OCN621 - BIOLOGICAL OCEANOGRAPHY
Spring 2006

MWF 9:30-10:20, MSB315

http://www.soest.hawaii.edu/oceanography/zij/ocn621.html

Instructors:
Zackary Johnson (MSB614, 956-0844)
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Guest Lectures:
Robert Bidigare (POST105, 956-8148)
Grieg Steward (MSB631, 956-7024)
Ruth Gates (HIMB, 236-7420)
Jeff Drazen (MSB606, 956-6567)

Grading:
10% class participation
30% exam I (Bioenergetics, Microbial Ecology, Biogeochemical Fluxes)
30% exam II (Coral Reef, Benthic Ecology, Deep Sea)
30% cumulative scores on 5 study questions for Zooplankton & Pelagic Ecology section

OBJECTIVES:
• To understand the processes affecting the distributions and abundances of marine organisms in space and time
  - develop a "feel" for the ocean environment & the selective pressures on organisms in it
  - define important problems & controversies
  - critically examine approaches (limitations) for studying ocean biological system sampling & experimental design
  - illustrate relationships among energetic, population, community, and system level processes & phenomena
• To understand the interactions of physical, geochemical, and biological systems in the oceans
  -examine the role of living organisms in the oceans in an ecosystem context
COURSE OUTLINE

I. Introduction
   A. Course objectives and overview
   B. Habitats and ecosystems
   C. Organizational details

II. Bioenergetics - transformations of energy by living organisms
   A. Utilization of external energy for the production of organic molecules
      1. Photosynthesis
      2. Chemosynthesis
   B. Breakdown of organic molecules yielding chemical energy
      1. Fermentation
      2. Respiration
   C. Utilization of chemical energy to do biological work
      1. Energy currency
      2. Active transport
      3. Motility
      4. Biosynthesis
   D. Relevance of bioenergetics and cellular biology to oceanography – Overview
      1. Measuring standing stocks
      2. Measuring process rates
      3. Relationships among cell constituents
      4. Energetic efficiency constraints
      5. Energetic tradeoffs in adaptation

III. Microbial ecology and primary production
   A. Diversity and adaptation
   B. Photosynthetic pigments
      1. Structures and absorption properties
      2. Distributions among algal classes
   C. Primary production
      1. Methodological constraints
      2. Incubation techniques
      3. Methodological artifacts
   D. Environmental effects on photosynthesis and growth rate
      1. Light
      2. Nutrients
      3. Depth relationships
      4. Seasonal phytoplankton blooms

IV. Marine Molecular Ecology: Viruses

V. Pelagic organisms and biogeochemical cycles
   A. Ocean primary production, vertical carbon transport, and global CO₂
   B. The "New Production" concept
   C. Nitrogen cycling
      1. New versus regenerated production
      2. Nitrification, denitrification, nitrogen fixation
   D. Alternative approaches for measuring new production
      1. Oxygen cycles
      2. Isotopic ratios

VI. Marine molecular ecology (Coral reefs)
VII. Benthic ecology
   A. Generalizations
   B. Microbial processes and sedimentary geochemistry
   C. Feeding processes
      1. Energy sources
      2. Suspension feeding
      3. Deposit feeding
   D. Distributional patterns
      1. Size classes
      2. Sedimentary type vs community correlations
      3. Pollution gradients
      4. Depth zonation
   E. Life history and recruitment
   F. Discussion of two recent papers on selected topics (e.g., deep-sea diversity, disturbance and succession)
   G. Deep-sea reducing habitats
      1. Hydrothermal vents
         a. Geologic setting and global distribution
         b. Microbial processes
         c. Macrofaunal structure and processes
      2. Characteristics of other reducing habitats
         a. Subduction zones
         b. Petroleum seeps
         c. Whale falls
      3. Biogeography of reducing habitats
   VIII. Mysteries of the Deep Sea
   IX. Pelagic consumers (Diversity, energetics and behaviors)
      A. Zooplankton diversity
      B. Feeding rates and behaviors
         1. Functional response relationships
         2. Selective feeding
      C. Carbon and energy utilization
         1. Assimilation and egestion
         2. Metabolism
         3. Growth and reproduction
      D. Vertical migratory behavior
   X. Structure and dynamics of pelagic communities
      A. Community organization
         1. Biogeography
         2. Food web structure
      B. Community production and dynamics
         1. Timing and magnitude of production cycles - "classical" blooms
         2. The microbial loop
         3. Coastal upwelling
         4. HNLC ecosystems
C. The mesopelagic environment
XI. Fisheries oceanography

A. Larval ecology and survival
   1. First feeding and the critical period
   2. Growth and mortality
   3. Larval transport and nursery grounds
   4. Environmental variability and larval survival

B. Fisheries management: Case histories
   1. North Sea herring
   2. California sardines
   3. Peruvian anchovetta
   4. George's Bank
   5. Whales and krill
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