EEB 2208 (Introduction to Conservation Biology)
Homework 11: Lectures 1-21

The CT DEEP plans to restore an area of grassland on an old landfill in Hartford. The goal is to restore all of the ecological functions of the historic grasslands, but only some of the species that occurred there historically because the site is too small to support area-sensitive species. Which of the following statements about the project apply?

1. This project is an example of site rehabilitation. **A**
2. This project meets the Society of Ecological Restoration's definition of ecological restoration. **B**
3. Doing nothing more than putting topsoil on the landfill is one option for restoration. **A**
4. A good reference site for this project would be a natural grassland with the full complement of functions and species that the DEEP hopes to see at the restored site. **A**
5. Controls should be set up to determine whether active restoration was necessary. **A**

Q1 is correct because the focus is on restoring functions, without necessarily achieving complete restoration. Q2 tests whether you understand that strict adherence to the formal definition of restoration excludes most restoration projects. Q3 tests whether you know that sometimes restoration can occur with minimal intervention. Q4 and Q5 test whether you understand the principles of clear goal setting and experimental design that I have talked about in a couple of lectures.

Which of the following statements about habitat corridors are true?

6. Corridors facilitate gene flow. **A**
7. Corridors help to prevent population fragmentation. **A**
8. Corridors can act as sink habitat. **A**
9. Corridors can help invasive species to spread. **A**
10. Corridors can help endangered species to persist. **A**

This straightforward set of questions simply tests your understanding of the pros and cons of corridors. It also tests whether you know the meaning of terms such as "gene flow" and "sink habitat".

Which of the following statements about the design of reserve networks are true?

11. Large reserves are generally better than small reserves. **A**
12. All other things being equal, the best shape for a reserve is generally a circle. **A**
13. Several small reserves can sometimes be better than one large reserve of equal area. **A**
14. Small reserves are always more effective when they are widely spaced. **B**
15. Maximizing the amount of edge habitat in a reserve network is important. **B**

This question tests whether you (a) know the general "rules" about reserve design (Q11, Q12, Q15), and also (b) know that reserve design is complex and that those rules all have exceptions (Q13, Q14).

These two figures come from the paper by Fuller et al. (2010) that we read as a discussion paper. The figure on the left plots the "contribution of Australian protected areas to conserving vegetation types relative to their rarity (B_j)" versus the "estimated cost of acquisition and management of the sites (C_j)" for nearly 7000 protected areas. The figure on the right plots the "change in total area under protection … as existing protected areas are progressively replaced with more efficient sites." Which of the following statements do the figures suggest are accurate?

16. Sites that provide greater conservation value tend to be more expensive. **A**
17. For a given cost, variation in conservation value varies across several orders of magnitude. **A**
18. The dashed line in the figure on the left represents the division between sites that contribute the most conservation value for money spent and sites that should be prioritized for sale in order to generate new funds for conservation. **B**
19. Replacing 2% of the currently protected areas can result in >200% increase in the protected area. **A**
20. Replacing more than 2% of the currently protected areas is probably not worthwhile. **A**

This is another question designed to test your ability to read graphs – in this case a complex one, but one we discussed in class recently. Q16 and Q17 test whether you understand the basic pattern shown in the figure – as cost goes up, so does value (i.e., the scatter of points shows a positive relationship), but there is a lot of scatter in the points around that overall trend (i.e., if you go up from any spot on the x axis, there are a lot of points with different y values). Q18 tests whether you understand the concept of a trade-off between costs and benefits – priority sites are those that provide a lot of benefit relative to the cost, not those that simply provide a lot of benefit. A site with moderate benefit may be a better conservation option than one that has 20% more value if it is substantially cheaper (because you could buy several other moderately good sites as well). Think about what line one should use to separate the best 50% of sites from the worst 50%. Q19 tests your ability to make more complex inferences from the graphs. 2% replacement is represented by 0.02 on the x axis of the right-hand graph – it you go up from there you can see that the protected area is several times greater than it is at x = 0.

The town of Mansfield is conducting a study of the effects of clearing invasive plants in town parks. They want to know whether using pesticides is more effective than removing plants by mechanical means. To study this question, they plan to use pesticides throughout one of their parks and mechanical methods at another. They will then measure the number of invasive plants in fifty 1-m^2 plots at each park and compare the two sets of numbers. Which of the following statements are accurate?

21. The management treatments in this study are well replicated. **B**
22. Ideally the investigators would determine which park gets which type of management, randomly. **A**
23. A strength of this study is the use of controls. **B**
24. A strength of this study is the absence of confounding factors. **B**
25. With this study design the investigators cannot answer their question very well. **A**

These questions were designed to test your understanding of basic experimental design principles. Q21 is incorrect because there is no replication of management treatments (each is applied only once), though there is pseudo-replication. Consequently, there is a good chance that confounding factors (other things that differ between the two parks) will influence the results. This is also why Q24 is wrong. Another problem with the design is that there is no control treatment, which is why Q23 is wrong. Consequently, it will be hard to tell if any changes are actually caused by the management (so Q25 is correct). Q22 is simply a good idea for any experiment. The study is better than not doing a comparison, and much better than not collecting any data, but overall clear conclusions will be hard to draw.

Large nest boxes are commonly used to help manage for wood ducks. Which of the following recommendations would reduce the effectiveness of using nest boxes to manage this species?

26. Clumping boxes in groups of ten. **A**
27. Hiding boxes deep in the woods. **B**
28. Building boxes with two compartments. **A**
29. Placing boxes in a dense tangle of vegetation. **B**
30. Placing boxes on tall poles in the middle of a pond. **A**

Anything that increases the chance of brood parasitism will reduce the effectiveness of nest boxes. Q26, Q28, and Q30 are correct because they will all make boxes more conspicuous to female wood ducks. The other responses will make boxes less conspicuous and so would increase effectiveness.

The figure below comes from the paper about the changes in abundance of various marine species (mostly sharks and rays). The three rows correspond to three levels in a food chain, with top predators in the top row. Each individual graph show population estimates in different years. The acronyms (NMFS, VIMS, etc.) all refer to the organizations that produced the data. Which of the statements that follow are correct?

31. The figure shows population change in twelve different species. **A**
32. The figure appears to illustrate a trophic cascade. **A**
33. A likely explanation for the patterns shown in the figure is overharvest. **A**
34. The figure illustrates the keystone species concept. **B**
35. One way to increase the number of great sharks would be reverse the decline in bay scallops. **B**

Q31 is designed to simply test whether you are actually looking at the labels on graphs – there are 15 panels, but 4 of them are for the same species (cownose ray), so the statement is correct. Q32 test both whether you can recognize a trophic cascade. In this case the top predator declines, the mesopredator increases, and the species at the bottom of the food chain also declines (after an initial increase). These changes are all consistent with a tropic cascade in which a change in species abundance at the top of the food chain "cascades" down, affecting species populations at lower levels. Q33 tests whether you can connect these results to the information I presented on shark population declines caused by over-fishing. Q34 is incorrect because there is nothing in this figure to indicate that any one species has a disproportionate effect on the overall system. One might think that the decline in scallops drives all the other

changes – but it is hard to envision a mechanism by which a decline in a prey species could lead to an increase in its predators. Consequently Q35 is wrong too.

36. In recent years, Starbucks has started selling "shade-coffee" and claiming that this decision has environmental benefits. What is shade-coffee and what benefits does it provide? (3 points)

Shade-coffee is coffee grown in the forest understory (i.e., with at least a partial canopy of large trees). Compared to "sun-coffee", shade-coffee is used by many forest species, results in less soil erosion, requires less agricultural chemical use, and provides benefits in terms of both pollinator and (pest) insectivore activity. (1 point for the definition and 1 point each for two distinct benefits)

37. Define the following terms and give an example of each. (6 points)

a) Ecological mitigation: An activity conducted to provide conservation value in lieu of some harm done elsewhere. For example, when wetland habitat is destroyed, developers are often required to create or restore wetland habitat elsewhere to make up for the losses.

b) Mesopredator: A predator at a mid-level in a food chain (not a top-predator). Examples include coyotes, skunks, crows, etc.). These are relevant in the course, because many have increased in numbers as a result of top predators being wiped out by humans – with resulting effects lower on the food chain.

c) Adaptive management: A system whereby management methods are systematically evaluated (via careful data collection and analysis, ideally in an experimental framework) and modified ("adapted") to increase their effectiveness. Either the wood duck or rhino examples given in class could be used as examples. I would also have accepted a hypothetical example if it was well explained and plausible.

38. For each of the following pairs of reserve design, explain which option is best and why. In each case you can assume that the total area of protected land is the same for both choices. For each example also give a reason why the option that you selected as best might not be the better choice. (6 points)

a) The complete circle is probably the best because it minimizes the impact of edges, but the elongate shape might be better if it allowed one to protect particular habitat features of interest (i.e., a more complete watershed), or if edge species were the target organisms.

b) The string of reserves near to one another is probably the best as they reduce the chance of any site being demographically isolated. But, proximity also facilitates movement of things like disease and invasive species, and increases the chance of a catastrophe affecting all populations.

c) The scenario with the corridor connecting patches is probably best, but corridors have many of the problems discussed in the previous example, so in some circumstances the other option might be better.