Tropical Marine Invertebrates

BI 569 (4 credits)
Marine Semester 2024 / Block 4

7 Class Days in Boston (October 25 - November 4)
Mon-Fri / 10:00-12:00 & 1:30-5:00; Location: BRB 115
13 Days in Belize (November 5 - November 17)
Mon-Sun / Daily Field work: ~8:30-11:30 am; 1:30-4:30 pm;
Daily Data Analysis & Talk Preparation: 7:30-9:30 pm
Location: Calabash Caye Field Station
2-Day Wrap-Up in Boston (November 18-19; 11:00-2:00)
Location: BRB 115

Instructors	**John R. Finnerty**	**Ninon Martinez**
Office	BRB 425	BRB 317
Office Hours	By appointment; contact via e-mail	By appointment; contact via e-mail
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Course Description: Tropical Marine Invertebrates explores the causes and consequences of animal biodiversity, with a special focus on Turneffe Atoll Marine Reserve in Belize. You will come to understand the major patterns of animal evolution including (1) the origin of metazoan cell types and body plans, (2) the diversification of animal developmental programs, and (3) the radiation of major lineages. You will explore the influence of contemporary ecological forces on the assemblages of marine animals found in three key tropical habitats: seagrass, mangrove and coral reef. You will develop an understanding of these organisms' natural history as you master essential research techniques used by tropical marine ecologists. You will produce "scientific deliverables" intended for multiple audiences, from original data destined for the peer-reviewed scientific literature to learning aids intended for broad public consumption.

Training you will receive in BI569:

Fundamentals of animal evolution // animal development // trophic strategies of animals // scientific snorkeling // systematic marine sampling // species identification // statistical analysis // phylogenetic inference // underwater photography // digital photo and video processing // seagrass ecology // mangrove ecology // coral reef ecology // sampling for genetic analysis // development of scientific graphs and figures // scientific presentation // *plus* a sampling of Belizean geography, history, and culture.

Additional Information & Course Reviews are available at: https://bumarine.smugmug.com/COURSES/Marine-Genomics/COURSE-INFO-REVIEWS

Hub Learning Outcomes. Completion of any 4-course sequence in the Marine Semester, will earn you 1 unit in each of 4 HUB areas: (1) Scientific Inquiry II, (2) Oral/Signed Communication,

(3) Creativity and Innovation, and (4) Teamwork. The course activities in Tropical Marine Invertebrates that contribute to these learning outcomes are described below.

—Scientific Inquiry II

You will conduct original research into the ecology of tropical marine invertebrates and the biodiversity of coral reef, seagrass and mangrove habitats in Belize, including the development of a hypothesis, the collection and statistical analysis of data, the generation of graphs, and the preparation and delivery of a formal scientific talk. You will be challenged to place your research in its broader scientific and societal context, discuss its implications for marine conservation, and propose future research directions.

—Oral and/or Signed Communication

You will prepare and deliver a thoroughly-referenced, scientifically-accurate final oral presentation on your field research in Belize. This formal scientific talks will incorporate original graphics and animations to assist in explaining the significance, methodology, data, and conclusions. Annotated versions of your slide presentation will become part of a permanent class portfolio disseminated though the BU Marine Program's Media Library (e.g., https://bumarine.smugmug.com/COURSES/Tropical-Marine-Invertebrates-/Student-Presentations/Research-Area-MangroveEpibionts/Mangrove-Epibiont-Presentations)

—Creativity/Innovation

Your creativity will be tested in multiple ways. First, you will be challenged to derive a feasible experimental approach to address a fundamental question on the ecology of tropical marine invertebrates having only ~10 days to collect data in specific and pre-determined habitats, with limited access to research infrastructure. You will also author educational materials targeted at a broad audience including "virtual habitat tours" and captions for photos and videos of marine organisms and habitats housed in *The BU Marine Program Media Library* that are simultaneously engaging and informative.

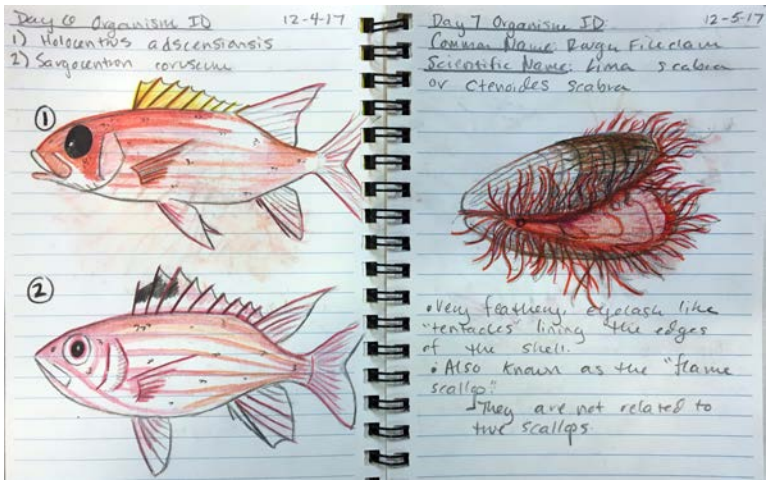
—Teamwork/Collaboration

During the conduct or you field and laboratory research and the associated planning exercises, data analysis, and talk preparation, you will be working as part of a collaborative research team. Within this team you will be part of a snorkel-buddy pair, where each members bears responsibility for the safety of his or her snorkel buddy, as well as for the effectiveness of the data collection performed in the field.

Course Materials

Lecture handouts, research protocols, and selected readings from the primary & secondary scientific literature (listed by lecture). Lecture handouts, assigned readings, and protocols will be accessible in a shared folder on Google Drive: https://drive.google.com/drive/folders/1ornP6AVTR_E98EzmzpmQCZGOeShRl4bA. Slideshows from lecture can be viewed on the BU Marine Program Media Library: https://drive.google.com/drive/folders/1Js72DzlrDTmBMnyvqtvMLOp1a5_IGlhC

Assignments and Grading



- ➢ **40%** of your grade is based on your performance as a field scientist.
- ➢ **35%** of your grade is based on the quality of your research & oral presentation
- ➢ **20%** of your grade is based on your scientific deliverables
  - 2 captions for the BU Marine Program Media Library (individual)
  - 1 annotated "virtual habitat tour" with narration (group project)
  - 1 "Interview from the Field" video description of your research (group)
  - 1 field notebook (individual)
- ➢ **5%** of your grade is based on the final exam

Resources/Support/How to Succeed in This Course:

1. Ask questions when you do not understand something, during lecture, field research, lab research, or small-group discussion. If you need help outside of the scheduled course meetings, please make an appointment with either Professor Finnerty or the TF.
2. Accommodations for Students with Documented Disabilities: If you are a student with a disability or believe you might have a disability that requires accommodations, please contact the Disability & Access Services at (617) 353-3658 or access@bu.edu to coordinate any reasonable accommodation requests.

Community of Learning: Class and University Policies

1. **Attendance & Absences.** Attendance at all lectures, collecting trips, and laboratory sessions is mandatory. Your final grade will be penalized 2.5% for each unexcused absence. *At any time, if you are not feeling fit to snorkel, you will be excused from that session's activities without penalty. Please let your instructors know when you are ill.*

2. **Turning in Assignments**. The final presentation will be given on December 17. You must provide Prof. Finnerty an electronic copy of the presentation (Powerpoint or comparable) before you give the presentation. Your scientific deliverables must be submitted via Google Drive & email by December 20 at 11:59 PM.
3. **Academic Conduct Statement.** Data integrity is essential to the scientific process. It is each student's responsibility to know and understand the provisions of the Academic Conduct Code at Boston University. The Code is available online at https://www.bu.edu/academics/policies/academic-conduct-code/. 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 have occurred, a grade of zero will be awarded for the assignment in question

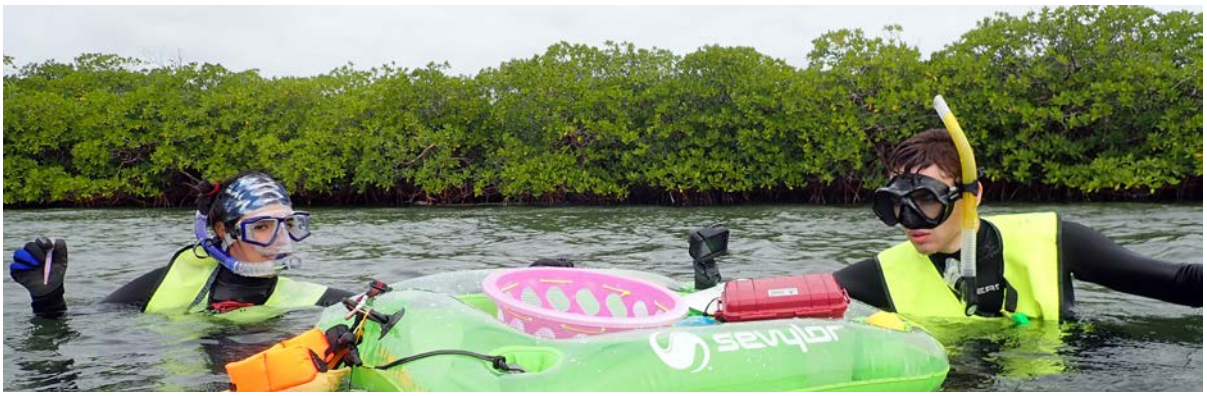
Schedule of Course Activities

Day 1 / October 25	
10:00-12:00	**COURSE INTRODUCTION** ◆ Course overview. ◆ "Final Exam" **LECTURE 1 [w/ SEAGRASS]** ◆ A traveler's guide to Belize. *READINGS*: Lecture 1 handout; slideshow;
2:00-4:00	**RESEARCH PLANNING SESSION 1** ◆ Overview of course projects READINGS: (1)Brower (2012) "MesoAmazing" National Geographic (2)Outline of course projects (3) 2023 Report to Belize Fisheries Department (4) 2024 BI569 Belize Fisheries Permit Application
Day 2 / October 28	
10:00-12:00	**LECTURE 2** ◆ Phylogeny Fundamentals *READINGS*: Lecture 2 handout; slideshow; **LECTURE 3** ◆ Major Characters in Animal Evolution & Animal Phylogeny *READINGS*: Lecture 3 handout; slideshow;
1:30-5:00	**LECTURE 4** ◆ Phylum Porifera—the sponges *READINGS*: Lecture 4 handout; slideshow; **RESEARCH PLANNING SESSION 2** ◆ Select project & convene with your team. ◆ Plan research, expected data types, equipment needs. ◆ Compile background materials: **a)** past class projects; **b)** photos from BUMP Media Library; **c)** scientific papers ◆ Project Folders: I. Team Associates; II. Team Finger; III. Team Mustard; IV. Team Starlet;

Day 3 / October 29	
10:00-12:00	**LECTURE 5** ◆ Phylum Cnidaria—anemones, corals, jellyfishes *READINGS*: Lecture 5 handout; slideshow; **LECTURE 6** ◆ Carribbean Coral Reefs *READINGS*: Lecture 6 handout; slideshow;
1:30-5:00	**LECTURE 7** ◆ Reef-associated Habitats: Mangrove & Seagrass *READINGS*: Lecture 7 handout; slideshow; **RESEARCH PLANNING SESSION 3** ◆ Species ID's: sponges & cnidarians ◆ Scientific Deliverables: ◆ Photo/video **Captions** for BUMP Media Library. ◆ **Virtual Habitat Tour:** assemble photos; begin organismal

Day 4 / October 30	
10:00-12:00	**LECTURE 8** ◆ Phylum Echinodermata—sea urchins, sea stars, brittle stars, sea cucumbers and sea lilies *READINGS*: Lecture 8 handout; slideshow; **LECTURE 9** ◆ Phylum Chordata—vertebrates, tunicates, salps and relatives *READINGS*: Lecture 9 handout; slideshow;
1:30-5:00	**LECTURE 10** ◆ Phylum Annelida *READINGS*: Lecture 10 handout; slideshow; **RESEARCH PLANNING SESSION 4** ◆ Species ID's: annelids, mollusks & arthropods ◆ Scientific Deliverables

Day 5 / October 31	
10:00-12:00	**LECTURE 11** ◆ Phylum Mollusca *READINGS*: Lecture 11 handout; slideshow; ◆ Species ID's: echinoderms; annelids; mollusks **LECTURE 12** ◆ Phylum Arthropoda & the Evolution of Axial Complexity *READINGS*: Lecture 12 handout; Lecture 12 slideshow;
1:30-5:00	**RESEARCH PLANNING SESSION 5 [w/ SEAGRASS]** ◆ **Scientific Snorkeling / Systematic Sampling** *READINGS*: handout; slideshow; ◆ Prepare Dive Slates ◆ Receive snorkel vest, fan, lantern, and bug tent. ◆ Finalize room assignments for Calabash Caye.



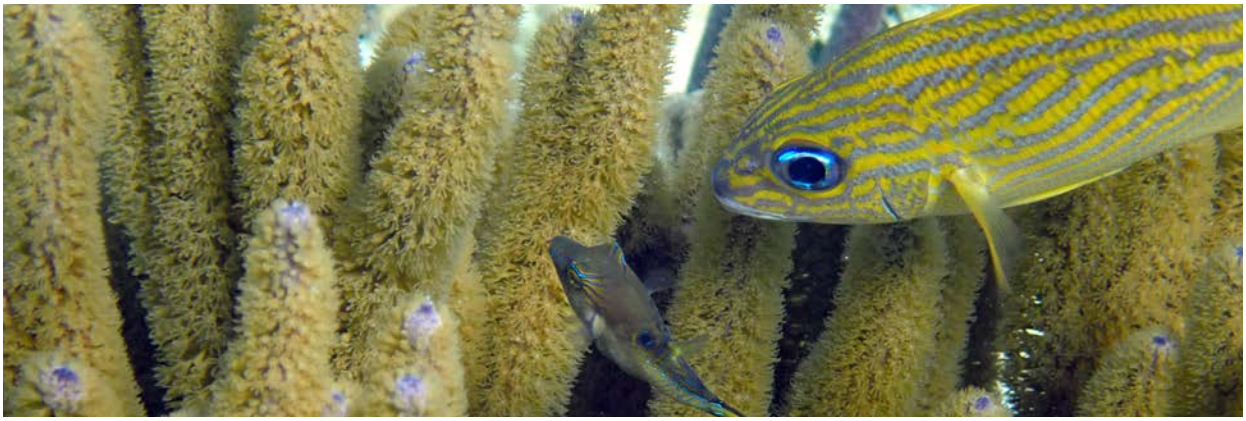
Day 6 / November 1	
9:00-12:00	**POOL SESSION — Scientific Snorkeling / Systematic Sampling** ◆ FitRec: Competition Pool / Bring mask, snorkel, booties, fins, snorkel vest, and dive slate. Wetsuits are optional.
1:30-5:00	**LECTURE 13** ◆ Troublesome worms: Platyhelminthes & Nematoda *READINGS*: Lecture 13 handout; Lecture 13 slideshow; **LECTURE 14** ◆ Parasitism *READINGS*: Lecture 14 handout; Lecture 14 slideshow; **RESEARCH PLANNING SESSION 7** (1) Pack your research gear (2) Produce first draft of your research talk ◆ Background & Significance ◆ Materials & Methods ◆ Results & Analysis (anticipated) ◆ Discussion and Future Directions

Day 7 / November 4	
***9:00-12:00** ***note early start time**	**Mini-lecture:** Conduct as a Field Scientist. handout; [**w/ SEAGRASS**] **LECTURE 15:** Potentially hazardous organisms. handout; slideshow; **PRESENTATIONS— DRAFT OF RESEARCH TALKS**
12:01 -	**FINISH PACKING FOR BELIZE**

Day 8 / November 5 / THE DAY OF DEPARTURE	
morning	**ARRIVE Boston Logan International Airport by 3:15 am (YIKES!)** ◆ Boston to Atlanta / **Delta 695** / 5:30-8:26 AM ◆ Atlanta to Belize City / **Delta 1983** / 10:05 AM-12:07 PM
afternoon	**LUNCH at BRODIE'S in Belize City** ◆ Bus to the marina. ◆ Boat to Calabash Caye Field Station. Arrival ~ 4:30 pm

Day 9 / November 6 / OUR FIRST FULL DAY AT CALABASH CAYE!	
8:30-11:30; 1:00-4:30	**Checkout Snorkel with Dive Safety Officer;** **Venue: Calabash embayment** **Gear & Preparations (always includes first aid kit & dive flag)** ◆ wetsuit; booties; snorkel vest; snorkel; mask; fins;
Day 10 / November 7	
8:30-11:30	**Ecosystem Tour 1: Seagrass & patchreef / Venue: Blackbird Seagrass / Turneffe Lagoon** ◆ lay out 30m transect; fish/invert IDs; video transect; deploy quadrats; benthic cover; **Gear & Preparations (always includes first aid kit & dive flag)** ◆ wetsuit; booties; snorkel vest; snorkel; mask; fins; camera; dive slate; transect tape; quadrat;
1:00-4:30	**Ecosystem Tour 2: Mangrove / Venue: Crooked Creek** ◆ fish IDs along both banks with video; scavenger hunt. **Gear & Preparations (always includes first aid kit & dive flag)** ◆ wetsuit; booties; snorkel vest; snorkel; mask; fins; camera; permanent tags;
7:30-8:30	**PHOTO/MOVIE NIGHT** ◆ sharing & evaluating photos and videos from ecosystem tours

Day 11 / November 8	
8:30-11:30	**Ecosystem Tour 3: Backreef to Forereef / Venue: Calabash Caye backreef / Roundhouse Reef** ◆ *adopt a coral* (tag, measure, photo, & assess elkhorn) ◆ coral health; coral associates; **Gear & Preparations (always includes first aid kit & dive flag)** ◆ wetsuit; booties; snorkel vest; snorkel; mask; fins; camera; dive slate; transect tape; quadrat; Coral Health Index cards
1:00-4:30	**Ecosystem Tour 4: Backreef to Forereef / Venue: Blackbird Caye baakreef/forereef** ◆ fish follows; Gear & Preparations (always includes first aid kit & dive flag) ◆ wetsuit; booties; snorkel vest; snorkel; mask; fins; camera; dive slate; transect tape; quadrat; Coral Health Index cards; GPS;
7:30-8:30	**MOVIE NIGHT** ◆ sharing & evaluating photos and videos from ecosystem tours



Day 12 / November 9	
8:30-11:30	**FIELD RESEARCH SESSION 1** ◆ test your field methods at what you anticipate to be a primary focal area of your study **Gear & Preparations (always includes first aid kit & dive flag)** ◆ wetsuit; booties; snorkel vest; snorkel; mask; fins; camera; dive slate; + your specific needs.
1:00-4:30	**FIELD RESEARCH SESSION 2 / Location will vary by team** ◆ collect data **Gear & Preparations (always includes first aid kit & dive flag)** ◆ wetsuit; booties; snorkel vest; snorkel; mask; fins; camera; dive slate; + your specific needs
7:30-8:30	**DATA ANALYSIS & PLANNING for Tomorrow's Research**

Day 13 / November 10	
8:30-11:30	**FIELD RESEARCH SESSION 3 / Location will vary by team** ◆ collect data **Gear & Preparations (always includes first aid kit & dive flag)** ◆ wetsuit; booties; snorkel vest; snorkel; mask; fins; camera; dive slate; + your specific needs
1:00-4:30	**FIELD RESEARCH SESSION 4 / Location will vary by team** ◆ collect data **Gear & Preparations (always includes first aid kit & dive flag)** ◆ wetsuit; booties; snorkel vest; snorkel; mask; fins; camera; dive slate; + your specific needs
7:30-8:30	**DATA ANALYSIS & PLANNING for Tomorrow's Research**

Day 14 / November 11	
VACATION DAY!	**Activities TBA**
7:30-8:30	**PLANNING for Tomorrow's Research**

Day 15 / November 12	
8:30-11:30	**FIELD RESEARCH SESSION 5 / Location will vary by team** ◆ collect data **Gear & Preparations (always includes first aid kit & dive flag)** ◆ wetsuit; booties; snorkel vest; snorkel; mask; fins; camera; dive slate; + your specific needs
1:00-4:30	**FIELD RESEARCH SESSION 6 / Location will vary by team** ◆ collect data **Gear & Preparations (always includes first aid kit & dive flag)** ◆ wetsuit; booties; snorkel vest; snorkel; mask; fins; camera; dive slate; + your specific needs
7:30-???	**DATA ANALYSIS & PLANNING for Tomorrow's Research**

Day 16 / November 13	
8:30-11:30	**FIELD RESEARCH SESSION 7 / Location will vary by team** ◆ collect data **Gear & Preparations (always includes first aid kit & dive flag)** ◆ wetsuit; booties; snorkel vest; snorkel; mask; fins; camera; dive slate; + your specific needs
1:00-4:30	**FIELD RESEARCH SESSION 8 / Location will vary by team** ◆ collect data **Gear & Preparations (always includes first aid kit & dive flag)** ◆ wetsuit; booties; snorkel vest; snorkel; mask; fins; camera; dive slate; + your specific needs
7:30-???	**DATA ANALYSIS & PLANNING for Tomorrow's Research**

Day 17 / November 14	
8:30-11:30	**FIELD RESEARCH SESSION 9 / Location will vary by team** ◆ collect data **Gear & Preparations (always includes first aid kit & dive flag)** ◆ wetsuit; booties; snorkel vest; snorkel; mask; fins; camera; dive slate; + your specific needs
1:00-4:30	**FIELD RESEARCH SESSION 10 / Location will vary by team** ◆ collect data **Gear & Preparations (always includes first aid kit & dive flag)** ◆ wetsuit; booties; snorkel vest; snorkel; mask; fins; camera; dive slate; + your specific needs
7:30-???	**DATA ANALYSIS & TALK PREP SESSION**

Day 18 / November 15	
8:30-11:30	**FIELD RESEARCH SESSION 11 / Location will vary by team** ◆ collect data **Gear & Preparations (always includes first aid kit & dive flag)** ◆ wetsuit; booties; snorkel vest; snorkel; mask; fins; camera; dive slate; + your specific needs
1:00-4:30	**DATA ANLYSIS & TALK PREP**
7:30-???	**TALK PREP SESSION**

DAY 19 / November 16	
10:00-12:0	**FINAL PRESENTATIONS**
1:00-4:00	**PACKING & LAB CLEAN-UP**
7:30-???	**CELEBRATION**

DAY 20 / November 17 — Belize to Boston	
8:00-9:15	**Boat to Belize City**
9:45-10:15	**Bus to the Airport**
	◆ Belize City to Atlanta / **Delta 1802** / 1:31-5:31 PM ◆ Atlanta to Boston / **Delta 518** / 7:55-10:31 PM