

- 1) Black-tailed prairie dogs are the favored prey of black-footed ferrets. In 2012, the population size of a group of prairie dogs is 100 individuals, and there are 10 ferrets living and feeding off of the prairie dog colony. The maximum per capita growth rate for the prairie dogs is 5, and for the ferrets is 1. The effect of the ferrets on the prairie dogs ( $\alpha_{12}$ ) is 0.75, and the effect of the prairie dogs on the ferrets ( $\alpha_{21}$ ) is 0.25. The carrying capacity for the prairie dogs is 200, and the carrying capacity for the ferrets is 50. Using the Lotka-Volterra model of population growth, predict how the populations of prairie dogs ( $\Delta N_1$ ) and their ferret ( $\Delta N_2$ ) predators might change over the course of a year.

$$\frac{\Delta N_1}{\Delta T} = r_{\max 1} N_1 \left( \frac{K_1 - N_1 - \alpha_{12} N_2}{K_1} \right) = \frac{(5)(100)(200 - 100 - (0.75 * 10))}{200} = 231.25$$

$$\frac{\Delta N_2}{\Delta T} = r_{\max 2} N_2 \left( \frac{K_2 - N_2 - \alpha_{21} N_1}{K_2} \right) = \frac{(1)(10)(50 - 10 - (0.25 * 100))}{50} = 3$$

$N_1 = 100$  prairie dogs

$N_2 = 10$  ferrets

$r_{\max 1} = 5$

$r_{\max 2} = 1$

$K_1 = 200$

$K_2 = 50$

$\alpha_{12} = 0.75$

$\alpha_{21} = 0.25$

- 2) Which type of species interaction is positive for both species involved? Give an example of this type of interaction.

- 3) The hormone ghrelin is associated with an increase in food intake in most mammals. You decide to inject this hormone into ground squirrels at different doses to see if it has the same result at different times of the year. You inject squirrels with 0mg/kg, 0.1mg/kg, 1 mg/kg, and 10 mg/kg in spring and again in autumn and measure food intake for 4 hours after the injection. Given the following statistical results, what conclusion might you draw about the effect of ghrelin on ground squirrels in spring vs. autumn (results are considered significant at  $p \leq 0.05$ )? (Hint: Which dose of ghrelin has a statistically significant increase in food intake in the spring? Which dose has a statistically significant increase in food intake in the autumn?)

	Spring		Autumn	
	Change in food intake (grams)	p-value	Change in food intake (grams)	p-value
<b>0 mg/kg</b>	1	0.999	2	0.999
<b>0.1 mg/kg ghrelin</b>	1	0.999	4	0.05
<b>1 mg/kg ghrelin</b>	5	0.1	16	0.01
<b>10 mg/kg ghrelin</b>	10	0.05	30	0.001

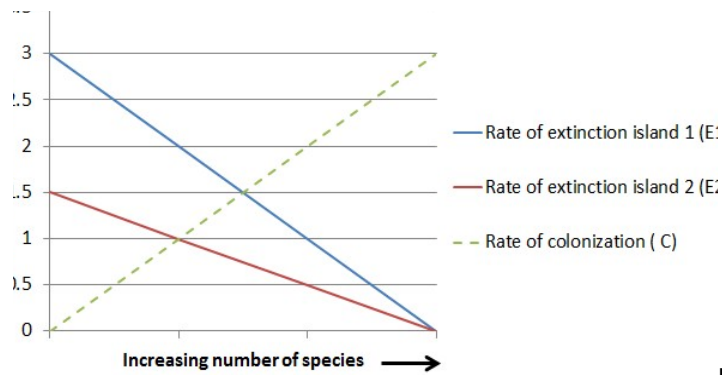
In the spring, we see a significant change in food intake when inject 10 mg/kg ghrelin. In autumn, we see a significant change in food in 0.1 mg/kg ghrelin, 1 mg/kg ghrelin, 10 mg/kg ghrelin.

In the spring, fairly resistant to ghrelin, in the autumn more reactive to ghrelin because increasing food intake to prepare for hibernation.

- 4) Which of the three main predictions of the Theory of Island Biogeography is described by the graph below?

Closer = more species

Larger= more species



Red represents the smaller island.

Blue represents the larger island. When  $\hat{s}$  is drawn, the larger island will have a higher number of species.