



# Lecture 20

## Interspecific interactions: Predation, part II

WILD3810 (Spring 2019)

# Readings

| Mills 150-153

# Do predators control the abundance of their prey?

If predators kill prey:

- does predation lower the overall survival probability of prey?



- does harvest lower abundance of prey (note - for humans, top predators might be "prey")?

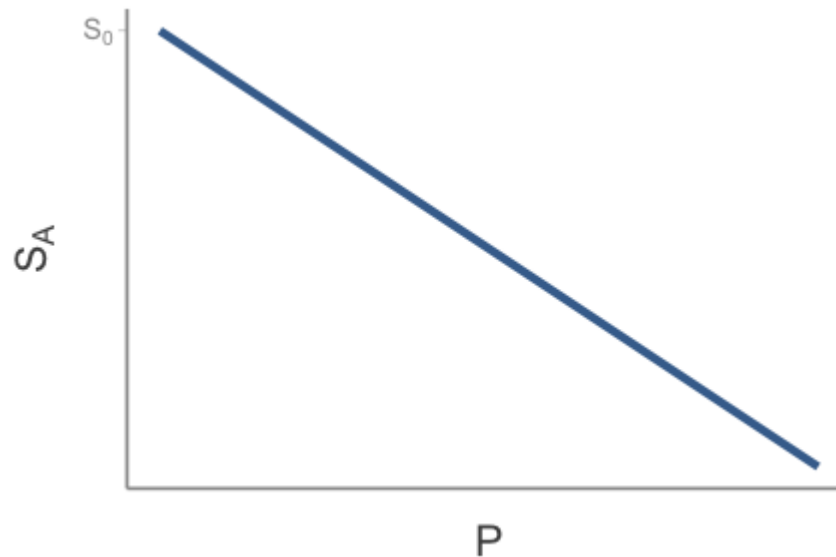


# The effect of predation on prey survival

Say  $s_0$  is the survival probability in the absence of predation/harvest

- if the predation rate is  $P$ , individuals must survive other sources of mortality *and* not be predated

$$s_A = s_0(1 - P)$$

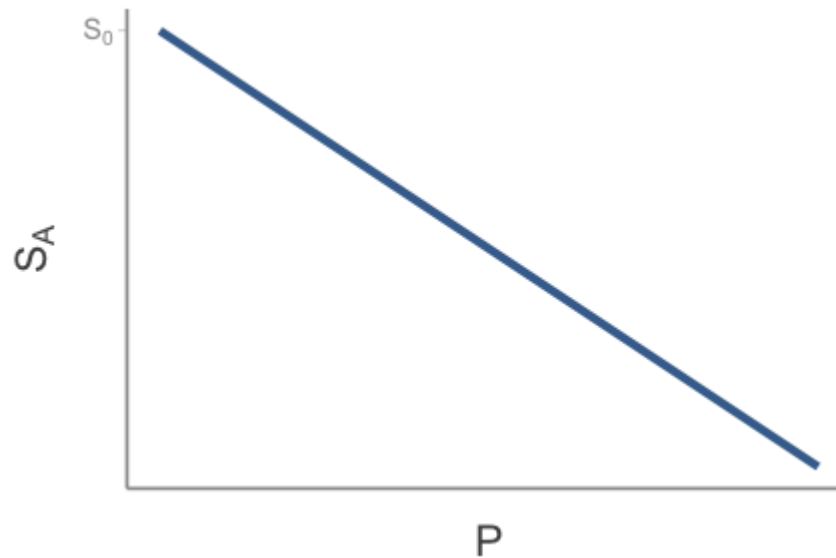


# The effect of predation on prey survival

## Additive mortality

- Predation/harvest occurs independently of other sources of mortality

$$S_A = S_0(1 - P)$$



# The effect of predation on prey survival

If predation/harvest is additive:

- removing predators should increase prey abundance



- harvest of game species should reduce their abundance

# The effect of predation on prey survival

In many populations, some individuals have very low survival:

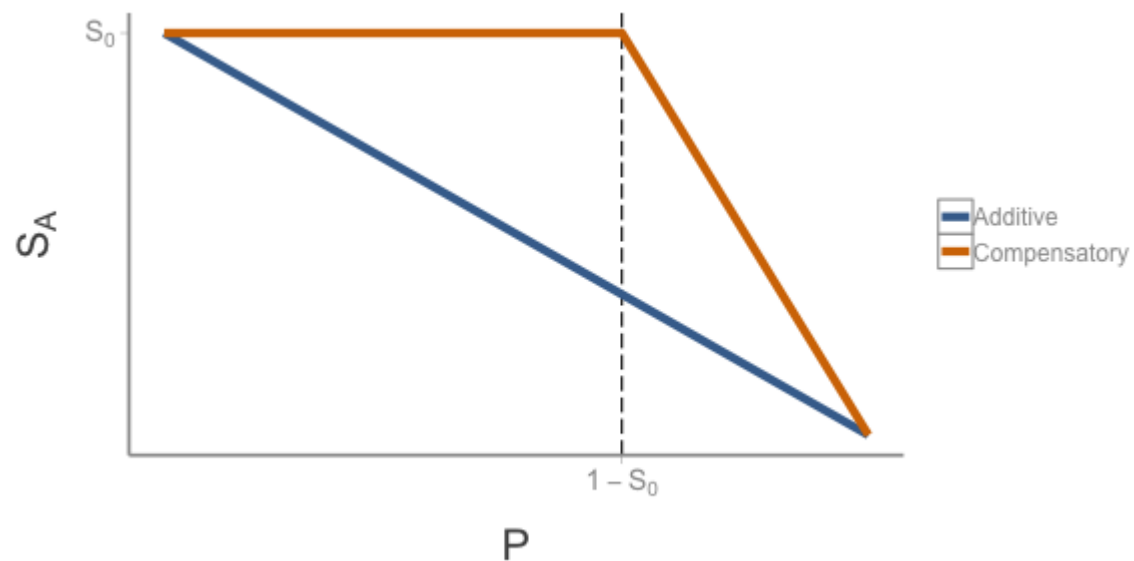
- floaters
- old individuals
- sick individual
- the "doomed surplus" (Errington 1956)

If predators/harvest take individuals that would have died from other causes, overall survival rate may be unaffected by  $P$

# The effect of predation on prey survival

## Compensatory mortality

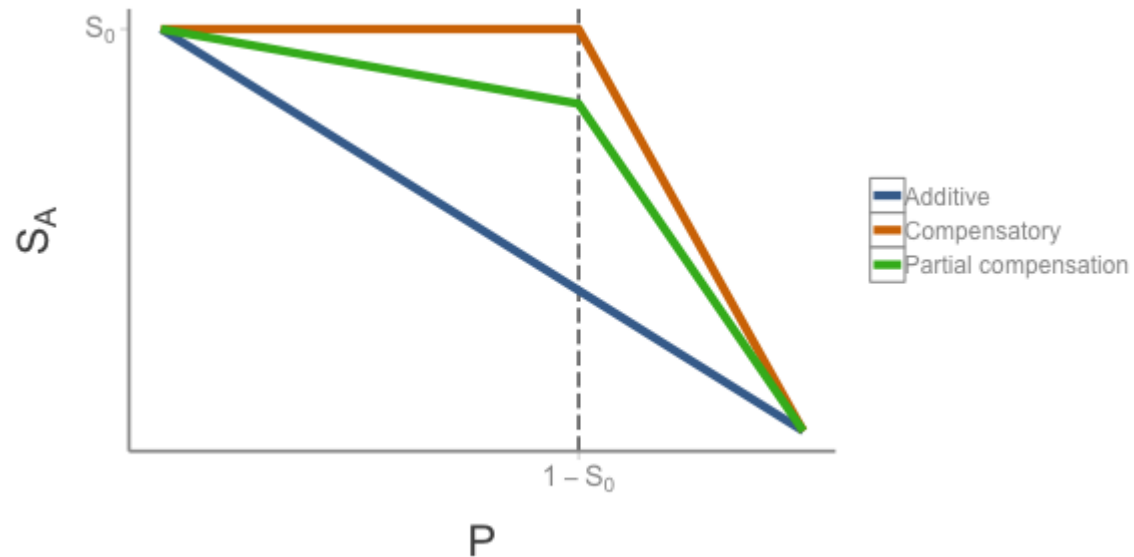
mortality due to predation/harvest is offset by lower mortality from other sources





# The effect of predation on prey survival

Partial compensatory mortality



# The effect of predation on prey survival

## Partial compensatory mortality

- Partial compensation in hunting of willow ptarmigan (Sandercock et al. 2010)
  - Typical of short-lived gamebirds

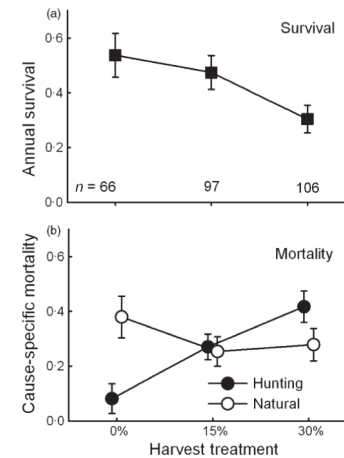


Fig. 2. (a) Annual survival rates ( $\pm$  SE) and (b) cause-specific mortality rates ( $\pm$  SE) of radio-marked willow ptarmigan exposed to three levels of experimental harvest at Meråker-Selbu, Norway, 1996–1998.

# The effect of predation on prey survival

## Partial compensatory mortality

- Partial compensation of predator mortality in elk calves
  - predation offset by winter severity and density-dependent malnutrition (Singer et al. 1997)



# The effect of predation on prey survival

Population dynamics can be compensated by Density-Dependent changes in other vital rates

- Immigration: mortality of territorial animals can open up space for 'floaters' and give them a chance to reproduce and gain fitness.
- Fertility: Reduced density through mortality can free up resources for survivors and enhance their reproductive output and success.

# The effect of harvest on predator abundance

Anthropogenic mortality is largely additive in lower-48 wolves (Murray et al. 2010)

- In absence of human pressure, mortality is fairly low, opportunity for compensation is low

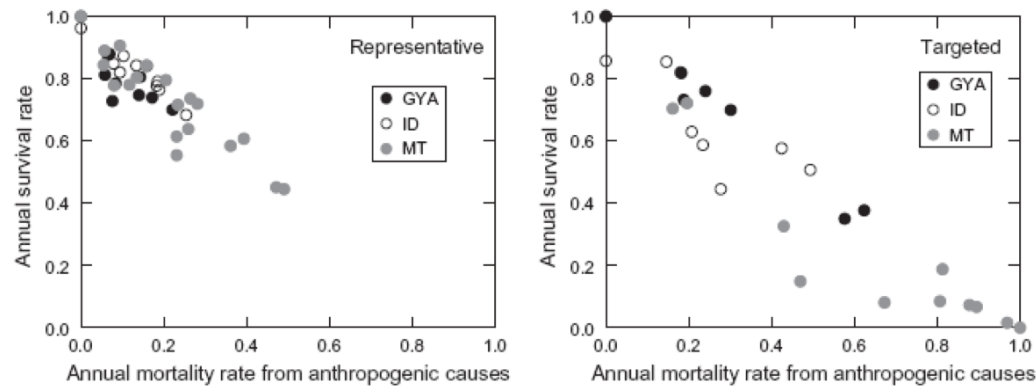
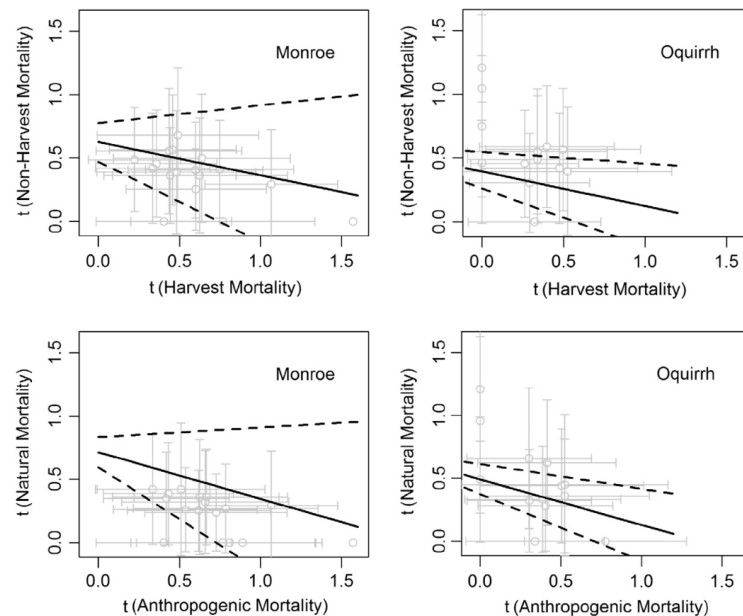


Fig. 6. Back-transformed annual survival rate and anthropogenic mortality rate for 711 wolves in western United States (1986–2004).

# The effect of harvest on predator abundance

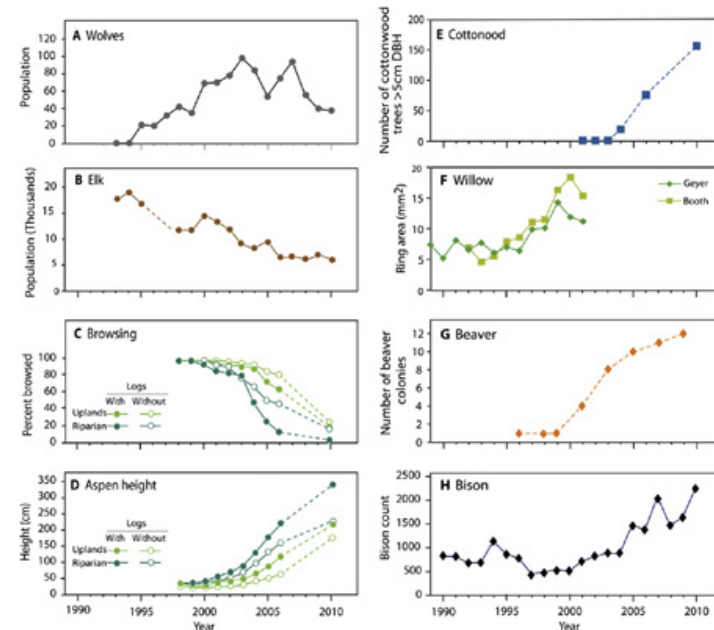
Cougars in Utah (Wolfe et al. 2015)

- In absence of human pressure, mortality is fairly low, opportunity for compensation is low



# Do predators control the abundance of their prey?

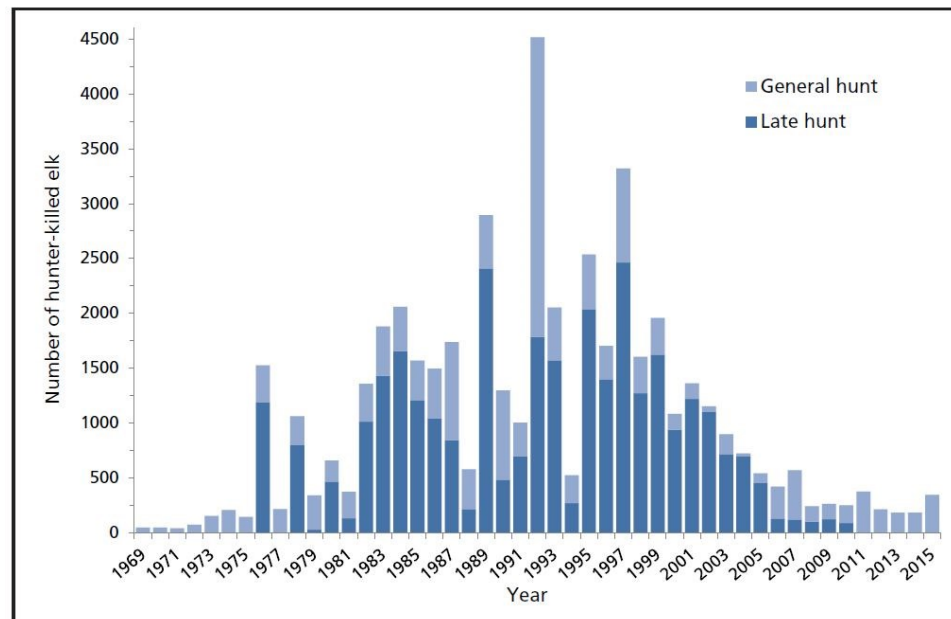
Did reintroduction of wolves to Yellowstone NP reduce elk populations?



# Do predators control the abundance of their prey?

Did reintroduction of wolves to Yellowstone NP reduce elk populations?

- During the time that elk populations started to decline, general and late season antlerless elk hunts were at historically high levels

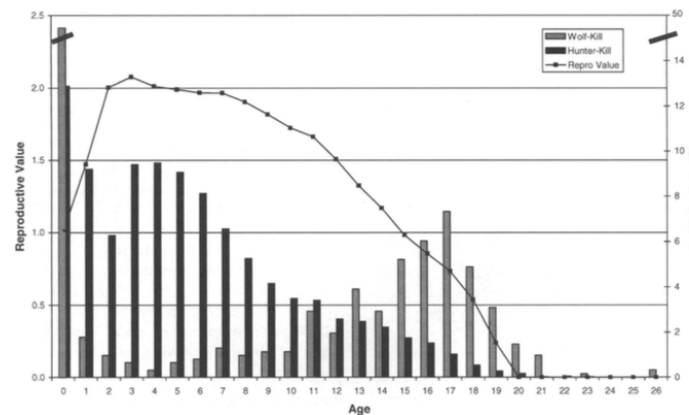




# Do predators control the abundance of their prey?

Did reintroduction of wolves to Yellowstone NP reduce elk populations?

- Age distribution differs between wolf kills and hunter kills
  - Wolves mainly take fawns and older elk
  - Hunters take females at the height of their reproductive value



**Figure 3.** Reproductive values of female northern Yellowstone elk and age distributions of hunter (Gardiner Late Hunt, 1996–2001) and wolf-killed females (1995–2001). Note the scale change for the Y axis on the right side of the chart for wolf-killed calves (49% of total wolf-kills).

# Do predators control the abundance of their prey?

Who gets killed?

- Young and old may be more vulnerable
  - loss of young may be compensated for by additional reproductive effort
  - old may have low reproductive value
- Effects on population growth depend on elasticities
  - loss of young may have big impact in species with high elasticity of fecundity/recruitment
  - loss of adults may have big impact in species with high elasticity of adult survival

# Do predators control the abundance of their prey?

It's complicated; need to know:

- Predation rate
  - Numerical response
  - Functional response
- Additive vs. compensatory

Central questions to many modern issues in natural resource management

- Predator control
- Hunting regulations
- Commercial harvest limits