

Name _____

Ecology & Evolutionary Biology 245
Exam 2
6 March 2008

1. Drs. Okamba and Ritoli have been studying the evolution of a very diverse family of insects endemic to the Marquesas islands in the Pacific Ocean. These insects are intriguing in that they exhibit a diversity of diets that are not seen in their relatives elsewhere in the world. The good doctors are beginning to suspect that this group of insects may have arrived on the Marquesas shortly after these islands arose from the Pacific Ocean. If their hypothesis is correct, which of the following evolutionary phenomena do these organisms illustrate? Justify your answer. (4 points)

Lazarus taxa
Convergence
Adaptive radiation
Pull of the recent

2. From the standpoint of biogeography, are vagile organisms living on oceanic or continental islands more likely to be affected by a drop in sea level? Explain your answer. (3 points)

3. Answer the following questions regarding extinction and diversification. (6 points)

- a. There is convincing evidence to support an extraterrestrial event as the cause of the mass extinction that occurred at the end of what PERIOD of Geological Time?

- b. Sepkoski's work with marine animal faunas showed the **Cambrian fauna** to be the LEAST diverse of the 3 faunas occurring over Phanerozoic time. TRUE or FALSE (circle one).

- c. List one difference between background extinctions and mass extinctions.

4. Use the following list of terms to answer questions a. through e. below. You may use each term only ONCE. (10 points)

Homalobatrachotoxin	Ultrabithorax gene	tetrodotoxin
Hox genes	Eyeless gene	Pitohu
Pax 6	Axolotl	neotony
Antennapedia	<i>Drosophila</i>	blue-ringed octopus

- a. The expression of gills in sexually mature individuals of this taxon is thought to have been the result of heterochrony. _____
- b. Mutation in this hox gene in *Drosophila* results in individuals that exhibit two pairs of wings _____.
- c. The highly conserved nature of some genes that regulate morphogenesis is illustrated by the fact that the human gene _____ functions like the Eyeless gene when ectopically expressed in *Drosophila*.
- d. These genes control segment identity along the anterior/posterior axis of the body of metazoans. _____
- e. This is an example of a complex of hox genes. _____

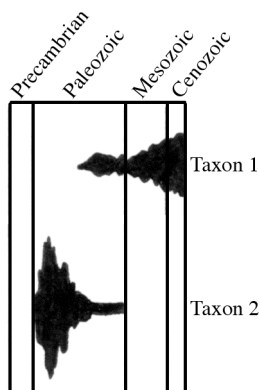
5. Fill in the following blanks. (10 points)

- a. Provide an example of a key innovation _____
- b. The distinction between convergence and parallelism is generally made at what category of classification? _____
- c. The wing of a bat and the wing of a bird are examples of what type of homoplasy?

- d. Provide an example of a Lazarus taxon. _____

6. Identify two sources of molecular sequence data appropriate for reconstructing phylogenetic relationships. (4 points)

7. Describe the differences in quantitative changes seen over Phanerozoic time in the two taxa whose diversity profiles are shown below. (4 points)



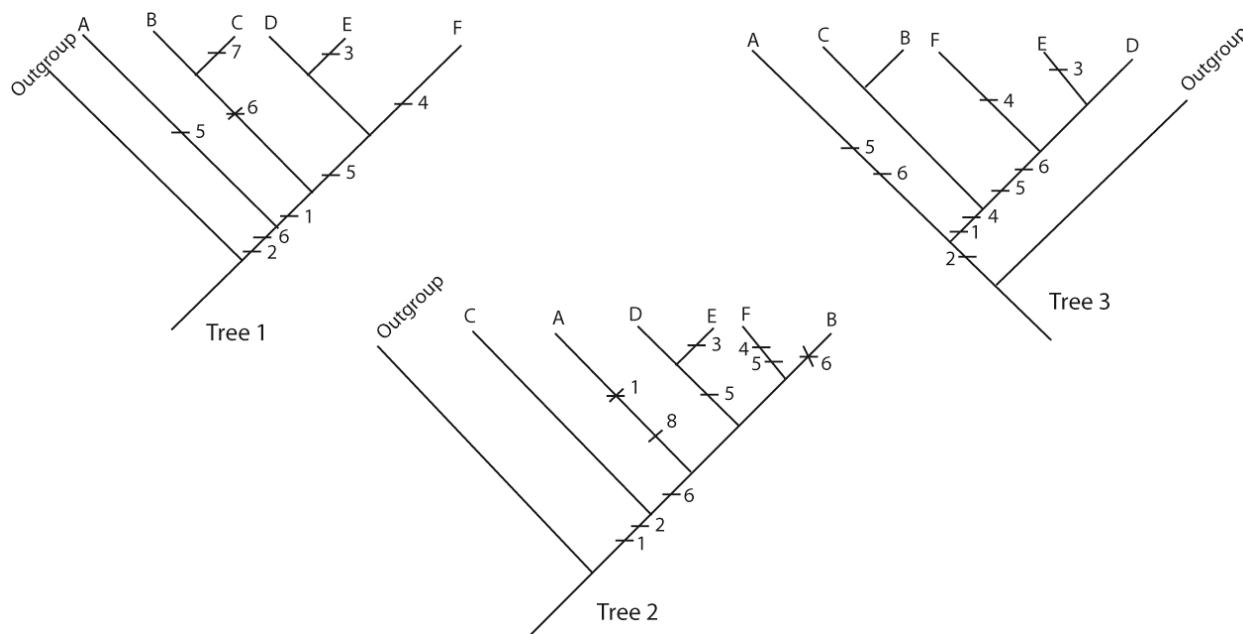
8. Use the following matrix of nucleotide sequence data to answer questions a. through e. below. (10 points)

Taxa	Characters								
	1	2	3	4	5	6	7	8	9
<i>Renyxa amplifica</i>	A	T	T	T	A	G	C	C	A
<i>Renyxa janovyi</i>	C	T	A	T	A	T	A	C	C
<i>Litobothrium nicholi</i>	T	G	C	G	A	G	A	C	T
<i>Litobothrium formis</i>	T	G	C	A	A	G	A	C	T
OUTGROUP	A	T	C	G	C	T	A	G	A

- a. Identify the plesiomorphic STATE of character 6. _____
- b. Identify a CHARACTER that is synapomorphic for the genus *Litobothrium*. _____
- c. Identify the only ingroup species that possesses the apomorphic state of character 7.

- d. Identify an apomorphic STATE of character 3. _____
- e. Identify a CHARACTER that has a character state distribution that is identical to that of character 1. _____

9. Use the following trees to answer questions a. through i. below. (18 points)



- Identify a synapomorphy for the group C + B + F + E + D on Tree 3. _____
- D + E + F is the sister group to what group on Tree 1? _____
- Identify a character that is homoplasious on Tree 2. _____
- What type of homoplasy is represented by the character you chose in c? _____
- Identify a tree, if any, that represents the identical phylogenetic relationships as those illustrated by Tree 3. _____
- Identify a monophyletic group that includes taxon F on Tree 1. _____
- Which of the 3 tree topologies shown is the LEAST parsimonious? _____
- Circle a monophyletic group on Tree 2; label it "M".
- Circle a paraphyletic group on Tree 1; label it "P".

10. Why is it inappropriate to refer to a SPECIES as being primitive or derived? (3 points)

11. Use the following character matrix to answer questions a. through c. below.

Taxa	Characters							
	A	B	C	D	E	F	G	H
<i>Ipsus antorus</i>	1	1	1	1	1	0	1	0
<i>Ipsus finneus</i>	1	1	0	0	0	1	0	1
<i>Ipsus ratous</i>	1	1	1	1	0	1	1	0
OUTGROUP	1	0	0	0	0	0	0	0

a. Draw all of the different possible dichotomous sets of relationships among the THREE INGROUP species included in the above data matrix. (3 points)

b. Map the character data provided in the data matrix above onto EACH of your tree topologies. (6 points).

c. Based on the character data provided in the matrix above, which tree topology is MOST parsimonious? (2 points)

12. Use the map provided below to answer questions a. through e.



- a.** Use stripes to illustrate the distribution of an organism that is endemic to the Neotropical biogeographic realm. (3 points)
- b.** Place Xs on 2 continents that were previously part of Laurasia. (3 points)
- c.** Approximately how old would a taxon distributed as you have indicated in b. need to be in order for its current distribution to be explained by the breakup of Laurasia? (circle one) (3 points)
- i. 140,000 years
 - ii. 14 million years
 - iii. 140 million years
 - iv. 540 million years
- d.** Place a Y on a continent that was previously part of Pangea. (2 points)
- e.** Use shading to illustrate a disjunct distribution within the Palearctic biogeographic realm. (3 points)
- 13.** Dr. Richmond and Dr. Castonguay are having an animated discussion about the molecular clock. Dr. Richmond asserts that the molecular clock runs at the same rate in all taxa and in all genes. Is Dr. Richmond's assertion true? Explain your answer. (3 points)

BONUS QUESTION: (1 pt)

Behold the Rhinogrades. These creatures exhibit adaptive radiation in what feature?

