MARS 3450 – Exam #2 Study Guide

Essay Questions

1. Explain what is meant by the statement that seabirds exhibit pronounced parental care. Give examples.

   The statement indicates that seabirds put a lot of effort into a small number of chicks, rather than put little effort into a large clutch and hope some survive. This statement is supported by the fact that seabirds tend to lay larger eggs than land birds and by the fact that seabirds have extended incubation and rearing times. One example of pronounced parental care is the male Emperor Penguin. Males incubate their eggs by themselves between their legs and cannot feed during the approximately 115 days of incubation.

2. Given the following information about a small fish, calculate: (1) how much it assimilates, (2) its production efficiency, and (3) assuming this follows the "rule of thumb" ecological transfer efficiency, how much of this organism's production is likely found as production in the next trophic level (your answer should be in kcal/h). For all parts of this question, please show your work.

   ingestion = 100 kcal/h
   egestion (excretion) = 10 kcal/h
   respiration = 20 kcal/h
   reproductive output = 0 kcal/h

   #1 – Assimilation

   assimilation efficiency = [(ingestion – egestion) / ingestion] x 100
   = [(100 kcal/h – 10 kcal/h) / 100 kcal/h] x 100
   = 90%

   The organism assimilates 90%.

   #2 – Production Efficiency

   production efficiency = [(ingestion – egestion – respiration) / assimilation] x 100
   = [(100 kcal/h – 10 kcal/h – 20 kcal/h) / 90] x 100
   = 78%

   The organism has a 78% production efficiency.

   #3 – How Much of the Organism's Production is Likely to Be Found in the Next Trophic Level

   production = ingestion – egestion – respiration
   = 100 kcal/h – 10 kcal/h – 20 kcal/h
   = 70 kcal/h

   (70 kcal/h) x 0.01 = 0.7 kcal/h

   0.7 kcal/h of this organism's production would likely be found in the next trophic level.

3. Answer the following:
   a) What are the major inorganic forms of C, N, and P in the marine environment?

The major inorganic form of carbon is found in carbonate rock. The major inorganic form of nitrogen is NH_4^+ (ammonium). The major inorganic form of phosphorus is PO_4 (phosphate).

b) For each element, what processes (and which type of organisms) are responsible for transforming from the inorganic to the organic forms?

Bacteria are responsible for the decomposition/resuspension process in which inorganic carbon is transformed into organic carbon. Nitrification, denitrification, and N-fixation are the processes responsible for transforming inorganic nitrogen into organic nitrogen. N-fixing bacteria play a major role in these processes. Upwelling and downwelling are the processes responsible for transforming inorganic phosphorus into organic phosphorus.

c) What processes (and which type of organisms) are responsible for transforming from the organic to the inorganic forms?

Sinking is the process responsible for transforming organic carbon into inorganic carbon. Ammonification is the process responsible for transforming organic nitrogen into inorganic nitrogen. Mineralization is the process responsible for transforming organic phosphorus into inorganic phosphorus.

**I am not asking you to reproduce the complete cycles for these nutrients, but rather to focus on the particular transformation asked about in these portions of the question. A drawing of the cycle without an explanation will not receive full credit.*

4. Near-shore environments are considered highly productive ecosystems. Describe the sources of nutrients to the coast, and explain how the presence of a bottom enhances primary production.

In near-shore environments, nutrients come from three places: (1) upwelling, (2) estuaries, and (3) tidal mixing. In all three cases, nutrient-rich salt water from the bottom is brought up to the surface. The presence of a bottom enhances primary production because it effectively blocks the loss of sinking nutrients. Since the nutrients are not sinking to the bottom, like they do in other environments, the primary producers essentially have access to a greater number of nutrients and can therefore perform more primary production.

5. It has been proposed that kelp ecosystems have two alternate steady states. Describe these two states and discuss differences in the role of detritus.

The first state is the kelp forest; in this state, there is a high kelp biomass, and urchins are sedentary and under cover. The second state is the barrens; in this state, there are storms and a high urchin biomass. The barren state is often referred to as the "urchin barrens," preventing kelp recruitment and establishing algal turf. Detritus plays a different role in each of these alternative steady states. In the kelp forest state, the kelp feeds on the detritus at the bottom of the ocean and grows. In the barrens state, the kelp is ripped from its hold on the rock below and drifts out to sea, where it is converted into detritus.

6. How does the more recent discovery of a "microbial food web" combine with the previous concept of a "pelagic food web," consisting only of macroorganisms?

The "microbial food web" essentially fits beneath the "pelagic food web." Before the discovery of the microbial food web, bacteria and small phytoplankton did not really have a defined order of trophic levels, diatoms were just placed at the bottom of the food web. With the discovery of the microbial food web, however, we know that bacteria are at the very bottom of the microbial food web and are eaten by phytoplankton, which are eaten by zooplankton, which are then eaten by the herbivores, located at the very bottom of the pelagic food web.

7. What is a marine "tetrapod," and what are the special challenges they face in living at sea?

Marine tetrapods are marine organisms with limbs and lungs that invaded land about 350 million years ago. They face special challenges because they still live in the water, even with these biological alterations. Their various challenges include having to: come up to the surface to breathe, return to land to reproduce (which often requires long migrations), and develop thick layers of blubber or fur to stay warm.