

Name: _____

For the midterm 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. The amount of space given for each answer indicates the approximate expected length, but you should feel free to use as little or as much space as you require to adequately answer the question.

Section I: Short definitions or concepts. A sentence or two is generally enough information. Describe or define the following (4 pts each):

1) ef-ratio

2) diffuse attenuation (K)

3) diversity

4) critical depth

5) photosynthetic unit (PSU)

Section II. Short answer. Answer each question with a drawing, paragraph, etc. (not an essay; 6 pts).

6) Why do phytoplankton have pigments other than chlorophyll a? Are all of these pigments used for photosynthesis?

7) In which environment would you expect the highest percentage of primary production to reach fish: a region with high f ratio, or a region with low f ratio? Explain.

8) When at sea, you often see fish and marine mammals (large animals) but you almost never see large plants. Why?

9) A physical oceanographer and a phytoplankton ecologist are having an argument. The physical oceanographer says that his measurements show that temperature and salinity are basically homogeneous from the surface down to 25 m depth, and therefore that's the depth of the mixed layer. The phytoplankton ecologist argues that s/he can measure a vertical gradient of P^B from the surface to 25 m depth (i.e it's not homogenous), therefore it can't possibly be a mixed layer. Reconcile the two arguments. About how fast is the mixed-layer mixing? Think about your answer to Homework 2 (time scales of adaptation in phytoplankton).

10) Draw a photosynthesis versus irradiance curve, labeling all of the major features. Now draw (second graph) a plot of the productivity index (photosynthesis normalized to biomass, or P^B) versus depth, labeling (at minimum) the x-axis, y-axis, compensation depth, and $P^{B_{opt}}$. What is the relationship (if any) between the PE curve and the P^B curve?

Essay Question. Answer ONE of the following questions. Your response will be graded on content, clarity, and critical thinking (35 pts).

- 1) You are adrift alone in a life raft after your research vessel sank in the Pacific north of Hawaii. You can tell by the sun that you are drifting east, and you're hoping to reach San Diego in a week or so. In the meantime, you decide to do something useful with your time. Luckily you have several hundred feet of string, and a picnic set containing the usual cutlery, cups and plates. Describe how you would measure the vertically integrated phytoplankton biomass along your route, and the patterns you would expect to see.
- 2) You've been invited to Sacramento to speak to Governor Schwarzenegger because he heard what a great job you did working for President Bush on that "iron thing". The Governor wants to boost California's economy by creating a bigger and more consistent fisheries, and has proposed to do so by dumping phosphorous into the ocean, since he remembers his childhood in Austria, where the lakes turned green because of detergents. Your job is to help the Governor with his plans, or convince him not to do it. Answer the following:
 - a. What would happen to the coastal ocean if we started dumping phosphorous into it? Why?
 - b. Explain to the Governor what would work better if he really wanted to increase fisheries production in California by modifying the environment.
 - c. If you convinced the Governor that you could modify coastal productivity, explain what the general consequences (for the biology) would be, and explain whether you think this is a good or bad idea.

Extra Credit: (2 points each)

- i. **How many different species of ocean fish exist (+/-10%)?**
- ii. **Where are the majority of fish in the ocean located (geographical region, not depth)?**