Tropical Marine Fisheries (BI/MR 529)

Proposed Offering: Marine Semester Block 4 (simultaneous with BI 569)
Instructor: Dr. Randi Rotjan (rrotjan@bu.edu)
Teaching Fellow: Rebecca Branconi (branconi@bu.edu)

Reading: Contemporary literature (pdfs, detailed below) and select chapters from:
Marine Fisheries Ecology. Jennings, Kaiser and Reynolds (1st Edition)
Interrelationships Between Corals and Fisheries. Bortone (2nd Edition)
Pre-requisutes: BI 260, and admission to the Marine Semester.

I. Course Introduction

Healthy coral reefs are among the most biologically diverse and economically valuable ecosystems on earth, providing vital ecosystem services including food for millions. Tropical Marine Fisheries (TMF) examines the ecology and management of commercially valuable fishes and shellfishes in the Belizean Barrier Reef with emphasis on the impacts of human activities on species diversity and abundance. Topics include population dynamics, essential fish habitat, bioeconomics, sustainable harvesting and management institutions. Students will design and conduct original field research focusing on the ecology and stock status of an exploited or potential coral reef fishery and present their findings during a symposium held at Calabash Caye Field Station, Turneffe Atoll, Belize.

II. Introduction to *Field Research: Calabash Caye Field Station, Turneffe Atoll, Belize*

As a class and in groups, we will work on various research projects related to tropical marine fisheries including the aquaculture and aquarium trade, catch and release, and food industries.

Target species for student project paths:

Currently exploited Belizean fisheries species
1. conch (*Strombus gigas*)
2. spiny lobster (*Panulirus argus*) and slipper lobster (*Scyllarides aequinoctialis)*
3. West Indian top shell (*Cittarium pica)*
4. parrotfish (*Scarus guacamaia, Scarus vetula, Sparisoma viride, Sparisoma aurofrenatum, etc)*

Currently unexploited Belizean fisheries species (exploited elsewhere in MAR)
5. West indian sea egg (*Tripneustes ventricosa*)
6. sea cucumber (*Holothuria Mexicana* and *Holothuria thomasi*)
7. macroalgae (*Gracilaria* spp., *Eucheuma* spp., *Sargassum natans*)

III. *QUICK LOOK* COURSE CALENDAR

◄ November **December 2017** January ►

Sun	Mon	Tue	Wed	Thu	Fri	Sat
	27 Introduction Coral Reef Biodiversity Ecosystem Function Ecosystem Services	**28** Mangrove-Seagrass-Reef Linkages Safety in the Field Virtual Ecosystem Tours Species IDs – Mangroves and Seagrasses	**29** Species ID's – Sponges and Cnidarians Wild Capture Fisheries – State of the Global Resource Seminar Discussion HMNH Trip	**30** Seminar Discussion Project Planning Session #1 Preparation for scientific snorkeling session #1 Guest Lecture: Matt Thompson (NEAq)	**1** Optimal Allocation Bioeconomics Pool Session – Scientific Snorkeling Session / Systematic Sampling Technques	**2**
3	**4** Commercially important Fisheries Field Trip to NEAq	**5** Commercially Important Shellfishes Project Planning Session #2	**6** Subtidal Field Methods / Statistics Essential Fish Habitat / MPAs Seminar Discussion	**7** Towards Sustainable Fisheries The Future of Wild Capture Packing	**8** Packing and Final Prep	**9** To Belize Delta Flight 203- Depart 6:20, arrive Chicago 8:14 Delta Flight 1150 – Depart Chicago 9:05, arrive Belize 1:25
10 Field Session #1 – Checkout Snorkel Field Session #2 – Ecosystem Tours – Seagrass and patchreef	**11** Field Session #3 – Ecosystem Tour – Backreef Field Session #4 – Ecosystem Tour – Blackbird Caye Forereef	**12** Field Session #5 – Ecocsystem Tour – Mangrove / Veue – Crooked Creek. Group Research Session #1 – Location TBD.	**13** Group Research Sessions 2&3 Data Analysis and Data Management	**14** Group Research Sessions 4&5 Data Analysis and Data Management	**15** Great Blue Hole and Half-Moon Caye	**16** Group Research Sessions 6&7 Data Analysis and Talk Prep
17 Group Research Sessions 8&9 Data Analysis and Talk Prep	**18** Semi-Dry Day – Last day in the field – Group Research Session #10	**19** Final Presentations Packing and Lab Clean-up Celebration Bonfire	**20** To Boston: Delta Flight 695 Depart 1:05, arrive Atlanta 5:00 Depart Atlanta 7:!5, arrive Boston 9:52	**21** Winter Solstice Course Wrap-up Lunch will be provided	**22**	**23**
24	**25** Christmas	**26**	**27**	**28**	**29**	**30**

III. SYLLABUS:
Lecture Topics, Activities, Learning Objectives and Readings
Nov 27th:

Course Introduction

Lectures: Coral Reef Biodiversity | Coral Reef Ecological Function

Learning Objectives: Introduce students to fundamentals in coral reef ecology and patterns in reefs species richness, abundance, productivity and biogeography.

Readings: Burkepile and Hay (2008). Herbivore species richness and feeding complementarity affect community structure and function on a coral reef. *PNAS*

Bellwood et al. (2006). Functional versatility supports coral reef biodiversity. *Proceedings of the Royal Society of London B*

Dornelas et al. (2006). Coral reef diversity refutes the neutral theory of biodiversity. *Nature*

Nov 28th:

Lectures: Mangrove-Seagrass-Coral Reef Linkages | Reef Ecosystem Service

Activities: Case study analysis of intact and degraded reef systems

Learning Objectives: Increase student understanding of reef system interconnectedness, connectivity, and nursery function. Unpack the concept of ecosystem service and identify essential market and nonmarket mangrove-seagrass-coral ecosystem services.

Readings: Polidoro and Carpenter (2013). Dynamics of coral reef recovery. *Science*

Adam et al. (2011). Herbivory, connectivity, and ecosystem resilience: response of a coral reef to a large-scale perturbation. *PLoS*

Barbier et al. (2011). The value of estuarine and coastal ecosystem services. *Ecological Monographs*

Nov 29th:

Lectures: Wild Capture Fisheries | The State of Global Fisheries Resources

Activities: Field Trip to the Harvard Museum of Natural History (HMNH)

Learning Objectives: Introduce students to commercial, subsistence, industrial and artisanal fisheries practices with particular attention to tropical nearshore wild capture harvest. The HMNH laboratory practical enables students to see and handle tropical fish, invertebrate, and coral specimens from the collections at the Museum of Comparative Zoology (behind the scenes tours by colleagues A. Baldinger and K. Hartel).

Readings: Hall et al. (2013) Innovations in capture fisheries are an imperative for nutrition security in the developing world. *PNAS*

Hobday et al. (2011). Ecological risk assessment for the effects of fishing. *Fisheries Research*

Garcia and Rosenberg (2010). Food security and marine capture fisheries: characteristics, trends, drivers and future

perspectives. *Philosophical Transactions of the Royal Society of London B*

Nov 30th:

Lectures: Optimal Allocation Theory | Bioeconomics

Activities: Student Project Menu Process

Learning Objectives: Advance student knowledge of the theory of optimal allocation of renewable resources and its failures and modern bioeconomic models (Gordon-Schaefer; efforts at *MSY*, *MEY*, and *BE*; Smith's distributed-delay, age-structured models, TAC, and ITQ). The Student Project Menu Process introduces students to seven potential project paths relevant to tropical marine fisheries on Turneffe Atoll, Belize (dive buddy teams based on ranking menu options, see below for summary of Target Field Projects)

Readings:
- Garcia et al. (2012). Reconsidering the consequences of selective fisheries. *Science*
- Dichmont et al. (2010). On implementing maximum economic yield in commercial fisheries. *PNAS*
- Sumaila (2010). A cautionary note on individual transferable quotas. *Ecology and Society*

Dec 1st:

Lectures: Commercially Important Tropical Marine Fishes

Activities: Field Trip to the New England Aquarium

Learning Objectives: Further student knowledge of targeted fish species, their ecological functional role, fishing gear type, use, economic value, and stock status. The New England Aquarium lab practical introduces students to visual survey methods via systematic observation of animals in residence (species richness and abundance, size estimation, activity budget estimation, etc).

Readings:
- Pittman and Brown (2011). Multi-scale approach for predicting fish species distributions across coral reef seascapes. *PLoS*
- Mumby et al. (2006). Fishing, Trophic Cascades, and the Process of Grazing on Coral Reefs. *Science*
- Jones et al. (2009). Larval retention and connectivity among populations of corals and reef fishes: history, advances and challenges. *Coral Reefs*

Dec 4th:

Lecture Topics: Commercially Important Tropical Marine Shellfishes

Activities: Lab Meeting #1: Literature search and annotated bibliography, research question, and proposed methods development

Learning Objectives: Further student knowledge of targeted shellfish species, their ecological functional role, fishing gear type, use, economic value, and stock status. Lab meeting #1 initiates the dive buddy team research process.

Readings: Stoner et al. (2012). Maturation and age in queen conch (Strombus gigas): urgent need for changes in harvest criteria. *Fisheries Research*

Paris et al. (2011). Behavior constrains the dispersal of long-lived spiny lobster larvae. *Marine Ecology Progress Series*

Schmidt, et al. 2002. Population ecology and fishery of Cittarium pica (Gastropoda: Trochidae) on the Caribbean coast of Costa Rica. *PloS*

Dec 5th:

Lecture Topics: Subtidal Field Methods | Statistics and Experimental Design

Activities: Lab Meeting #2: Sampling protocol, target data and appropriate statistical tools, graphing expected findings based on literature, research proposal presentation development.

Learning Objectives: Train students in standard subtidal sampling methods, when to use them, their power and inherent limitations. The statistics session introduces students to basic types of data and analyses and guides them through a rigorous tutorial on CHI-square, linear regression, ANOVA and post-hoc tests using real subtidal data (JMP).

Readings: Hill and Wilkinson (2004). Methods for the ecological monitoring of coral reefs. *Australian Institute of Marine Science*

Brown et al. (2004). Development of benthic sampling methods for the Coral Reef Assessment and Monitoring Program in Hawai'i. *Pacific Science*

Plaisance et al. (2011). The diversity of coral reefs: what are we missing? *PLoS*

Dec 6th:

Lecture Topics: Essential Fish Habitat | MPAs, PPAs and Fisheries Management

Activities: FitRec Field Methods Training

Learning Objectives: Further student knowledge of fish and shellfish critical habitat (EFH), essential water column and substrate-based life history (spawning, breeding, feeding, and growing to maturity), and the efficacy of marine and pelagic protected areas in achieving fisheries goals (refugia, spillover, and recruitment). The FitRec field methods training challenges students to collect snorkel survey data in the olympic pool facility at BU using transects, quadrats, and life-size color photocopies of tropical marine fishes and invertebrate species (underwater species identification, counts, and size estimates).

Readings: McClanahan et al. (2011). Critical thresholds and tangible targets for ecosystem-based management of coral reef fisheries. *PNAS*

Wilson et al. (2010). Habitat degradation and fishing effects on the size structure of coral reef fish communities. *Ecological Applications*

Bene and Tewfik (2003). Biological evaluation of marine

protected areas: evidence of crowding effect on a protected population of queen conch in the Caribbean. *Marine Ecology*

Dec 7th:

Lecture: Towards Sustainable Fisheries | The Future of Wild Capture Fisheries

Learning Objectives: Introduce students to sustainable fisheries strategies including conservation, economic, equity, and intergenerational equity approaches to management. The future of tropical wild capture fisheries will be discussed in light of human population growth and the coral reef crisis.

Readings:
Bell et al. (2015). Mixed responses of tropical Pacific fisheries and aquaculture to climate change. *Nature*

Mumby and Steneck (2008). Coral reef management and conservation in light of rapidly evolving ecological paradigms. *TREE*

Pauly et al. (2002). Towards sustainability in world fisheries. *Nature*

Dec 8th:

Packing and final preparation

IV. Grading

30% of your grade will be based on your performance as a field scientist.
30% of your grade will be based on the quality of your research.
30% of your grade will be based on your scientific deliverables.
10% of your grade will be based on the seminar discussions (lead and participation).

Discussion and collaboration among students is encouraged, but I will also be looking for signs of individual effort, scientific logic, and creativity. Hard work and enthusiastic participation will be rewarded.

Attendance at all lectures, paper discussions, collecting trips, and laboratory sessions is mandatory. Your final grade will be penalized 2.5% for each unexcused absence from a lecture or lab session.

V. Academic Conduct

It is each student's responsibility to know and understand the provisions of the Academic Conduct Code in the College of Arts and Sciences. The Code is available online at http://www.cs.bu.edu/ugradprogram/conduct.html. Cases of suspected misconduct will be referred to the Dean of the College. If the Dean's office comes to the conclusion that cheating or plagiarism has occurred, a grade of zero will be awarded for the assignment in question.