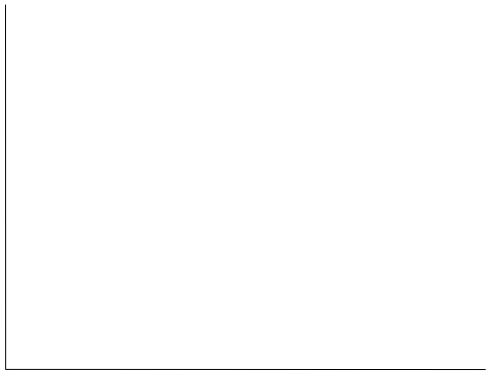
ECOL 8310: POPULATION AND COMMUNITY ECOLOGY
HW 7

A few practice problems from an old undergraduate course I taught. These should be "simple" and quick, but provide a good way to gauge your basic understanding.

1. Dr. Science from the University of Florida studies an important fishery, the Gorgeous Grouper. The Gorgeous grouper feeds exclusively on a smaller prey fish, the Hairy Herring.
   - This system is "closed" (no migration from other sites);
   - predators do not directly interfere with one another;
   - In the absence of the predator, the prey shows logistic growth, with a carrying capacity of 100 individuals/m^2;
   - The per capita death rate of the predator is 0.1/day;
   - When the prey are at a density of 60 prey/m^2, the predator achieves a per capita birth rate of 0.1/day.

   a. Draw and label a phase plane diagram (predator density against prey density) showing the predator and prey no growth isoclines. Indicate all relevant landmarks with quantitative values (where possible -- not all landmarks can be defined).



   b. After the election of Governor Scott, Dr. Science noticed that the marine environment had changed for the first time in many years due to the introduction of additional physical structure (i.e., trash) in the environment. This structure interferes with the predator's ability to search for and attack prey, but has no other effect. A predator now requires twice the density of prey it used to (i.e., it now requires 120 prey/m^2) to achieve a per capita birth rate of 0.1/day. Find the equilibrium densities of the predator and prey in this new environment?

   Predator (Gorgeous grouper): _____ fish/m^2

   Prey (Hairy Herring): _____ fish/m^2

3. Compared with the standard Lotka-Volterra predator-prey model (which is neutrally stable), how will each of the following modifications affect the stability of the equilibrium? Circle the best answer for each item.

Intraspecific compet. in prey	Stabilize	Destabilize	Either	No effect
Type II functional response	Stabilize	Destabilize	Either	No effect
Type III functional response	Stabilize	Destabilize	Either	No effect
Predator interference	Stabilize	Destabilize	Either	No effect
Cooperative foraging among predators	Stabilize	Destabilize	Either	No effect
High conversion efficiency of the predator	Stabilize	Destabilize	Either	No effect

4. The dynamics of three species can be described using the following equations (where N is density, in no./m^2):

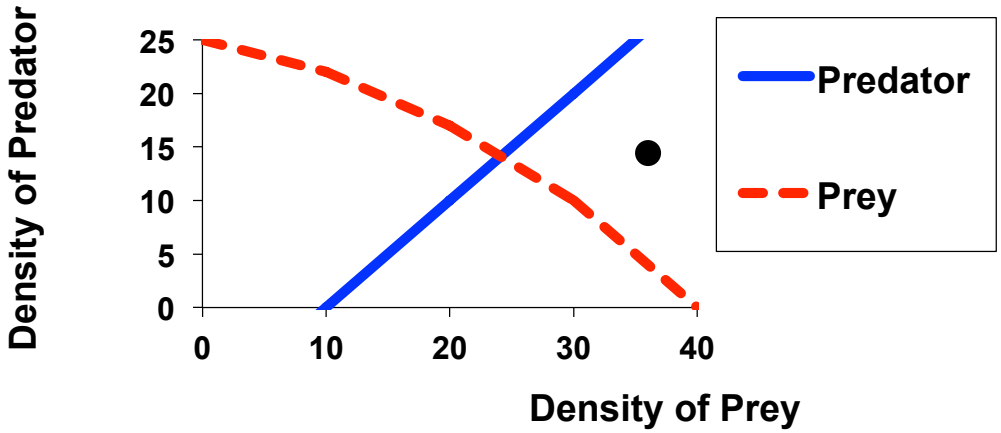
$dN_1/N_1dt = +1.0 - 0.1N_1 - 0.2N_2 + 0.1N_3$
$dN_2/N_2dt = -1.6 + 0.1N_1$
$dN_3/N_3dt = -0.5 + 0.1N_1 - 0.01N_3$

For each of the following, choose (i.e., circle) the best option from those available within parentheses:

a) Species 1 and 2 are:
(competitors; predator and prey; mutualists, do not interact directly)
b) Species 1 and 3:
(competitors; predator and prey; mutualists, do not interact directly)
c) Species 2 and 3:
(competitors; predator and prey; mutualists, do not interact directly)
d) Which species show(s) direct self limitation? (circle all that apply):
(Species 1; Species 2; Species 3)
e) In the absence of Species 3, Species 1 and 2 will:
coexist (both persist);
only species 1 will persist;
only species 2 will persist;
neither will persist;
there is not enough information provided

5. Based on the following phase-plane diagram and isoclines for a predator and its prey:

a) Plot the predator-prey dynamics on the phase-plane for a system that starts at the densities indicated by the dark dot (i.e., when the predator starts at 3 and the prey starts at 36). Make sure you give the entire trajectory (i.e., showing the trajectory of the system over all time).



b) Based on the above phase-plane provide one plausible statement about the biology of the predator (your answer must reveal something about the shape of the predator's isocline).

c) Based on the above phase-plane provide one plausible statement about the biology of the prey (your answer must reveal something about the shape of the prey's isocline).

d) Plot predator and prey densities through time. Make sure the dynamics line-up properly on the y-axis.

This HW is due (via email) by 5pm Monday.