Bio 320 Ecology Fall 2008 Problem Set 3

Published 29 September 2008, Answers Due in Class Wednesday, 8 October 2008

1. In discrete time, a population with density-dependent dynamics grows according to:

$$x_{t+1} = 2\, x_t\, (1 - x_t)$$

where x_t is proportional density. At dynamic equilibrium $x^* = x_{t+1} = x_t$. Find the equilibrium x^*.

2. At time t a population has size N_t, where $0 \le N_t \le N_{maximum}$. Let $x_t = N_t/N_{maximum}$, so that $0 \le x_t \le 1$. In discrete time x_t has dynamics:

$$x_{t+1} = 2.5\, x_t\, (1 - x_t)$$

At positive equilibrium $x_{t+1} = x_t > 0$. (a) Find the positive equilibrium. (b) What will happen (briefly) if $x_{t+1} = 0.5\, x_t\, (1 - x_t)$?

3. Consider one form of the discrete time logistic:

$$N_{t+1} \quad = \quad N_t\, e^{r\left(1 - N_t/K\right)}$$

Show that $N = K$ at positive equilibrium.

4. The following life table shows an initial cohort and the number of individuals left alive as age x advances. b_x is the average number of births per x-yr old. Estimate the intrinsic rate of increase. To do so, you must first find R_0, then find generation time, and then estimate the intrinsic rate of increase (under the assumption of density-independent growth).

Age	No. Alive	b_x
0	560	0.5
1	350	8/5
2	70	1.6
3	0	-

5. This problem has parts A and B.

(A) Briefly describe the hypothesis of character displacement between species.

(B) Consider a population with the following discrete-time dynamics

$$N_{t+1} = N_t\left[(1 + r) - \frac{r}{K} N_t\right],$$

where r, $K > 0$. Show that if $N_t = K$, the population size has reached positive equilibrium.