Name: _____ Student Number (optional): _____

EEB 2208: INTRODUCTION TO CONSERVATION BIOLOGY - Midterm

Correct answers are in boldface. 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 haven't written anything then most people got the answer right and/or it was just a matter of reproducing information from the lecture material.

Which of the following is a component of biological diversity?

1. **Interactions among species.**
2. **Species evenness.**
3. **Species richness.**
4. **DNA differences among humans.**
5. **Different species assemblages.**

Q4 was the hardest part of this set, and was designed to test both (a) that you understand that genetic variation is a component of biodiversity and (b) that humans are part of biodiversity (because we're living organisms).

Why did heath hens go extinct?

6. Because no land was protected for them.
7. **Because their habitat was destroyed.**
8. Because they are a long-lived species, with high reproductive rates.
9. **Because a harsh winter killed many individuals.**
10. **Because they were hunted.**

A recent study by Koh et al. described patterns of co-extinction. Which of the following results arose from that study?

11. **Many symbiotic species are vulnerable to extinction.**
12. Most future extinctions are likely to be due to co-extinctions.
13. The risk of co-extinctions is far less serious than previously thought.
14. **The extinction of currently endangered species will result in 1000s of co-extinctions.**
15. In the past 100 years, millions of species have gone extinct because their host species have gone extinct.

Q12 was hard because there will be a lot of co-extinctions in the future…but probably not "most". In the example I gave, the number of predicted co-extinctions was a lot less than the number of species known to have gone extinct. Based on this result, the number of co-extinctions is expected to be less than half of all future extinctions (about 30-40% if you do the math, based on the example). Q15 also related to co-extinctions, but was designed primarily to determine whether you know the approximate number of extinctions in recent times. Given that the current estimate of the number of species on the planet is only 5-30 million, it is very unlikely that millions of species could have gone extinct in the past 100 years. If you then limit things further by focusing only on co-extinctions, then it is even less likely.

Name: _____ Student Number (optional): _____

Which of these statements about habitat loss are true?

16. The area of tropical rainforest destroyed each year is about the same as the area of Connecticut.
17. **About half of the wetland habitat in the U.S. (excluding Alaska) has been lost in the last two centuries.**
18. Most habitat loss is caused by urban development.
19. Well over half the coral reef habitat in the world has been lost or severely damaged.
20. **Habitat loss and degradation affects more endangered species in the US than any other threat.**

This set of questions was primarily designed to test whether you have a general idea of the magnitude of habitat losses. For Q16, it is sixteen times the area of CT; for Q18, most loss is due to agriculture (if you think about it relatively little of the world's land is actually urban); for Q19, it is <30%.

Based on what I have told you in lectures, which of these places are likely to be species richness hotspots?

21. Alaska.
22. **Madagascar.**
23. **The South American Andes.**
24. Easter Island.
25. **The ocean between Australia and SE Asia.**

Only Q23 tripped up many people here. I included this example as it was the primary hot spot area from the discussion reading on hot spots (Orme et al.), which found that it was the one area where all three types of hotspots overlapped … ironically, it was probably the one site that we talked about a lot in class. Alaska, Madagascar, and Easter Island were not discussed at all in class, but were included to determine whether you understood the general patterns of where richness is highest (high in tropics, low towards poles and on small/remote islands).

Which of the following statements about extinction are correct?

26. Mass extinctions have been very common throughout geological time.
27. Extinction rates were far higher during past mass extinctions than they are today.
28. **Extinction is a natural process.**
29. Extinction rates in marine species are much higher than for terrestrial species.
30. Initial estimates suggest that climate change will cause about 5% of species to go extinct.

A lot of people asked questions in the exam that suggest that they were confused by the word "very" in Q26. I included that word thinking it would help you, though, by removing absolutely any hint of ambiguity (not to make it "tricky"!). Since there have only been 5 documented mass extinctions since life arose, they are exceedingly rare events – so the statement would be wrong whether the word "very" is there or not. The answer to Q30 was in the abstract of the paper I assigned you to read for the climate change lecture (I mentioned the same information briefly in

class, but mostly I expected you to get it from the reading; 15-37% is correct). I included this question partly because it is important to know just how big an effect climate change could have, but mostly to test the skills that the discussion readings are designed to teach – the main one of which is whether you can identify the key ("bottom-line") result when you read a scientific paper.

Which of the following disciplines play an important role in conservation biology?

31. Genetics.
32. Political science.
33. Geography.
34. Economics.
35. Environmental activism.

Mostly this set was designed to determine whether you understood the multi-disciplinary nature of conservation biology. Q35, however, was designed to determine whether you understood that conservation biology (a scientific discipline, where people strive to be objective) is not the same as environmentalism (where political agendas are paramount, and objectivity often is not).

In 1989, E. O. Wilson concluded that 34 species go extinct every day in one of the first attempts to estimate global extinction rates. Which of the following assumptions did he make in deriving this estimate?

36. Patches of habitat act like 'islands" in a "sea" of unsuitable habitat.
37. All species are found in temperate countries.
38. The number of species in a habitat patch does not change as the area of habitat changes.
39. There are 5 million species on Earth.
40. Marine species are not important.

Only Q40 gave a lot of people trouble. Wilson's estimates were based only on tropical rainforest species (that was one of his key assumptions), so his estimate ignores all marine species – hence he assumed they are unimportant.

Which of the following statements about over-harvest are true?

41. Species with high reproductive rates are most vulnerable to over-harvest.
42. Over-harvest tends to affect plants more than animals.
43. Bush-meat is widely exported from Africa for profit.
44. Many marine species are threatened by over-harvest even though they have no commercial value.
45. The annual harvest of millions of mourning doves is sustainable.

This set was fairly straightforward and most people got each question right.

Why are there more endangered species in Hawaii than in California?

46. Introduced predators have a bigger impact on island species than on mainland species.
47. Hawaiian species have higher reproductive rates than Californian species.
48. Island species generally have small geographic ranges.
49. Hawaii is a group of remote islands.
50. Island species have lower population fluctuations.

Again, for each of these most people got the answer right.

Which of the following statements about global change are accurate?

51. In parts of the world over 75% of river water is already allocated to human use.
52. Atmospheric carbon dioxide concentrations are at their lowest point in 400,000 years.
53. Global precipitation is likely to increase, and areas suffering water stress are expected to grow.
54. Biotech (genetically-modified) crops are rarely used, but could revolutionize agriculture.
55. Increased air-travel by humans is likely to increase the spread of disease organisms.

Only, Q54 caused much trouble here. It is wrong because these crops are already very widespread around the world (I presented a map when I spoke about the many ways that global change is occurring). I admit that this was not something I spent a lot of time on in lecture, and normally I would not ask about things covered so briefly. But, since it was in the lecture I gave only 2 days before the exam I thought it would still be fresh in people's minds.

Which of the following is an accurate definition of the word "average"?

56. The middle value when all values are organized from smallest to largest.
57. The sum of all the values divided by the number of values.
58. The sum of all the values divided by the mean.
59. The most common value.
60. The mid-point between the largest value and the smallest value.

Q56 and Q60 test whether you know the definition of the median; Q57 and Q58, whether you know the definition of the mean; Q59 whether you know the definition of the mode; overall the set tests whether you understand that "average" can mean several different things.

Which of the following statements refers to an effort designed to limit the effects of introduced species?

61. Harvest of Nile Perch in Lake Victoria in the Rift Valley of Africa.
62. Releasing all of the birds mentioned by Shakespeare into North America.
63. Releasing mongoose into the cane fields of Hawaii.
64. Causing the space craft Galileo to crash into Jupiter.
65. Introducing the moth *Cactoblastis* into Australia.

These all come directly from the examples I talked about in lecture; Q61 was the only one that a lot of people got wrong – in this case harvest was the reason why Nile perch was introduced.

Which of the following could be considered keystone species?

66. Wolves.
67. Beavers.
68. Puritan tiger beetles.
69. Humans.
70. Sea otters.

Wolves, beavers and sea otters are all examples that were given in class and/or the text book. The other two species were included to see whether you could generalize the concept. Puritan tiger beetles are exceedingly rare so they are very unlikely to have a disproportionately large effect on an ecosystem. The lecture on global change (and much of the course so far) was about how humans are having dramatic effects on ecosystems all over the world, so they easily meet the definition.

One of the best studies to examine the characteristics of successful invading species involved birds introduced to New Zealand. In this study, what were the best predictors of invasion success?

71. The number of individuals released.
72. Reproductive rates.
73. The number of potential competitors.
74. Life spans.
75. The number of introduction attempts.

In lecture, I presented a number of general factors that have been associated with invasion success. I then presented the New Zealand example, saying that it was one of the best and that it found that most of those general factors were not actually important (suggesting that they might have been identified due to spurious correlation). Q71 and Q75 give the things that are unambiguously important. So, this question is focused on a case study that combined the use of skills discussed in the "use of statistics" lecture with the interpretation of data in a specific example.

Climate change has been predicted to cause many changes in the future. For which of the following things, is there already good evidence?

76. Growing season lengths have declined.
77. Net primary production by plants in the Amazon Basin has declined.
78. Sea-levels are rising faster than IPCC reports have predicted.
79. Arctic permafrost is spreading.
80. Many species have shifted their geographic ranges to the north.

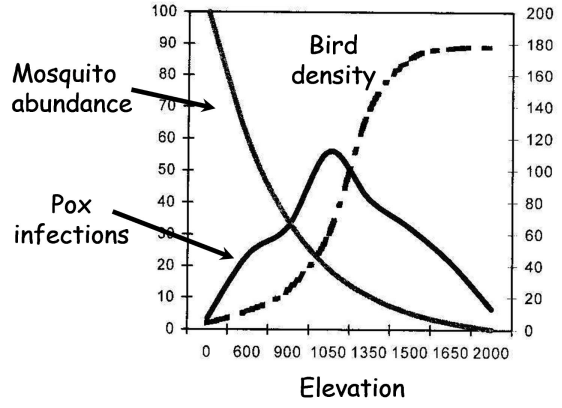
These are simply changes I talked about in the lecture. For questions like this, even if you do not remember what was said in class, you can often work the right answer out if you think it through carefully. E.g., if the climate is getting warmer, then it is likely that growing seasons will be longer (because most plants grow better when it is warm), that plant production will increase (for the same reason), that things that are frozen (like permafrost) will shrink, and that species will move north (because more northern places will warm up and become more like southern areas; at least in the northern hemisphere).

Which of these definitions are correct?

81. An extirpated species is one that is locally extinct.
82. By-catch refers to species that are caught for bush meat.
83. Beta-diversity refers to the number of endemic species in a place.
84. Abiotic refers to the biological portion of an ecosystem.
85. Heterozygosity refers to a measure of genetic variation within a population.

This set was just a matter of learning definitions of key words. Obviously, any term I give you in lecture is important, but when it is bold faced in my notes (or part of a subheading) you should take that as a sign that it is especially important.

The figure below was discussed in the lecture on diseases and describes factors affecting the incidence of avian pox in Hawaii. Which of the following statements about the figure are true?



.

86. This figure shows that birds are uncommon in the lowlands of Hawaii.
87. This figure shows that birds can effectively control introduced mosquito populations.
88. This figure suggests that pox infections are highest where the mosquito vector is most common.
89. This figure plots data for two introduced organisms.
90. From this figure it is impossible to tell how many pox infections occur at 1050 m.

This question was designed to test your ability to interpret graphs. Only Q89 required that you know anything about the specific example (i.e., that both the disease and the mosquitoes are introduced). Q86 was simple graph interpretation; Q87 tests whether you understand that correlation does not mean causation (i.e., mosquitoes decrease as bird numbers increase, but

this is not because birds eat the mosquitoes – that correlation is spurious); Q88 is simple graph interpretation again (the infection peak is at an intermediate elevation, which is not where mosquitoes are most common); and Q90 tests whether you recognize that without label axes you cannot tell which numbers go with which lines.

91. Give an example of each of the following. In each case you must be specific to get the points. (5 points)

For all of these it really was important to be specific. I did not require that you had the formal species names, but mentioning broad groups of organisms ("fish", "plants", "that bird") was not good enough.

An invertebrate that has been overharvested:

Lots of options here, but among those discussed in class are medicinal leeches (no one got this even though I put up that creepy picture to help you remember!), oysters, cone snails, scallops. Shrimp (and various other marine organisms that form by-catch) would also be acceptable. The main reason people got this wrong was by listing something that is not an invertebrate.

An endangered species currently found in Connecticut:

Again, lots of examples. In class I've mentioned Puritan tiger beetle, American chestnut, grasshopper and Savannah sparrow, and a few others, but I accepted anything that met the description. In some cases, species were mentioned that I do not know much about. For these, I did a little research to see if they were listed as endangered and gave points if I found evidence that they are. If I marked your answer wrong, but you can provide evidence that the species is endangered then bring me the evidence (it needs to be good – peer-reviewed science and/or government/legal documents) and I will regrade.

A species that has been extirpated from Connecticut since European settlement:

In class I discussed in detail passenger pigeon and heath hen, and mentioned a few others, but anything that is documented as having been wiped out (either temporarily or permanently) would be acceptable. Again, I will consider a regrade if you can provide convincing evidence to support your claim.

A species that has declined severely due to pollution and the pollutant that caused the decline:

In class I described the decline of three species of Asian vultures due to diclofenac. I also stressed the importance of reading the pollution section of the text book, where other examples are given. There were two points for this part of the question – one for the species and one for the pollutant. Again, I will consider a regrade if you can provide convincing evidence to support your claim.

92. The graph below illustrates the relationship described by the equation $S = c*A^z$. Label the graph to indicate how the terms in the equation relate to the figure. Explain (by

drawing on the figure if necessary) how you would use this graph to determine how many species would be lost from a patch if its size were reduced due to habitat destruction. (4 points)

Two points were available for labeling the figure. For full points you needed to get at least four of these five things right: labels for (a) area on the x axis, (b) species count on the y axis, (c) z as a constant describing the slope of the dotted line, (d) log c (I also accepted just c) as the point of intersection between the dotted line and the y axis, and (e) recognizing that area and size should be plotted on log scales.

The other two points were for showing that you can plot the starting patch size (A_1) on the x axis, then go up to the dotted line, and then left to the y axis to figure out the expected species richness (S_1). You can repeat this for the reduced patch size (A_2) to get the species richness after habitat loss (S_2). The difference (S_1 - S_2) is the amount of species loss due to habitat destruction.

93. State one thing that I could do to help you understand the material better (presenting less information, or saying that there is nothing I can do, are not acceptable answers ☺). (1 point)

Pretty much anything would have been OK here, as long as you didn't do one of the things that I said was unacceptable. And, I should add that I really appreciate the comments. I responded to many on the exam papers, and I will post some general responses on huskyct. I will also try to adopt some of the suggestions in the second half of the course.