FW662 -- Final Exam

March 10, 1995

1. (20 pts) The following data collected on the Mexican Spotted Owl in New Mexico and Arizona, 1989-1993: number of pairs checked (*n*), mean, and standard deviation (SD) for number of young produced per pair, based on formal monitoring methods.

Year	*n*	Mean	SD
1989	61	1.246	0.906
1990	20	0.200	0.411
1991	79	1.177	0.942
1992	99	1.172	0.965
1993	85	0.882	0.968

a. Compute the variance component for the year effect of the number of pairs fledged, plus a 95% confidence interval.

b. Comment on other sources of variation that might exist in these data, what additional information would be needed to estimate these sources of variation..

2. (20 pts) The endangered red-bellied toad has been extensively studied by the Colorado Division of Wildlife. About 100 adults remain in a population located in the Eagle Nest Wilderness . CDOW biologists have monitored survival of adults and recruitment to the adult age class during the last 5 years, and provided the following estimates (per capita rates) for the recovery plan.

Year	Recruitment	Survival
1989	0.624	0.731
1990	0.331	0.483
1991	0.580	0.552
1992	0.371	0.372
1993	0.476	0.425
Mean	0.476	0.513

The Group for Rabid Expression of Environmental Negativity (GREEN) hired a consultant that developed a population viability model based on these estimates. This model predicts a median persistence time of less than 200 years. However, the Basic Logging And Concrete Korporation (BLACK) also hired a consultant (different than the GREEN consultant), and he also developed a population viability model. This model predicts a median persistence time of >200 years. You are hired by the Colorado Division of Wildlife to develop a position statement on these 2 models, and explain the differences in their predictions. Both models are provided in the FINAL2.WB1 spreadsheet. Explain what the differences are in the 2 models that causes their predictions to be different. Which model would you select as the model the CDOW should support, if either? Why? What can be done to improve the estimates of persistence?

3. (20 pts) Critically review the conclusions of the attached paper:

Swenson, J. E. 1978. Prey and foraging behavior of ospreys on Yellowstone Lake, Wyoming. J. Wildl. Manage. 42:87-90.

Do you accept the conclusions? If yes, discuss why the conclusions are valid. If no, suggest what is wrong, and suggest additional work that might be needed.

4. (20 pts) The attached Box 19 from Primack, R. B., 1993, Essentials of conservation biology, Sinauer Associates, Inc., Sunderland, MA., pages 261-262, suggests that remaining black rhinos should be mixed ("made panmictic") to increase genetic diversity and enhance the persistence of this species. Discuss this issue in some detail (broader than just genetics) for the <u>black rhino only</u>. Do you agree or disagree with this recommendation? Give your arguments for both sides of the issue, and make a recommendation for rhino managers such as Peter Goodman (the Thursday pm seminar speaker about a month ago). If you can give a conclusive, persuasive answer, you can undoubtedly become both rich and famous (which means, I don't know the real answer, but I hopefully can recognize a really thoughtful one!).

5. (20 pts) The black-tailed prairie dog (*Cynomys ludovicianus*) has received much attention in the news lately as a possible Category 2 species under the Endangered Species Act, not because their own populations are in danger so much as because numerous other threatened or endangered species are dependent on prairie dog town habitat. However, prairie dogs are viewed as pests by many ranchers and farmers and continue to be exterminated. Recent newspaper editorials have advocated that prairie dogs be more aggressively managed on public lands in order to avert future conflicts between private land rights and species management goals. However, the success of this strategy depends on knowledge of the relationship between prairie dog colonies on public land to those on adjacent private lands. Prairie dog colonies, or towns, may be considered patches; thus, they are a spatially divided population.

a. (5 pts) If these patches represent a metapopulation in the classic sense of Levins, what do you think will be the long-term effect on the metapopulation of continued extermination of patches on private lands?

b. (5 pts) If the patches have a source-sink structure, what would the effect of exterminations be?

c. (10 pts) If you could conduct a study of prairie dogs in both public and private patches (neither subject to extermination during the study), what specific demographic parameters would you measure to determine which type of spatial structure (classic metapopulation or source-sink) that the prairie dog population exhibits? Give the parameters you would measure and the characteristics of each that would lead you to conclude which type of spatial structure you have.

Answers

1.a. The most common mistake was to try to treat fecundity estimates as a binomial variable. You were given the SD of each estimate. Hence, you should have computed the SE of the estimate as $SD/\sqrt{n}$, and the sampling variance of each estimate as $(SD/\sqrt{n})^2$. The correct answer is $\sigma^2 = 0.1792$ with 95% CI 0.0583 - 1.5481.

b. Other sources of variation you should mention are demographic, spatial, and individual heterogeneity. Some of you were pretty cleaver about coming up with other realistic sources: observers and techniques. Good job on thinking about the problem.

2. Red-bellied toad = *Bufo abdorubra*. The GREEN model only has demographic variation. The BLACK model incorporates environmental variation with linked survival and recruitment rates. However, the BLACK model has a dreadful flaw -- when the population reaches only 2 individuals, it will never go extinct with the values in the table. Hence, it is totally unrealistic. If you missed this flaw, I took off 5 points.

3. This study lacks a manipulation to demonstrate cause and effect -- hence the conclusion of "lack of competition with other piscivores" (including humans) is totally unfounded. Competition can only be demonstrated via manipulation of competitor populations, or manipulation of the exploited resource. No measures of fitness, either reproduction or survival, were collected, so the conclusion that food shortages were not a limiting factor is unsupported. To support this conclusions, a food supplementation (or food removal) study would be needed. Many of you worried about the small criticisms (observer differences, bone ID, fish size determination) -- but didn't think about the MAJOR problems described above. When reviewing papers, think about the BIG picture as well as the study-specific stuff.

4. Arguments for mixing: increases genetic variation within sites (but loses local adaptations), decreases inbreeding, augments small populations with immigrants improving population viability (increase each local population to over 50 animals, decreases effect of demographic variation), better control of poaching. Many of you lost 5 pts. for not talking about effect of demographic variation on small populations.

   Arguments for not mixing: maintains genetic variation across the population, prevents outbreeding depression, philosophical concerns (intrinsic worth of an organism higher if not manipulated by humans), guards against catastrophic events by "spreading the risk".

   Solution: I would try combining a few of the smaller populations that are clearly in trouble from demographic variation. The real answer also must involve some devaluing of rhino horn. The most creative answer: "To achieve this we need to recruit the guy responsible for the U.S. Tylenol™ scare of several years ago. In concert with the CIA, Greenpeace, Dave Foreman, or similar entity, this person should leak into the rhino horn market vast amounts of product contaminated with something that would bring the consumer some hideous fate, perhaps spontaneous projectile leprosy. Within a few days, word-of-mouth should sufficiently reduce rhino horn demand to eliminate most or all poaching pressure."