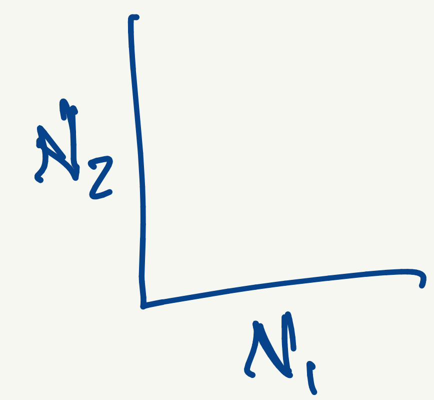
$$\begin{cases} \dfrac{dN_1}{dt} = r_1 N_1\left(1 - \dfrac{N_1+\alpha N_2}{K_1}\right) \\[2ex] \dfrac{dN_2}{dt} = r_2 N_2\left(1-\dfrac{N_2+\beta N_1}{K_2}\right)\end{cases}$$

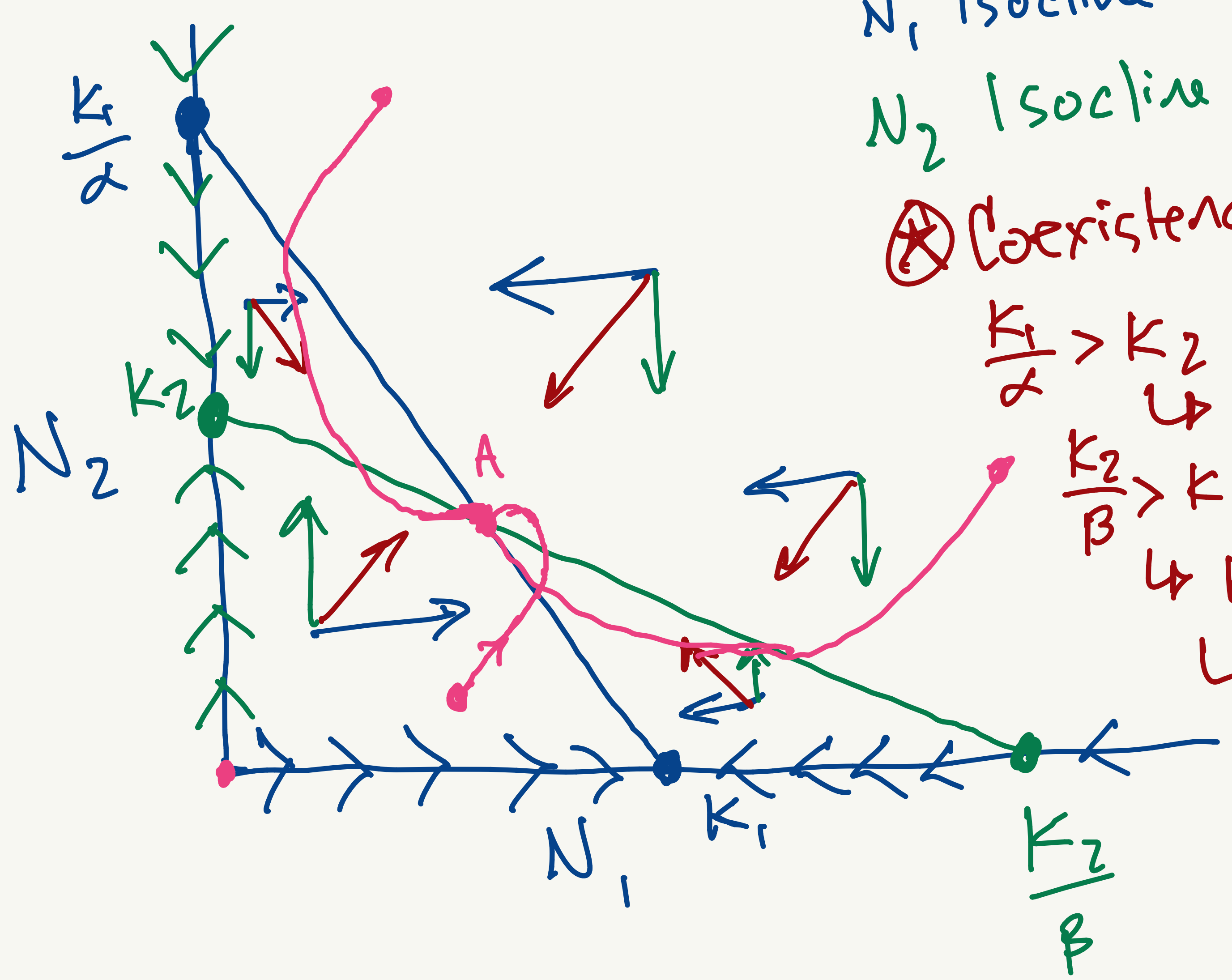
1. First solve for $\frac{dN_1}{dt}=\emptyset$, $\frac{dN_2}{dt}=\emptyset$

↳ give us $\left.\begin{array}{l} N_1 \text{ Isocline} \\ N_2 \text{ Isocline}\end{array}\right\}$



N_1 Isocline

N_2 Isocline



Coexistence

$\frac{K_1}{\alpha} > K_2$

↳ $K_1 > \alpha K_2$

$\frac{K_2}{\beta} > K_1$

↳ $K_2 > \beta K_1$

2. Isoclines

N_1 Isocline

$N_1^* = K_1 - \alpha N_2$

N_2 Isocline

$N_2^* = K_2 - \beta N_1$

- Draw lines by solving for intercepts

y int: $\emptyset = K_1 - \alpha N_2$

$\alpha N_2 = K_1$

$N_2 = \frac{K_1}{\alpha}$

x int: $N_1^* = K_1 - \emptyset$

$N_1^* = K_1$

y int: $N_2^* = K_2 - \emptyset$

x int: $\emptyset = K_2 - \beta N_1$

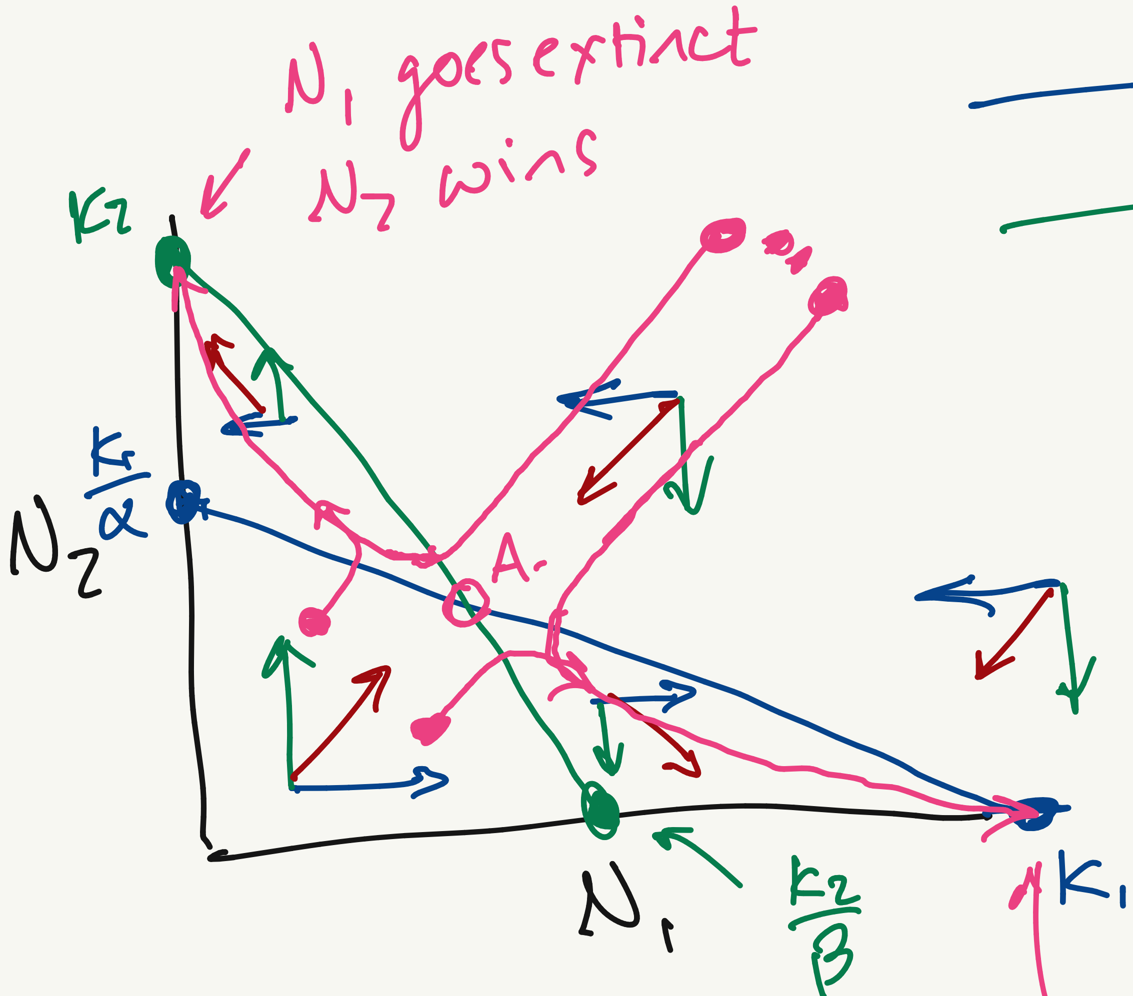
$\beta N_1 = K_2$

$N_1 = \frac{K_2}{\beta}$

3. Determine the flow

A: $\frac{dN_1}{dt}, \frac{dN_2}{dt} = \emptyset$

(Attractor)



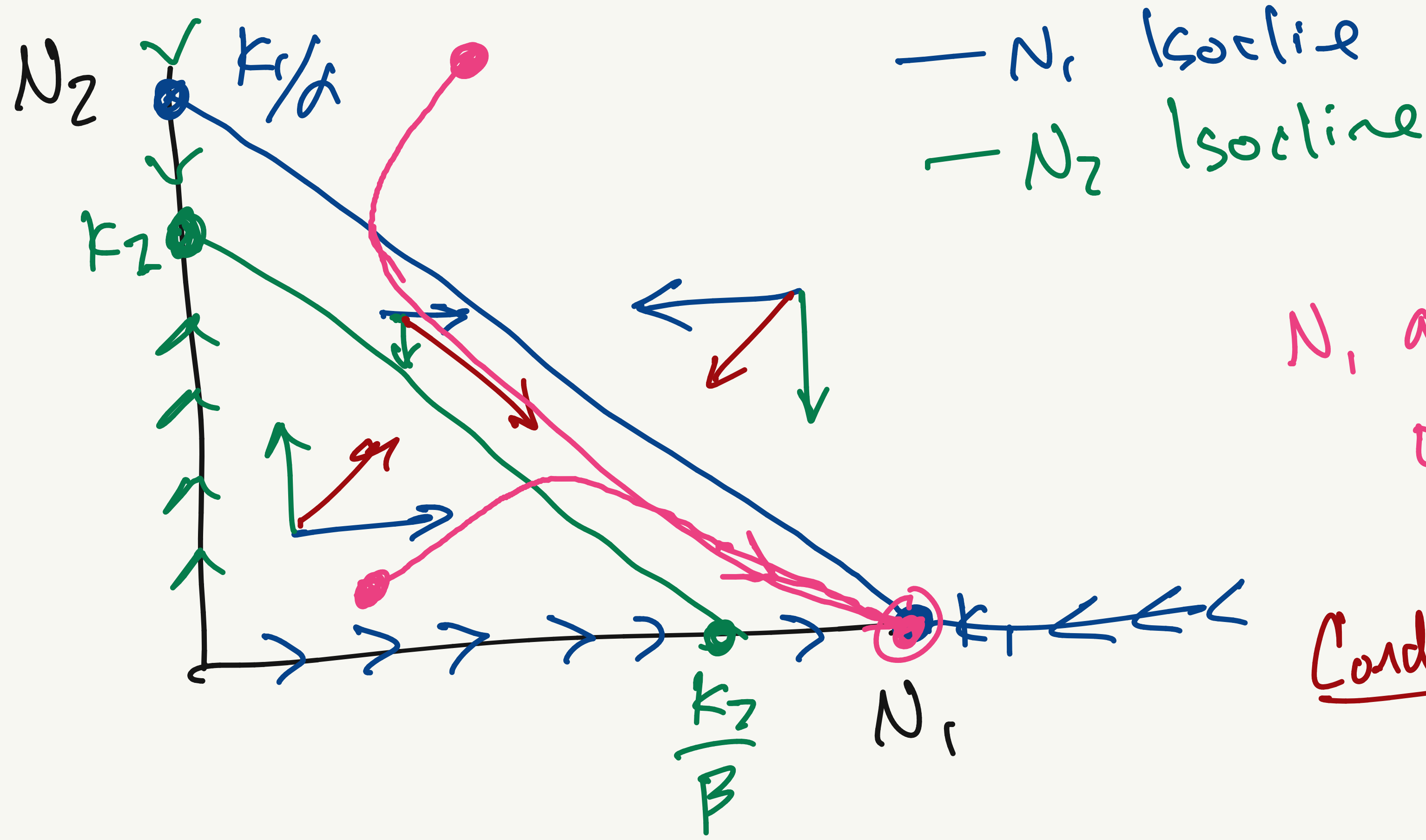
— N_1 Isocline

— N_2 Isocline

$$\begin{cases} K_2 > \dfrac{K_1}{\alpha} & \text{i.e. } K_1 < \alpha K_2 \\ K_1 > \dfrac{K_2}{\beta} & \text{i.e. } K_2 < \beta K_1 \end{cases}$$

A. $\dfrac{dN_1}{dt} = \dfrac{dN_2}{dt} = \emptyset$ but UNSTABLE (Repellor)

- Sensitivity to initial conditions
- Competitive Exclusion of one over the other depending on where the populations start in (N_1, N_2) space



N_1 always outcompetes N_2

Condition:

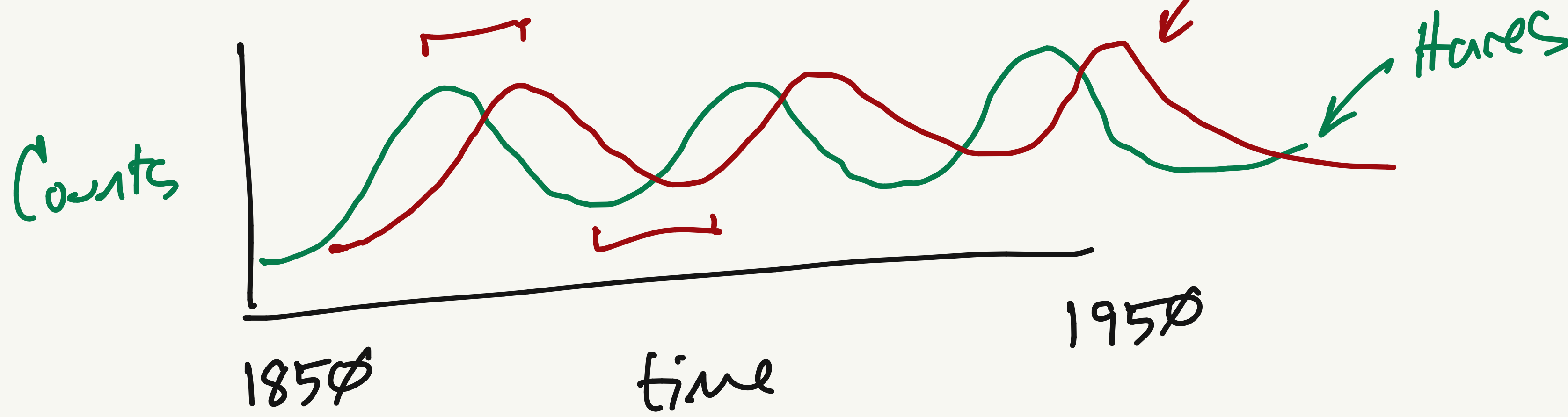
$\frac{K_1}{\alpha} > K_2 \rightarrow K_1 > \alpha K_2$

$K_1 > \frac{K_2}{\beta} \qquad K_1 > \frac{K_2}{\beta}$

Predation & Herbivory ~ Chap. 12

Hudson's Bay Company

- 200 years of fur counts { Snowshoe hares, Lynx }



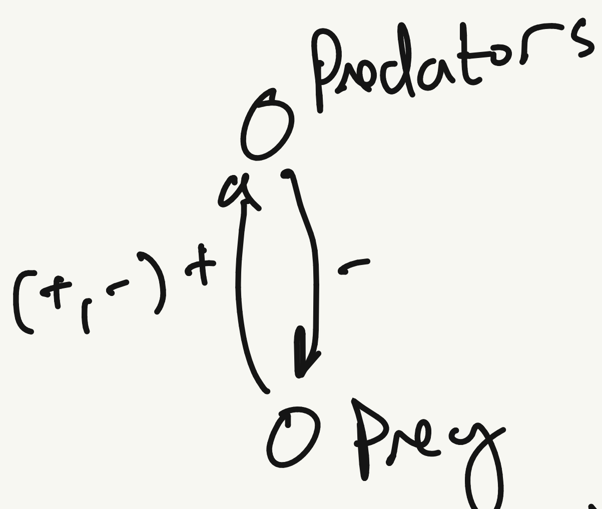
- Original idea was that these ~~fad~~ trends were due to climate

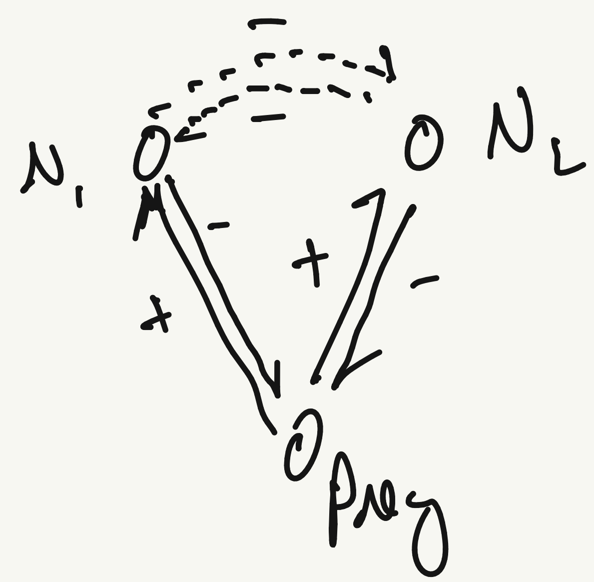
Lynx

↑

Hare

- Predation is a form of exploitation





Arrows represent not biomass flow but "effect"

- Predators kill and eat other organisms

- Herbivores and parasites eat tissues/internal fluids of organisms they rely on

* ~~Harm~~ Harm but not immediatly kill

- Predators → Hypercarnivores (cats)
  → Generalist consumers such as omnivores

Food Chain

Foodchain

etc.

o Even bigger fish

o Bigger fish

o Fish

o Zooplankton

o Phytoplankton (algae)

sun o   o chemo

FOOD WEB

o Hypercarnivores

− +

omnivores o

− + − + − +

o Herbivores

} Trophic Level

o plants — Tough supportive structure to compete for Light

o sun

Terrestrial Systems

Marine Systems

→ Consider the species in each of these functional groups

- Parasitoids - insects that lay one or a few eggs in another host insect
  - As the eggs grow and hatch, the parasitoid offspring consume the host and kill it