BIO 320 Ecology Fall 2016 Quiz 2, Version A

Answer all questions in your exam booklet. Be sure to write your **name**, last 4 digits of your student ID, and the **version** of your test on the booklet cover. **Show your work**.

1. Distinguish the following discrete-generation growth models:

- Normal compensation
- Critical depensation
- Overcompensation

Graphical representations, carefully labelled, can be sufficient.

Consider 1-D maps $N_{t+1} = F(N_t)N_t$, where N_t is population size.

Normal compensation: N_{t+1} strictly concave function of N_t.

$0 < N_t < N_{t+1} < N^*$ for $N_t < N^*$, where $N_t = N_{t+1} = N^*$.

Critical depensation: N_{t+1} initially convex and then concave function of N_t. Three equilibria result: $N^* = 0, k_0, andK$, in increasing magnitude. Since $N_{t+1} < N_t$ for $N_t < k_0$, extinction is locally stable.

Overcompensation: N_{t+1} strictly concave function of N_t. N_{t+1} exceeds N^* for certain $0 < N_t < N^*$. The degree of overcompensation determines the dynamic complexity.

2. State one or more assumptions common to all models of logistic population growth.

Population growth (dN_t/dt) maximal at densities intermediate to extinction and the resource-limited carrying capacity.
Growth per individual ($[1/N_t]dN_t/dt$) a decreasing function of population density near the carrying capacity, a consequence of intra-specific competition (*i.e.*, density-dependent self-regulation).

3. Consider an example of continuous-time logistic growth. If N_t represents population density at time t, we have:

$$dN_t/dt = aN_t - bN_t^2$$

Find the value of N_t where population growth dN_t/dt is maximal.

$$(d/dN_t)(dN_t/dt) = a - 2bN - t$$
$$(d/dN_t)(dN_t/dt) = 0 \quad \Rightarrow \quad a = 2bN`$$
$$N` = a/2b$$

4. Consider an example of discrete-time logistic growth. If x_t is population density$(0 < x_t < 1)$, we have:

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

Find the positive equilibrium density.

At equilibrium, $x_{t+1} = x_t = x^*$.

$$x^* = \lambda x^*(1 - x^*)$$
$$1/\lambda = 1 - x^* \quad \Rightarrow \quad x^* = 1 - (1/\lambda)$$

5. When we have a continuous population growth model (*e.g.*, logistic growth), we write something like

$$dN_t/dt = G(N_t)$$

where G is some function that tells us how fast N_t grows or declines at any possible density. The we set the equation to 0: $G(N_t) = 0$. What does this represent? Why do we do so?

$G(N_t) = 0$ implies that births and deaths are balanced the population level, so that population density rests at equilibrium. We identify population densities N^* generating equilibrium, so that we can generate predictions about natural ad managed populations. We consider stability of possible equilibria, and what ecological conditions (parameter values) promote stability, to specify predictions.