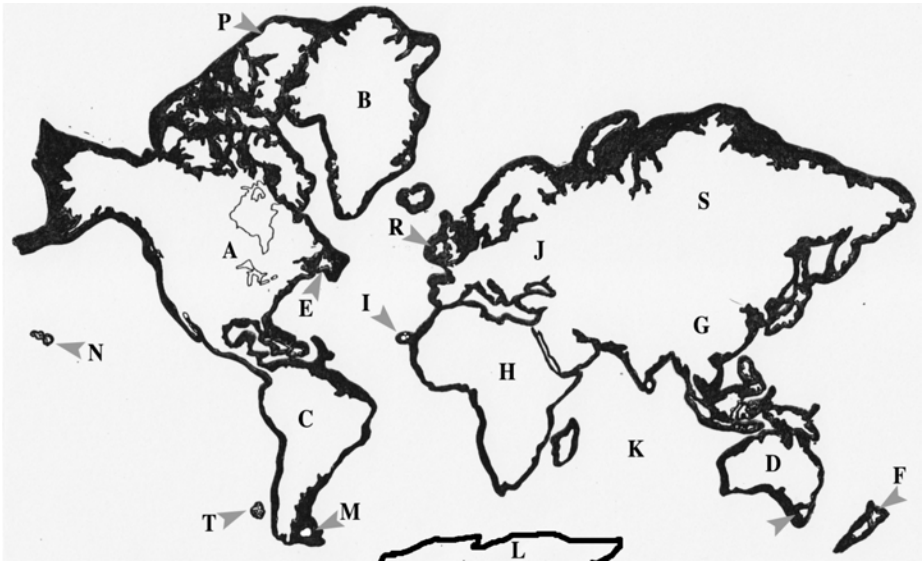
Name _____

Ecology & Evolutionary Biology 2245/2245W
Exam 2
2 March 2017
Version 1

1. **Use the following map, which illustrates the extent of the continental shelf in black, to answer questions a. through g. below.**



a. Could the distribution of a 60 million year-old fossil taxon found on continents A and J be explained by the break-up of Gondwana? Justify your answer (3 points)

b. Would the disjunct distribution of a taxon found on E and in biogeographic realm A best be explained by dispersal or vicariance? Justify your answer. (3 points)

c. Illustrate the distribution of a taxon that is endemic to the Ethiopian realm using stripes on the map above. (2 points)

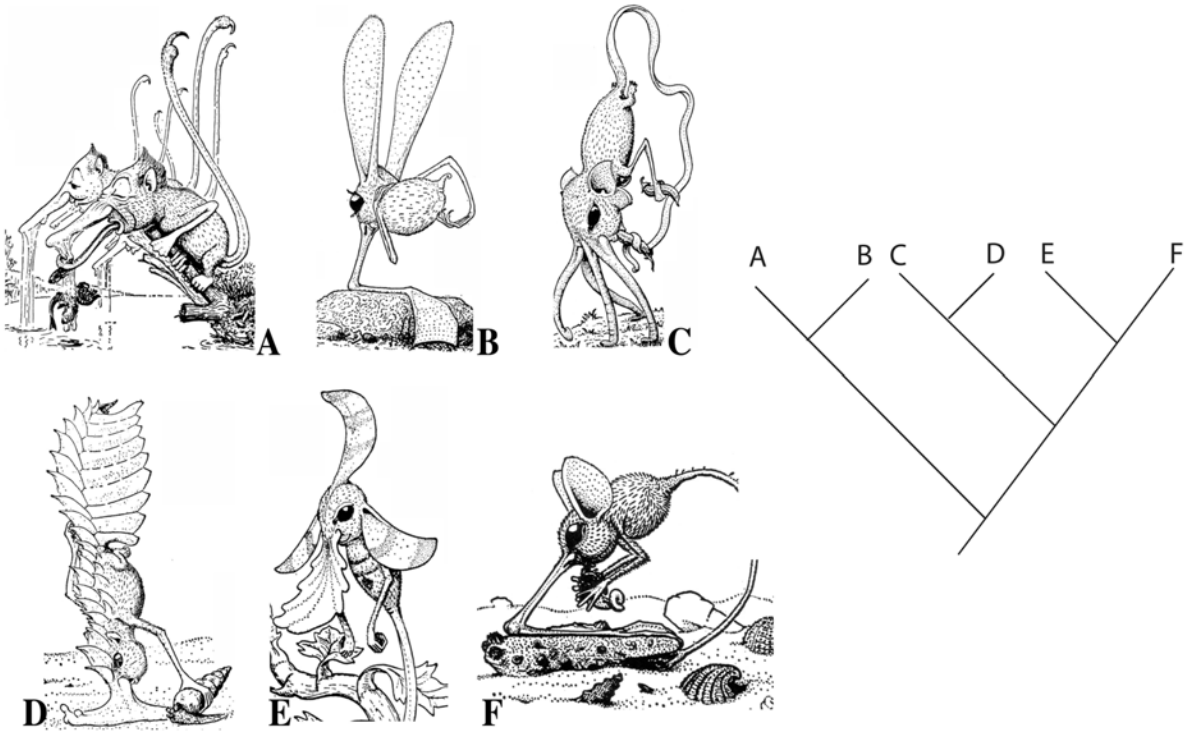
d. Place Xs on the map to illustrate the distribution of a taxon that exhibits a cosmopolitan distribution (you need use only one X per realm). (2 points)

e. Use shading on the map above to illustrate the distribution of a taxon that exhibits a disjunct distribution within the Australian biogeographic realm. (2 points)

f. Identify the type of barrier that separates the Oriental and Palearctic biogeographic realms. (2 points)

g. From the map above, provide a letter that indicates an oceanic island (or group of islands) located off the coast of the Neotropical biogeographic realm. (1 points)

2. **Consider the family Rhinogradidae, or "snouters", six species of which (labeled A through F) are illustrated below. In this (unusual) family of mammals, as can be seen from these illustrations, the nose (i.e., the snout) has been modified over the evolution of the group to serve a variety of different functions. Assuming the topology of the tree of "snouter" relationships shown at the right below is correct, answer the following questions. In all cases feel free to justify your answer.**



a. Is the jointed nose seen in snouter species B and snouter species F homologous or homoplasious in those two taxa? (2 points)

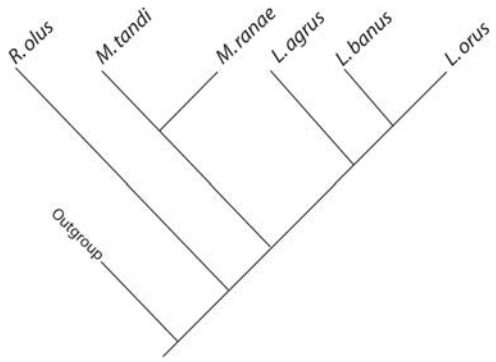
b. Does the presence of a nose represent a symplesiomorphy or a synapomorphy for the family Rhinogradidae? **(Hint: remember that you too are a mammal).** (2 points)

c. Is the jointed nose in species F and species B an example of a parallelism or a convergence? (2 points)

d. Identify a character *other than the snout* that varies among these snouters and identify at least 2 states of the character you have selected. (2 points)

3. **Use the following matrix of nucleotide sequence data AND THE TREE PROVIDED to answer questions a. through h. below**.

	Characters									
Taxa	1	2	3	4	5	6	7	8	9	10
OUTGROUP	A	T	C	G	A	T	C	G	A	T
Ruxus olus	G	T	C	C	C	T	C	G	A	A
Luxus orus	C	T	C	A	C	G	T	G	C	A
Luxus banus	C	T	C	A	C	G	T	G	C	T
Luxus agrus	C	T	T	A	C	G	T	G	A	T
Muxus tandi	C	T	C	T	C	T	C	T	C	T
Muxus ranae	C	T	C	T	C	T	A	T	A	T



a. Based on this tree topology, is the genus *Luxus* monophyletic or paraphyletic? (2 points)

b. Which, if any, of the ingroup species possess the plesiomorphic state of Character 9? (2 points)

c. Identify a CHARACTER that is synapomorphic for the genus *Muxus*. (2 points)

d. Identify the/an apomorphic STATE of Character 4. (2 points)

e. Character 8 is found in its apomorphic state in which SPECIES? (list all if more than one) (2 points)

f. Identify a CHARACTER that is binary in this matrix. (2 points)

g. Identify a synapomorphy for the genus *Luxus*. (Be certain to indicate both the character and the state) (2 points)

h. Map Character 4 onto the tree in the most parsimonious way possible. (2 points)

i. Based on the tree topology shown, identify the sister taxon of *Luxus agrus*. (2 points)

4. **Select the term from the following list that MOST CLOSELY applies to 12 (twelve) of the following 15 (fifteen) statements (i.e., a through o). You may use each term only once. (Note that if you answer more than 12 parts, only the first 12 will be graded).** (24 points)

reversal	Gondwana	plesiomorphic	Anthropocene
parsimony	convergence	mitochondrial genome	Bayesian methods
mosaic evolution	continental drift	biogenetic law	outgroup comparison
synapomorphy	monophyly	molecular clock	mitochondrial genome
paralagous genes	homoplasies	symplesiomorphy	Likelihood methods
multiple hits	paraphyletic	symplesiomorphy	character polarization

a. The process of determining the plesiomorphic state of a character using an Outgroup.

b. Characters you do NOT want to use to reconstruct phylogenetic relationships.

c. Ernst Haeckel's notion that ontogeny recapitulates phylogeny.

d. One of the limitations of using molecular data to reconstruct phylogenetic relationships associated with the fact that molecular characters have only four character states.

e. Type of homoplasy seen only in taxa that are **distantly** related to one another (i.e., in taxa of different families or above.

f. The fact that different features of species evolve at the same times and thus no species exhibits the plesiomorphic conditions of all characters.

g. One of several different sources of molecular data.

h. Epoch of Geological Time the boundary of which is a result of human activities.

i. The concept that the tree topology with the fewest steps (i.e., character state changes) is preferable over topologies with a greater number of steps.

j. One of several methods for assessing phylogenetic relationships among species.

k. Hennig's objective method of reconstructing evolutionary relationships uses this method to polarize characters.

l. It is important that the Ingroup exhibit this type of relationship to one another relative to the Outgroup.

m. Heterodonty in humans.

n. A group that includes only a subset of the descendants of a common ancestor.

o. A shared ancestral trait.

5. **Dr. Onabia has been studying a monophyletic group of moths. He has been fortunate to have been able to follow the evolution of his study group fairly carefully by studying specimens preserved in amber. He has determined with confidence that the group originated about 5 million years ago in the Pliocene Epoch. The species in his group exhibit a very disjunct distribution, occurring only in the Southern hemisphere, specifically in New Zealand, Australia, South America, and South Africa. Can Dr. Onabia include continental drift among the possible explanations he might develop in invoking vicariance to explain the distribution of his moths? Justify your answer.** (3 points)

6. **Identify whether each of the following pairs of features is homologous or homplasious in the taxa indicated. If, in any case, you believe there may be some ambiguity about the answer, be certain to provide an explanation for the answer you have chosen.** (10 points)

   a. Wing of fruit bat and wing of vampire bat. **Homoplasious/Homologous** (circle one)

   b. Wing of sea gull and wing of vampire bat. **Homoplasious/Homologous** (circle one)

   c. Wing of sea gull and wing of crow. **Homoplasious/Homologous** (circle one)

   d. Forelimb of sea gull and forelimb of vampire bat. **Homoplasious/Homologous** (circle one)

   e. Wing of crow and wing of butterfly. **Homoplasious/Homologous** (circle one)

7. **Indicate whether each of the following statements is True or False. If, in any case, you believe there may be ambiguity about an answer, be certain to provide an explanation for your answer.** (6 points)

   a. The end Cretaceous extinction is considered to be the greatest of the 5 mass extinction events in the history of the earth. True/False (circle one)

   b. All 5 mass extinction events are considered to be likely to have been caused by the same type of phenomenon. True/False (circle one)

   c. Background rates of extinction appear to have decreased over geological time. True/False (circle one)

8. **Indicate whether each of the following statements regarding the reconstruction of phylogenetic relationships is** TRUE or FALSE. **If, in any case, you believe there may be some ambiguity about the answer, be certain to provide an explanation for the answer you have chosen.** (8 points)

   a. There is no need for the ingroup to be monophyletic with respect to the outgroup. **True** or **False** (circle one).

   b. Only two of the three major types of homoplasy are possible with molecular data. **True** or **False** (circle one).

   c. Typically, when using molecular sequence data to reconstruct phylogenetic relationships, sites of a gee are treated as characters and nucleotides at each site are treated as character states. **True** or **False** (circle one).

   d. Multiple hits at a site are not a problem with using molecular sequence data in analyses of phylogentic relationships. **True** or **False** (circle one).

9. a. Illustrate the three possible sets of dichotomous relationships for *Taenia solium*, *Taenia asiatica*, and *Taenia ursus*. (6 points)

b. Based on the character data provided for these species in the matrix below circle the tree that is most parsimonious. (i.e., the tree that best reflects the relationships among these three species based on the character data provided). (2 points)

	Characters						
Taxa	1	2	3	4	5	6	7
Taenia asiatica	0	1	0	1	1	0	1
Taenia solium	0	0	0	0	1	1	1
Taenia ursus	1	0	0	1	0	0	1
OUTGROUP	1	0	1	0	0	0	1

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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)