EXAM 2 KEY

1. It has been suggested that the cheetah (*Acinonyx jubatus*) is suffering from reduced genetic heterozygosity in the wild. Discuss the support or lack of support for this contention. (15 pts)

See Caughly 1994

Support

1. Lack of heterozygosity at 47 alleles in 50 cheetah tested by O'brien
2. Skin grafts accepted without indication of rejection on 14 reciprocal crosses reported by O'brien
3. Low sperm motility
4. Some authors have suggested that cheetahs have a limited distribution in Africa and therefore are prone to inbreeding and other deleterious genetic effects.
5. Over a 5 yr period only ~10% of cheetahs in NA captive breeding programs have produced live cubs
6. Cheetahs show higher fluctuating asymmetry than other felids

Lack of support

1. Two-dimensional electorphoresis fo 155 soluable proteins yielded an H value of 0.013 which is in the range of values found for other mammals.
2. Results of skin graft experiments are questionable because of inconsistencies in reporting of results
3. Many felids have low sperm motility and there has been no demonstration of reduced conception rates in the wild
4. Cheetahs are more widely distributed than O'brien suggested
5. Breeding success has been high (~70%) in captive breeding programs in South Africa
6. More recent analyses have shown that levels of fluctuating asymmetry in cheetahs are no lower than other felids
7. Cheetah populations are declining as a result of habitat loss, predation, hunting pressure, and disease transmission. None of these factors have been demonstrated to have a genetic basis.

2. Figure 4 of Donovan et al. 1995 displays the source-sink status of three bird species that they studied (the y-axes on the graphs on the left are not defined on the ONCORES version, they are fecundity/adult female/year). Starting with the equation for source-sink status (1 - adult survivorship = mean number of female offspring/female/year x juvenile survival (page 1385)) show how they derive the axes for the graphs on the left of this figure and why the line they draw separates source and sink populations. (15 pts)

1-s=m x s_0 => (1-s)/s_0=m where s=adult survival, s_0=survival of newborns, and m=fecundity. 1-s is equivalent to adult mortality so the values on either side of the equal sign are the same as the axes on the graphs. When the two sides of the equation are equivalent, 8=1, hence the line with slope=1 (the line on the graphs) separates the area where 8>1 (above the line) from the area where 8<1 (below the line).

3a. Suppose that you were studying the life history of racoons on the northcoast. You didn't have much funding for your project so you estimated the l_x values for the population from road kills you and your friends picked up on the roads in the area. During a month long period in late spring (after the birth pulse) you scraped up the following number of animals: 156 newborns, 65 1-year olds, 42 2-year olds, 17 3-year olds, and 2 4-year olds. You can assume that racoons don't live beyond 4 years. Compute the l_x and s_x values from the data. (10 pts)

Age	No. Dead	No Alive	lx	sx
0	156	282	1	0.45
1	65	126	0.45	0.48
2	42	61	0.22	0.31
3	17	19	0.07	0.14
4	2	2	0.01	0.00
total	282	0		

b. After careful study of racoon families visiting some local garbage dumps you estimated the following fecundity rates. Note: these are the total number of offspring observed. You may assume an equal sex ratio when making your calculations.

Age	0	1	2	3	4
Fecundity	0	3.0	3.4	3.6	1.8

Assuming that all births occur at the beginning of the age interval, calculate the intrinsic rate of increase for this population to the second decimal place. (10 pts)

Note you must divide the fecundity values in half to estimate the growth rate of the female population.

$\Sigma lxmx=R_0=1.16$

$\Sigma xl_xm_x=1.79$

=> Generation Time=G=1.54

estimated $r=\ln(R_0)/G=0.10$

For r=0.10, $\Sigma l_xm_xe^{-rx}=1.002$, which is slightly greater than 1 so try a larger r. (this value is acceptable for the exam)

For r=0.11 $\Sigma l_xm_xe^{-rx}=0.987$ which is farther from 1 than r=0.10.

c. Using the information above, build a Leslie matrix for the population. (8 pts)

$$\begin{bmatrix} 0.67 & 0.82 & 0.56 & 0.09 & 0 \\ 0.45 & 0 & 0 & 0 & 0 \\ 0 & 0.48 & 0 & 0 & 0 \\ 0 & 0 & 0.31 & 0 & 0 \\ 0 & 0 & 0 & 0.11 & 0 \end{bmatrix}$$

d. Using the following age class vector, project the population one time step into the future. Is the population at the stable age distribution (carry your calculations out to 2 significant digits for this question)? Why or why not? (6 pts)

$$\underline{N}_t = \begin{bmatrix} 390 \\ 158 \\ 69 \\ 19 \\ 2 \end{bmatrix} \qquad \underline{N}_{t+1} = \begin{bmatrix} 432 \\ 174 \\ 76 \\ 21 \\ 2 \end{bmatrix}$$

The proportions in each age class remain constant (0=0.61, 1=0.25, 2=0.11, 3=0.03, 4=0.01 vs 0=0.61, 1=0.25, 2=0.11, 3=0.03, 4=0.01) so the population has reached the SAD.

e.Compare the sensitivity of 8 to variation in survival of 0, 1, and 2 year-olds. Which parameter has the greatest effect on 8 and which has the least? (10 pts)
Increasing survival by 0.1 for ages 0, 1, and 2 leads to the following values of 8, 1.27, 1.16, and 1.13, respectively. Thus, survival of the 0 age class has the greatest effect on 8.

4. In your text, Gotelli describes a metapopulation model that incorporates a "rescue effect". Explain what he means by a rescue effect and how this effect is incorporated into the model. Explain what the constant e is and how it would be measured.(10 pts)
Rescue effect is the reduction in extinction rate as a result of immigrants colonizing occupied sites and thereby increasing population size and reducing extinction probability. This is incorporated assuming that the probability of local extinction decreases as most sites are occupied i.e. $p_e = e(1-f)$. e is measured by the slope of the relationship between extinction rate and proportion of occupied sites.

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5. Using the following hypothetical data for an introduced bighorn sheep population, calculate N_e for the entire period. (10 pts)

Year	Breeding Males	Breeding Females	Total Population	N_e	$1/N_e$
1977	1	5	14	3.33	0.30
1978	2	5	17	5.71	0.18
1979	2	7	25	6.22	0.16
1980	1	6	23	3.43	0.29
1981	3	7	31	8.40	0.12
1982	2	11	39	6.77	0.15
1983	2	19	53	7.24	0.14
1984	4	23	62	13.63	0.07
1985	5	29	84	17.06	0.06
1986	4	27	92	13.94	0.07
1987	4	37	112	14.44	0.07
1988	6	44	127	21.12	0.05
1989	7	49	141	24.50	0.04
1990	5	68	165	18.63	0.05
1991	5	71	191	18.68	0.05

Harmonic mean of N_e = $1/t*E(1/N_e)=(1/15)*1.80 = 8.33$

b. Assuming that this period represents five generations, calculate the percent of heterozygosity remaining in the population after this period. (5 pts)

% heterozygosity remaining after 5 generations= 73