**FW364 Spring 2012**

**Competition Practice Problems**

1. Exploitative interspecific competition refers to:
2. direct competitive interactions within a species
3. indirect competitive interactions between species
4. indirect competitive interactions within a species
5. direct competitive interactions between species
6. Draw a SIMPLE conceptual model representing two species resource competition. Note: by simple conceptual model, I am referring to the basic box and arrow diagrams we have used during lecture; I am NOT referring to the complex box and arrow diagrams that we have built in Stella.
7. How would we modify the conceptual model from Question 2 if the two consumer species were competing over **two** shared resources?
8. Under the competitive exclusion principle (circle all that apply):
9. the consumer with the lowest resource requirement at equilibrium will win
10. there can be only one winner of resource competition
11. the consumer with the lowest R\* will dominate initially
12. the consumer with the greatest R\* wins
13. Which assumptions apply to the following set of equations (circle all that apply)?

$^{dP\_{1}}/\_{dt}=a\_{1}c\_{1}RP\_{1}- d\_{1}P\_{1}$ $^{dP\_{2}}/\_{dt}=a\_{2}c\_{2}RP\_{2}- d\_{2}P\_{2}$

$$^{dR}/\_{dt}=b\_{r}R- d\_{r}R-a\_{1}RP\_{1}- a\_{2}RP\_{2}$$

1. in the absence of consumer one, the resources grow exponentially
2. consumers encounter prey randomly
3. consumers have a satiating (Type II) functional response
4. the consumer populations will increase exponentially in the absence of prey
5. exploitative competition
6. R\* for a consumer species is determined by:
7. allowing two consumer species to compete over a shared resource and measuring the equilibrium abundance of the resource
8. allowing a single consumer species to grow to equilibrium while consuming a single resource and measuring the equilibrium abundance of the consumer
9. allowing a single consumer species to grow to equilibrium while consuming two resources and measuring the equilibrium abundance of the resources
10. allowing a single consumer species to grow to equilibrium while consuming a single resource and measuring the equilibrium abundance of the resource
11. Solve the equation below for R\*. What type of functional response does the consumer have in this equation?

$$^{dP}/\_{dt}=acRP- d\_{p}P$$

1. According to the type II functional response equation below, what happens to the feeding rate, *f*, when the number of resources is high?

$$f=\frac{f\_{max}R}{R+h}$$

1. *f* approaches *fmax*
2. *f* approaches zero
3. *f* approaches 1
4. *f* approaches *h*
5. What is the half-saturation constant, *h*, for the feeding rate curve below if the maximum feeding rate, *fmax*, is 6?



1. Solve the equation below for R\*. What type of functional response does the consumer have in this equation?

$$^{dP}/\_{dt}=\frac{cf\_{max}RP}{R+h}- d\_{p}P$$

1. According to your R\* solution for Question 10, which of the below make a better competitor (circle all that apply)?
2. competitor with a low feeding rate
3. competitor with a high death rate
4. competitor with a low half-saturation constant
5. competitor with a high conversion efficiency
6. What part of the equation in Question 10 represents the consumer birth rate?
7. If the solid curve represents the consumer birth rate, and the dashed line represents the consumer death rate, what is R\* for the consumer represented in the figure below?

 

*bp*

*dp*

1. Use the following figure to answer the questions below.

 

*b*1

*d*1

*d*2

*b*2

Assuming that *b*1 and *b*2 are functions relating the birth rates of two consumer species (1 and 2) to resource abundance, and that *d*1 and *d*2 are death rate functions:

1. Which species will be the winner of competition if the death rate of both species is given by *d*1?
2. Which species will be the winner of competition if the death rate of both species is given by *d*2?
3. Circle the correct option from each pair below to describe the characteristics of *r*- and *K*-selected species.

*K*-selected (climax species)

low birth rate vs. high birth rate

low death rate vs. high death rate

low *h* vs. high *h*

*r*-selected (weedy species)

low birth rate vs. high birth rate

low death rate vs. high death rate

low *h* vs. high *h*

1. Use the following figure to answer the questions below.

 

*b*2

*d*1

*d*2

*b*1

Assuming that *b*1 and *b*2 are functions relating the birth rates of two consumer species (1 and 2) to resource abundance, and that *d*1 and *d*2 are death rate functions:

1. Which species will be the winner of competition if the death rate of both species is given by *d*1?
2. Which species will be the winner of competition if the death rate of both species is given by *d*2?
3. Which species will be the winner of competition if the death rate of consumer 1 is *d*1 and the death rate of consumer 2 is *d*2?
4. Given the parameters in part c, would consumer 1 represent a weedy species or a climax species?
5. The figure below is a competition-disturbance figure, showing how the abundance of two competing species changes through time with multiple disturbance events (black arrows). Does the consumer with the dashed line represent a weedy species or a climax species?



1. Which of the following could promote co-existence of competing species, even if one species is a superior competitor for a shared single resource (circle all that apply)?
2. harvest of the superior competitor
3. periodic disturbances that favor the inferior competitor
4. the introduction of a predator species that prefers the inferior competitor
5. the inclusion of a second resource for which the inferior competitor (inferior based on the original resource) has a lower R\*
6. Given one example of an application of competition modeling.
7. \*\*This is a challenging question. Be sure to read the questions for parts a-c carefully.

 Note: there may be extraneous information provided.\*\*

A resource has a birth rate of 4 individuals per month and a death rate of 2 individuals per month due to non-predatory sources of mortality. The resource is eaten by two consumers that are not aggressive to each other. The conversion efficiency of both consumers is 0.5. Consumer 1 has an attack rate that is 2 times greater than the attack rate of consumer 2. Consumer 1 has a death rate that is 4 times greater than the death rate of consumer 2. Given the equations below, answer the following three questions.

$^{dP\_{1}}/\_{dt}=a\_{1}c\_{1}RP\_{1}- d\_{1}P\_{1}$ $^{dP\_{2}}/\_{dt}=a\_{2}c\_{2}RP\_{2}- d\_{2}P\_{2}$

$$^{dR}/\_{dt}=b\_{r}R- d\_{r}R-a\_{1}RP\_{1}- a\_{2}RP\_{2}$$

1. Which consumer has the greater birth rate?
2. What is the **growth rate** of each consumer at **equilibrium**?
3. Does one species drive the other extinct at steady state? If so, which persists and which goes extinct?