Like #6 on p165

$$\frac{\Delta x}{\Delta t} = 4x - .04x^2 - .03xy$$

$$\frac{\Delta y}{\Delta t} = 2y - .01y^2 - .005xy$$

Model Type: Look at interaction terms

Both Positive → Symbiotic relationship (Cooperative)

Both negative → Competing species

Equilibrium Points

$\Delta x = 0$

$x = 0$: $4 - .04x - .03y = 0$

$4 - .04x = 0$ (100, 0)

$\frac{4}{.04} = x = 100$

$y = 0$: (0, 0)

$\Delta y = 0$

$2 - .01y - .005xy = 0$

$2 - .01y = 0$

$y = \frac{2}{.01}$

$= 200$

(0, 200)

$4 - .04x - .03y = 0$ *①

$-3(2 - .005x - .01y = 0)$

$-6 + .015x + .03y = 0$ *②

$-2 - .025x = 0$ Add ①, ②

$x = \frac{2}{-.025} = -80$

↳ Solve ① for y if $x = -80$

but $x < 0$ means no Eq real point

Eg Points (0,0) (0,200), (100,0)

$\Delta x = 0 \iff x = 0$ or $4 - .04x - .03y = 0$

(100,0) - y intercept

y-axis Let $x = 0$ $\quad 4 - .03y = 0$

$133 = \frac{4}{.03} = y \quad (0, 133)$

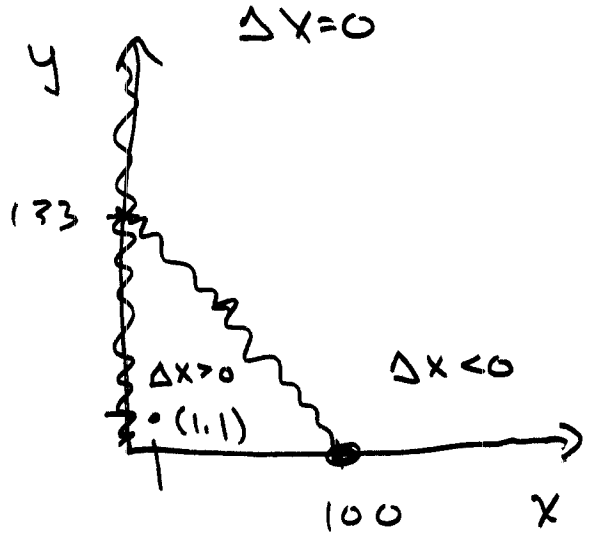
$\Delta y = 0 \iff y = 0$ or $2 - .01y - .005x = 0$

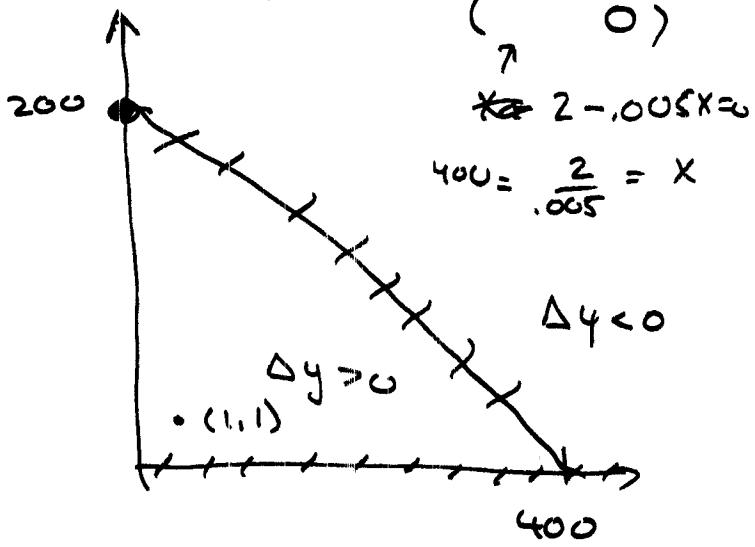
$\Delta y = 0$ $\quad (0, 200)$

$(\quad 0)$

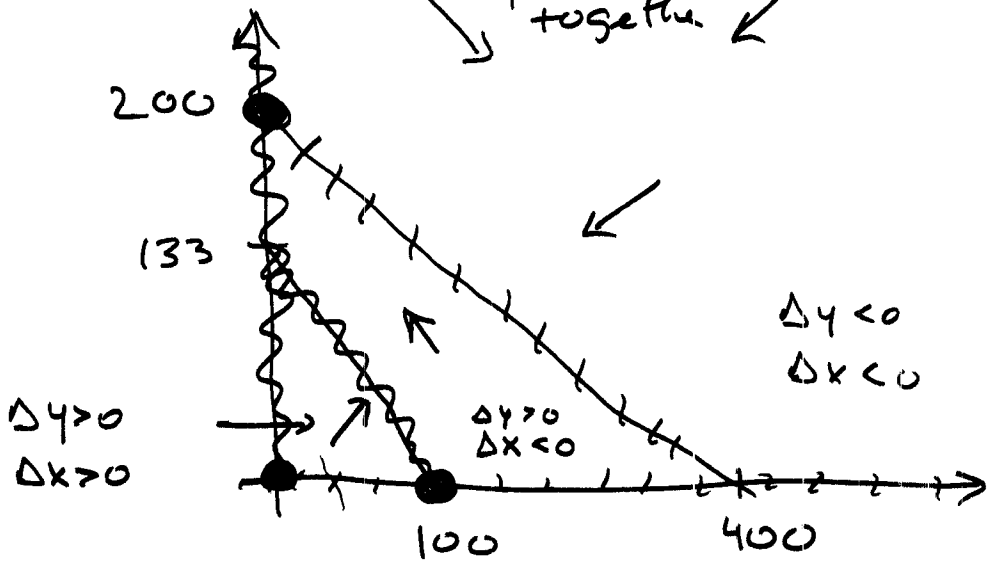
$2 - .005x = 0$

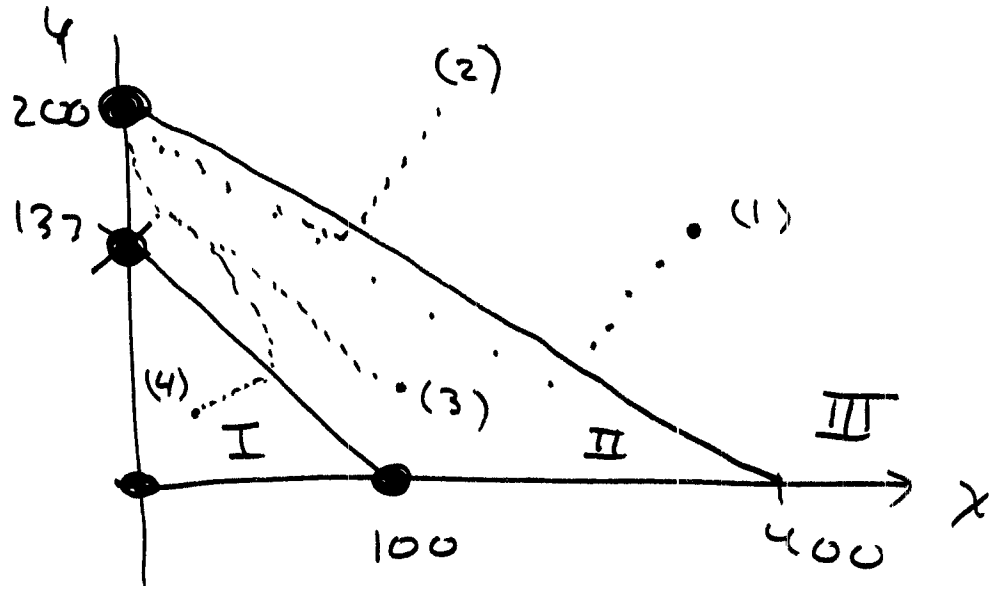
$400 = \frac{2}{.005} = x$





put together





We make predictions of the long range outcomes if the species start with different combinations in regions I, II, III

In Region III, both species decrease until the combination ends up in Region II

In Region ~~III~~ I both species increase & the combo ends up in Region II

In Region II y increases & x decreases towards the equilibrium point ~~(0,0)~~ (0, 200).

Biologically speaking, regardless of how many x, y to start with x will eventually become extinct & y will settle at its carrying capacity.