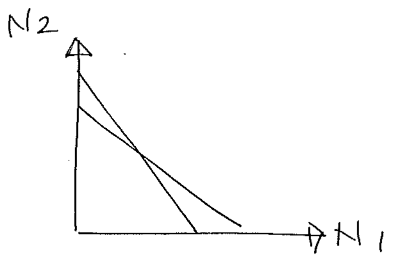
HW#4

7.1) Adding to equation 7.3 the term $-mN_i$ gives us

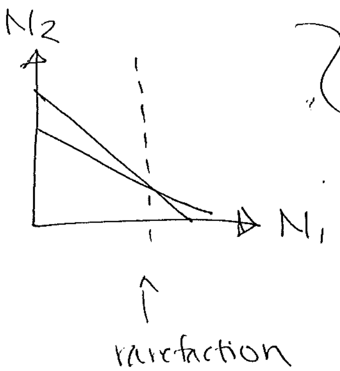
$$\frac{dN_1}{dt} = r_1N_1(1-a_{11}N_1 - a_{12}N_2) - mN_i$$

where m is a measure of the colonization rate of species i (unspecified)

$-mN_i$ is the equivalent of removing a patch of the habitat for hydra species i, and inhibiting its rate of colonization by a rate of negative m. By adding this term to equation 7.4 $\left(\frac{dN_2}{dt}\right) = r_2N_2(1-a_{22}N_2 - a_{21}N_1))$, both species' rates of growth (dN/dt) are adversely affected, so that neither can reach the point of outcompeting the other, thus both coexist.



VS.



Slopes decrease, allowing for more coexistence before rarefaction

7.2) (A) $\frac{dp_1}{dt} = m_1p_1(1-p_1) - ep_1$

$\hookrightarrow m_1p_1(1-p_1) - ep_1 = 0$

Solve for p_1:

$m_1p_1 - p_1^2 - ep_1 = 0$

$\hookrightarrow \frac{-p_1^2 - ep_1}{p} = \frac{-m_1p_1}{p_1}$

$\hookrightarrow p_1 - e = -m_1$

$\hookrightarrow p_1 = -m_1 + e$

$\hookrightarrow \boxed{p_1 = e - m_1}$

In order for this equilibrium to be positive, e must be greater than m_1 $(e > m_1)$

This means that the extinction rate must be greater than the rate of colonisation.

(B) $\frac{dp_2}{dt} = m_2p_2(1-p_1-p_2) - m_1p_1p_2 - ep_2$

$\hookrightarrow m_2p_2(1-(e-m_1)-p_2) - m_1(e-m_1)p_2 - ep_2 = 0$

$\hookrightarrow m_2p_2 - em_2p_2 - m_2p_2m_1 - m_1e + m_1^2 + -m_1p_2 - ep_2 = 0$

$\boxed{m_1 \text{ must be } \geq m_2}$

(c) Species #2 would be elimanted first.

(D) As the exstinction rate is increased, The equilibriom level of species #2 appears to decrease, which makes sense in an ecological perspective, since The species is dying off more quickly.

7.4) (a) Competition in The field likely involves not only multiple (i.e. more Than two) species involved, as well as changable environmental conditions, which wouldn't adhere to The Lotka-Voltorra model.

However, in order to otilize L-V equations in The field you would need to choose two species; perhaps Those That affect eachother most quantitatively.

In The lab, you could easily model L-V equations more accuratly (i.e. more closely to the paramaters of The model), but The results wouldn't actual simulate control studies in The field.

(b) Looking at numbers of species grown together includes observing The rate at which Those populations change over time.

(c) Observation would be an efficient method to conform overlap in resources used by competitors.

(d) Experimental field manipulations could include controlling The type/amount of certain resources, or limiting/encouraging direct or indirect interactions between species.