Conservation Biology 565 -- Spring 2007 -- MID-TERM

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NOTE: **ADD** YOUR LAST NAME TO THE **NAME** OF THIS DOCUMENT WHEN YOU SAVE IT!! DO THIS NOW SO SUBSEQUENT SAVES WILL USE THIS NAME.

***Then**: **Email** the **renamed** file to Grad TA Dane Kuppinger by **midnight** on **Friday**, March 9th. His email address is kupp@email.unc.edu.*

There are 30 short answer and mostly multipart questions! Answer as many as you can in 2 hrs.

***Directions**: Spend **2 hrs** on this exam. This exam is **open** book, **open** notes, **open** web, and **open** mind. Except for class readings, powerpoint, and lectures, you must **ACKNOWLEDGE** your sources (sources other than class material), if you consult outside sources to find the answer! Do not submit a bibliography, just explain in plain English how you constructed your answer as you provide the answer. Note that the web may not agree with class material…so be thoughtful!*

***SECOND NOTE:** For certain questions you are to choose one of several phrases by turning the correct phrase RED…but you can also **BOLD** the right answer or make it* STAND OUT *however you choose.*

These are supposed to be SHORT *answer.*

1a. Paleo refuges are most similar to (turn one of the following RED: DEEP OCEAN ISLANDS, LANDBRIDGE ISLANDS).
1b. Paleo refuge species lists are most structured by (Turn one of the following RED: AREA, ISOLATION).
1c. Barro Colorado Island is a (Turn one of the following RED: PALEO, NEO) Refuge.

2a. What variable governs the amount of loss of species form area loss? z, the rate at which species accumulate with area.
2b. What value would you use for this variable to predict species loss after fragmentation?
- z varies from 0.15 to 0.35, but I would use a value of 0.3 so that I can predict that 90% of species would remain after a 50% reduction in area, or if only 10% of the area remained, I would expect 50% of the original species to remain.
2c. How do the three steps of species loss relate to Extinction Debt?
- The 3 steps are an immediate sampling loss, a near-term loss of species that do not reproduce in the isolated fragments but are there because of dispersal, and a longer-term loss of species whose fragmented populations have become too small or vulnerable. These 3 steps cause species richness to relax to a new, lower equilibrium, but that process takes time. As soon as the fragmentation occurs, this causes species to be already doomed to extinction, hence the term extinction debt. The debt gets paid off over time as species go extinct from the original fragmentation event.

3a. Classic Island biogeography models Extinction from (Turn one of the following RED: AREA, DISTANCE) and Immigration from (Turn one of the following RED: AREA, DISTANCE).
3b. Two extensions of this theory are
- a distance effect on extinction (rescue effect – the closer the island, the greater the chance an immigration event will occur to rescue the population from extinction)
- an area effect on immigration (target effect – the larger the island area, the greater the chance an individual will find it)
3c. If these two extensions are of equal magnitude (that is, they don't change the predicted equilibrium), how would they affect the species dynamics on a Large, Far Island compared to the classic model?

- they would only lead to greater species turnover because of the increase in immigrations caused by the rescue and target effects. However, the number of species on the island wouldn't change since that is determined by the equilibrium between immigration and extinction, and the equilibrium doesn't change.

4a. What evidence compelled Simberloff and Abele to suggest that Island Biogeography (TURN ONE OF THE FOLLOWING RED: COULD, COULD NOT) be used for preserve design principles?
- they did an experiment measuring arthropod richness after fumigating mangrove islands. Several small islands together, depending on their similarity, could sometimes have more species than one large island. Thus, a larger preserve area does not guarantee a higher species richness, which is what the theory of island biogeography would suggest.
4b. In the simplest case of one large reserve vs. two half reserves, what two factors do you need to know to predict the answer to SLOSS?
- the percent of species overlap between the two half reserves
- and the value of z.
4c. If beta diversity is high, what is the likely answer to SLOSS?
- beta diversity measures species turnover. A higher beta diversity means that over short distances, there is a rapid decay in similarity, probably due to greater environmental heterogeneity. Having several small reserves spread across a wide area would capture more of the species richness.

5. What primary value system(s) underlie the Preservation Ethic as articulated by John Muir?
- all species have an intrinsic value, wilderness had value for its own sake, and that wilderness was a source of human inspiration and spirituality.

6a. An investigator ranked national parks for ozone sensitivity by counting the number of ozone sensitive trees and then dividing by area because the parks were different sizes and he didn't want large parks to outrank small parks just based on size. Why is his method the wrong thing to do?
- he assumed that the number of tree species was directly proportional to area, so that by dividing all the sensitive tree species in each park by that park's area he would be able to compare all the parks equally. However, his assumption is wrong because he failed to account for the rate at which species accumulate with area, which is a function of the sampling scale. Most of the sensitive trees might have been located within a particular portion of the park (like a watershed) – there, z would be high compared to the rest of the park.
6b. What is the correct formula for correcting richness estimations for area?
$S = cA^z$; this means that species is not directly proportional to area, but area raised to the power of z (the rate at which species accumulate with area).

7a. It seems counterintuitive, but protecting turtle nesting sites is currently less important than lowering the mortality of older turtles. What parameter derived from life table analysis give us a solid clue about this?
- reproductive value (an individual's future lifetime contribution of offspring to the population). Older turtles have a higher reproductive value than hatchling turtles, so by increasing their survival this has a higher effect on improving the population growth rate than increasing the survival of hatchlings.
7b. Given that the older individuals are a priority, what would you investigate in order to evaluate and recommend among alternative actions?
- what is the contribution of older turtles to the growth of the turtle population (their sensitivity)? How important is uncertainty in this contribution to our management choices, and how much would it cost to increase growth rate by a certain amount (by using turtle excluder nets) to increase population growth?

8. In the declining species paradigm, species can fall into an extinction vortex. How do genetics play a role in the vortex (spell out the logic)?
- threats to biodiversity reduce population size -> lower population size results in less genetic diversity due to genetic drift and inbreeding -> lower genetic diversity leads to lower fitness -> lower fitness leads to lower survival and birth rates which leads to an even lower population size, and so on until extinction occurs.

9. How is Hardy-Weinberg used in the concept of expected heterozygosity?
- If a population is at Hardy-Weinberg equilibrium, then $p^2 + 2pq + q^2 = 1$, where p and q are two different alleles, p^2 and q^2 represent the expected homozygosity, and 2pq represents the expected heterozygosity.

10a. What parameters would you pick to define quasi-extinction risk? Give the parameters a **TITLE** and a **VALUE**.
- quasi-extinction risk is the likelihood that a population will decline below a certain size in a certain time. For size, I would pick the size of the minimum viable population.
10b. Write a one sentence justification of the VALUE you picked.
- the MVP is the population size below which stochastic events would lead to an unacceptable increase in extinction risk.

11a. Even as we speak, the National Park Service is preparing a celebration in 2016 because that date is __the centennial of the NPS (100 years since it was founded in 1916 – source: US Dept. of the Interior, http://www.doi.gov/news/07_News_Releases/070206.html)___
11b. How does origin of this event shape questions about park management today—that is, what does it say about values that underlie management?
- the NPS was founded to preserve natural areas for future enjoyment and use. However, this depends on continued funding (which seems to have been declining in recent years). In preparation for the centennial event, the largest-ever increase in funding for the NPS has been requested, which reflects the importance of national parks in the eyes of today's people.

12a. What important question was tested in Belovsky's work on brine shrimp?
- whether population size or carrying capacity had a greater influence on extinction risk.
12b. What insight should we derive from the answer?
- a population will persist longer if its habitat quality is improved (higher carrying capacity), not by increasing its population size, survival, or reproduction in its current habitat. Thus, when trying to save endangered species like the spotted owl, protecting and increasing the quality of its habitat should be the first step we take.

13a. How is environmental stochasticity incorporated in the population matrix models we examined in class?
- as a standard deviation in the growth rate R.
13b. What assumption does this make?
- that environmental stochasticity is constant over the entire area of the population.
13c. What would be a more realistic way to model environmental stochasticity?
- in a more spatially explicit way, so that different areas have different values for environmental stochasticity.

14a. The Levins Metapopulation Model was formulated to answer the following question:
- under what conditions will a metapopulation persist, despite the local extinction of its subpopulations?
14b. What conditions provide the answer **YES** to the Levins question?
- the metapopulation will persist despite local extinction when m, the migration rate among patches, is greater than E, the probability of extinction of patches in a given time. Thus, if individuals from a subpopulation can migrate to a new patch before the subpopulation goes extinct, the metapopulation can persist.
14c. Suppose the answer is YES to the Levins question. The larger the equilibrium patch occupancy, the (TURN ONE OF THE FOLLOWING RED: MORE, LESS) robust the **YES** is the total number of patches.

15. Explain why it is possible for a population with a finite growth rate greater than 1 to become extinct?
The population might have a growth rate greater than 1, but if it is a very small population it will have a high risk of extinction due to demographic or environmental stochasticity. For example, if the population had a growth rate of 1.1 but was only made up of 4 individuals, the likelihood is high that chance events would lead to extinction.

16. List and define the variables of the matching coefficient.

17. Consider that a set of islands with a z value of .25. There is one SL and 16 islands in the SS set. A SL has 4 species and an individual island in SS has 1 species. If SL wins in SLOSS, (TURN ONE OF THE FOLLOWING RED: SPECIES-ACCUMULATION, SPECIES-AREA) gives a lower prediction than the number predicted by the equation: 16 divided by ____4_____.
1 SL with 4 species vs. 16 SS each with 1 species
A = 1 (SL) vs. A = A/16 (SS)
SS = c(A/16)^z = (A^z)/4
SL = cA^z = SS/4 = 16/4

18a. Describe a use of incidence functions in conservation.
- Incidence function models can be used to describe a metapopulation's dynamics, which can provide information on whether the metapopulation as a whole might persist.
18b. What is disharmonious in the disharmony of islands?
- there are some taxonomic and functional groups that are present on the mainland, but are underrepresented or even absent from the islands. Thus, there is a disharmony in the types of species found on islands vs. the mainland.
18c. What causes this disharmony?
- as distance from the mainland increases, fewer taxonomic and functional groups can reach the island due to dispersal limitations. For example, mainland amphibians, freshwater fish, and large mammalian predators are often absent from islands because they cannot swim or be carried there easily, while mainland birds are more likely to be find on the more distant islands.

19. Intrinsic rights is one rationale for species conservation. How would you have to articulate a a parallel intrinsic rights value if you believed that not all species were equal because of phylogenetic relationships?
- a group of species may be very closely related on the phylogenetic tree, such that if one goes extinct its genes may still survive in the other related species. However, each species, no matter how closely related, is still unique and irreplaceable, and still has an intrinsic right to exist.

20. Inbreeding depression can be avoided in 3 ways:
a. high enough population growth rate (high-fitness individuals are available to replace the low-fitness individuals resulting from inbreeding depression)
b. if there is low environmental stress (the higher percentage of homozygous, deleterious genes in inbred individuals will not disadvantage them as much if environmental conditions are optimal)
c. in captive populations, making sure they are large, and that individuals with the greatest amount of genetic dissimilarity are allowed to mate

21a. There are two causes of GFCs:
(genetics-fitness correlations) – genetic drift and variance in inbreeding.
21b. How would you distinguish these?

22. The First Law of Conservation Biology argues that a 1% increase in inbreeding per generation is tolerable. What underlies the proposition than any increase in inbreeding is tolerable?
- if the population growth rate is high enough, this can offset inbreeding depression since with a high enough growth rate there will be enough high-fitness individuals to replace the low-fitness individuals, creating either a stable or increasing population. However, if the population growth rate were low, the uncompensated-for inbreeding depression would lead to population decline.

23. Give examples of each of 5 problems with utilitarianism as the basis of conservation of biological diversity:

a. species loss – a species is irreplaceable, which makes it difficult to assign a value to a species (or a cost for losing the species). If the species is lost, how many dollars is it worth? How many days of mourning?
b. species with negative human value – utilitarianism would argue for the removal of lions, termites, wolves, and all other species that could potentially harm people or property, although these species play an important role in ecosystem function.
c. unknown value problem – we don't know all the species that exist, and even for the ones we do know, we don't know their ecosystem roles. Thus, ecologically important species may be lost just because we haven't assigned them a value.
d. short vs. long-term value – we are better at assigning values to things that exist in the present. Things that might exist in the future, such as new drugs created because of preserved species, have a fuzzier valuation because they don't yet exist and we don't know if they will.
e. cultural bias/experience – we tend to value things more highly if we have positive experiences with them. If we grow up in a city, we might not value wilderness as much because we haven't had much exposure to it. We also can't assign values at all to things we have no experience with. (Maybe if Bush had made a fortune saving land instead of from the oil industry, or spent lots of time camping in deep wilderness while growing up, he would assign a higher value to the environment than he currently does.)

24. You suspect that a particular endangered species has low genetic diversity. What two sorts of comparisons would you make to test the proposition that the genetic diversity was lower than expected and therefore might be related to its endangerment:
a. quantitative: compare observed with expected heterozygosity – if H_o is lower than H_e, then the genetic diversity is lower than expected.
b. qualitative: compare the allelic diversity or variance in current allelic frequencies with what it was at an earlier date (before the species' endangerment).

25a. After fragmentation, (TURN ONE OF THE FOLLOWING RED: DETERMINISTIC, RANDOM) extinctions based on area sensitivity would likley (TURN ONE OF THE FOLLOWING RED: INCREASE, NOT EFFECT, DECREASE) similarity across the fragments.
25b. After fragmentation of a continuous population (TURN ONE OF THE FOLLOWING RED: DETERMINISTIC, RANDOM) loss of genes based on genetic drift would (TURN ONE OF THE FOLLOWING RED: INCREASE, NOT EFFECT, DECREASE) genetic similarity across the fragments.
25c. Aggregating the species across the fragments (TURN ONE OF THE FOLLOWING RED: DOES, DOES NOT) reconstitute the species list.
25d. Aggregating the genes across the fragments (TURN ONE OF THE FOLLOWING RED: DOES, DOES NOT) reconstitute the genetic diversity of the continuous population.

26. In SLOPP, PP wins when ____demographic stochasticity____ is low
and ____environmental stochasticity____ is high.

27. What parameter must you quantify to validate Island Biogeography is a sufficient theory to explain species richness on islands?
- The distance of each island from the mainland must be quantified. If this is known, then IBT can be used to predict the island's species richness.

28. Are black bears a good umbrella species for conservation of biological diversity in the southern Appalachians—support your answer with a short explanation?
- No. Black bears do require large ranges and play important ecosystem roles, so we might think that managing the land for the protection of this umbrella species will protect all other species that falls within the range of the umbrella species. However, there are many endemic and/or rare plant, insect, and salamander species that occur in only a few small areas that might be overlooked or destroyed while managing for black bears.

29. What do the Badgeworth Nature Reserve and grassy balds have in common?
- This nature reserve is the smallest in Britain and was supposed to protect a species of Ranunculus. However, the Ranunculus population later moved outside the borders of the reserve because that was where the cows were (their soil disturbance was needed for the population to persist, and the reserve had fenced out the cows). Similarly, grassy balds act as a reserve for grass and herb species in the area because of the open space, but if the disturbance regime that keeps this area open ends, woody species will take over and kill the grasses and herbs. Then, the only places where the grasses and herbs will persist will be disturbed areas outside the bald.

30a. Why is Ne an important concept in conservation biology?
- Ne, the effective population size, lets us model the effect of population size on genetic changes. Unlike a census population (Nc) where individuals have unequal reproductive roles and do not equally contribute to genetic changes correlated with small population size, Ne is the size of a population where all individuals are reproductive and identical to each other, and lose heterozygosity at the same rate as the observed population.
30b. Ne/Nc can be approximated by the value __0.11___.
30c. Based on material in class, list 4 criteria that need to be met for Ne=Nc?
- the variance of family size equals the mean (since Ne assumes a Poisson distribution)
- the sex ratio of males to females is 1:1
- there is random mating and no overlap in generations
- population size does not fluctuate

END OF EXAM
The following question is OPTIONAL and doesn't count on the 2 hrs.
LASTLY: Was this exam (TURN ONE OF THE FOLLOWING RED: TOO LONG? TOO SHORT? JUST RIGHT?). What neat thing did you learn and therefore wish the exam had addressed?
A bit too long—I had to rush through some of them.