

# PREDATION

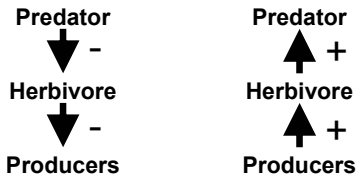
Page 1

## What role(s) do predators play?

- Do they
  - control prey populations?
  - increase biodiversity?
  - improve prey vigor?
- Answer: *yes* and *no*...

## Do predators control prey populations, or vice versa?

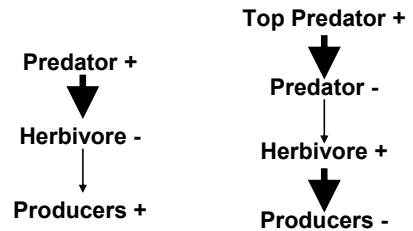
- Top-down vs. bottom up regulation



Answer: Sometimes yes, sometimes no

## Do predators control prey populations?

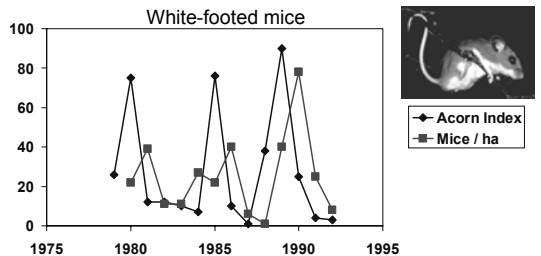
- Evidence for *yes*: **trophic cascades**



## Trophic Cascade: Killer Whales to Kelp

- Estes et al. 1998 Science 282:473-476.
- In 1990's, predation by killer whales appeared to cause sea otter populations to decline
- sea otter decline → increase in abundance of prey (sea urchins)
- sea urchins grazed on kelp → kelp biomass dropped to 1/12th

## Evidence for No: Food-driven prey populations



Mountain Lake Biological Station, Virginia (Jerry Wolff 1996)

## Do predators control prey populations?

- Evidence for *no*: **compensatory mortality**
  - Errington (1956,1957)
  - Mink killed many muskrats when muskrats were abundant
  - Muskrats that were killed were almost exclusively “social outcasts” that (presumably) would otherwise die of starvation or disease (“doomed surplus”)

Banks, P. B. 1999. Predation by introduced foxes on native bush rats in Australia: do foxes take the doomed surplus? *Journal of Applied Ecology* 36:1063-1071

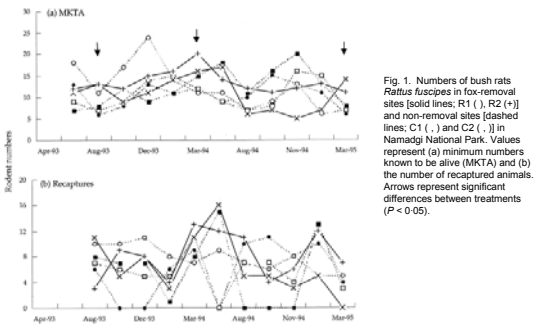


Fig. 1. Numbers of bush rats *Rattus fuscipes* in fox-removal sites [solid lines: R1 (•), R2 (+)] and non-removal sites [dashed lines: C1 (◊) and C2 (◻)] in Namadji National Park. Values represent (a) minimum numbers known to be alive (MKTA) and (b) the number of recaptured animals. Arrows represent significant differences between treatments ( $P < 0.05$ ).

## Do predators control prey populations?

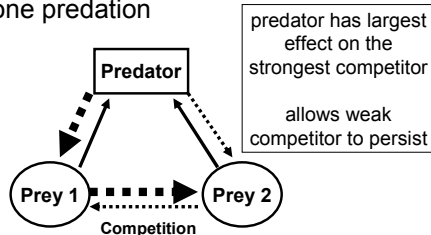
- Predators are more likely to control their prey if:
  - predation mortality is **additive**
  - predation rate responds quickly to changes in prey abundance (little or no time lag)
    - predators have high fecundity or
    - predators have strong behavioral response
  - food supply for prey is relatively stable

## Do predators increase biodiversity?

- Yes: Keystone predation**
  - predators can increase biodiversity by preventing competitive exclusion between prey species
- No: Apparent competition**
  - predators can decrease biodiversity by preventing prey species from coexisting

## Do predators increase biodiversity?

- Keystone predation



## Keystone Predation

- Pacific rocky intertidal zone (Paine 1966)
- Predator = *Pisaster* (sea star)
- Prey =
  - Mytilus* (mussel)
  - various barnacles, seaweeds, sea anemones, sponges
- Prey compete for space on rocks
  - Mytilus* is competitively dominant

## Keystone Predation

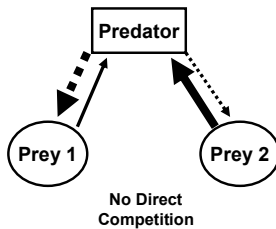
- *Pisaster* prefers *Mytilus*
- Excluding *Pisaster* allows *Mytilus* to dominate, reducing species diversity

## Keystone Predation

- Coyote impacts on rodent diversity in west Texas (Henke and Bryant 1999)
- Experiment: remove coyotes
- Results: reduced rodent **species richness** (# species) and **diversity** (# and evenness of species)
  - Ord's kangaroo rat (*Dipodomys ordii*) took over

## Do predators increase biodiversity?

- Apparent competition



Prey affected less by predator increase predator numbers

Can cause extinction of prey affected more by predator

## Apparent Competition

- New Zealand forest birds (O'Donnell et al. 1996)
- Non **native** mice support populations of non **native** weasels
- Masting by beech trees → many mice
  - → many weasels
    - → high predation by weasels on endangered native birds (kaka, mohua, & others)

## Do predators improve prey vigor?



"Listen, I'm fed up with this weeding-out-the-sick-and-the-old business ... I want something in its prime."

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## Do predators improve prey vigor?

- Keeping prey below carrying capacity → yes
  - reduces disease
  - improves food availability
  - increases fertility
- Weeding out the weak and the sick → yes
  - side effect of predators taking what is easy
  - Wolves are selective -- prey are chased & tested

## Do predators improve prey vigor?

- Not selecting weak & sick individuals → *no*
  - cougars are not very selective – prey are ambushed (Hornocker 1970)
- Forcing prey to avoid certain habitats → *no?*
  - white-tailed deer coexisting with wolves primarily live in gaps between pack territories (Mech 1977; Nelson & Mech 1981), which may be suboptimal habitat

Page 19

## Things to Remember

- Conditions when predators are likely to:
  - Control prey populations
  - Not control prey populations
  - Increase prey diversity
  - Reduce prey diversity
  - Promote prey vigor
  - Reduce prey vigor
- Specific Examples

Page 20