Population ecology assignment: Competition

1. (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 αs (remember the course definition (see notes) may differ from your textbook). Assuming we are counting population size by individuals, which species do you think has bigger individuals?

α_{12} is the relative effect of a type 1 individual, compared to a type 2 individual, on the type 2 population, and vice verse. Since $\alpha_{12} < 1$ and $\alpha_{21} > 1$, this means that the relative effect of type 2 individuals is larger in both cases, so they are likely to be bigger individuals.

b. (2 points) Do these beetles have a tendency for coexistence, or for mutual exclusion (i.e., founder effects)? Explain.

Since the product of the αs is $C = 1.2 > 1$, between-species competition is stronger than within-species competition, and they have a *tendency* 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.

We expect species 1 to dominate if $E_{12} > 1 > E_{21}$. These should both be true if $K_1/K_2 > 1.5$. So we pick, for example, $K_1 = 16$, $K_2 = 10$. This gives $E_{12} = 1.28$, $E_{21} = 0.94$. The values of $r_{\max}$ don't matter (as long as they are > 0, as we generally assume).

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?

We expect mutual exclusion if $E_{12}, E_{21} > 1$. This should be true if $1.25 < K_1/K_2 < 1.5$. So we pick, for example, $K_1 = 14$, $K_2 = 10$. This gives $E_{12} = 1.12$, $E_{21} = 1.07$.

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.

We used the default parameters, except for the values listed above. We started each simulation from three points (an advantage to each species, plus one in the middle). We increased MaxTime for the coexistence simulation. The phase plot is the clearest way to show the result of competition. We show species 1 dominance on the left, and mutual exclusion on the right.