Homework assigned Monday, September 27

(1) A population of fish in a pond has discrete logistic growth with a carrying capacity of 400 and a per capita growth rate of 1.8 (fish/year)/fish. A some point the someone starts to harvest 40% of the current population.

(a) What is the new equation for the population growth?
Solution: It is

$$N_{t+1} = N_t + 1.8N_t\left(1 - \frac{N_t}{400}\right) - .4N_t$$

(b) What is the new carrying capacity?
Solution: This may not be quite the shortest method, but it gives a lot of information about what is going on.

$$\begin{aligned}
N_{t+1} &= N_t + 1.8N_t\left(1 - \frac{N_t}{400}\right) - .4N_t \\
&= N_t + N_t\left(1.8\left(1 - \frac{N_t}{400}\right) - .4\right) && \text{(Factor } N_t \text{ out of last two terms)} \\
&= N_t + N_t\left(1.8 - \frac{1.8N_t}{400} - .4\right) && \text{(Distribute the 1.8)} \\
&= N_t + N_t\left(1.4 - \frac{1.8N_t}{400}\right) && \text{(Subtract)} \\
&= N_t + 1.4N_t\left(1 - \frac{1.8N_t}{(1.4)(400)}\right) && \text{(Factor out 1.4)} \\
&= N_t + 1.4N_t\left(1 - \frac{N_t}{311.111\ldots}\right) && \text{(Simplify)}
\end{aligned}$$

So we have written the new equation as a discrete logistic with new carrying capacity $K = 311.111$ and new per capita growth rate $r = 1.4$.

(2) A population of annual cicada in park has a discrete logistic growth with a carrying capacity of 2,000 and a per capita growth rate of 1.4 (bugs/year)/bug. A new predator in introduced that kills 20% of the cicadas per year.

(a) What is the new equation for the population growth?
(b) What is the new carrying capacity?

(3) A population of deer in a forest has a discrete logistic growth with a carrying capacity of 2,000 and a per capita growth rate of .8 (deer/year)/deer. They become a pest and 20% of the population is harvested each year.

(a) What is the new equation for the population growth?
(b) What is the new carrying capacity?