FW662 — Final Exam 2001

March 12, 2001

1. (20 pts) Mule deer age ratios (fawns per 100 does) were estimated in Colorado during December, 1999, with helicopter surveys for 12 Data Analysis Units (DAU):

DAU	Fawns:100 Does	Standard Error
D-3	48.52	4.7
D-7	48.32	6.94
D-8	65.32	2.92
D-9	68.31	5.29
D-10	52.83	4.34
D-13	53.69	3.34
D-14	42.54	3.7
D-16	38.54	4.22
D-19	38.46	4.4
D-27	75.1	4.84
D-43	36.31	3.03
D-53	42.53	4.64

Compute the process variance and process standard deviation, and their confidence intervals across these 12 DAU. Bring your analysis on a diskette in case I need to check your work.

2. (20 pts) For the above table, what is your biological interpretation of these estimates? What might be causing these differences across DAU? Consider the list of factors that have been discussed in the class. What evidence is there from this table that the mule deer in Colorado should be considered as a meta-population in the sense of Levins?

3. (60 pts) Study the attached article, Creel, S. 2001. Four factors modifying the effect of competition on carnivore population dynamics as illustrated by African Wild Dogs. Conservation Biology 15(1):271-274. Be prepared to answer/discuss the following questions.

A. (5 pts) Explain the concepts <u>interference competition</u> and <u>exploitative competition</u> relative to wild dogs and lions/hyenas.

B. (10 pts) What is the role of the prey population in the competition model between wild dogs and lions?

C. (15 pts) What conceptual modification(s) is/are needed to the Lotka-Volterra equations to develop the proposed model of competition between wild dogs and lions? Bring a written copy of your answer with you to the exam, so that you can explain your result to me.

D. (10 pts) Set up a 3-species competition model for wild dogs, lions, and hyenas. Bring a written copy of your answer with you to the exam, so that you can explain your result to me.

E. (7 pts) Explain the statement "In general, competition theory suggests that effects on population dynamics are greatest when resources are strongly limited.", Page 272, near top of the 2nd column. Do the Lotka-Volterra equations support this statement?

F. (8 pts) Given the conclusions from this article, what would you do as a reserve manager to help wild dogs compete against lions and hyenas? Consider the four factors identified in this article.

G. (5 pts) How could an experiment(s) be set up to test the ideas provided in this article?

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Student: _____ Final Score: _____ Course Grade: ____

1. (20 pts) Numerical results you should have obtained: Comments:

Parameter	Estimate	Lower 95% CI	Upper 95% CI
Mean	50.8725	42.78819	58.95681
Sigma^2	142.6945455	62.34657	447.3139
Sigma	11.94548222	7.895984	21.1498

2. (20 pts) The biological interpretation of these estimates is that there is considerable spatial variation operating on December age ratios in mule deer populations across Colorado. An estimate of the range across the state would be 51 fawns:100 does $\pm 2 \times 11.9$. Given the past models we've run in this course with survival estimates from the Piceance mule deer population, this level of December fawn:doe ratios suggests that the population is declining. The differences across DAU may be attributed to differences in:

a. habitat quality,

b. deer density (i.e., density-dependence),

c. elk competition,

d. predation,

e. weather, or

f. disease (e.g., Chronic Wasting Disease)

Absolutely no evidence of a meta-population operating because no information was provided about emigration/immigration between DAU.

3. (60 pts)

a. (5 pts) Interference competition – direct harm to others by physical or chemical means, Exploitive competition – use of resources deprives others

b. (10 pts) Prey population can be viewed as setting the K_i Comments: carrying capacities in the competition model.

c. (15 pts) The competition coefficients for wild dogs change in the model as a function of prey density interacting with lion density. Each lion has a bigger effect on each wild dog as the lion population increases.

d. (10 pts) Define N_1, N_2, and N_3 as populations of wild dogs, lions, and hyenas, respectively.
Then

$$\frac{dN_1}{dt} = r_1 N_1 \left(\frac{K_1 - a_{11}N_1 - a_{12}N_2 - a_{13}N_3}{K_1} \right)$$

$$\frac{dN_2}{dt} = r_2 N_2 \left(\frac{K_2 - a_{21}N_1 - a_{22}N_2 - a_{23}N_3}{K_2} \right)$$

$$\frac{dN_3}{dt} = r_3 N_3 \left(\frac{K_3 - a_{31}N_1 - a_{32}N_2 - a_{33}N_3}{K_3} \right)$$

e. (7 pts) When populations are near K, and hence near the maximum they can achieve, the effect from subtracting the product of the competition coefficients times the other populations is greatest, and hence produces the maximum effect on population growth rate.

f. (8 pts) Habitat fragmentation – reduce,
Effects of prey density – maintain low prey populations, Predatory/Prey body size ratios – can't do anything! Habitat type – allow habitats to close up, minimize burning.

g. (5 pts) One obvious is to manipulate prey densities to see if you get a response in the wild dog population. A second is to manipulate habitat fragmentation by either creating fragments or providing corridors to see if you get a response in the wild dog population. A third is to either open up habitat or allow habitat closure to again provide a range of habitat covers to see if you get a response in wild dog populations.