

Take-Home Final Exam

For the final exam, you will be graded on the accuracy of your answer (facts and errors), your ability to synthesize concepts, and the clarity of your answers..

Section I. Short answer. Answer any 5 questions with a drawing, paragraph, descriptive answer, etc. You are welcome to use references and/or graphics if it helps to justify your answer (10 pts each).

- 1) Draw the “ideal” foodweb in terms of an NPZ-type model, and explain why it’s ideal. Why is it better than an NPZ model?
- 2) Discuss how the various physiological and behavioral responses of the plankton allow them to exploit spatial and/or temporal patchiness in their environment.
- 3) Design an experiment to quantify how much of bacterial production is eventually consumed by macrozooplankton in some region of the ocean.
- 4) You are an ecologist trying to predict the effects of global warming on kelp forests and coral reefs off the coast of North and Central America. To make these predictions you will attempt to extrapolate from El Niño effects on these habitats. Discuss how El Niño conditions change the physical environment, and how these changes affect the biological properties of these habitats, and whether extrapolating from these events to long-term global warming is reasonable.
- 5) You’ve been asked to determine the loss processes associated with phytoplankton growth rates inside Monterey Bay (everything “inside” an imaginary line drawn from Davenport to Monterey). How would you do it? Be specific.
- 6) Based on everything we’ve discussed in class, explain what (if anything) is limiting ocean primary productivity and export production. Defend your answer. Second, explain what you would expect to happen (large-scale patterns) if global warming is real.
- 7) Give ballpark values (and units) for the following: 1) average surface chlorophyll at the MBARI M1 mooring, 2) surface chlorophyll during a red tide, 3) nitrate concentration at 100 m, 50 km offshore, 4) nitrate concentration at the surface, 500 km offshore, 5) a typical carbon:chlorophyll ratio for phytoplankton, 6) a typical phytoplankton and zooplankton growth rate for Monterey, 7) the proportion of total primary production by the <math><5 \mu\text{m}</math> size class (explain where you are), 8) a typical concentration of viruses in the coastal ocean, 9) a typical half-saturation constant for nitrate uptake by phytoplankton, 10) the diffuse attenuation coefficient in a coastal and open ocean region.

Take-Home Final Exam

8) For some obscure reason, you want to start a red tide of dinoflagellates in your coastal area. Discuss some ways that you might do this, and the factors that you would consider in designing your program. Assume you're very wealthy, and not constrained by EPA regulations.

9) You have joined a cult whose leader has guaranteed that you can be reincarnated as any organism you wish in your next life. While most of your friends are choosing to be dolphins and whales, you wisely choose to become a marine invertebrate. Discuss five choices you will have to make as you decide what invertebrate to become (for example: benthic vs. pelagic, brooder vs. spawner, etc.), and the pros and cons of the choices you make.

10) Discuss three types of disturbance and how they influence the structure of planktonic and benthic communities.

Section II. The Big Kahuna (50 points). Re-read Boyd et al. (SOIREE), then read the following papers: Coale et al, Buesseler et al., Bishop et al. (April 16, 2004, Science—available on the class web page). Then answer the following:

- 1) After reading the papers, do you feel like you have a good understanding of the content? If not, what is still confusing?
- 2) The original Iron Hypothesis (Martin) suggested that: (a) the oceans are iron-limited; (b) natural or anthropogenic iron fertilization would result in enhanced carbon sequestration from the atmosphere; (c) this would have global consequences (another ice age, to be specific). Do you feel that these experiments adequately tested this original hypothesis?
- 3) Why are the Science papers in Science? What did they contribute beyond the SOIREE experiment?
- 4) Iron fertilization has also been proposed as a way to enhance fisheries. Would this work? Why or why not?
- 5) You've been asked to design a follow-on experiment anywhere in the world, related to iron fertilization. You must come up with a compelling rationale for how your experiment would significantly advance our understanding (beyond the existing experiments). Explain what you would propose to do, and why.

Extra Credit (worth a 6-pack). There's a serious scientific error in the Coale et al. paper. What is it?

