

## Biology Foreign Studies Program (Bio 55,56,57): Winter 2012

### Course description and grading policy

**Instructors:** Ryan Calsbeek, Matt Ayres, Celia Chen

**Graduate TAs:** Mike Logan, Nina Lany, Sam Fey

**Textbooks:** *Tropical Nature* by A. Forsyth and K. Miyata (Charles Scribner's Sons, NY)  
*The Tapir's Morning Bath* by Elizabeth Royte (Mariner Books)  
*Neotropical Companion* by John Kricher (Princeton University Press, 2nd ed., 1997).  
*A Guide to the Birds of Costa Rica* by Stiles and Skutch (Cornell University Press)  
*Costa Rican Natural History*, edited by D.H. Janzen, University of Chicago Press.  
*A Field Guide to Coral Reefs: Caribbean and Florida*. Roger Tory Peterson. 1982.  
*Reef Fish Identification: Florida, Caribbean, Bahamas*. Humann and DeLoach. 2002.  
*Reef Fish Behavior: Florida, Caribbean, Bahamas*. DeLoach and Humann. 1999.

**Meeting times:** Various sites in Costa Rica (3 Jan - 19 Feb). See schedule.  
Little Cayman Research Center (19 Feb - 8 March). See schedule.

**Course website:** [www.dartmouth.edu/~biofsp](http://www.dartmouth.edu/~biofsp)

#### Ecological Research in the Tropics I and II (Bio 55 and 56)

The Biology Foreign Studies Program (Biology 55, 56, 57) exposes students, through intensive, full-immersion study, to Earth's most diverse biological communities. Biology 56 is a continuation of Biology 55; these courses comprise the first two-thirds of the FSP, and focus on land (tropical forests) and tropical freshwater ecosystems in Costa Rica. Biology 57 focuses on coral reef ecosystems in the Caribbean. Students are challenged to know, understand and appreciate the diversity of form and function in organisms, and the interactions that generate the often-spectacular patterns they see in the field. Habitats in Costa Rica include lowland rain forest (La Selva and Corcovado), cloud forest (Monteverde), dry forest (Palo Verde and Santa Rosa), pre-montane wet forest (Las Cruces), montane forest (Cuerici), alpine paramo, streams, and wetlands. The schedule is full, including fieldwork, laboratories, lectures and discussions, with emphasis on original research, mostly in small groups of 2-3. Faculty and advanced graduate TAs share field accommodations with students, and are in continuous contact as mentors, day and evening, throughout the program. Students master field and analytical methods (including hypothesis testing, statistical and software skills) for observational and experimental research. We pursue a great variety of research topics, including plant-pollinator and plant-herbivore interactions, processes driving coral reef structure (and coral reef decline), determinants of species distributions, animal behavior, and conservation ecology. Students practice the contemporary scientific inquiry: making observations, asking testable questions, generating hypotheses, developing experimental protocols, collecting data, making statistical inferences - including multi-model comparisons, writing scientific papers, and presenting seminars. Research papers are published in an annual book. Accommodations are at field stations in Costa Rica, and at a marine laboratory in the Caribbean.

#### Ecological Research on Coral Reefs (Bio 57)

Field and laboratory investigations of marine organisms and coral reef communities. Lecture and research topics include studies of algae, aquatic plants, invertebrates, and fish, with emphasis on populations, species interactions, community structure and energetics, and reef conservation and management. The course is based at the Little Cayman Research Center, Little Cayman Island. Scuba diving is optional. See Biology 55 for an overview of the Biology Foreign Study Program.

Prerequisite: Bio 16; one course from among Bio 20-28, 31; acceptance into program. Bio 15 and 29 recommended.

**Grading policy:** Grades are based on the quality of research projects (including seminar presentations and resulting manuscripts); development of skills in natural history; development of skills in research design, statistical analyses, and strong inference; and development of skills as collaborators within research work groups.

Students with disabilities are encouraged to discuss them with the staff so that appropriate accommodations can be made.

Bio Foreign Studies Program: schedule for Costa Rica 2012.

Date	Day	Location	Morning	Afternoon	Evening
5-Jan	Wed	To San Jose	Travel	Travel	Arrive in evening
6-Jan		In San Jose	OTS, InBIO	free: shopping etc.	Group dinner in SJ
7-Jan		To Palo Verde	Travel	Orientation	<b>Lec: Intro CR ecol (RC, HC)</b>
8-Jan	Sun	At PV	Orientation	<b>Lec: Primate Ecol (ML, AD)</b> . Res. Qs.	<b>Lec: Avian Ecol (NL, NF)</b>
9-Jan		At PV	FP-1 (ant-acacia)	Stat lab (ML/NL)	Data analysis/synthesis
10-Jan		At PV	FP-2	ArthLab(NL/RC). <b>Lec: Behav (RC, WC)</b>	FP-1 symposium. Writing.
11-Jan		At PV	FP-2	VertLab(RC/ML). <b>Lec: DivCoex (RC, JR)</b>	Writing. FP-1 ms due
12-Jan		At PV	SIFP-1 plan/proposals	Plant lab (NL)-Data Anal/Writ.	FP-2 seminars. Writing
13-Jan		At PV	SIFP-1	SIFP-1	Writing. FP-2 ms due.
14-Jan		At PV	SIFP-1	SIFP-1/analysis. Revisions.	SIFP-1/anal. Revs.
15-Jan	Sun	At PV	River trip	SIFP-1 symposium. Writing.	Writing: SIFP-1 ms due
16-Jan		To Santa Rosa	Travel/walk	Orientation. Lec:Turtles(ML)	Field: Sea turtle nesting
17-Jan		At SR	Lec: Mngrv(NL)	Exploration	Field: Sea turtle nesting
18-Jan		To Monteverde	Travel	Orientation	Writing (revisions)
19-Jan		At MV	Orientation	SIFP-2 planning	Lec: Amphibs? (A Pounds?)
20-Jan		At MV	SIFP-2 pilot /props	SIFP-2	<b>Lec: His/Orig (RC, MK)</b>
21-Jan		At MV	SIFP-2	SIFP-2	Analysis. Writing (rev.)
22-Jan	Sun	At MV	SIFP-2	Analysis/synthesis	SIFP-2 symposium
23-Jan		At MV	Writing	Writing SIFP-2 ms due. Bat Jngl	Writing
24-Jan		At MV	All final mss due	Exploration	Free
25-Jan		To Cuerici	Travel	Travel/Orientation	<b>Lec: Coevol 1 (MA, SF)</b>
26-Jan		At Cuerici	Trip to Paramo	Orientation	Writing lab 1 (MA)
27-Jan		At Cuerici	SIFP-3 planning / proposals	SIFP-3 pilot	SIFP-3 final proposals
28-Jan		At Cuerici	SIFP-3	SIFP-3	<b>Lec: Coevol 2 (MA, BK)</b>
29-Jan	Sun	At Cuerici	SIFP-3	SIFP-3	Analysis, writing
30-Jan		At Cuerici	Analysis, writing	SIFP-3 symposium	Writing SIFP-3 ms due
31-Jan		To La Palma	Exploration at Cuerici	Travel to La Palma	Sirena preparation
1-Feb		To Sirena	Hike to Sirena	Hike to Sirena	Natural history reports from hike
2-Feb		At Sirena	Orientation	SIFP-4 plan	<b>Lec: Social insects (MA, AvS)</b>
3-Feb		At Sirena	SIFP-4 pilot	SIFP-4	<b>Lec: Plant-Herb. interactions (NL, MG)</b>
4-Feb		At Sirena	SIFP-4	SIFP-4	Writing lab 2 (MA)
5-Feb	Sun	At Sirena	SIFP-4	SIFP-4	Analysis. Writing
6-Feb		At Sirena	SIFP-4	Analysis. Writing	SIFP-4 symposium.
7-Feb		To Las Cruces	Hike out of Sirena	Travel to Las Cruces	Writing
8-Feb		At Las Cruces	Orientation	Writing. Botany.	Writing
9-Feb		At Las Cruces	Writing. Botany.	Writing. Botany practicum.	What is the purpose of science?
10-Feb		To La Selva	Travel	Travel	<b>Lec: Aquatic Ecology (SF, MJ)</b>
11-Feb		At La Selva	Orientation	SIFP-5 plan/pilot	SIFP-5 proposals. Night walk.
12-Feb	Sun	At La Selva	SIFP-5	SIFP-5	<b>Lec: Herpetology (ML, RC)</b>
13-Feb		At La Selva	SIFP-5	SIFP-5	<b>Lec: Ecosystems (SF, JM)</b>
14-Feb		At La Selva	SIFP-5	SIFP-5	<b>Lec: Cons. Biology (MA)</b>
15-Feb		At La Selva	SIFP-5	Analysis. Writing	Analysis. Writing. Night walk.
16-Feb		At La Selva	Agroecology field trip	Analysis. Writing	SIFP-5 symposium.
17-Feb		At La Selva	Final revisions to all CR mss.	Final revisions to all CR mss.	Final revisions to all CR mss.
18-Feb		To San Jose	Exploration	Travel to SJ	Free
19-Feb	Sun	To Little Cayman until 8 March			

FP = "Field problem" (staff initiated)

SIFP = "Student initiated field problems".

Each FP and SIFP culminates in a seminar presentation and a polished manuscript for publication in [Dartmouth Studies in Tropical Ecology](#).

### Schedule for Little Cayman 2012

The schedule is very likely to change depending on weather conditions, which influence when we are able to dive. When the weather is good (low winds), we will do a dive. See [www.windfinder.com](http://www.windfinder.com), winds less than 10 knots are best but we can dive when winds are slightly greater (15) but from the east or southeast. Nearly all morning and afternoon activities will be outdoors and will usually last from 8-12 and 1-5. Take 1 Bonine or Dramamine the NIGHT BEFORE a dive and also in the morning depending on your susceptibility to sea sickness.

Breakfast is at 7 am, lunch at noon, and dinner at 6 pm. If you will be late for lunch or dinner, then ask someone to set food aside.

IF YOU GO ANYWHERE, ALWAYS GO WITH A BUDDY AND SIGN OUT ON THE WHITEBOARD IN THE DINING HALL. Enjoy these 3 weeks in paradise!

Date		Morning	Afternoon	Evening
19 Feb Sun	Arrive from CR			<u>13 people arrive 5:35 pm</u> Unpack Main orientation and safety information – Rob, Celia, and Perry
20 Feb Mon	Orientation	Discussion about program to date and expectations for LC segment. Unpack equipment Get BCD and regulator from Lowell <i>Assign expert taxonomic groups</i>	<b>Coral biology lecture &amp; Reef morphology (CC)</b> Snorkel to see coral followed by <i>Natural history discussion before dinner</i>	<b>Critique: Coral biogeochemistry (Robin Costello) and Coral Recruitment (Nina Frankel)</b>
21 Feb Tues	General natural history	<b>SCUBA</b> –shore dive at Cumber's Cave (check dive)	<b>Algae lecture and Sea Grass lecture &amp; lab (CC)</b> Snorkel to see invertebrates and collect algae followed by <i>Natural history discussion before dinner</i>	<b>Critique: Coral/Algae interaction (Menayat Chowdhury) and Invertebrate Ecology (Maddie Gamble)</b>
22 Feb Wed	General natural history	<b>SCUBA</b> – Sailfin and Meadows	<b>Zooplankton and Invertebrate lecture (CC)</b> Project 1 exploration <i>Natural history discussion before dinner</i>	<b>Critique: Invertebrate ecology II (Milo Johnson)</b> Zooplankton lab (SF) & night sampling
23 Feb Thurs	Project 1 begins	<b>Fish ecology (CC)</b> Snorkel to see sponge lab (ML)	3:30pm – Finalize project 1 idea, design, and group members 4:30 – <b>Fish behavior lecture (ML)</b> <b>Weekly Group Meeting</b>	<b>Critique: Fish larvae recruitment (Shea Flanagan) and Diversity and Coexistence (Carter Wales)</b> <b>Project 1 idea discussion</b>
24 Feb Fri	<b>Project 1 proposal</b>	Project 1 - pilot	Project 1	<b>Fish Behavior (Anna Deffebach)</b> RR: Karaoke for those interested

25 Feb Sat	Dia libre (OFF)		Beach Cleanup	BBQ
26 Feb Sun	<b>Project 1 proposal DUE</b>	Project 1	Project 1	Critique: Trophic Cascades I (Benji Kessler) and II (Madeline Kreher)

Date		Morning	Afternoon	Evening
27 Feb Mon	Project 1	Project 1	Coral reefs and climate change (CC) Project 1	Critique: Coral Reef decline (Jamie McLaughlin) and II (Jesse Rieb)
28 Feb Tues	Project 1	SCUBA – Marilyn's Cut & Soto Trader Project 1	Tropical Invasives (SF) Project 1 - writing and analysis	Project 1 – data analysis, write methods, stats help
29 Feb Wed	**Project 1 DUE** Project 2 begins	Project 2 brainstorming & pilot	Conservation and Management (CC) Project 2 1pm - Project 2 idea discussion	**Project 1 PRESENTATIONS**
1 Mar Thurs	<b>Project 2 proposal DUE</b>	Project 2	Project 2	Critique: Fish Community Response (Amy van Scoyoc) Finalize project 2 idea, design, and group members Graduate school discussion Grouper Moon video
2 Mar Fri		SCUBA - Coconut Walk & Sara's Set	Project 2 Weekly Group Meeting	RR: Karaoke for those interested
3 Mar Sat	Project 2	Project 2	Project 2	Night dive – Cumber's Caves
4 Mar Sun	Project 2	Project 2	Project 2	**Project 2 – writing and analysis
5 Mar Mon	<b>**Project 2 DUE @ 6pm**</b>	Project 2	Project 2 – writing and analysis Presentations: Project 2	<b>**Project 2 DUE @ 6pm**</b> Clean up science equipment and field sites
6 Mar Tues		SCUBA – Baracuda Bight & Great Wall West Clean up	**Project 2 revisions DUE @ 1pm** Revisions and copy editing of all LC projects	Revisions & copy editing of all LC projects Discussion of papers on authorship
7 Mar Wed		Revisions & copy editing of all LC projects	Clean up & pack	Dinner and campfire (pending wind)
8 Mar Thurs	Depart LC 9:00 am			

**PAPERS FOR PRESENTATION BY STUDENTS TO THE GROUP WHILE IN COSTA RICA.**

<b>Student</b>	<b>Student Paper</b>
Hemayat R. Chowdhury	McCain, C. 2009. Vertebrate range sizes indicate that mountains may be 'higher' in the tropics. <i>Ecology Letters</i> 12:550-560. (*See also: Janzen, D. H. 1967. Why mountain passes are higher in the tropics. <i>American Naturalist</i> 101:230-243.)
Nina B. Frankel	Emlen, S. T. and P. H. Wrege. 2004. Size dimorphism, intrasexual competition, and sexual selection in wattled jacana ( <i>Jacana jacana</i> ), a sex-role-reversed shorebird in Panama. <i>The Auk</i> 121(2): 391-403.
Anna L. Deffebach	Fedigan, L. M. and Jack, K. M. 2011. Two girls for every boy: the effects of group size and composition on the reproductive success of male and female white-faced capuchins. <i>American Journal of Physical Anthropology</i> 144:317-326.
Wales A. Carter	Irwin D.E. et al. 2001. Speciation in a ring. <i>Nature</i> 409, 333-337.
Jesse T. Rieb	Molino, J.-F. and D. Sabatier. 2001. Tree diversity in tropical rain forests: a validation of the intermediate disturbance hypothesis. <i>Science</i> 294:1702-1704.
Madeline K. Kreher	Janzen, D. H. 1981. Neotropical anachronisms: the fruits the gomphotheres ate. <i>Science</i> 215:19-27.
Shea E. Flanagan	Ramirez, S. R., T. Eltz, M. K. Fujiwara, G. Gerlach, B. Goldman-Huertas, N. D. Tsutsui, and N. E. Pierce. 2011. Asynchronous diversification in a specialized plant-pollinator mutualism. <i>Science</i> 333:1742-1746.
Benjamin J. Kessler	Becerra, J. X., K. Noge, and D. L. Venable. 2009. Macroevolutionary chemical escalation in an ancient plant-herbivore arms race. <i>Proceedings of the National Academy of Sciences of the United States of America</i> 106:18062-18066.
Amy E. Van Scoyoc	Waters, J. S., C. T. Holbrook, J. H. Fewell, and J. F. Harrison. 2010. Allometric scaling of metabolism, growth, and activity in whole colonies of the seed-harvester ant <i>Pogonomyrmex californicus</i> . <i>American Naturalist</i> 176:501-510.
Madilyn M. Gamble	Novotny, V. et al. 2006. Why are there so many species of herbivorous insects in tropical rainforests? <i>Science</i> 313: 115. (* see also: "Crafting the pieces of the diversity jigsaw puzzle" by R.L. Kitching from the same issue).
Robin A. Costello	Anchukaitisa, K. J. and Evansa, M. N. 2010. Tropical cloud forest climate variability and the demise of the Monteverde golden toad. <i>Proceedings of the National Academy of Sciences of the United States of America</i> 107:5036-5040.
Milo S. Johnson	Anderson, J. T., T. Nuttle, J. S. S. Rojas, T. H. Pendergast, and A. S. Flecker. 2011. Extremely long-distance seed dispersal by an overfished Amazonian frugivore. <i>Proceedings of the Royal Society B-Biological Sciences</i> 278:3329-3335.
Jamie E. McLaughlin	Yvon-Durocher, G., J. I. Jones, M. Trimmer, G. Woodward, and J. M. Montoya. 2010. Warming alters the metabolic balance of ecosystems. <i>Philosophical Transactions of the Royal Society B-Biological Sciences</i> 365:2117-2126.

## **REQUIRED READINGS FOR LITTLE CAYMAN**

- Hoegh-Guldberg et al. 2007. Coral reefs under rapid climate change and ocean acidification. *Science* 318: 1737.
- Hughes et al. 2010. Rising to the challenge of sustaining coral reef resilience. *TREE* 25: 633.
- Odum and Odum. 1955. Structure and productivity of a windward coral reef community on Eniwetok Atoll. *Ecological Monographs* 25:291.
- Hixon. 2011. 60 years of coral reef fish ecology: past, present, future. *Bull. of Marine Science* 87: 727.
- Nybakken and Bertness. 2005. *Marine Biology: An Ecological Approach*. 6<sup>th</sup> Edition, Pearson Education Inc. Chapter 9: Coral Reefs, pp. 407-453.

## **PAPER PRESENTATIONS FOR LITTLE CAYMAN**

### **Coral biology - biogeochemistry (Robin Costello)**

Stat et al. 2008. Functional diversity in coral-dinoflagellate symbiosis. *PNAS* 105: 9256.

### **Coral/Algae interaction (Menayat Chowdhury)**

Rasher et al. 2011. Macroalgal terpenes function as allelopathic agents against reef corals. *PNAS* 108: 17726.

### **Fish Behavior (Anna Deffebach)**

Meyer, J. L. and E. T. Schultz. 1985. Migrating haemulid fishes as a source of nutrients and organic matter on coral reefs. *Limnology and Oceanography* 30:146-156.

### **Fish larvae recruitment (Shea Flanagan)**

Allmany, G.R. 2007. Local replenishment of coral reef fish populations in a marine reserve. *Science* 316: 742-744.

### **Coral Recruitment (Nina Frankel)**

Albright et al. 2010. Acidification compromises recruitment success of the threatened Caribbean coral *Acropora palmata*. *PNAS* 107: 20400.

### **Invertebrate ecology I (Madilyn Gamble)**

Przeslawski R, Anyong S, Byrne M, Worheide G, and Hutchings P. 2008. Beyond corals and fish: the effects of climate change on noncoral benthic invertebrates of tropical reefs. *Global Change Biology* 14: 2773–2795.

### **Invertebrate ecology - Zooplankton (Milo Johnson)**

Ohlhorst, S.L., *Diel migration patterns of demersal reef zooplankton*. *Journal of Experimental Marine Biology and Ecology*, 1982. **60**(1): p. 1-15.

### **Diversity and coexistence (Carter Wales)**

Munday, P. L. (2004). Competitive coexistence of coral-dwelling fishes: The lottery hypothesis revisited. *Ecology* 85(3): 623-628.

### **Trophic cascades I (Benjamin Kessler)**

Mumby, P.J. et al. 2007. Trophic cascade facilitates coral recruitment in a marine preserve. *PNAS* 104: 8362-8367.

### **Trophic cascades II (Madeline Kreher)**

Mumby, P.J. et al. 2006. Fishing, trophic cascades and the process of grazing on coral reefs. *Science* 311: 98-101.

### **Coral reef decline I (Jamie McLaughlin)**

Lesser, M.P. 2007. Coral reef bleaching and global climate change: Can corals survive the next century? *PNAS* 104:5259-5260.

### **Coral reef decline II (Jesse Rieb)**

Pandolfi, J.M. and J.B.C. Jackson. 2006. Ecological persistence interrupted in Caribbean coral reefs. *Ecology Letters* 9: 818-826.

### **Fish community response to coral decline (Amy van Scoyoc)**

Jones, G.P, M.I. McCormick, M. Srinivasan and J.V. Eagle. 2004. Coral decline threatens fish diversity in marine reserves. *PNAS* 101:8251-8253.