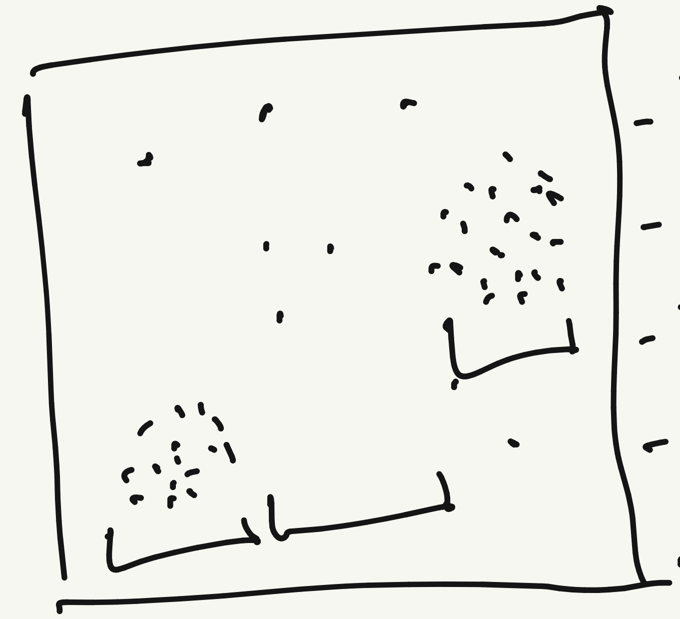
- Different ways to be a predator
  - Move about in search of prey



- Prey density
- Variability in density
- Predator velocity
- Handling time
- Prey velocity

Encounter Rate

  - Some sit-and-wait
    - Moray eels
    - Many spiders

Different strategies nested with active predation

Actively hunt

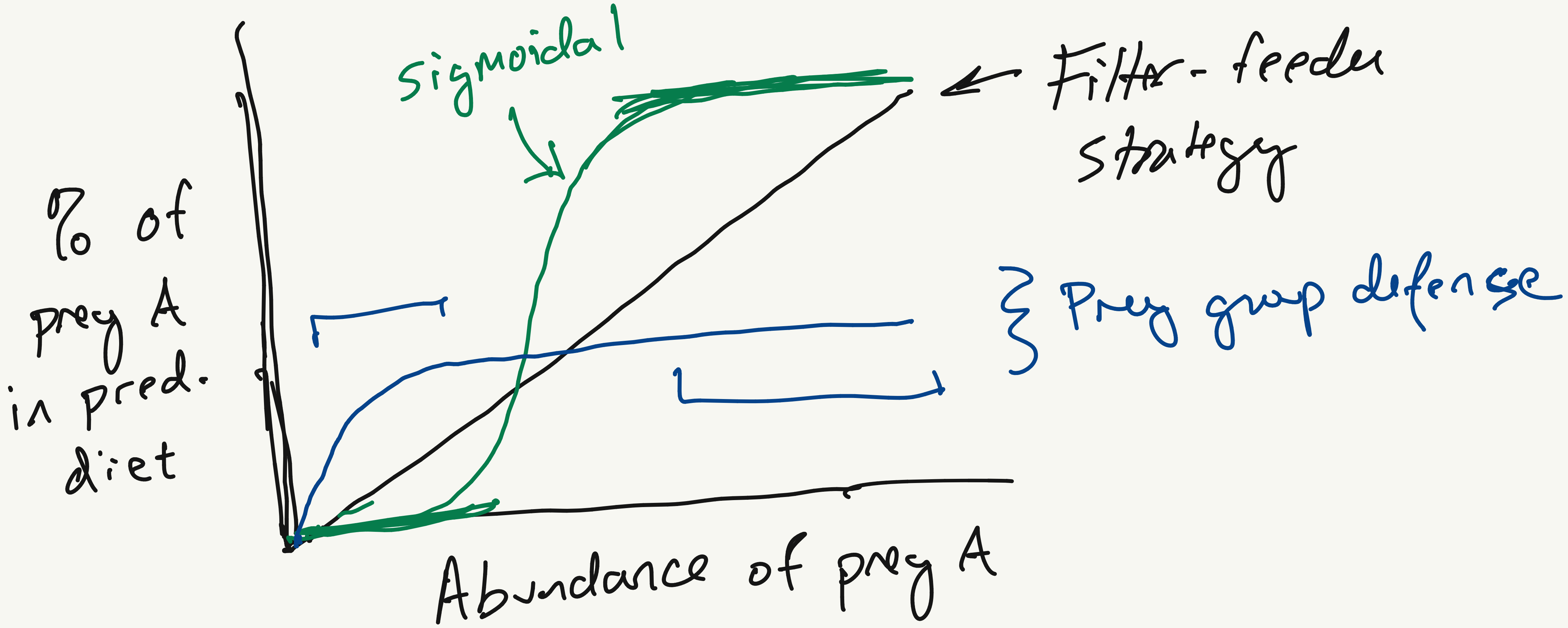
Scavenge

Steal (kleptoparasitism)
↳ seabirds

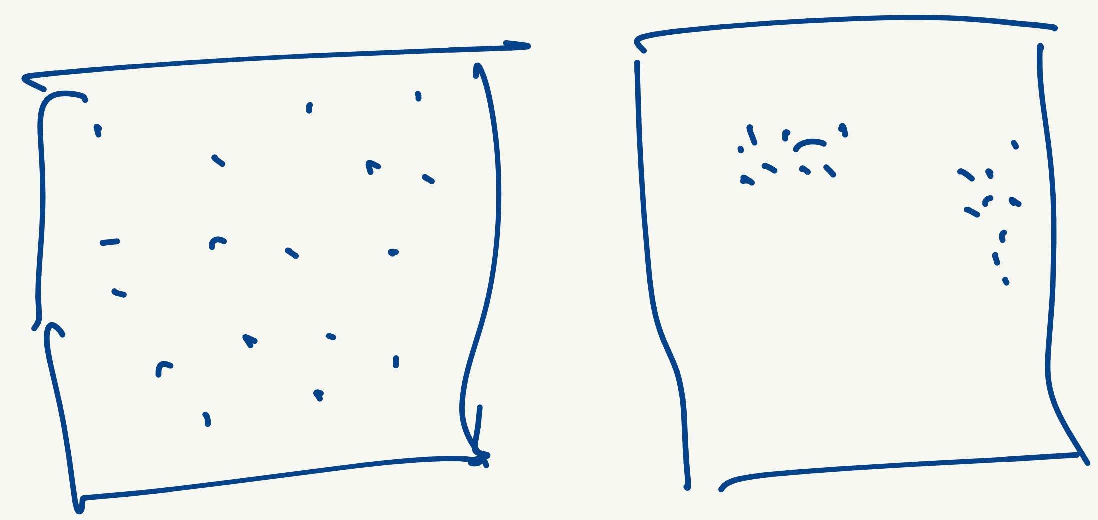
- Foraging Decisions

Filter Feeding — consuming prey in proportion to their abundance

Strong Preference
- Consume specific prey more than expected based on abundance



- Filter-feeding strategy is a good strategy if ~~foo~~ food is uniformly distributed



- Whatever prey is more profitable

$$P = \frac{E}{T}$$

$$P = \frac{E}{T}$$

$$P = \frac{\phi E}{\underbrace{\phi T + (1-\phi) W}}$$

ϕ Prob. of success

$\boxed{P_{day}}$

Low density prey ~ 1 encounter per day

ϕ ~ Prob. that we successfully obtain at least 1 prey

$\phi_1 = s$ ← Probability that we successfully obtain the prey in a single encounter

High density prey ~ 10 encounters

1 ø ø ø 0 . . . .

ø 1 ø ø ø 0

1 1 1 1 ø 0

Many combinations of success

Failure: ø ø ø ø ø ø ø ø ø ø

$$Pr(\text{at least one success}) = 1 - \underbrace{Pr(\text{failure})}$$

$$Pr(\text{at least one success}) = 1 - (1-s)^{10}$$

$$P_{day} = \frac{\overbrace{\phi (E_{gain} - E_{loss})}^{\text{Catching at least one}} + (1-\phi)(ø - E_{loss})}{\phi(1\ \text{day}) + (1-\phi)(1\ \text{day})}$$

$$P_{day} = \frac{\phi(E_{gain} - E_{loss}) + (1-\phi)(0 - E_{loss})}{\phi(1) + (1-\phi)(1)}$$

$$\phi + 1 - \phi = 1$$

$E_{gain} = 3000$ kcal

$E_{loss} = 2000$ kcal

Low density prey (1 encounter)

if $\phi_1 = s$

0.10

$$P_{day} = 0.10(3000) + 0.9(-2000)$$

$$= -1500 \text{ kcal}$$

High prey density environment

$$\phi_{10} = 1 - (1-s)^{10}$$

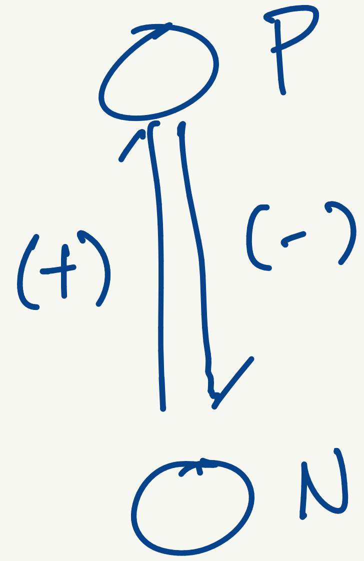
0.10

$$\phi_{10} = 0.65$$

$$P_{day} = (0.65)(3000) + (0.35)(-2000)$$

$$= 1250 \text{ kcal}$$

Lotka-Volterra Predator Prey Model



$$\frac{dP}{dt} = baNP - mP$$

conversion efficiency ~ 0.10

$$\frac{dN}{dt} = rN - aNP$$

Examine the Units

$$\frac{[\text{individuals}]}{[\text{time}]} = \frac{1}{[\text{time}]}[\text{inds}] - [?][\text{inds}][\text{inds}]$$

$$\frac{[\text{inds}]}{[\text{time}]} = \frac{[\text{inds}]}{[\text{time}]} - \underbrace{\frac{1}{[\text{inds}][\text{time}]}[\text{inds}^2]}_{\frac{[\text{inds}]}{[\text{time}]}}$$

$$a = \frac{1}{[\text{ind}][\text{time}]}$$

Capture efficiency

$a \cdot N$ = # of prey killed per predator per unit time

$$\frac{dP}{dt} = baNP - mP$$

$$\frac{dN}{dt} = rN - aNP$$

1) Solve for steady states

2) This gives you the N-isocline : $\frac{dN}{dt} = \emptyset$

P-isocline : $\frac{dP}{dt} = \emptyset$

N-isocline: $\frac{dN}{dt} = \emptyset$

$$rN - aNP = \emptyset$$

$$r\cancel{N} = a\cancel{N}P$$

$$r = aP$$

$$\underline{\underline{P = \frac{r}{a}}}$$

if a ↑ then P ↓

because predators that are too efficient consume their sole source of growth