## Population ecology assignment: Life history

*Do by Fri 25 Mar (not for credit)*

1. (6 points in total) Scientists investigate an annual plant species for three years. The adults produce 150 seeds per year, on average. In the first year of the study, 2% of the seeds survive to become adults. In the second year of the study, 1% survive to become adults in the second year. In the third year of the study, 0.2% survive to become adults.

a. (3 points) What is the finite growth rate $\lambda$ for this population in each of the three years?

b. (1 point) What is the ratio of the population at the end of the study to that at the beginning?

c. (2 points) What is the "correct" average value of $\lambda$ – ie., the constant value which would give the same total growth of the population over three years?

2. (4 points in total) Scientists investigate another annual plant species for one year. The adults produce 150 seeds, on average. 1/3 of the seeds go to a place where 2% survive, 1/3 go to a place where 1% survive, and 1/3 go to a place where 0.2% survive.

a. (3 points) What is the overall proportion of seeds that survive?

b. (1 points) What is the value of $\lambda$ for this population?

3. (10 points in total) Two species of flour beetles have competition coefficients of $\alpha_{12} = 0.8$, $\alpha_{21} = 1.5$. These remain more or less constant, while their values of $r_{\max}$ and $K$ change in different experimental conditions.

a. (2 points) Explain the meaning of the $\alpha$s. Assuming we are counting population size by individuals, which species do you think has bigger individuals?

b. (2 points) Do these beetles have a tendency for coexistence, or for mutual exclusion?

c. (2 points) Use a calculation of effective competition coefficients to find parameters for which you would expect species 1 to dominate.

d. (2 points) Use a calculation of effective competition coefficients to find parameters for which you would not expect one species to dominate. What will happen in this case?

e. (2 points) Use the R function `compPlot` documented at `http://yushan.mcmaster.ca/theobio/3SS/index.php/Competition_models` to verify your

answers above. Playing with this function may also help you find answers to the questions above, or to check your thinking. You can increase `MaxTime` if the simulations seem to stop in the middle. Show your plots.