Bio 608 Problem Set – Fall 2007

1. Consider the following hypothetical game, which is sort of a 2-player producer-scrounger game. Animals form pairs and harvest resources on their territories. Let the resource value of a territory be V. If two producers get the territory, they share V; i.e. they each get V/2. Scroungers are incapable of harvesting resources themselves, so if they share a territory, they each get 0. If a Producer shares a territory with a Scrounger, the Producer gets proportion *p* of V; whereas, the Scrounger gets the remainder (i.e. proportion (1-*p*) of V). So the payoff matrix looks like this (payoffs are to players along the rows, given an opponent who plays a strategy in the columns):

	Producer	**Scrounger**
Producer	**V/2**	***p* V**
Scrounger	**(1-*p*) V**	**0**

Using your vast knowledge of game theory, your job is to determine the evolutionarily stable strategy, or ESS.

Let *f* equal the frequency of Producers at the ESS, and solve for *f* in terms of *p*. How does the ESS depend on *p (if at all)*? Are there conditions that favor a mixed ESS or genetic polymorphism versus a pure ESS? If so, what are they? (Hint: consult your notes on the Hawk-Dove game.)

2. Consider the Ideal Free Distribution. You have a habitat with five patches (i.e. mechanical bird feeders) in an aviary with 200 hungry foragers (i.e. birds). The 5 patches distribute bird seed at the following rates: Patch A, 5 units per minute; Patch B, 10 units per minute; Patch C, 15 units per minute; Patch D, 20 units per minute; and Patch E, 50 units per minute.

What is the predicted Ideal Free Distribution of foragers among patches?

What is the average feeding rate within and among patches?

Show the graphical solution to this problem.

3. Consider the following cohort life table, with 5 age classes (0, 1, 2, 3, 4), the following numbers in each age class, n_x, and the following schedule of birth, m_x. (Hint: import into Excel and use formulas)

x	n_x	l_x	$s_{x,x+1}$	m_x	$l_x m_x$	R_x
0	67523			0		
1	2113			0		
2	276			166		
3	133			166		
4	0			-		

- **Fill in the missing columns in the table (l_x, $s_{x,x+1}$, $l_x m_x$, and R_x).**
- **Plot a graph of R_x versus x.**
- **Imagine a mutation that increased fecundity by 10% at age 2, but reduced survival from age 2 to age 3 by 10%. Would such a mutation be favored by natural selection? Why or why not (show calculations)?**
- **Where on the following graph (Ensminger 2007) does this tradeoff take place?**