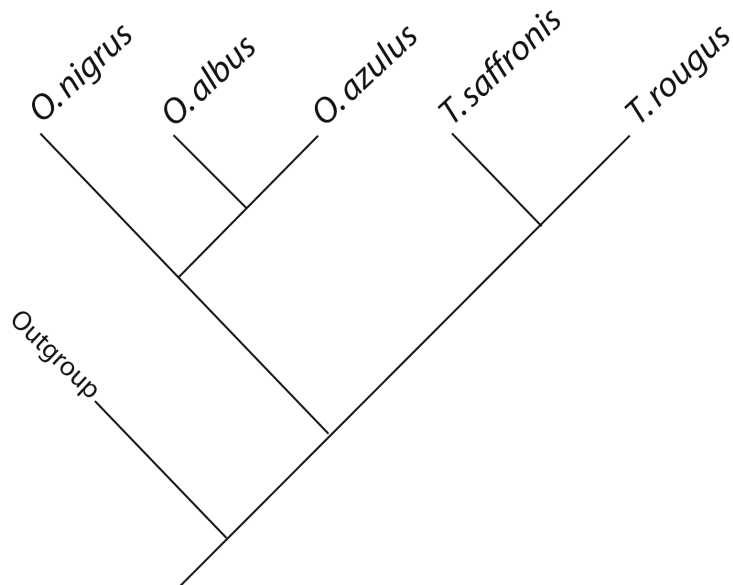


Name _____

Ecology & Evolutionary Biology 2245/2245W
Exam 2
1 March 2014

1. Use the following matrix of nucleotide sequence data and the corresponding tree to answer questions a. through h. below. (16 points)

Taxa	Characters									
	1	2	3	4	5	6	7	8	9	10
<i>Orantinus albus</i>	C	T	G	A	C	A	T	G	C	A
<i>Orantinus nigrus</i>	C	T	G	A	C	G	T	T	A	A
<i>Orantinus azulus</i>	C	T	G	A	C	A	T	G	A	T
<i>Tilinus saffronis</i>	C	A	C	A	G	G	T	G	T	T
<i>Tilinus rougus</i>	C	A	C	A	G	G	A	G	A	T
OUTGROUP	A	T	C	A	G	G	T	G	A	T



a. Identify a CHARACTER that occurs in only a single state in both the ingroup and outgroup. _____

b. Identify the plesiomorphic STATE of Character 2. _____

c. Identify a CHARACTER that is multistate, rather than binary in this matrix. _____

d. Character 6 is found in its apomorphic state in which SPECIES?
(list all if more than one) _____

e. Do any of the ingroup taxa possess the plesiomorphic state of Character 1?

Yes or No (circle one)

f. Identify a CHARACTER that is synapomorphic for the genus *Orantinus*. _____

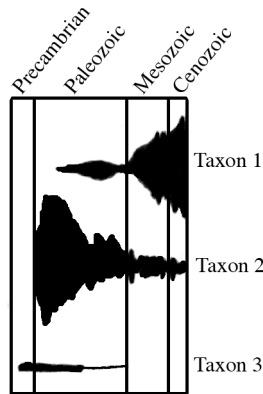
g. The tree above provides the most parsimonious topology for the 5 ingroup taxa based on the data in the above matrix. Map characters 1, 2, 3, 5, 6, 7, 8, and 10 (and only those characters) on that topology in the most parsimonious way possible (hint: the most parsimonious mapping includes only 1 character that is homoplasious on this tree topology).

h. Based on the topology shown above, identify the sister taxon of the group *O. albus* + *O. azulus*.

2. Identify whether each of the following statements about the evolution of biodiversity and extinction is True or False in the blank provided. In each case, feel free to justify your answer. (16 points)

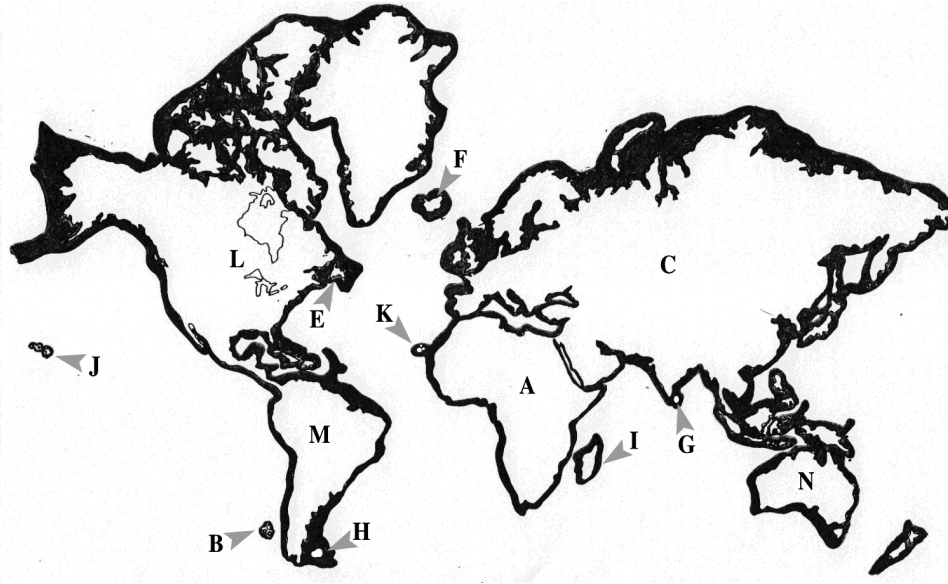
- a. Sepkoski's data suggest that marine animal family diversity has decreased over Phanerozoic time.

- b. All 5 major mass extinction events over the course of Phanerozoic time have been caused by asteroids impacting the earth's surface. _____
- c. The coelacanth, *Latimeria*, is a good example of a Lazarus taxon. _____
- d. The fact that the Mesozoic Era was characterized by a diversity of dinosaurs, whereas the Cenozoic Era was characterized by a diversity of mammals illustrates that there have been *quantitative* changes in diversity over evolutionary time. _____
- e. In general, background extinction rates appear to have increased over Phanerozoic time _____
- f. With respect to the diversity profiles shown below, they indicate that whereas Taxon 3 arose in the Precambrian and remained relatively low in diversity over time, going extinct at the end of the Paleozoic Era, Taxon 2 arose at the beginning of the Paleozoic Era, expanded in diversity in the first half of that Era but then decreased in diversity to a much lower level which it maintains today. _____



- g. With respect to the above diversity profiles, were living individuals of Taxon 3 to be found today, this would be an example of a Lazarus taxon. _____
- h. The lesser volume of sediments found today, relative to that found in previous times, accounts for the fact that we have fewer fossils from recent times than we have from times in the past. _____

3. Use the letters on the following map, which illustrates the extent of the continental shelf in black, to answer questions a. through j. below. In each case, feel free to justify your answer. (25 total points)



- From the map above, provide the letter indicating an oceanic island (or group of islands) located off the coast of the Ethiopian biogeographic realm. _____ (1 point)
- Would a taxon found in the realms marked L, M, A and N be considered to be cosmopolitan in distribution? (1 point)
Yes or No (circle one)
- From the map above, provide a letter that indicates a continental island located off the coast of the Oriental biogeographic realm. _____ (1 point)
- Using stripes on the map above, illustrate the distribution of a taxon that is endemic to a single realm. Identify that realm _____. (2 points)
- During periods of intense glaciation, when sea levels are low, would you expect there to be contact between the flora and fauna of the island marked I and its adjacent mainland? (1 point)
Yes or No (circle one)
- Was the continent marked L once part of: Gondwana, Laurasia, or neither (circle one) (1 point)
- Place X's on the map above to illustrate the distribution of a taxon that exhibits a disjunct distribution within the Nearctic biogeographic realm. (1 point)
- Identify the type of barrier that separates the Ethiopian and Palearctic biogeographic realms. _____ (1 point)
- Draw a line on the map in the approximate location of Wallace's line. (1 point)
- The disjunct distribution of a non-vagile taxon found in realms M, A and N, but NOT L and C, would best be explained by the breakup of what supercontinent? _____. If that were the case, the taxon in question would have to be at least how many million years old (± 10 my) _____. (2 points)
- Would this be an example of dispersal or vicariance? _____. (1 point)

4. Select the term from the following list that **MOST CLOSELY** applies to **NINE (9)** of the following 13 statements/taxa in parts a. through l. below. Use each term only once. (Note that if you complete more than 9 parts, only the first 9 will be graded). (18 points)

character polarization	autapomorphy	parsimony	homologous genes
biogenetic law	symplesiomorphy	mosaic evolution	molecular clock
synapomorphy	Lazarus taxon	character polarization	monophyletic
phylogenetic tree	convergence	homobatrachotoxin	Likelihood method
reversal	endosymbiosis	ancestral	mitochondrial genome
paraphyletic	multiple hits	chloroplast genome	outgroup comparison

- a. A cause of homoplasy seen in molecular data. _____
- b. Method employed to place absolute dates on branching events in a phylogenetic tree

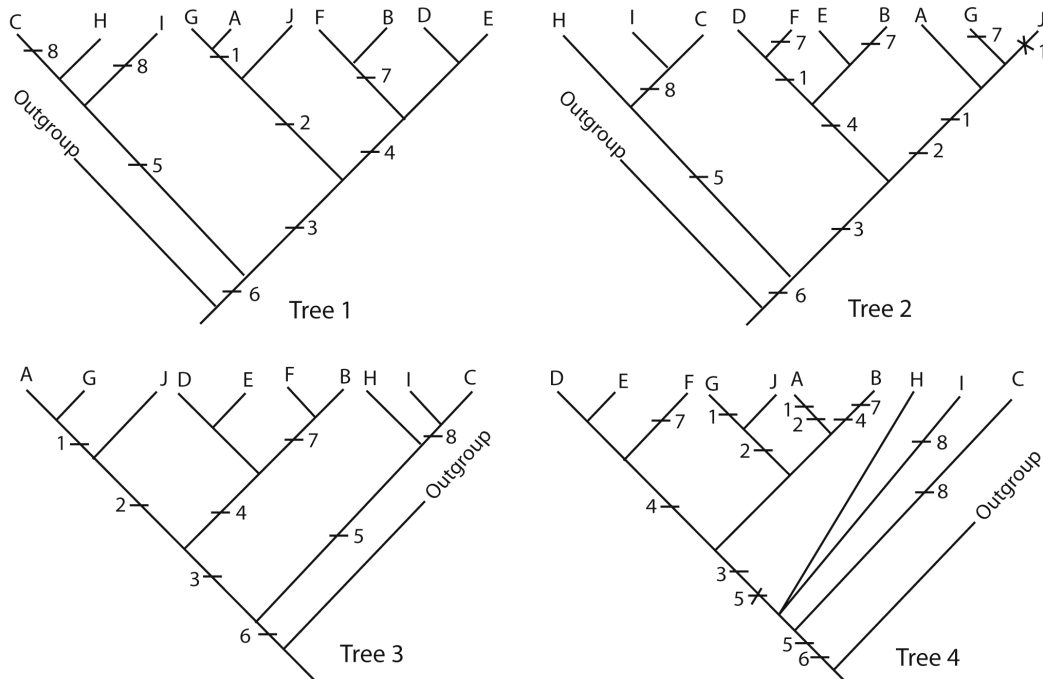
- c. Type of homoplasy seen only in taxa that are **distantly** related to one another _____
- d. Feathers in birds. _____
- e. Hennig's objective method of reconstructing evolutionary relationships uses this method to polarize characters. _____
- f. It is important that the Ingroup exhibit this type of relationship to one another relative to the Outgroup.

- g. Feathers in sea gulls _____
- h. A chemical compound considered to exhibit convergence in two different groups of vertebrates.

- i. A source of data for molecular phylogenetic analyses of both animals and plants.

- j. The notion that evolution occurs at different rates in different characters in a lineage, such that no taxon exhibits entirely plesiomorphic or entirely apomorphic features _____
- k. A group that includes only some of the descendents of a common ancestor. _____
- l. Homodonty in toothed whales is an example of this type of homoplasy. _____
- m. Ontogeny recapitulates phylogeny _____

5. Use the following 4 trees to answer questions a. through k. below. (17 points)



- a. Indicate the length (in number of character changes/steps) of each of the above 4 trees:
 Tree 1 _____ Tree 2 _____ Tree 3 _____ Tree 4 _____
- b. Which of the above 4 trees represents the MOST parsimonious topology? _____
- c. Do any of the 4 trees shown above represent the identical topologies? (yes or no) _____.
 If yes, which ones are identical? _____
- d. On **Tree 1**, does the Outgroup possess the apomorphic or plesiomorphic condition of Character 6?

- e. Provide a synapomorphy for the Group H + I + C on **Tree 2**. _____
- f. Circle a paraphyletic group that includes H on **Tree 3**.
- g. Provide a character that is homoplasious on **Tree 2** _____; assuming this is a tree of 10 species in the genus *Aus*, is the character you have listed an example of a reversal, parallelism, or a congruence?

- h. On the topology of **Tree 1**, use an arrow to indicate the location of the most recent common ancestor of taxa A + G + J + F + B + D + E
- i. What is the sister group of F + B + D + E on **Tree 1**? _____
- j. Identify a monophyletic group consisting of three taxa based on the topology of **Tree 3** _____
- k. Do any of these trees include a polytomy? _____ If so, which one(s)? _____

6. Identify whether each of the following statements about molecular data is TRUE or FALSE. In each case, feel free to justify your answer. (4 points)

- One of the advantages of molecular sequence data over morphological data as a source of phylogenetic characters is that with respect to homoplasy, one need only be concerned with convergences and parallelisms; reversals are not an issue with sequence data.
- Among eukaryotes, amount of genomic DNA is not directly proportional to organismal complexity.
- When using molecular sequence data to reconstruct phylogenetic relationships, each site in the sequence represents a character state, and the nucleotides found at each site are the characters.
- Because of the endosymbiotic origin of organelles, one need not be concerned about phylogenetic trees generated from organelle sequence data differing from those generated from nuclear sequence data.

7. Use the following data matrix for 3 species of the genus *Atoa* to answer questions a. and b. below.

Taxa	Characters							
	A	B	C	D	E	F	G	H
<i>Atoa tintara</i>	1	1	1	1	1	0	1	1
<i>Atoa orientalis</i>	0	1	0	0	0	1	0	1
<i>Atoa balina</i>	1	1	1	1	0	1	1	1
OUTGROUP	1	0	0	0	0	0	0	1

- Without mapping characters, draw the trees illustrating all possible (different) dichotomous relationships among the 3 ingroup taxa in the matrix above. (3 points)

- Circle the tree that shows *Atoa tintara* as the sister taxon to *Atoa balina*, with *Atoa orientalis* as their next closest relative. (1 point)

BONUS QUESTION: Which of the 5 famous Evolutionary Biologists who have visited class since the first exam did you find to be the most interesting (last name only is fine)? Justify your answer. (1 point)