Conservation Biology 565 -- Spring 2007 – FINAL EXAM Part I – Take Home

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DON'T FORGET TO WRITE YOUR NAME ABOVE!!
SAVE YOUR FILE WITH YOUR LAST NAME AS THE BEGINNING OF THE FILE NAME!!

*Take up to **1.5 hrs** to complete this exam. Please email it to **Grad TA Dane Kuppinger** by midnight on Thursday, May 3rd. His email address is kupp@email.unc.edu.*

***Directions**: This exam is **OPEN** book, **OPEN** notes, **OPEN** web, and **OPEN** mind. You must **ACKNOWLEDGE** your sources if you consult sources to find the answer (that is sources other than class materials and lectures)! These are supposed to be SHORT answer. Please use **WORD** to embed your answers **UNDER** the questions.*
*There are **10** questions—answer as many as you can in **1.5** hrs. You will receive up to **5** pts for each answer, for a total possible score of **50**. Good luck, have fun, and **LEARN**.*

1a. How large must a conservation area be to sustain populations of large carnivores?
The minimum area to sustain one large carnivore is 10-1000 km^2, depending on its body mass. To sustain a population, we need a minimum area of 10,000 km^2. However, to have the population continue its evolution, we need a minimum area of 600,000 km^2.
Below, cite three lines of evidence that support your answer to 1a (e.g., class material that helps us answer 1a with specific numbers):
1b. Frankel and Soule – the minimum island size for continued large mammal evolution is 600,000 km^2.
1c. Schonewald-Cox 1983 (from the Fragmentation slides): the size of a reserve should be greater than 10^6 hectares to sustain a population of at least 1000 large carnivores. (A million hectares equals 10,000 km^2.)
1d. Crooks 2002 (also from the Fragmentation slides): the home range sizes of carnivores with body masses between that of coyotes and mountain lions are between 10-1000 km^2.

2 . Why should the Intermediate Disturbance Hypothesis of species coexistence be considered to require patch dynamics?
IDH states that maximum species richness is obtained in an area that has intermediate disturbance frequencies, magnitudes, and times between disturbances. However, not all the species in an area experiencing intermediate disturbances will reproduce under such conditions. There could be other species coexisting in the same area, but are present purely as a result of patch dynamics. For example, there could be disturbance-sensitive species that require the existence of other nearby patches that experience lower disturbance frequencies or magnitudes. Also, the area might be a sink for other species that arrive there only by dispersal, so other nearby patches must exist that serve as seed sources.

3a. In general terms, how is Ne potentially affected by behavior?
Effective population size can vary if there is an unequal sex ratio, variation in family size, or variation in population size. The mating behavior of a species could produce an unequal sex ratio, or the species might be social and this behavior causes them to prefer large family groups. In both cases, Ne would be affected by these behaviors.
3b. Give a specific example of this effect.
Elephant seal populations have highly skewed sex ratios because one male seal will mate with a large group of female seals. Austin and Short (1984) described how Ne for a population of 101

individuals (one male seal and 100 female seals) is very low, 3.96. If the population were ideal (all individuals of reproductive age and equal numbers of breeding females and males), Ne would be equal to the population size.

4. The questions below (4a, 4b) ask you to compare a fully developed Landscape Ecology model to the original and simplest form of the Theory of Island Biogeography.

4a. List the similarities here:

1. Distance is important in both models – the lower the amount of isolation, the greater the likelihood of immigration (TIB)/dispersal (LE).
2. Area is important in both models. As area increases in the form of island size (TIB)/patch size (LE), species richness increases.

4b. List the differences here:

1. LE divides the landscape into habitat patches and matrix of varying degrees of quality, while TIB only recognizes habitat and non-habitat separated by inhabitable matrix. LE is spatially realistic; corridors, stepping stones, and barriers exist whereas these are not accounted for in TIB.
2. Islands, populations, and patches can vary in LE. TIB treats all species as equal (it does not predict which species are present; all species have equal dispersal capability). TIB also treats all islands as equal (there is no habitat heterogeneity, and thus there can be no edge effects).

5a. Define FLOSS:

This is a term that originated from the field of biocontrol for invasive species. It is a bigger/many dilemma like SLOSS but means few large releases or several small releases (of biocontrol agents). The dilemma is whether it is more effective to release one or a few large populations, or several/many small populations at different places or different times.

5b. FL is important to success because: the larger the release of biocontrol, the more pests could be wiped out/controlled before they had time to develop resistance.

5c. SS is important to success because: by releasing the biocontrol in several smaller areas across the extent of the invasion, more of the invasive species can be reached, and control can occur in a shorter period of time as the biocontrol spreads out and establishes itself.

6. You are designing an ex situ program for an insect-pollinated, short-lived plant.

6a. What is your hypothesis about how to collect genetic diversity for this species?

Since I likely wouldn't have data available on the amount of genetic diversity in the plant population, I'd have to follow the rule of thumb of collecting at least 10 seeds from at least 50 individuals in a population (the minimum number needed to preserve allele and genotype frequencies). However, I'd collect many times this number because of the uncertainties involved in getting an adequate sample of genetic diversity. I'd also sample more within a few populations than among different populations because more genetic diversity is carried within populations than among populations.

6b. What grain of salt would temper your assurance that you were correct?

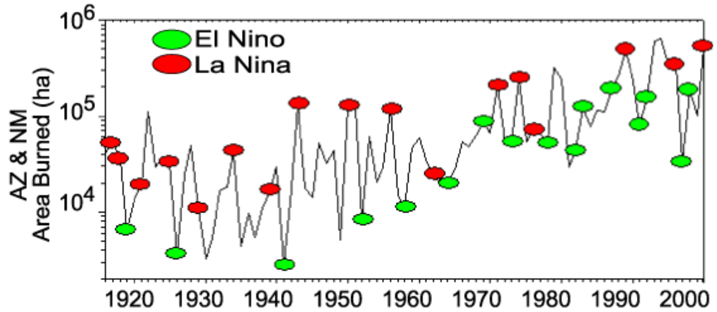
There are significant but low correlations between genetic diversity and the factors listed above (pollination mode, lifespan, diversity within/among populations). Thus, following the method above, I may only capture a fraction of the total genetic diversity for the species.

7. Give 3 areas of conservation biology for which the figure below has important consequences:

7a. Landscape ecology - Patch dynamics (bounded variation). The greatest amount of burned area nearly always occurs during La Nina years, while the least amount of burned area nearly always occurs during El Nino years. The two extremes of the Southern Oscillation set the bounds on the area that is burned in AZ and NM.

7b. Populations – environmental stochasticity. In any year, the number of trees that will be killed by fire changes, largely due to the influence of the Southern Oscillation but also due to fire suppression (see below). If there are rare or endangered animal species living in AZ and NM forests, they will face a higher extinction risk from environmental stochasticity in most La Nina years than in most El Nino years.

7c. Disturbance - fire suppression. There is a certain amount of variation of burned areas between El Nino and La Nina years in the graph, but the mean of the graph has also been increasing from about the 1940's onward. This may coincide with the increasing suppression of fire in AZ and NM, which has helped fuels to accumulate and cause very large fires.



8. Fire frequency in the dry ridges of the western Smokies has dropped in the last 70 years from a 7-12 year fire interval to a very long (centuries) fire return interval.

8a. What has resulted from this change that is of concern to conservation biologists?

The grassy balds that are often found on dry ridges are undergoing succession to dense hardwood forest. Thus, the unique open character of the grassy balds is being lost.

8b. Will an immediate return to the historic fire regime alone reverse this situation? Explain.

No. The forest regrowth is so dense that a fire would likely burn hot enough to sterilize the soil. The grassy balds first need to be restored by removing the trees, then allowing grass and herb species to colonize the area, then using fire at 7-12 year intervals to maintain the bald.

9. Consider an exotic that is closely related to native species in the area where it has been introduced.

9a. What general principle would cause you to hypothesize it would not be an aggressive invader?

Enemy release/biotic resistance – since the exotic is closely related to native species and the native species have enemies that control their populations, there is a chance that some of these enemies might also be able to control the closely related exotic's populations.

9b. What general principle would cause to you to hypothesize it would be likely to be an aggressive invader?

Innate biology/preadaptation – since the exotic is closely related to the native species in the area and the native species are likely well adapted to the environmental conditions of the area, it could be that the exotic is also adapted to similar environmental conditions. In that case, it would thrive and have a high potential of spreading.

10a. Contrast "ecological meltdown" and "biomass collapse".

Ecological meltdown: when fragmentation causes species interactions to change, such as changes in competition or trophic relationships.
Biomass collapse: when fragmentation creates environmental changes to edges, which creates disturbance and causes biomass to be reduced along edges.

10b. Contrast the expectations for a "bottom up" and a "top down" ecosystem in terms of regard to ecological meltdown--

Bottom up: More edge allows edge-loving plants to thrive, which may increase herbivory and thus increase the number of large predators.
Top down: Large predators have population declines in fragments, which means more herbivores are available, which means fewer plants

10c. Contrast the expectations for a "bottom up" and a "top down" ecosystem with regard to biomass collapse:

Bottom up: Lower forest biomass at edges would likely mean more sunlight input there, so that a variety of smaller plants could thrive, which would increase herbivore populations that depend on these plants.
Top Down: Lower forest biomass at edges would increase the amount of predation because of the lack of cover for prey animals.

10d. Characterize an ecosystem in which you'd expect both ecological meltdown AND biomass collapse.

An example would be a forest that was highly broken up into fragments too small to support large predators. If this was a top down ecosystem, I would expect the absence of large predators to create an increase in herbivores, which would lead to a decline in plants. If the plants in question included seedlings of the trees that form the forest, over time this would lead to biomass collapse. The high amount of edge in these small forest fragments would increase the likelihood of windthrow and temperature/moisture fluctuations that would worsen seedling regeneration near the edges. Thus, biomass collapse would occur if regeneration could not occur fast enough, as would happen if large predators were removed.