EEB 2208 (Introduction to Conservation Biology)

Homework 6: Lectures 1-12

Homework checklist

- Answer every question or you will get no points
- Submit your responses before midnight on the Friday they are due or you will get no points
- Put your answers in the body of an email (no attachments) and send it to manette.sandor@uconn.edu.
- Make sure that the subject line of your email says: EEB2208_homework_6
- Be sure to use the format explained in class and for Homework 1. Each numbered item is a separate question and would be worth 1 point on an exam.
- A = demonstrably true, B = not demonstrably true (i.e., false)

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

1. Growing season lengths have declined. **B**
2. Net primary production by plants in the Amazon Basin has declined. **B**
3. Sea-levels are rising faster than IPCC reports have predicted. **A**
4. Arctic permafrost is spreading. **B**
5. Many species have shifted their geographic ranges to the north. **A**

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). In this question, I considered those 4 parts to be pretty easy because they just follow basic logic. The final part (Q3) requires more specific knowledge and was included to help identify someone who has above-average knowledge of the material.

Which of the following statements about global change are accurate?

6. A major effect of increasing atmospheric CO_2 is that the world's oceans are becoming more acidic. **A**
7. Atmospheric carbon dioxide concentrations are at their lowest point in 400,000 years. **B**
8. A major reanalysis of global temperature data that was conducted recently suggests that warming trends are quite different from what previous analyses have predicted. **B**
9. Melting of Arctic sea ice is predicted to cause sea-levels to rise over the next century. **B**
10. Increased air-travel by humans is likely to increase the spread of disease organisms. **A**

Mostly these questions relate to straightforward factual information that I talked about. Acidification is a direct consequence of atmospheric CO_2 being absorbed into the ocean. CO_2 concentrations are currently much higher than they have been for 400,000 years. The recent reanalysis that I described in class – conducted by scientists who had questioned whether climate was changing in the way that most climate scientists suggest – produced results that are barely distinguishable from previous analyses. Melting sea-ice is not an important contributor to sea-level rise, most of which is caused by either thermal expansion (as water gets warmer it expands) and the addition of water as land-based ice (glaciers, ice caps,

Greenland, Antarctica) melts. Finally, increased movements by humans will increase the spread of many organisms, including those that cause disease.

Which of the following examples are correct?

11. Animal Planet, the cable TV channel, derives from a cultural ecosystem service. **A**
12. Vultures provide ecosystem services that are threatened by painkiller use. **A**
13. Bushmeat is an example of a supporting ecosystem service. **B**
14. The disappearance of wolves from Connecticut is an example of extirpation. **A**
15. Humans are an example of an ecosystem engineer. **A**

Q11 and 13 were designed to test whether you could correctly classify ecosystem services according to the MEA criteria. Q13 was straightforward, but Q11 perhaps required a little more thought. Q12 required that you know both that vultures provide an important service to people (carcass disposal, especially in tropical areas) and that their populations have undergone serious declines due to use of a painkiller in livestock. Q14 and 15 were designed simply to test whether you understood the terms extirpation and ecosystem engineer and could apply them to examples that I did not talk about in class (i.e., whether you could go beyond memorizing my examples, and apply the concepts to new situations).

Which of the following statements about ecosystem services are correct?

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

Q16 and 17 were intended to test whether you recognize that both clear human benefits and high biodiversity costs can arise from the same action. Assessing these trade-offs is not simple and makes any attempt to quantify ecosystem services tricky. Q18 tests whether you understand that places that provide the most services do not necessarily have the most biodiversity, and that protecting for one will not necessarily protect for both. Q19 is straightforward and derives from the graphs I discussed in class. Q20 simply recognizes that everything we do depends on the functioning of ecosystems.

The following graph summarizes information from many studies of the way in which climate change is affecting species. Which of the following statements about the graph are accurate?

21. The phenology of entire communities of organisms are changing in synchrony. **B**
22. Key events in the life-history of most species studied now happen earlier in the year. **A**
23. Climate induced extinctions are getting more and more common. **B**
24. This figure provides support for climate-caused changes in phenology. **A**
25. A possible consequence of the results shown here is that symbiotic relationships will be disrupted. **A**

Q21 is incorrect because the wide spread of phenology changes along the x axis suggests a lack of synchrony, plus there is no reason to believe that these species all come from the same communities. Q22 is correct because the bulk of the species that are shown in the figure show negative values, suggesting that the trait has moved earlier in the year. Q23 is not an accurate statement about the graph, simply because the figure gives no information about extinctions, just about changes in the timing of events.

Q24 was designed to test whether you understand the term "phenology". Q25 was the hardest part of this set because it requires that you connect the discussion of symbiotic relationships discussed earlier in the semester with the more recent material. If the phenology of species is being changed by climate change, and the amount of change varies among species (as shown in the figure) then it is possible that mismatches in the timing of key events in symbiotic species may occur. For example the emergence of a caterpillar species may not be synchronous with the emergence of its host plant, or the timing of egg-laying in a bird may occur too early or too late for chick hatching to coincide with times when there is a lot of food available (I discussed this second example in class).

Which of the following statements about species endangerment are correct?

26. In Wilcove et al.'s study of endangered species in the U.S., most species were threatened by habitat loss alone. **B**
27. In the same study, disease was found to affect about 40% of all species. **B**
28. The IUCN has conducted complete assessments of all of the world's species to provide information on how many are endangered. **B**
29. IUCN assessments are based only on population size and known threats. **B**
30. In an analysis of potential future extinctions, Thomas et al. found that climate change alone is likely to cause a 6th mass extinction. **B**

Q26 was designed to test whether you understood that most species are threatened by multiple factors. Q27 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). Q28 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 just a couple of years ago forcing me to go back and change the numbers I used in my lecture in previous years). Q29 is simply factual, although you could have guessed that more was involved given the long list of things affecting extinction that I have presented. Q30 tests both whether you have a sense of how many species could go extinct due to climate change (up to a maximum of 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. To get this last part right you would have had to have read the assigned reading for the global change lecture.

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

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

This set of questions was difficult because I'm asking you to assess how "reasonable" the statements are. Unfortunately, outside the classroom many things are not black and white and so it is important to be able to take a complex problem and make this kind of assessment. That said if you really understand the class material well, you should have no trouble assessing each of these statements. Q31 is not reasonable because I presented several examples that show that hotspots based on different types of organisms often do not overlap. Q32 is not reasonable because, even though there are a lot of data deficient species, we

can still generate ballpark estimates of extinction rates (albeit with uncertainty); you should know this because I've presented several such estimates in class. Q33 is reasonable because the vast majority of species studied are declining at least in part because of habitat loss. Given that this is true, and that we know that most natural habitats are declining, it is likely that even those species we don't know much about are also being affected by habitat loss. Q34 is reasonable because I told you that species richness declines with elevation and with latitude. Consequently, it is very likely that there will be more species in the lowlands than in montane areas and more species in the tropics than the boreal zone. Combining those two things makes it almost certain that the statement is accurate. Finally, Q35 is reasonable because most habitat destruction occurs as a result of land conversion to agriculture.

36. Describe three broad categories of ecosystem service, as described by the Millennium Ecosystem Assessment, and give an example of each. (6 points)

See notes for Lecture 12. 1 point for each category named, 1 point for each valid example. You could even use the ones from earlier in the homework – assuming that you knew whether they were right or not. On an exam I'd probably be more careful about not giving the answer to one question somewhere else (you never know though ….).

37. Give specific examples for each of the following things. (5 points)

a) An introduced species and a native species that it affected: Lots of examples could have been used here – e.g., see notes for Lecture 10. The tricky part is that you would have needed to know specific names. E.g. "cane toad and northern quoll" would get the points; "that desert shrub and the bird that nests in it" would not. Note that in the question I just said "affected" so even a positive affect would have received points.

b) A greenhouse gas: Carbon dioxide is the most obvious answer, but there are others (e.g., methane, nitrous oxide).

c) A species used for biological control and the species it was supposed to control: Three that I talked about in class are the introduction of mongoose to Hawaii to control rats (which failed), and the introduction of *Cactoblastis* moths to Australia to control prickly pear cactus (which succeeded). I would have accepted the introduction of myxomatosis (a virus) into Australia to control rabbits, even though some would not consider a virus to be a species. I would also have accepted any other valid examples, as long as I could find evidence to back them up.

38. Describe the way in which the ecology of four particular species of your choice have changed as a result of climate change (4 points)

Lots you could have written here. If you can't think of any go back over notes from the climate change lecture. Again, I would have accepted any valid response, including examples you've read about in the news or on my twitter feed. For points though, you must name a particular species.