Optimizing Kelp and Oyster Integrated Multi-Trophic Aquaculture

SUPERVISOR: Dr. Austin Humphries (Assistant Professor, University of Rhode Island, USA)

WHY DO THIS SCIENCE

Harvesting sugar kelp grown in Rhode Island in 2017.

As marine capture fisheries are unable to keep pace with increasing seafood demand, the sustainable use and production of marine resources has developed into a major concern. Aquaculture may reduce the need for capture fisheries and imported seafood in the U.S., but it can potentially have negative environmental impacts. Aquaculture of "extractive" species such as shellfish and seaweeds, however, have the potential to improve water quality while also providing healthy seafood for human consumption.

Integrated multi-trophic aquaculture, or IMTA, combines two or more trophic levels of farming in one area, and one goal of IMTA is to recycle farm-derived waste from higher trophic level species into harvestable production. Shellfish-seaweed IMTA systems can potentially provide an aquaculture farm with a diversified crop yield throughout the year that increases profits, sustains employment, and bolsters production of ecologically efficient protein, while having net positive effects on the environment. Little information is available, however, to help sea farmers in the U.S. determine where shellfish-seaweed IMTA might succeed, or whether current aquaculture sites might have the biophysical and geochemical factors that will allow both shellfish and seaweed to flourish. This MS project will use field experiments and computer modeling approaches to determine optimum growth conditions for kelp production in IMTA systems across Rhode Island, as well as quantify bioassimilation rates.

WHAT'S IN IT FOR YOU

This project will provide you with experience in conducting field experiments as well as working with oyster farmers across coastal Rhode Island. The research will be at the cutting edge of sustainable aquaculture and you will develop a theoretical foundation in bioenergetics modeling. Specifically, you will learn how to apply dynamic energy budget modeling to kelp and oysters, and analyze, interpret, publish and communicate your research. You will regularly interact with leading scientists, non-profits (GreenWave), gov't agencies (US EPA), and the aquaculture industry, helping to position you to enter the job market at the end of your studies.

The Humphries Lab is an exciting young research environment and you will benefit from the large and multidisciplinary College of Environment and Life Sciences at the University of Rhode Island. Your MS degree will be carried out within the interdisciplinary Biological and Environmental Sciences program (i.e. Ecology and Ecosystem Science specialization). You will spend time on the water in Narraganset Bay and the coastal salt ponds, and your MS will fit into a broader project, enabling you to build an understanding of integrated assessments of aquaculture for multiple ecosystem services.

WHO SHOULD APPLY

I am seeking applications from recent BS graduates who have a strong quantitative background in the Biological, Environmental, or Computer Sciences. Of particular importance for applicants is demonstrable

ability to complete research tasks independently. Ability to link theory to practical work and modeling will be important, and therefore, relevant research and quantitative experience will be beneficial.

THE SMALL PRINT

Funding: Support for the MS student will be provided through a NOAA Saltonstall-Kennedy grant to Dr. Humphries. The successful applicant will be funded for two academic years and two summers through a combination of Research and Teaching Assistantships and tuition is also covered. The Assistantship stipend is approximately $26,000 per year for two years ($19k for the academic year and $7k for summer), including health benefits.

Academic Requirements: Undergraduate GPA > 3.0; GRE scores > 75th percentile for Quantitative Reasoning.

Application Deadline: 11:59pm on 21 July 2017

Start Date: September 2017 or January 2018

For further information or informal discussion about the position, please send your CV and an email to Dr. Austin Humphries (humphries@uri.edu).

APPLICATION PROCESS

Please download and complete an application form outlining your background and suitability for this project from http://ahumphrieslab.com/s/HumphriesLab-Application-Form-sp58.docx. Applications and CVs must be submitted as a ***single*** PDF document (application form first, then CV) using the following naming scheme, "*LastName_FirstName_Year*_GradApplication" to humphries@uri.edu, with "Kelp IMTA MS application" in the Subject line. No other file types will be accepted. Please note only applications submitted as per these instructions will be considered.

SUGGESTED READING

Filgueira, R., Guyondet, T., Comeau, L.A., Grant, J. (2014) A fully-spatial ecosystem-DEB model of oyster (*Crassostrea virginica*) carrying capacity in the Richibucto Estuary, Eastern Canada. *Journal of Marine Systems* 136, 42–54.

Hadley, S., Wild-Allen, K., Johnson, C., Macleod, C. (2016). Quantification of the impacts of finfish aquaculture and bioremediation capacity of integrated multi-trophic aquaculture using a 3D estuary model. *Journal of Applied Phycology* 28(3), 1875–1889.

Kim, J.K., Kraemer, G.P., Yarish, C. (2015) Use of sugar kelp aquaculture in Long Island Sound and the Bronx River Estuary for nutrient extraction. *Marine Ecology Progress Series* 531, 155–166.

Neori, A., Chopin, T., Troell, M., Buschmann, A.H., Kraemer, G.P., Halling, C., Shpigel, M., Yarish, C. (2004) Integrated aquaculture: rationale, evolution and state of the art emphasizing seaweed biofiltration in modern mariculture. *Aquaculture* 231, 361–391.

Ren, J.S., Stenton-Dozey, J., Plew, D.R., Fang, J., Gall, M. (2012) An ecosystem model for optimising production in integrated-multitrophic aquaculture systems. *Ecological Modelling* 246, 34–46.