OCN621 - BIOLOGICAL OCEANOGRAPHY
Spring 2008

MWF 9:30-10:20, MSB315

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

Instructors:
Zackary Johnson (MSB614, 956-0844) – lead
Karen Selph (MSB608, 956-7941)
Craig Smith (MSB617, 956-7776)

Guest Lectures:
Ruth Gates (HIMB, 236-7420)
Guangyi Wang (POST103B, 956-3744)

Text:
Marine Ecology: Processes, systems, and impacts, Kaiser et al. (2005) Oxford University Press (New York)

Grading:
10% class participation
30% exam I (Bioenergetics, Microbial Ecology, Biogeochemical Fluxes)
30% exam II (Zooplankton & Pelagic Ecology)
30% exam III (Coral Reef, Benthic Ecology)

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 of pelagic primary producers
    A. Measuring Biomass and Rates of Primary Producers
    B. Factors Limiting Primary Producers
        1. Nutrients
        2. Light
        3. Temperature
    C. Vertical variability
    D. Horizontal Variability
    E. Temporal Variability
    F. Major Clades of Phytoplankton

IV. Marine Molecular Ecology: Viruses

V. Pelagic organisms and biogeochemical cycles
    A. Ocean primary production, vertical carbon transport, and global CO_2
    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

VII. Pelagic consumers (Diversity, energetics and behaviors
    A. Zooplankton diversity
    B. Feeding rates and behaviors
        1. Functional response relationships
        2. Selective feeding

3. Methods used to Measure Feeding Rates

C. Carbon and energy utilization

1. Assimilation and egestion
2. Metabolism
3. Growth and reproduction
4. Elemental Stoichiometry and Grazer-Mediated Remineralization

D. Vertical migratory behavior

VIII. Structure and dynamics of pelagic communities

A. Community organization

1. Biogeography: Classical Methods and Modern Tools
2. Food web structure

B. Community production and dynamics

1. Timing and magnitude of production cycles - "classical" blooms
2. The microbial loop
3.. Pacific Ocean Ecosystems

IX. 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.. California sardines
2.. Peruvian anchovetta
3.. Whales and krill

C. Global Fisheries: Current Thoughts

1. Multispecies Management
2. Global Fish Catches and Maximum Sustainable Yields
3. Marine Protected Areas

X. Coral Reef Ecosystems

XI. Benthic ecology

A. Generalizations

B. Microbial processes and sedimentary geochemistry / redox

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