ENST 499: Sustainable Aquaculture and Food Security
Units: 4
Fall 2019, MW 2-3:20
Location: SOS B41

Instructor: Scott Applebaum
Office: CAS116
Office Hours: TBA
Email: sappleba@usc.edu
Phone: 213-740-8287 (office)

Course Description

Global population is on a trajectory to exceed 10 billion by the year 2050, intensifying the need for sustainable approaches to food production and food security. Aquatic systems, including oceans represent more than 99% of the biosphere and offer vast potential for offsetting sustainability challenges and limitations inherent in terrestrial agriculture and livestock production. Seafood from marine and freshwaters offer a valuable nutritional source; however, yield from wild-capture fisheries have attained a maximum. In this course we explore the potential and problems of aquaculture, the production of fish, invertebrate and plants from marine and freshwater aquatic systems, to advance sustainable food production and security. We will address the potential for aquaculture to contribute the environmentally sustainable food production and highlight salient challenges for aquaculture from the perspective of science, technology, economics and policy.

Learning Objectives and Outcomes

Through this course students will be able to demonstrate:

- knowledge of the biological and technical challenges of culturing marine and freshwater animal and plant species
- knowledge of the social and economic factors relevant to aquaculture as an industry
- the ability to critically evaluate information from pertinent primary literature
- the ability to critically evaluate the potential for multiple forms of aquaculture to contribute to food security and sustainability
- the ability to write effectively on complex environmental problems for both specialist and general audiences
- quantitative reasoning and analyses through evaluation of impacts and benefits (ecological, environmental, social, economic) of multiple forms of aquaculture production

Recommended Preparation

Completion of ENST 100 recommended

Course Notes

This course will use Blackboard for communication, distribution of course materials including supplementary reading and lecture slides (generally posted after the lecture) and for turning in assignments. Sometimes computers will be used in class to work with data in excel or in a website interface. This course involves in-depth reading and critical analyses outside of lecture, as it is a four-unit course.

Required Readings and Supplementary Materials

Readings will be noted in the course schedule and will be provided through Blackboard and/or USC Library electronic access.

Exams, Assignments and Project and Grading
Exam questions will be drawn from course readings, lecture materials and discussions. The Final Exam is partially cumulative and will include ~20% of material covered in the first two- thirds of the course; the remaining ~80% of the Final Exam will include course material from after the second midterm. If there is a conflict with the scheduled time for an exam, you must email the instructor two weeks in advance to see if alternative arrangements can be made (under reasonable circumstances). Otherwise, **make-up exams will not be given, except in extreme emergencies**. If a student misses an exam and/or assignment due to an unexcused absence, they may receive a zero for that portion of the course. During exams, students will NOT be allowed to have notes, books, cell phones, etc. Only pens/pencils and a calculator are required. Failure to comply with exam policies will automatically result in a grade of "0" for that particular exam.

Reading guides will involve reading primary literature, answering questions outside of class and turning them in ahead of time, and a discussion of these readings in class.

Data assignments will involve the analysis simple datasets, interpretation of data and observed trends, and synthesis of findings into a written report (~2 pages, single spaced). The quantitative analytical, and data interpretation skills developed in these assignments will be applied collectively to a group project.

For the group project, groups of 2-3 students will use information provided during the course and supplemental data discovered through research (available literature and databases) to analyze a complex dataset and produce a written (4-5 page, single-spaced) report as well as an oral presentation of their findings. Data assignments will be evaluated based upon originality, accuracy and thoroughness of research, and quality of finished project.

Course grade will be based upon your performance on exams, written assignments, group presentations and class participation (e.g., study guide discussions, Blackboard assignments, etc.). Lecture presentations will be posted on Blackboard after the lectures.

Assignment	Points	% of Grade
Midterm 1	75	15%
Midterm 2	75	15%
Final Exam	100	20%
Readings/Discussions	75	15%
Data analyses	100	20%
Group Data Project & Presentation	75	15%
TOTAL	**500**	

Course final grades will be determined using the following scale:

Grade	Percent	Grade	Percent
A	95-100	C	73-76
A-	90-94	C-	70-72
B+	87-89	D+	67-69
B	83-86	D	63-66
B-	80-82	D-	60-62
C+	77-79	F	59 and below

Expectations:
- Come to class prepared
- Be respectful of me and other students in class
- Please leave cell phones outside the classroom or turned off
- If you have to miss class, make sure you arrange to get notes and announcements.

Course Schedule

	Topics/Daily Activities	Readings	Assignments Due
Aug26 *Week 1*	**Introduction to Aquaculture** Trends in fish production and consumption Finfish, shellfish and marine plant culture	LST: Ch 1,2 *FAO Fisheries and Aquaculture report*	
Sep 2 *Week 2*	**Aquaculture systems: Many forms, challenges, and opportunities** Inshore, offshore, and recirculating and land based, IMTA Site selection and water quality management	LST: Ch 3,4	
Sep 9 *Week 3*	**Biological considerations: Species selection and maintenance** Species selection, reproduction, genetics and gene modification Feed sources, feed efficiency, and no-feed systems Hatcheries	LST: Ch 6,7,9 You and Hedgecock 2018	**Data Analysis 1**
Sep 16 *Week 4*	**Environmental considerations: Potentials impacts** Escapes and invasive, land and water resources, effluent, fish feed sources, energy use and environmental considerations	LST: Ch 5	
Sep 23 *Week 5*	**Markets and marketability: Social issues and public perceptions** seafood certifications, traceability, nutritional value	Froehlich et al 2016	
Sep 30 *Week 6*	**Regulation, economic sustainability: scale, trade, labor** Exports versus local consumption, demand, yield, costs, regulatory frameworks	LST: Ch 14	**Midterm 1**
Case studies: Contrasts in productivity, policy and impacts		
Oct 7 *Week 7*	*Asia dominates productivity*: Regulation and aquaculture extension system in China	Abate et al 2016	**Data Analysis 2**
Oct 14 *Week 8*	*Greening of Norwegian salmon industry*: Big production from a small nation and aggressive investment in a sustainable future for the industry	LST: Ch 17 Christiansen and Jacobsen 2017	
Oct 21 *Week 9*	*US and Southern California emerging industry:* Careful regulation and policy evaluations. Groundwork for inshore/offshore finfish and shellfish culture	LST: Ch 20, 24 Knapp and Rubino, 2016	
Oct 28 *Week 10*	**Sustainability under environmental change** Resilience to environmental, climate/ocean change	LST: Ch 27 Froehlich et al 2018	
Nov 4 *Week 11*	**Social impacts** Workers and communities Slave labor in Thai shrimp industry	Nakamura et al 2018	**Data Analysis 3**
Nov 11 *Week 12*	**Restoration and conservation aquaculture** Restocking programs, Marine and freshwater ornamentals, zoos and aquariums	LST: Ch 26	**Midterm 2**
Nov 18 *Week 13*	**Kelp culture for food and fuel**	LST: Ch 15	
Nov 25 *Week 14*	**Public awareness and education programs** Seafood watch	www.seafoodwatch.org Willette et al 2017	
Nov 27	Thanksgiving recess. No class.		
Dec 2 *Week 15*	Group project presentations		**Projects due**
FINAL	Friday, Dec. 13 2-4 PM		

General Course Policies:
Any document associated with grading may be photocopied by the instructional staff.

Policy on Re-grades: All graded documents will be graded in the context of expectations set by an initial evaluation of all student responses. the If you feel that an error was made in the grading of an examination or lab activity, you must: 1) Prepare a printed statement explaining why you feel your grade was incorrect, and 2) submit this and your original examination to your instructor within one week of the time the examination or assignment was returned to you. Your entire exam or assignment may be re-graded and, as a result, your grade may increase or decrease from a requested re-grade. No frivolous reasons will be accepted for requesting grade changes; stated reasons for a grade change must be legitimate (e.g., error in totaling the score).

Late work: Late assignments must be uploaded to *TurnItIn* or to your professor (whichever is specified in the assignment). All will be date stamped. Late assignments incur a 5% penalty per day unless otherwise specified.

Attendance and participation: Students are strongly encouraged to attend lectures. Students who miss classes are responsible for finding out about any class announcements. It is in your best interest to participate in class discussions, as well as interact positively with other members of the class.

Policy on missed lecture exams, quizzes or activities:
UNPLANNED ABSENCES: You may be excused from an exam or lab only in the event of a documented illness or emergency as outlined by university policy, with notification to the Instructor within 48 hours. An invalid excuse, or the excuse turned in late, will result in a score of zero for the activity missed. If you miss the final examination and have provided a valid medical excuse within 72 hours of the examination time, a final course grade of incomplete (IN) will be recorded, and you will be permitted to take a make-up final examination during the following semester.

PLANNED ABSENCES: Students who wish to miss an examination or graded activity for observance of a religious holy day should be aware of the University's policy on such absences, published at: http://orl.usc.edu/religiouslife/holydays/absences.html. If the absence is approved as determined by the USC Office of Religious Life, a reasonable accommodation will be provided. If you have any anticipated exam date conflicts due to athletic schedules or religious holidays, see an instructor by WEEK 2 of the course.

Website: Postings on Blackboard (https://blackboard.usc.edu) will be an official source for announcements, course materials, lecture notes, grade postings and general discussions. Students are responsible for checking the course website on a regular basis. Please notify the Instructor ASAP in the event of any mistakes.

Statement on Academic Conduct and Support Systems
Academic Conduct:

Plagiarism – presenting someone else's ideas as your own, either verbatim or recast in your own words – is a serious academic offense with serious consequences. Please familiarize yourself with the discussion of plagiarism in SCampus in Part B, Section 11, "Behavior Violating University Standards" policy.usc.edu/scampus-part-b. Other forms of academic dishonesty are equally unacceptable. See additional information in SCampus and university policies on scientific misconduct, policy.usc.edu/scientific-misconduct.

Support Systems:

Student Health Counseling Services - (213) 740-7711 – 24/7 on call
engemannshc.usc.edu/counseling

Free and confidential mental health treatment for students, including short-term psychotherapy, group counseling, stress fitness workshops, and crisis intervention.

National Suicide Prevention Lifeline - 1 (800) 273-8255 – 24/7 on call
suicidepreventionlifeline.org
Free and confidential emotional support to people in suicidal crisis or emotional distress 24 hours a day, 7 days a week.

Relationship and Sexual Violence Prevention Services (RSVP) - (213) 740-4900 – 24/7 on call
engemannshc.usc.edu/rsvp
Free and confidential therapy services, workshops, and training for situations related to gender-based harm.

Office of Equity and Diversity (OED) | Title IX - (213) 740-5086
equity.usc.edu, titleix.usc.edu
Information about how to get help or help a survivor of harassment or discrimination, rights of protected classes, reporting options, and additional resources for students, faculty, staff, visitors, and applicants. The university prohibits discrimination or harassment based on the following protected characteristics: race, color, national origin, ancestry, religion, sex, gender, gender identity, gender expression, sexual orientation, age, physical disability, medical condition, mental disability, marital status, pregnancy, veteran status, genetic information, and any other characteristic which may be specified in applicable laws and governmental regulations.

Bias Assessment Response and Support - (213) 740-2421
studentaffairs.usc.edu/bias-assessment-response-support
Avenue to report incidents of bias, hate crimes, and microaggressions for appropriate investigation and response.

The Office of Disability Services and Programs - (213) 740-0776
dsp.usc.edu
Support and accommodations for students with disabilities. Services include assistance in providing readers/notetakers/interpreters, special accommodations for test taking needs, assistance with architectural barriers, assistive technology, and support for individual needs.

USC Support and Advocacy - (213) 821-4710
studentaffairs.usc.edu/ssa
Assists students and families in resolving complex personal, financial, and academic issues adversely affecting their success as a student.
Diversity at USC - (213) 740-2101
diversity.usc.edu
Information on events, programs and training, the Provost's Diversity and Inclusion Council, Diversity Liaisons for each academic school, chronology, participation, and various resources for students.

USC Emergency - UPC: (213) 740-4321, HSC: (323) 442-1000 – 24/7 on call
dps.usc.edu, emergency.usc.edu
Emergency assistance and avenue to report a crime. Latest updates regarding safety, including ways in which instruction will be continued if an officially declared emergency makes travel to campus infeasible.

USC Department of Public Safety - UPC: (213) 740-6000, HSC: (323) 442-120 – 24/7 on call
dps.usc.edu
Non-emergency assistance or information.