

Syllabus - CORAL REEF ECOLOGY
MAR410; January Block 2004

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Prerequisite: Junior or higher standing; permission of instructor; SC310

Required Text: Gulko, D. 1999. Hawaiian Coral Reef Ecology. Mutual Publishing: Honolulu.
ISBN: 1-56647-234-2 \$26.95

Ronald H. Karlson. 2002. Dynamics of Coral Communities. Vol 23 in Population and
Community Biology Series. Kluwer Academic Publishers. ISBN 1-4020-1046-X, Paperback \$38.00

Reading packet:

Plathong, S., G. J. Inglis and M. E. Huber. 2000. Effects of self-guided snorkeling trails on corals in a tropical marine park. *Conservation Biology* 14(6):1821-1830.

Stachowicz, J. J., and M. E. Hay. 1999. Mutualism and coral persistence: the role of herbivore resistance to algal chemical defense. *Ecology* 80(6):2085-2101.

Pratchett, M. S., E. Vytopil and P. Parks. 2000. Coral crabs influence the feeding patterns of crown-of-thorn starfish. *Coral Reefs* 19:36.

Choat, J. H., Bellwood, D. R. 1991. Ch. 3 - Reef fishes: their history and evolution, pp39-66 in P. F. Sale, ed. The ecology of fishes on coral reefs. Academic Press, San Francisco. 754 pages.

Wainwright, P. C., Bellwood, D. R. 2002. Ch. 2 - Ecomorphology of feeding in coral reef fishes, pp 33-55 in P. F. Sale, ed. Coral Reef Fishes: Dynamics and Diversity in a complex ecosystem. Academic Press, San Francisco.

Ebeling, A. W., M. A. Hixon. 1991. Ch. 18 - Tropical and temperate reef fishes: comparison of community structures. Pp 509-563 in: Sale, P. F. (ed). The Ecology of Fishes on Coral Reefs. San Francisco: Academic Press.

Pandolfi, J. M., R. H. Bradbury, E. Sala, T. P. Hughes, K. A. Bjorndal, R. G. Cooke, D. McArdle, L. McClenachan, M. J. H. Newman, G. Paredes, R. R. Warner and J. B. C. Jackson. 2003. Global trajectories of the long-term decline of coral reef ecosystems. *Science* 301:955-958.

West, J. M., and R. V. Salm. 2003. Resistance and resilience to coral bleaching: implications for coral reef conservation and management. *Conservation Biology* 17(4):956-967.

Recommended Field Guides: Hoover, John P. 1999. Hawaii's Sea Creatures, a Guide to Hawaii's Marine Invertebrates. Mutual Publishing: Honolulu; and
Randall, J. E. 1998. Shore Fishes of Hawai'i. University of Hawaii Press: Honolulu

Course Description: A field-oriented block course that examines the ecology of coral reefs and associated organisms, including reef building organisms, organisms that live on or in the reef, and coral reef ecosystems. Topics include coral taxonomy, reproduction, morphology and ecology, reef structure and zonation, coral identification, symbionts on coral reefs, and coral reef ecosystems. Students will spend substantial time in or on the water. Includes lab. Lab fee required. Additional costs of travel to and within the tropics, are required of the student.

Course Objectives: This course will give the student an understanding and familiarity with coral reef ecology, including:

- evolution, classification, diversity, and identification of reef-building corals;
- ecology and behavior of reef-associated plants and animals;
- coral reef ecosystems;
- field techniques for surveying coral reefs.

Assignments: Hand-written assignments are expected in the field, provided that they are NEAT and LEGIBLE.

Field Notebooks, consisting of the following parts:

1. **Coral ID, Fish ID, Invertebrate ID:** Identify, describe and watch five individuals representing five different species of each group. IN EACH CASE, briefly describe the morphology of the specimen, key characteristics allowing identification, and a brief description of where the specimen was observed (depth, exposure, bottom type, habitat association).

For corals, identify one each of a massive, plate-like, and branching or columnar growth forms (Gulko p 39). Identify one family Poritidae coral (Gulko, p 55-57). Identify at least three different Families.

For Invertebrates, identify at least three different phyla, and at least two different classes within one phyla.

For Fish, identify specimens from at least three different families. Include in your descriptions notes from a brief observation of behavior, including interactions and orientation to the bottom, social interactions (other fish), and interactions with potential predators or prey (any feeding behavior). See also Gulko p 146-165.

2. **Mutualism Exercises:** Complete both.

Exhaustive list of associates: Select a coral head, “bommie” or conspicuous rock accessible by snorkeling. Make an exhaustive list of all organisms associated with the feature, including identifying the coral itself, mobile fish and invertebrates in, on, below, or orienting to the feature, sessile invertebrates or algae growing on the feature, and organisms burrowing into the feature, to the extent possible without damaging the organisms. See Gulko, pp 104-120.

Cleaner Behavior: Search for, observe, and describe two cleaner associations (Gulko p 164-165) on the reef involving different species. Identify the participants and their roles (cleaner, client), duration of interactions, frequency of interactions, soliciting behaviors of cleaner or client, areas of client cleaned, etc.

3. **Questions & Reflections (Q&R):** At each site, note and reflect on community composition (dominant organism or group), **diversity** (how diverse? Which groups?), and **rarity** (Relative abundance of common & rare taxa); as well as parameters having the greatest effect on community and diversity. Compare between sites. List questions that occur to you (these might become mini-projects).

Scavenger Hunt: Collect, identify or observe as many items as possible from a list provided by the instructor in a specified time and search area.

Mini-projects. Design and complete three. You will need graph paper. See next sheet.

Course Grading:

Field notebooks	(50%)
Organisms ID (Coral, Inverts, Fish, 10% ea)	
Exercises (Associates, Cleaner Behavior, 5% ea)	
Site reflections and questions (10%)	
Mini projects (1 st one 10%; 2 nd and 3 rd , 15% ea)	(40%)
Scavenger hunt	(10%)

Minimum grades: A for $\geq 90\%$; B for $\geq 80\%$ but $<90\%$; C for $\geq 70\%$ but $< 80\%$; D for $\geq 65\%$ but $<70\%$; F for $<65\%$. Grading will reflect performance as described below. *Please note that an above average grade requires performing above expectations!*

Course Expenses: As described in handout at organizational meeting.

Mini-projects. Design and complete three. One on associations (i.e. commensals); one on distribution and/or abundance, and one on behavior.

(1) At each site, data can be collected during a single visit;

(2) data can be presented graphically and in tables, and analyses can be conducted (Upper division & grad students use simple statistics when appropriate);

(3) involve a comparison or trend across different conditions (e.g. comparison between two groups or sites; or trends across an ecocline);

(4) an introduction can be developed from available texts or references to provide a theoretical basis for the project (e.g. ecocline from protected to unprotected water should determine differences related to water flow. UD & Grad students should test theories or examine patterns presented in the readings);

(5) methods require primarily snorkeling and visual observation or measurement without other manipulation;

(6) discussion focuses on describing any pattern detected, and presenting and evaluating alternative possible explanations for the pattern.

Time-line: Planning and background reading, one afternoon; field work, one morning per site, maximum 3 sites; analysis and write-up, one afternoon. First mini-project must require only one field day; second and third project no more than 1-3 field days. Suggested length 2-3 handwritten pages plus graphs and tables. You will need graph paper to make graphs.

Starter List of possible project ideas/activities

Comparisons

sites	exposure/wave action	feeding modes
depths	light (shaded vs. not)	Sensory modes
diurnal variation	species or taxa	Current flow

Graduate: Build dichotomous field key to local corals, distinguishing Hawaiian genera or all Hawaiian species within a single genus.

Measurements

Diversity	Size distribution	Rarity
Community composition	Frequency of behavior(s)	Associations
Abundance/Percent cover	Colony size (# polyps / colony) or density	
Health (bleached, tumors, etc)	colony shape (measure angle of bifurcation and branching rate)	

What did you learn (WDYL)

An exercise to review the reading. Each student will be asked to discuss something learned from the day's reading. You may be called on in any order; and you need to discuss something that has not already been presented, even if you are last. Following this at each discussion, we will consider ways to test the ideas presented in the reading within the context of a mini-project (short, quick data collection with simple techniques and minimal planning).

TENTATIVE SCHEDULE (subject to change)

Week 1**Tue, 6 Jan** - Class starts on OahuStudents arriving from Anc can take NA404 01:15 AM 06:05 AM
<http://www.hawaiianvacations.com/> 1-800-770-2700 or 907-261-2700**Read:** Topic 1 Gulko p 1-36; Plathong et al. 2000.**a.m.** - Airport pick-ups, unpack, site orientation etc.**p.m.** - Intros & admin; Zoology of Coral; WDYL* Topic 1
* "What did you learn?"**eve** - Study time**Wed, 7 Jan** - Turtle Bay resort at Kuilima Cove**Read:** Topic 2 Gulko p 36-73; Karlson Ch. 2 Diversity**a.m.** - WDYL Topic 2, Reef building organisms & coral ID**p.m.** - Snorkeling safety and impacts**eve** - Study time**Thur, 8 Jan** - Makao Beach, Hau'ula (or Laniloa Beach)**a.m.** - Organisms, cont.**p.m.** - Relocate to Coconut Island**eve** - Study time**Fri, 9 Jan** - HIMB, Coconut Island**Read:** Topic 3 Gulko p 75-104; Karlson Ch. 3 Stability**a.m.** - WDYL* Topic 3, Coral ecology.**noon - Due:** Seven I.D.s + questions & reflections for 4 sites**p.m.** - Project & study time**eve** - Study time**Sat, 10 Jan** - HIMB, Coconut Island**Day** - Boat trip, projects & notebooks**eve** - Study time**Sun, 11 Jan** - Return to Oahu; Hanauma Bay (arrive early)**Read:** Topic 4 Gulko p 105-120; Karlson Ch. 5 Competition**a.m.** - Depart early from HIMB Coconut Is. to Hanauma B.
WDYL* Topic 4, Reef organisms & invert ID.**p.m.** - Hanauma Bay, cont. Settle in new lodging**eve** - Study timeWeek 2**Mon, 12 Jan** - Waikiki Aquarium & Honolulu**Due:** Turn in Mini-project 1 on entering Aquarium**a.m.** - Self-tour of Waikiki Aquarium**p.m.** - 1 pm - Charles DelBeek "Coral Propagation around the World" & behind the scenes tour.**After aquarium** - Unsupervised time, Waikiki Beach, shopping & dinner on your own in Honolulu; after dinner return to lodging. You might also want to visit the Pacific Beach Hotel three-story indoor Oceanarium (2490 Kalakaua Avenue). The Hotel's restaurants face the exhibits if you want to have a meal there (kinda posh).**Tue, 13 Jan** - Travel & study**a.m.** - Pack up and travel preparation**p.m.** - Travel from Honolulu to Kona. Please travel:
HON-KON HA Fl# 148 1:26 to 2:09 PM. **Purchase groceries in Kona.****eve** - Study time**Wed, 14 Jan** - Pu'uhonua O' honaunau**Read:** Topic 5 Gulko p 121-145; Karlson Ch. 7 Disturbance**a.m.** - WDYL* Topic 5; Reef structure & zonation**p.m.** - Assignment time**Eve.** - Optional night snorkel @ Pu'uhonua or alt. site**Thur, 15 Jan** - Kahalu'u Beach (see site guide, swim to reef)**a.m. to 2 p.m.** - Coral reef fish IDComplete **Reef Fish ID; Cleaner Behavior****after 2 p.m.** - Unsupervised time in Kona;

Kona Chocolate factory (optional)

eve - Study time**Fri, 16 Jan** - Kaimana Guest House, no snorkeling.**Read:** Topic 6 Gulko p 146-171; Choat & Bellwood; Wainwright & Bellwood**day** - WDYL Topic 6, Coral reef fishes; Assignments & study**noon - Due:** Q&Rs, 1 Mutualism, all I.D.s**5 p.m. - Due:** Mini-project 2**eve** - Study time**Sat, 17 Jan** - Volcano National ParkLava tubes, park sites, possible hike to flowing lava
Paul Twardock to Hilo.**Sun, 18 Jan** - **Kahalu'u or alt. site****Read:** Topic 7 Gulko p 172-194; Pandolfi et al 2003; Ebleing & Hixon 1991.**a.m.** - WDYL, Topic 7, Reef fish communities**p.m.** - In-water time for assignments **eve** - Study timeWeek 3**Mon, 19 Jan** **Pu'uhonua O' honaunau or alt. site**

Martin Luther King Holiday

Read: Topic 8 Gulko p 195-219; West & Salm 2003..**a.m.** - WDYL, Topic 8, Impacts & management**p.m.** - In-water time for assignments **eve** - Study time**Tue, 20 Jan** - Kealakekua Bay by kayak (reserved)**Day** - Mutualism & projects,Complete **Mutualism Exercises; Due: Scavenger Hunt****eve** - Study time**Wed, 21 Jan** - Kaimana Guest House, no snorkeling**Day** - Complete assignments**noon - Due:** All notebook **5 p.m. - Due:** Mini-project 3**eve** - CRE dinner, Kona. Class ends on Big Island.**Thur, 22 Jan** -**a.m.** - Students as needed to airport.**Fri, 23 Jan** -

Students departing to Anchorage can take

Jan 23 2004 Friday 05:05 PM 11:55 PM HA938

Fri, Jan 30 - DLS to Anchorage.

KON-HON Fl# HA347 1:58PM to 2:38PM;

HON-ANC Fl# HA938 5:05PM to 11:55PM

Tues, Feb 02 Last day of block

Topics:

- (1) INTRODUCTION - CORALS AS ORGANISMS Gulko, pp 1-36
Plathong, S., G. J. Inglis and M. E. Huber. 2000. Effects of self-guided snorkeling trails on corals in a tropical marine park. *Conservation Biology* 14(6):1821-1830.
- (2) REEF BUILDING ORGANISMS, CORAL TAXONOMY, CORAL IDENTIFICATION Gulko, pp 36-73.
Karlson, R. H. 1999. Diversity. Ch. 2 in Dynamics of Coral Communities. Kluwar Academic Publ. P 29-50.
- (3) CORAL REPRODUCTION, MORPHOLOGY AND ECOLOGY Gulko, pp 75-104
Stability. Ch. 3 in Karlson, 1999. P 51-73.
- (4) ORGANISMS THAT LIVE ON OR IN THE REEF Gulko, pp 104-120
Interspecific Competition. Ch. 5 in Karlson, 1999. P 94-117.
Stachowicz, J. J., and M. E. Hay. 1999. Mutualism and coral persistence: the role of herbivore resistance to algal chemical defense. *Ecology* 80(6):2085-2101.
Pratchett, M. S., E. Vytupil and P. Parks. 2000. Coral crabs influence the feeding patterns of crown-of-thorn starfish. *Coral Reefs* 19:36.
- (5) REEF STRUCTURE AND ZONATION Gulko, pp 121-145
Disturbance. Ch. 7 in Karlson, 1999. P 140-164.
- (6) CORAL REEF FISHES - TAXONOMY & BIODIVERSITY Gulko p 146-171
Choat, J. H., Bellwood, D. R. 1991. Chapter 3 - Reef fishes: their history and evolution, pp39-66 in P. F. Sale, ed. The ecology of fishes on coral reefs. Academic Press, San Francisco. 754 pages.
Wainwright, P. C., Bellwood, D. R. 2002. Chapter 2 - Ecomorphology of feeding in coral reef fishes, pp 33-55 in P. F. Sale, ed. Coral Reef Fishes: Dynamics and Diversity in a complex ecosystem. Academic Press, San Francisco. 549 pages.
Read at least Parts IV and VI (V also recommended) in Choat & Bellwood 1991 and through p. 50 in Wainwright and Bellwood 2002.
- (7) CORAL REEF ECOSYSTEMS, CORAL REEF FISHES - PROCESSES STRUCTURING COMMUNITY, AND HUMAN IMPACTS (PART I) Gulko 172-194
LONG-TERM HISTORY OF CORAL REEFS
Pandolfi, J. M., R. H. Bradbury, E. Sala, T. P. Hughes, K. A. Bjorndal, R. G. Cooke, D. McArdle, L. McClenachan, M. J. H. Newman, G. Paredes, R. R. Warner and J. B. C. Jackson. 2003. Global trajectories of the long-term decline of coral reef ecosystems. *Science* 301:955-958.
Ebeling, A. W., and M. A. Hixon. 1991. Chapter 18 - Tropical and temperate reef fishes: comparison of community structures. Pp 509-563 in: Sale, P. F. (ed). The Ecology of Fishes on Coral Reefs. San Francisco: Academic Press.
- (8) HUMAN IMPACTS (PART II) AND MANAGEMENT Gulko 195-219
CORAL REEF RESILIENCE
West, J. M., and R. V. Salm. 2003. Resistance and resilience to coral bleaching: implications for coral reef conservation and management. *Conservation Biology* 17(4):956-967.

Transportation Schedule

Tuesday, 6 January Students arrive various times & flights no later than early a.m. today.

- Drop of rental car in airport
- Pick up rental vans (2) @ airport Value Rent-a-Car

Thursday, 8 January Travel to Coconut Is.

- Boat to Coconut Island (HIMB, 808-236-7401)

Sunday, 11 January Return from Coconut Is.

- Boat from Coconut Is.

Tuesday, 13 January Oahu to Big Island

- Drop off rental vans (2) in airport
- Flight: HON-KONA HA #148 1:26 PM departure to 2:09 PM arrival (Scheel)
- Pick up rental van call using the Harper courtesy phone located at the baggage claim

Thursday, 22 January, Kona Big Island

- Take students to airport as needed

Friday, 23 January, Kona Big Island

Students returning HON-ANC can take HA #938 Depart 5:05 PM Arrive 11:55 PM

Lodging Schedule

Tuesday 6 January to Thursday 8 January

Countryside Cabins 53-224 Kamehameha Hwy, Hauula, Hawaii 96717 (808) 237-1203. Variety of accommodations: from bunkhouse hostel to double rooms in the house.
www.hawaiicabins.com/

Thursday 8 January to Sunday 11 January

Hawaii Institute of Marine Biology, Coconut Island, Oahu. HIMB, 808-236-7401. Bunk beds, kitchen, bathroom, showers in adjacent building, 4-6 per room.

Sunday 11 January to Tuesday 13 January

Hostelling International - Honolulu (University), 2323A Seaview Ave., Honolulu, Hawaii 96822. Tel: (808) 946-0591; located in the quiet green residential community of lower Manoa Valley. We are across the street from the University of Hawaii and are just up the hill from several restaurants, pubs and health food stores. 2 Male Dormitories and 3 Female Dormitories (5-10 guests per dorm room); Shared Bathrooms/Showers; Lockers (bring padlock); Fully Equipped Shared Kitchen; Washer and Dryer - coin operated; Payphone.

Tuesday 13 January to Thursday 22 January

Kaimana Guest House, Milolii Big Island. Tel: 808-328-2207; business address (not where lodging is located): Kaimana Guest House, Box 946, Captain Cook, Hawaii 96704. Hostel style lodging, beds and linens are provided. <http://www.kaimanavacations.com/>