



Study Center in Bonaire, Caribbean Netherlands

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| Course name: | Tropical Marine Conservation Biology |
| Course number: | ENVI 3002 BONA/MARI 3003 BONA |
| Programs offering course: | Tropical Marine Ecology and Conservation |
| Language of instruction: | English |
| Semester Credits: | 3 |
| Contact Hours: | 45 |
| Term: | Spring 2017 |

Course Description

The management of tropical marine resources is an evolving, interdisciplinary science based on a concept of conservation that includes both sustainable use and environmental protection. This course addresses the following questions from a biological/ecological perspective: What is tropical marine biodiversity? Why do we need to conserve it? What are the problems that threaten this biodiversity? What are the solutions to these problems? Examples and case studies will be drawn from around the Caribbean (particularly the Bonaire National Marine Park) and tropical seas in other regions to illustrate concepts as well as the practical application of management tools.

Learning Objectives

- Gain an understanding of tropical marine ecosystem processes and functions as they relate to conservation management.
- Develop appreciation for threats to tropical marine biodiversity in the context of historical rather than contemporary baselines.
- Apply concepts and knowledge to practical conservation management challenges.
- Develop critical thinking and problem solving abilities applicable to marine conservation biology.

Course Prerequisites

Two semesters of college-level biology courses required; 1 upper-level ecology/zoology/botany or equivalent required; Open water scuba certification or referral, AAUS dive medical exam, and DAN diving insurance.

Methods of Instruction

The instructor incorporates a variety of education methods and settings. For any particular topic, there will be a lecture (using PowerPoint) with class discussion(s) intertwined within. Following the lecture/discussion various activities are used to reiterate and clarify the main point of the lecture. Such activities include SCUBA dives, snorkeling trips, laboratory activities, films, and role-playing activities where students work together and act the part of a conservation biologist working on current environmental issues.

Assessment and Final Grade

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| 1. Exams 1 and 2: | 40% |
| 2. Quizzes: | 10% |
| 3. Assignments: | 45% |
| 4. Attendance and participation: | 5% |

Course Requirements

Exams 1 and 2

The two exams are non-cumulative and include multiple choice, true and false, short response, and essay questions. The exams include materials from lectures, activities, and readings.

Quizzes

There will be unannounced quizzes on the readings for given lectures. It is important that students complete the readings before each lecture as the readings are discussed.

Assignments

The course includes several assignments that vary in topic, scope, structure, and may be completed by a group or individual. The length of assignments varies from one page to five pages of text or a single excel spreadsheet. Given the variation among the assignments, each one is evaluated differently, but all evaluated based on quality, clarity, and logic. Assignments that are turned in late will be penalized with a 10% reduction per day, i.e. an assignment turned in one day late will be graded out of 90%.

Attendance and participation

It is mandatory for students to attend lectures and activities. Additionally, students must arrive on time and participate in class discussions, activities, etc. Much of the material covered in lectures or activities cannot be found in the readings. Students that fail to attend lectures or activities, arrive late, or do not participate will be penalized at the discretion of the instructor based on the frequency of these infractions. In-class assignments, quizzes, and exams can only be made up with a valid and documented excuse, ex. doctor's note.

Students are expected to adhere to CIEE Research Station Bonaire's Academic Honesty Policy. Students found violating the conditions of academic honesty are subject to receiving an "F" for the course. The violation will also be reported to the Director of CIEE Research Station Bonaire and may be documented on the student's permanent record at their home institution.

Weekly Schedule

Due to the nature of this course, the schedule may be subjected to changes. For an updated schedule, check Google Calendar, which is posted on the website, www.cieebonaire.org.

Week 1

Monday

Lecture/Discussion: Introduction to conservation biology

Tuesday

Activity: Snorkeling field trip to seagrass, mangrove, and coral-reef communities
Readings: Costanza (1987) Social traps; Soule et al. (1985) What is conservation biology?

Week 2 and 3

No classes

Week 4

Monday

Lecture/Discussion: Biodiversity

Activity: Fish biodiversity measurement dive

Readings: Gray (1997) Marine biodiversity; Worm et al. (2006) Effect of the loss of biodiversity

Week 5

Monday

Lecture/Discussion: IUCN and the Red List of Endangered Species
Activity: Group project - Red list sheet for a coral-reef species

Readings: Roberts & Hawkins (1999) Extinction in the sea; IUCN Criteria

Fish biodiversity assignment due Monday

Week 6

Monday

Lecture/Discussion: Habitat Loss and Structural Complexity of Coral Reefs
Activity: Reef complexity dive

Readings: Alvarez-Filip (2009) Flattening of reefs; Hughes (1994) Phase shifts

IUCN red list sheet due Monday

Week 7

Monday

Lecture/Discussion: Nutrient pollution and marine debris
Activity: Nutrient monitoring lab

Tuesday

Activity: Beach cleanup

Readings: Reopanichkul et al. (2009) Sewage effect on coral reef communities; Derraik (2002) Marine plastics

Wednesday

Midterm exam

Week 8

Monday

Lecture/Discussion: Restoration biology and coral reefs
 Activity: Snorkel trip to artificial reefs and coral farm
 Activity: Group activity - Restoration proposal

Week 9

Monday

Lecture/Discussion: Invasion biology theory and lionfish
 Activity: Lionfish hunting dive and lionfish dissection
 Readings: Kolar & Lodge (2001) Progress in invasion biology; de Leon et al. (2013) Lionfish removals in Bonaire; Cote et al. (2013) Insights from lionfish invasion; Creed (2006) Tubastraea; Montelatto et al. (2011) Tubastraea **Restoration proposal assignment due Monday**

Readings: Elliot et al. (2007) Marine restoration; Rinkevich (2005) Active coral restoration

Week 10

Monday

Lecture/Discussion: Fisheries management and spawning aggregations
 Activity: *The End of the Line* movie screening and discussion
 Activity: Blue tang spawning aggregation dive
 Readings: Jackson et al. (2001) Fisheries collapse effect on ecosystems; Myers & Worm (2003) Collapse of worldwide fisheries; Whaylen et al (2006) Nassau grouper spawning aggregations

Week 11

Monday
reefs

Lecture/Discussion: Climate change and coral

Activity: *Inconvenient Truth* movie screening and discussion
 Readings: Hoegh-Guldberg et al. (2007) Coral reefs & climate change **Blue tang fisheries management plan due Monday**

Week 12

Monday

Lecture/Discussion: Marine protected areas
 Activity: Group project - Marine protecting area zoning plan
 Readings: Roberts et al. (2001) MPA effect on fisheries; Almany et al. (2009) MPA design; Russ et al. (2008) MPA Fish increases

Week 13

Monday

Final exam
Marine protected area zoning plan due Monday

Readings

There is no required textbook for the course. The readings indicated above are from peer-reviewed scientific journals and will be provided to the students electronically.

Some potentially useful supplemental textbooks include:

Norse, E.A. & L.B. Crowder (eds.). *Marine Conservation Biology: The Science of Maintaining the Sea's Biodiversity* (2005).

Côté, I.M. & J. D. Reynolds (eds.). *Coral Reef Conservation* (2006).

The peer-reviewed journals include:

Almany, et. al. (2009). Connectivity, biodiversity conservation and the design of marine reserve networks for coral reefs. *Coral Reefs*, 28(2), 339-351.

Alvarez-Filip, L., Dulvy, N. K., Gill, J. A., Côté, I. M., & Watkinson, A. R. (2009). Flattening of Caribbean coral reefs: region-wide declines in architectural complexity. *Proceedings of the Royal Society B: Biological Sciences*, 276(1669), 3019-3025.

Costanza, R. Social traps and environmental policy. *BioScience* (1987): 407-412.

Côté, Isabelle M., Stephanie J. Green, and Mark A. Hixon. Predatory fish invaders: Insights from Indo-Pacific lionfish in the western Atlantic and Caribbean. *Biological Conservation* 164 (2013): 50-61.

Creed, J. C. Two invasive alien azooxanthellate corals, *Tubastraea coccinea* and *Tubastraea tagusensis*, dominate the native zooxanthellate *Mussismilia hispida* in Brazil. *Coral Reefs* 25.3 (2006): 350-350.

de León, R., Vane, K., Bertuol, P., Chamberland, V. C., Simal, F., Imms, E., & Vermeij, M. J. (2013). Effectiveness of lionfish removal efforts in the southern Caribbean.

Derraik, J. The pollution of the marine environment by plastic debris: a review. *Marine pollution bulletin* 44.9 (2002): 842-852.

Elliott, M., Burdon, D., Hemingway, K. L., & Apitz, S. E. (2007). Estuarine, coastal and marine ecosystem restoration: confusing management and science—a revision of concepts.

Estuarine, Coastal and Shelf Science, 74(3), 349-366.

Gray, J. S. Marine biodiversity: patterns, threats and conservation needs. *Biodiversity & Conservation* 6.1 (1997): 153-175.

Hoegh-Guldberg, O. et al. Coral reefs under rapid climate change and ocean acidification. *science* 318.5857 (2007): 1737-1742.

Hughes, T. P. Catastrophes, phase shifts, and large-scale degradation of a Caribbean coral reef. *Science-AAAS-Weekly Paper Edition* 265.5178 (1994): 1547-1551.

Jackson, J. B., Kirby, M. X., Berger, W. H., Bjorndal, K. A., Botsford, L. W., Bourque, B. J., ... & Warner, R. R. (2001). Historical overfishing and the recent collapse of coastal ecosystems. *science*, 293(5530), 629-637.

Kolar, C. S., and D. M. Lodge. Progress in invasion biology: predicting invaders. *Trends in Ecology & Evolution* 16.4 (2001): 199-204.

Mantelatto M.C., Mourao G, Mugotto A, Linder A, (2011) Range expansion of the invasive coral *Tubastraea coccinea* and *Tubastraea tagusensis* in the Southwest Atlantic. *Coral Reefs* (2011) 30:397

Myers, R. A., & Worm, B. (2003). Rapid worldwide depletion of predatory fish communities. *Nature*, 423(6937), 280-283.

Reopanichkul, P., Schlacher, T. A., Carter, R. W., & Worachananant, S. (2009). Sewage impacts coral reefs at multiple levels of ecological organization. *Marine Pollution Bulletin*, 58(9), 1356-1362.

Rinkevich, B. Conservation of coral reefs through active restoration measures: recent approaches and last decade progress. *Environmental science & technology* 39.12 (2005): 4333-4342.

- Roberts, C. M., Bohnsack, J. A., Gell, F., Hawkins, J. P., & Goodridge, R. (2001). Effects of marine reserves on adjacent fisheries. *science*, 294(5548), 1920-1923.
- Roberts, Callum M., and Julie P. Hawkins. Extinction risk in the sea. *Trends in Ecology & Evolution* 14.6 (1999): 241-246.
- Russ, G. R., Cheal, A. J., Dolman, A. M., Emslie, M. J., Evans, R. D., Miller, I., ... & Williamson, D. H. (2008). Rapid increase in fish numbers follows creation of world's largest marine reserve network. *Current Biology*, 18(12), R514-R515.
- Soulé, M. E. What is conservation biology. *BioScience* 35.11 (1985).
- Whaylen, L. et al. Aggregation dynamics and lessons learned from five years of monitoring at a Nassau grouper (*Epinephelus striatus*) spawning aggregation in Little Cayman, Cayman Islands, BWI. *Proceedings of the 59th Annual Gulf and Caribbean Fisheries Institute*. Fort Pierce Florida: Gulf and Caribbean Fisheries Institute (2006).
- Worm, B. et al. (2006). Impacts of biodiversity loss on ocean ecosystem services. *science*, 314(5800), 787-790.