboratory and fieldwork. It is assumed that the students will work together to learn the material, conduct analyses, and discuss the readings.

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SCHEDULE Tentative:
Students arrive on Jan 15 at housing site ECIM, Las Cruces.

Date	Morning	Afternoon	Assignment*
Jan 16 (Wed)	1. Brief introduction to the goals of the course, the experiment, and the methods (Graham) **9:00 – 10 am lecture room** 2. Ecology Overview of Central and Southern Chile (Buschmann) **10:30-1 pm lecture room**	3. Introduction to the field system (Perez-Matus) **2:30 pm – 3:30 pm Las Cruces Field trip** 4. History of research at ECIM **3:30 – 4:30 pm lecture room**	Welcome BBQ **6 p**
Jan 17 (Thurs)	5. Carbon and nitrogen physiology of kelps and kelp population ecology (Buschmann) **9 – 11:30 am lecture room**	**12-2 pm Las Cruces Field trip (collect kelp density and size data)** 6. Analyze data **3-5 pm lecture room**	Compare kelp density and size between experimental treatments
Jan 18 (Fri)	4. Phylogeography and population genetics of kelps: evolutionary and demographic inferences; Population genetic diversity and spatial structure of kelp populations (Faugeron, Valero) **9 – 12 pm lecture room**	5. Pop gen case studies, techniques, data analysis (Faugeron, Valero) **1-5 pm lecture room**	Correlations between kelp genetic diversity and community diversity at different spatial scales *Guest Speaker*: 6-7 pm Dr. Erasmo Macaya: "Algal Diversity at Higher Latitudes"
Jan 19 (Sat)	6. Kelp Community ecology (Perez-Matus) **9 – 12 pm lecture room**	**1:30-3:30 pm Las Cruces Field trip (collect community data)** 7. Analyze data **4-6 pm lecture room**	Compare species abundances among experimental treatments
Jan 20 (Sun)	8. Species interactions and community structure (Hamilton) **9 – 12 p lecture room**	**1:30-3:30 pm Las Cruces Field trip (collect community data)** 9. Analyze data	Compare community structure among experimental treatments

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		4-6 pm lecture room	
Jan 21 (Mon)	10. Moore lecture **9 – 12 p lecture**	10. Climate Change Lab (Heat Shock proteins and Diving PAM) LAB STUDIES	Guest Speaker 6-7 pm Dr. Evie Wieters "Kelp and Defoliated kelp shifts in a local forest" Beer and wine tasting
Jan 22 (Tue)	11. Ecosystem processes and energy flow (Graham) **10 - 12 lecture room**	12. Multivariate analyses of correlative and experimental species association data	**Final Exam**

* All assignments are due the morning after they are assigned. Final exam is take-home and due the following afternoon (Jan 23, Wed).