Environmental Biology 206 EXAM I 16 February 2005 (exam worth 100 points)

Multiple Choice (questions have only one correct answer; 21 points total; 1.5 points each)

1. Current human population is closest to
   a) 5.2 billion,  b) 6.2 billion,  c) 7.2 billion,  d) 8.2 billion,  e) 9.2 billion.

2. The most dangerous threat to biodiversity is
   a) disease,  b) over exploitation,  c) pollution,  d) alien species,  e) habitat loss

3. On average, what percent of the useful energy in organisms at one trophic level is passed on to the next higher trophic level?
   a) 10%,  b) 15%,  c) 20%,  d) 25%,  e) 30%

4. What do Rhi zobium bacteria do?
   a) fix nitrogen  b) convert nitrogen to ammonia  c) convert ammonia to nitrogen  d) two of the above  e) none of the above

5. Which of these ecosystem types has the highest net primary productivity per square meter? (fig. 2-20)
   a) Lakes and Streams  b) Swamps and Marshes  c) Savanna  d) Agricultural Land  e) Desert

6. A mutualism is an interaction between two species in which
   a) both species benefit.  b) one species benefits and one is not affected.  c) one species benefits and one is hurt.  d) both species are hurt.  e) one species is hurt and one is not affected.

7. According to Ishmael, where did the story of the Garden of Eden originate?
   a) In the native cultures of North America.  b) In the savannas of Africa.  c) In an early agricultural society.  d) In a pastoral culture displaced by an early agricultural society.  e) Among early Christians.

8. What is the most appropriate definition of the biological species concept introduced by Ernst Mayr in the 1950’s?
   a) a unique, shared evolutionary history for a group of organisms  b) shared morphological similarity within a group of organisms  c) genetic variation less than 2% for a group of organisms  d) interbreeding populations reproductively isolated from other such populations  e) none of the above

9. Which of the following is an example of biodiversity?
   a) Genetic variation  b) Species richness  c) Ecological variation  d) Functional variation  e) All of the above
10. Which of the following is not typical of invasive species?
   a. Limited geographic distribution
   b. Great dispersal ability or migratory tendencies
   c. Early maturation and short generation time
   d. Small body size
   e. Capacity for clonal/asexual reproduction

11. Which of the following is an example of a biocontrol management strategy that seems to have worked rather well?
   a. Zebra Mussels introduced to great lakes to control Lampreys
   b. Myxoma virus introduced to Australia to control Rabbits
   c. *Beetle (Diorhabda elongata)* introduced in U.S. to control Salt Cedar (Tamarisk)
   d. Cane Toads introduced in Australia to control Cane Grub
   e. Rosy Wolfsnail introduced to Hawaii to control Giant African Snail

12. According to your Costanza et al. (1997) reading, what is an average estimate of the economic value of ecosystem services?
   a) $20 billion, b) $240 billion, c) $18 trillion, d) $33 trillion, e) $147 trillion

13. Which amount above was the global GNP (gross national product) estimate for ~1995?

14. According to Chuck Price's lecture, how different are current extinction rates thought to be when compared to background extinction rates estimated from long-term average trends in the fossil record?
   a. 10-100x greater
   b. 100-1,000x greater
   c. 1,000-10,000x greater
   d. 10,000-100,000x greater
   e. 10-100x less

Fill in the Blank (2 points per blank; 26 points total)

1. In the biosphere, matter is recycled but there is a __________________ flow of energy.

2. CO₂ + H₂O + _______________ solar energy → C₆H₁₂O₆ + _______________ O₂
   in a process known as ____________________________.

3. Life first evolved on this planet about 3.5 ____________ years ago.

4. ____________ is an example of a perpetual resource.

5. A generalist species (e.g., cockroach or coyote) has a ________ broad (wide) ___________ niche.
   A specialist species (e.g., giant panda) has a narrow niche.

6. The three important characteristics of pollution are its a) ______________, b) chemical composition and activity, and c) persistence.

7. ________________ is a non-native species commonly seen around Tucson.

8. ________________ is a term for consequences of human activities not typically included in economic decision making.

9. Please give two examples of ecosystem services discussed in class:
   a) ________________
   b) ________________

10. In the context of graphing data, regression implies a causal relationship whereas correlation does not.
Really Short Answer (not more than a sentence; 33 points total; 3 points each)

1. What point does McPherson make in *Killing the Natives* by discussing Lifeboats, Elevators, and Restaurants?
   - Planet may have carrying capacity for humans

2. What is the goal of the Kyoto Protocol?
   - Slew global climate by 1 greenhouse gas emissions

3. Why is genetic variation thought to be important for long-term persistence of populations of plants and animals?
   - Allows populations to adapt/evolve in face of environmental change

4. List each of the terms in the IPAT model.
   - Impact, Population, Affluence (Consumption), Technology

5. Answer A or B:
   - a. List two adaptations that plants have for existence in arid environments.
   - b. List three of the four mountain ranges surrounding Tucson.
     - Tucson, Santa Rita, Catalina, Rincon

6. How would you explain to someone the difference between Environment and Ecology?
   - Everything that affects surrounding a living organism

7. Define keystone species and give an appropriate example discussed in class.
   - Species whose function in ecosystem is greater/more important than might be predicted by the # of indivs or biomass of that species

8. What is the 'tens rule' in the context of invasive species?
   - Missed often

9. What two criteria, other than heritability, must be met for evolution by natural selection to take place?
   - Trait variable among indivs, trait differentially affects fitness

10. Why did megafaunal extinctions take place in several areas of the world within the last 50,000 years, but not in Africa?
    - Humans evolved in Africa, the species there adapted over time to prevent extinction, native fauna in areas which humans migrated to were in trouble, and indeed became prey

11. Give two examples of ways humans are affecting the carbon cycle.
    - Removing CO2 sinks such as forests
    - Adding CO2 to atmosphere when combusting fossil fuels that have been sequestered underground for millions of years
Short Answer (20 points total; 5 points each; a few sentences required)

1. The baobab tree is a native of Madagascar. The individual on campus is one of the oldest individuals of that species in North America. It is a monocious tree that is pollinated by nocturnal pollinators, such as moths and lemurs. Although the individual on campus flowers, it has never produced fruit. List two possible hypotheses to explain why it does not produce fruit.

   - No appropriate pollinators.
   - No other trees to exchange genetic material with.
   - Self incompatible.
   - Wrong environmental conditions or cues, etc.

2. Distinguish between exponential and logistic population growth using graphs with labelled axes. What ecological processes cause them to differ?

   ![Graphs showing exponential and logistic growth]

   - Exponential: Growth rate is constant and population increases rapidly.
   - Logistic: Growth rate slows as resources become limited.

   - Environmental constraints in habitat (carrying capacity), competition for scarce resources (space, food, etc.), above or below K, population growth or decline.

3. In Annie Dillard’s chapter entitled ‘fecundity’ she relates a story about trains. How is her discussion of 9,000 vs. 3 trains both similar to, and different than, what happens in natural biotic populations?

   In both cases more individuals are produced than the habitat can support. Over time # indivs. reduced to carrying capacity of the habitat. With train story, 9000 -> 3 all b/c of chance. In nature lots of chance, but also heritable variation among individuals that might contribute to fitness differences and therefore evolution by natural selection across generations.

4. Explain how stage of ecological succession and degree of niche partitioning might be related over time. Provide a simple, labelled graph of the hypothesized relationship.

   ![Graph showing relationship between ecological succession and niche partitioning]

   I might expect the two to be positively correlated. In very early stages of succession soil is simple, plants are few, and the habitat has very little structure. Over time as the habitat becomes more complex, specialists will narrow niches will be able to persist whereas early on pioneer species + generalists would do well.