4.1, 4.3, 2, 3, 4; 5 cred

HW 2 - SARAH WARD

Ch 4 ① $\frac{dN}{dt} = rN\left[1-(N/K)^{\theta}\right]$

a. $\frac{dN}{dt} = F(N) = 0 = F(\hat{N})$ ← equilibria

$$0 = r\hat{N}\left[1-(\hat{N}/K)^{\theta}\right]$$

$$0 = 1-\left(\frac{\hat{N}}{K}\right)^{\theta}$$

$$1 = \left(\frac{\hat{N}}{K}\right)^{\theta} = \frac{\hat{N}^{\theta}}{K^{\theta}}$$

$$K^{\theta} = \hat{N}^{\theta} \quad \text{so} \quad \boxed{K = \hat{N}}$$

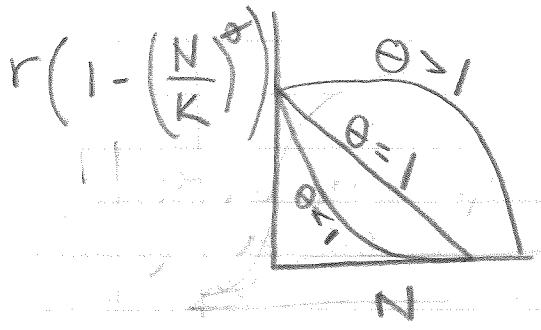
r/K = SLOPE

b. $\frac{dN/dt}{N} = \left[1-(N/K)^{\theta}\right]$ $r = .1$ $K = 100$

$\theta = 0.5$ $r\left[1-(N/K)^{0.5}\right]$

$\theta = 1$ $r\left[1-(N/K)^{1}\right] = r\left[1-\frac{N}{K}\right]$ LOGISTIC GROWTH

$\theta = 2$ $r\left[1-(N/K)^{2}\right]$



c. This model allows for greater detail in displaying growth rate over time than the logistic model.

TAXA examples:

- when $\theta < 1$: A PARASITE; as the population ↑, host populations ↓ and dN/dt will decline
- when $\theta = 1$: MICROBES; as N ↑, resources ↓ and dN/dt falls at a constant rate
- when $\theta > 1$: Territorial animals; as N ↑, space declines and dN/dt falls sharply

Ch4 Problem 3

$$\frac{dN}{dt} = rN(N-a)[1-(N/K)]$$

a. $\frac{dN}{dt} = f(N) = 0 = f(\hat{N})$ ← EQUILIBRIA

$$0 = r\hat{N}(\hat{N}-a)[1-(\hat{N}/K)]$$

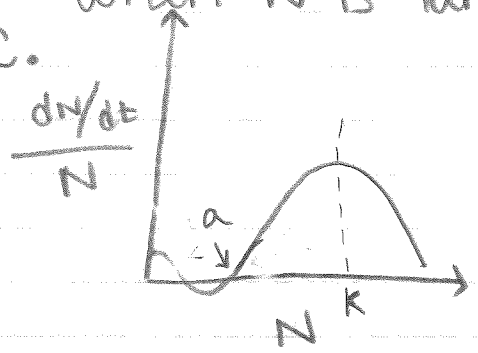
$$0 = (\hat{N}-a)[1-(\hat{N}/K)]$$

$$\hat{N}-a=0 \quad , \quad 1-\frac{\hat{N}}{K}=0$$

$$\hat{N}=a \qquad \hat{N}=K$$

b. when N is small ($<a$) a is more stable ? when N is larger ($>a$) K is more stable ?

c.



d. This model is more complex than the simplistic logistic model because growth rate actually falls if N is less than a (allee threshold). An example would be large bodied mammals; if the N is too low, then encounters become rare and $\frac{dN}{dt}$ falls. ~~After~~ the population reaches a, encounters become frequent enough for $\frac{dN}{dt}$ to increase.