Name: _____   Student Number (optional): _____

EEB 2208: INTRODUCTION TO CONSERVATION BIOLOGY - Midterm

Below each set of questions I've added some explanation of the answers and the rationale for the question (i.e., what I was trying to test). If I have not written anything, most people got the answer right and/or it was just a matter of reproducing information from the lecture material.

Which of the following organisms have undergone major declines following high levels of harvest?

1. Passenger pigeon. A
2. Mourning dove. B
3. Medicinal leeches. A
4. Large sharks. A
5. Gorillas. A

This set should have been fairly straightforward. For the species that have declined, I specifically chose examples that were described as part of a case study that illustrated some larger point. I chose mourning dove because it is a species that I specifically compared to passenger pigeon, to illustrate how closely related species can produce contrasting patterns.

Which of the following statements about species richness are true?

6. The total number of species on Earth is between 1.2 million and 1.5 million. B
7. Species richness tends to peak at high latitudes and low elevations. B
8. Estimating species richness is hard because the rate of speciation leads to new species discoveries every year. B
9. Data from beetles provide a good first approximation of the number of species on Earth. A
10. A majority of the Earth's undescribed species are probably invertebrates. A

The statement in Q6 gives the number of described species, not the total number of species and was included to test whether you recognize that many species remain undescribed. Q9 is correct because beetles were used as the basis for estimating the total number of species on Earth in the example I worked through in class.

Which of these statements about habitat loss are correct?

11. Most habitat loss is caused by urban development. B
12. The area of tropical rainforest destroyed each year is about the same as the area of Connecticut. B
13. More than 90% of wetland habitat in the U.S. (excluding Alaska) has been lost in the last two centuries. B
14. More than 90% of the tall-grass prairie in the U.S. has been destroyed since settlement by Europeans. A
15. More than 90% of the world's coral reefs have been destroyed in the past 200 years. B

The figure below shows how the number of storks and human births varied over time in a German study. Which of the conclusions that follow can you draw from the graph?

16. The human birth rate declined over the time frame of the study, but increased slightly at the very end. B
17. This graph probably illustrates a spurious correlation. A
18. At the start of the study the stork population numbered slightly more than 2000. B
19. The overall trend is similar for both storks and babies. A
20. Human population growth is harming the stork population in Germany. B

These questions were designed to test your ability to interpret graphs, rather than to test anything about your biological knowledge. The conclusions in Q16 and Q18 could not be drawn because no information was provided to enable you to distinguish the two lines on the graph.

The skylark, starling, and tree sparrow are three species that were introduced to North America several decades ago. Populations of all three species persist, with skylarks restricted to a small part of Vancouver Island, starlings found in large numbers across the continent, and tree sparrows found in a small area near St. Louis. Which of the following statements about these birds are correct?

21. Skylarks and tree sparrows are both vulnerable to local extinction. A
22. Persistence of these three populations was probably aided by high propagule pressure. A
23. A likely reason for their introductions is that these species are all referred to in Shakespeare's plays. A
24. All three species are considered invasive. B
25. All three species are likely to be generalists. B

In Q22, "propagule pressure" refers to the number of individuals being brought into a new area, and studies of invasive species suggest that this is one of the better predictors of whether an introduced species will persist and become invasive. Q23 refers to the discussion of cultural reasons behind species introductions, in which I described the existence of societies in North America and elsewhere that set out to introduce all the birds named by Shakespeare. Q24 tests whether you understand the differences between a species that has simply been introduced outside its normal range and one that has become invasive. Q25 tests whether you recognize that generalists tend to do well and become invasive; of the three species in the question only starlings are likely to be generalists, given what you are told about their population growth.

Which of these statements about biological diversity are correct?

26. A comprehensive definition of biodiversity is: "all species of animals on Earth, including their genetic diversity". B
27. Species diversity encompasses variation in morphology, behavior, physiology, and taxonomic uniqueness, among other things. A
28. Temperature, humidity, and salinity are a key part of biological diversity. B
29. Keystone species are those that have a disproportionately large influence on what biodiversity occurs in an area. A

30. Protecting the genetic diversity of species is an important aspect of their conservation. A

Q28 is wrong because all of the variables listed are abiotic. Abiotic factors do help shape biodiversity, but they are not biological themselves.

The graph below illustrates the relationship described by the equation S = c*A^z. Which of the following statements about this figure and equation are correct?

31. The "A" in the equation refers to Area, which increases from left to right. A
32. The "S", "c" and "z" in the equation are all constants. B
33. The equation and graph can be used to determine the number of extirpations caused by habitat loss. A
34. Each dot on the graph represents a different species. B
35. The figure shows the relationship described by the equation after taking logs. A

These questions were designed to test whether you understood the equation underlying island biogeographic theory, and its uses in conservation biology, which we discussed in detail in class. Because this is an introductory course, I present very little math, even though math is central to much of the work done in conservation biology. I do, however, expect you to understand the equations that are presented. Q34 is wrong because each dot on the graph represents data from a different island (or habitat patch).

Which of the following activities fall within the field of conservation biology?

36. Monitoring air pollutants that cause asthma. B
37. Developing legislation to prevent the release of untreated ballast water. A
38. Devising strategies to reduce fisheries bycatch. A
39. Building sand dunes to protect houses from storm surges. B
40. Identifying richness hotspots. A

These questions were designed to test whether you understand the difference between conservation biology and the broader range of topics that encompass the environmental sciences (Q36 and 39) and to test your knowledge of some of the vocabulary relevant to the topic (Q37, 38 and 40).

Global change takes many forms. For which of the following things, is there already good evidence?

41. Oceans are becoming more acidic. A
42. Permafrost is extending towards the equator. B
43. Sea levels are rising due to thermal expansion. A
44. Widespread species extinctions have been caused by recent global warming. B
45. Timing of key life-history events in many species are occurring later each spring. B

Q44 is wrong because few recent extinctions are known to have been caused by global warming to date; the paper you read focused on projected extinctions in the future (which are expected to

be widespread), and I was testing whether you understood this difference. Q45 is wrong because events are generally occurring earlier in the spring, not later. This is because warming means that the temperatures needed for those events to occur happens earlier in the year.

Which of the following examples are correct?

    46. Animal Planet, the cable TV channel, derives from a cultural ecosystem service. A
    47. Vultures provide ecosystem services that are threatened by painkiller use. A
    48. Bushmeat is an example of a provisioning ecosystem service. A
    49. The disappearance of wolves from Connecticut is an example of extirpation. A
    50. Humans are an example of an ecosystem engineer. A

Q46 is correct because nature shows would not be possible were it not for biodiversity (= ecosystem service) and because the values provided are largely for education and entertainment purposes (= cultural).

Which of the following statements about species endangerment are correct?

    51. In Wilcove et al.'s study of endangered species in the U.S., most species were threatened by habitat loss alone. B
    52. In the same study, disease was found to affect about 20% of all species. B
    53. The IUCN has conducted complete assessments of all the world's species to provide information on how many are endangered. B
    54. IUCN assessments are based only on population size and known threats. B
    55. In an analysis of potential future extinctions, Thomas et al. found that climate change alone is likely to cause a 6th mass extinction. B

Q51 was designed to test whether you understood that most species are threatened by multiple factors. Q52 tests whether you understand that disease affects a small percentage of species (e.g., we discussed how it was not thought to affect any invertebrates). Q53 was designed to test whether you understood that assessments are ongoing and knowledge about endangerment is changing all the time (remember the reptile example I gave – whereby the reptile assessment was completed a few days after I lectured on the topic forcing me to go back and change the numbers I'd presented). Q54 is simply factual, although you could have guessed that more was involved given the long list of things affecting extinction that I'd presented. Q55 tests both whether you have a sense of how many species could go extinct due to climate change (up to 20-30%) and how many went extinct during past mass extinctions (>75%), and whether you can put those numbers together to draw an informed conclusion.

Which of the following statements about habitat fragmentation are correct?

    56. Edge effects are caused by the slow erosion of species ranges through local extinctions. B
    57. Habitat fragmentation tends to be most harmful to edge species. B
    58. Roads, powerlines, and dams are all causes of habitat fragmentation. A
    59. There is no need to worry about habitat fragmentation as long as the total amount of habitat lost is less than 30%. B

60. Island biogeographic theory provides important insights into the effect of habitat fragmentation. A

These questions focus on basic understanding of concepts. Q56 tests whether you understand that edge effects relate to edges of habitat patches (not species ranges). Q57 tests whether you understand that it is habitat patch interior species that are most affected by fragmentation (which tends to increase the amount of edge habitat, thereby benefiting edge species). Q58 tests whether you understand that things that cause relatively little habitat loss (roads, power lines) can still cause habitat fragmentation and that fragmentation also happens in freshwater systems (e.g., when dams subdivide rivers).

Which of these statements about disease are true?

61. The transmission of cancer during fights has put Tasmanian devils on a trajectory towards extinction. A
62. Species introductions have been responsible for the spread of avian disease in Hawaii. A
63. Disease can be effectively controlled in some endangered populations, even if the majority of individuals in the population are not vaccinated. A
64. Introduced disease has caused major changes to eastern North American forests. A
65. Small population size makes species more vulnerable to extinction due to disease. A

Which statements correctly connect the named species to a cause of their endangerment?

66. The Puritan tiger beetle is a narrow range species at risk of catastrophe. A
67. The rainbow trout is at risk from hybridization. A
68. The large blue butterfly is at risk from co-extinction. A
69. The heath hen is at risk from recent climate change. B
70. Cone shells are at risk because of their use in biomedical research. A

The figure below comes from the paper by Myers et al. that was assigned for discussion. Which of the statements that follow are correct?

71. The figure shows population change in twelve different species. A
72. The figure illustrates a trophic cascade. A
73. The figure illustrates the effects of overharvest. A
74. The figure illustrates extrapolation beyond the data. B
75. The figure illustrates the keystone species concept. A

This was another set of questions designed in part to test your ability to interpret graphs. Q71 simply tested whether you had read the labeling on the graph – if you did you would know that four of the graphs related to a single species (something we also talked about in the discussion). Q74 tests whether you understand the concept of extrapolating beyond the data.

Conservation biologists frequently make inferences based on imperfect knowledge and extrapolation. Which of the following statements, based on extrapolation, are reasonable?

76. Identifying biodiversity hotspots based on well-studied groups of organisms will ensure the protection of all groups. B
77. Data deficient species are so numerous that it is impossible to compare modern extinction rates to those in the past. B
78. If a data deficient species is declining, habitat loss is probably a contributing factor. A
79. Protecting habitat in the lowland tropics is likely to benefit more species than protecting habitat in the montane boreal zone. A
80. If a terrestrial species has declined due to habitat loss, it is likely that agriculture is the cause. A

Which of the following statements about extinction are correct?

81. Widespread human-caused extinctions are a phenomenon that has emerged in the past 100 years. B
82. Documented declines in the extinction rates of island birds suggest that conservation is working. B
83. One way to determine whether a species is likely to be extant is to look at the length of the time gaps between past sightings. A
84. Global assessments of the number of declining and endangered species provide a way of determining the size of the current extinction debt. A
85. Background extinction rates are similar to what is seen today. B

Q81 tests whether you recognize that humans have been causing extinctions for many 100s of years (several examples were given in class). Q82 tests whether you understand that a decline in extinction rates could simply be because we are approaching the point where there are not many species left to go extinct (i.e., as the number of species approaches zero, extinction rates have to slow down no matter what conservation is being done) – again this is an idea we discussed in the context of 2-3 different examples.

Which of the following statements about ecosystem services are correct?

86. Increased nitrogen use, in the form of fertilizers, has provided an important ecosystem service to humans. A
87. Increased nitrogen use, in the form of fertilizers, has created "dead zones" in the world's oceans. A
88. High biodiversity is nearly always found in places that provide a lot of ecosystem services. B
89. The magnitude of pollination services depends on the proximity of natural habitats. A
90. Ecosystem services are the basis for human well-being. A

91. Earlier in the exam I gave you a figure from Myers et al.'s paper on sharks. How could one confirm that the relationship between cownose rays and bay scallops shown in that figure is not simply a spurious correlation? (2 points)

You would need to conduct an experiment similar to the one described in the paper, in which the researchers excluded rays from an area and measured the effects on scallops. If the scallops increase relative to areas outside the exclusion zone then it supports the idea that there is no spurious correlation. 1 point for describing the experiment; 1 point for describing the response needed to confirm that the correlation is not spurious. Partial credit was given for other approaches that would have bolstered the evidence for a mechanistic relationship, but that alone was not sufficient to ensure that the correlation was meaningful.

92. What is Ehrlich's "rivet-popping" analogy and how does it relate to conservation biology? (2 points)

Ehrlich likened communities to an airplane. If a plane loses a few of the rivets holding it together it probably will still fly without any problems. If you progressively remove more rivets, however, the plane will eventually fall apart in a way that could be disastrous. Similarly, ecosystems can probably lose a few species without any major repercussions. But if you lose too many, major changes are likely (e.g. think back to the Easter Island example). 1 point for describing the airplane example; 1 point for explaining how it compares to an ecosystem.

93. The pictures below represent two ecological communities. Brian tells me that the community on the right has higher diversity. I think he is wrong. Explain the source of our disagreement as fully as you can. Use only the information in the two pictures (i.e., there is no need to invoke hypothetical issues, such as the fact that we know nothing about genetic diversity in the species involved). (3 points)

Brian thinks that the community on the right has higher diversity because it has greater species evenness. I disagree because the community on the left has greater species richness (more species). Either of these points of view is legitimate because species diversity can be measured in multiple ways that are often inconsistent. 1 point for each of these three ideas.

94. Give an example of each of the following. Examples must be individual species, rather than references to groups of species (e.g., "coral reef" would not be acceptable). Listing multiple options will get no points unless all are correct. If you use an example that was not mentioned in class please explain your answer. (3 points)

a) An invasive plant: Any verifiable example. Examples given in class include purple loosestrife, salt cedar (tamarix), prickly pear cactus, *Phragmites*, and kudzu. Others may have been mentioned in the cane toad movie or the Hawaiian bird discussion paper. If you got this question marked wrong, but believe your example is valid, then I will consider a re-grade if you can provide convincing evidence to support your claim.

b) A species used for biological control: Any verifiable example. Examples mentioned in class include the *Cactoblasti*s moth and mongoose. If you got this question marked wrong, but

believe your example is valid, then I will consider a re-grade if you can provide convincing evidence to support your claim.

c) A species that has been the target of biological control: Any verifiable example. Examples mentioned in class include prickly pear cactus and rats. If you got this question marked wrong, but believe your example is valid, then I will consider a re-grade if you can provide convincing evidence to support your claim.