Predation: Concepts and Complexities

Joel Ruprecht

Oregon State University

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What is predation?

"When one organism kills and consumes another organism"

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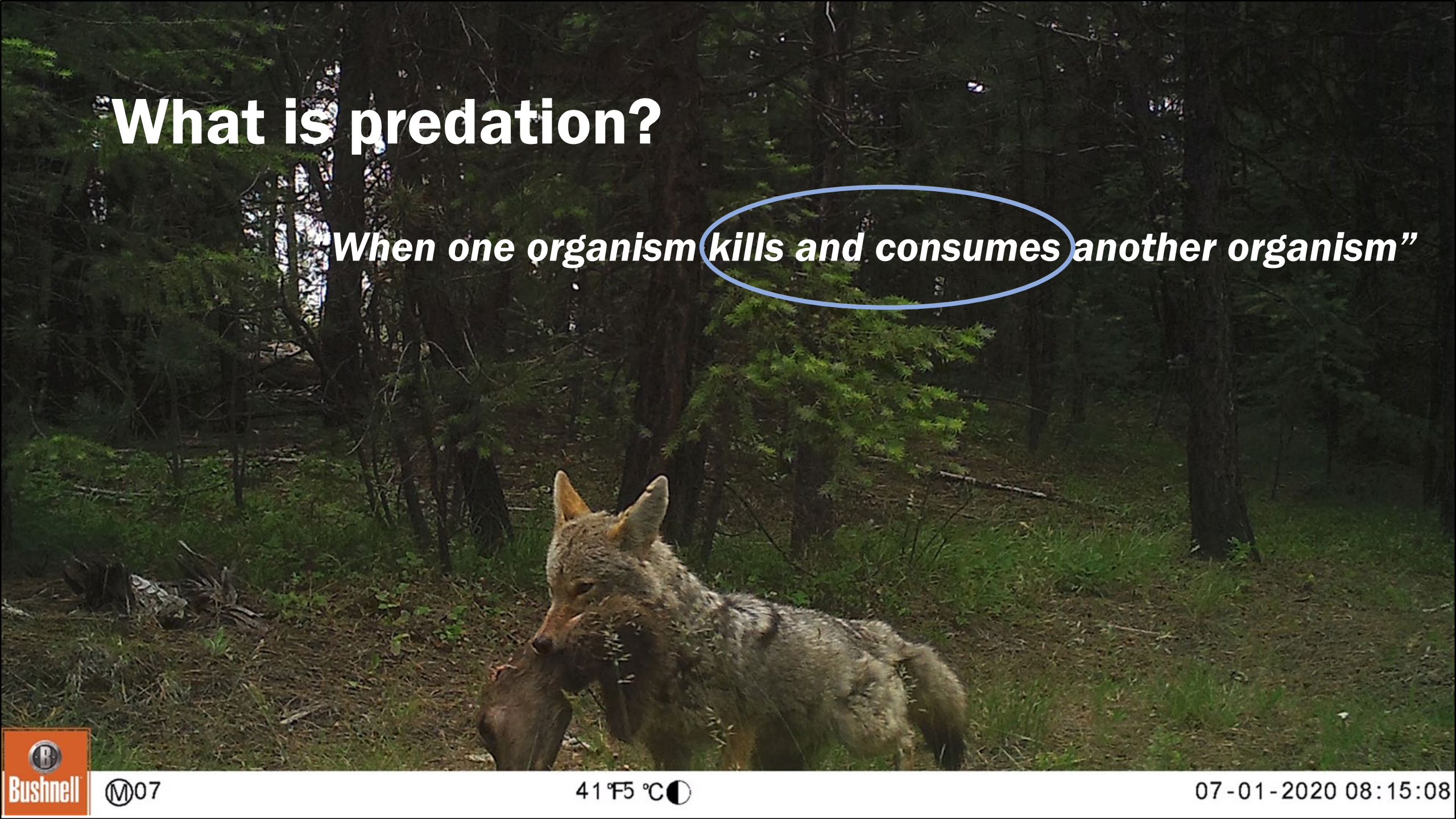
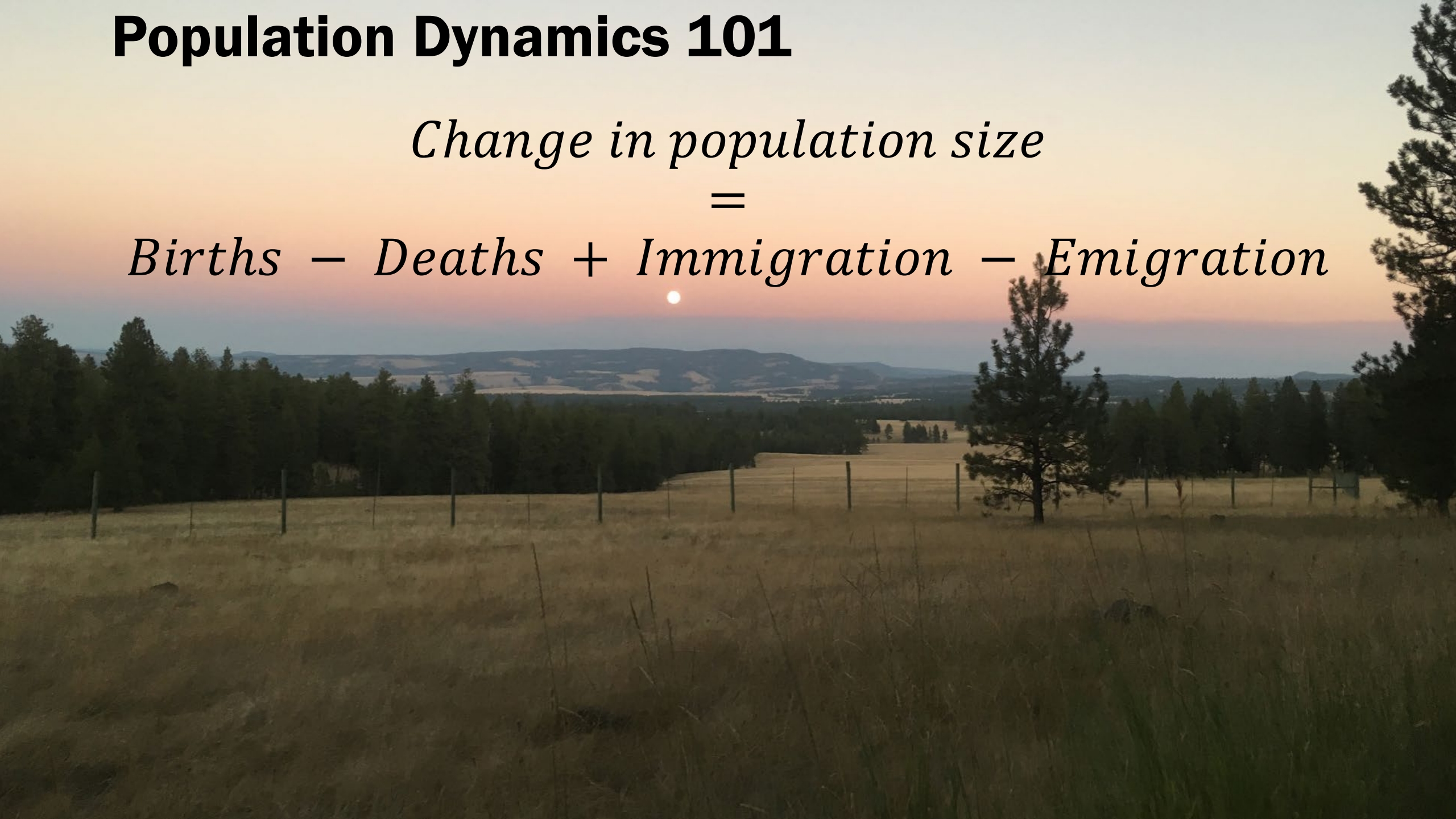
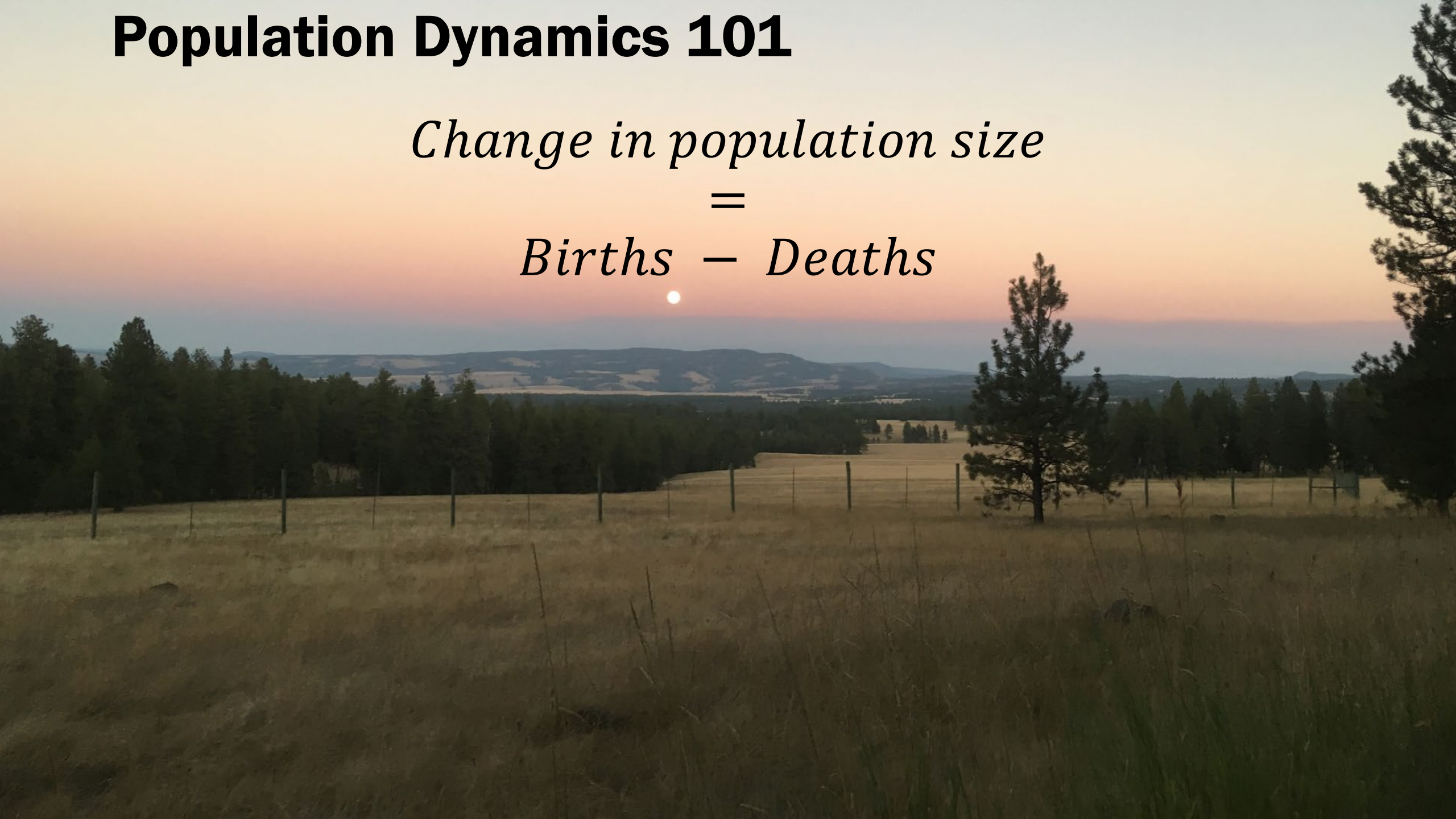


Population Dynamics 101



$$Change\ in\ population\ size$$
$$=$$
$$Births - Deaths + Immigration - Emigration$$

Population Dynamics 101



$$Change\ in\ population\ size$$
$$=$$
$$Births\ -\ Deaths$$

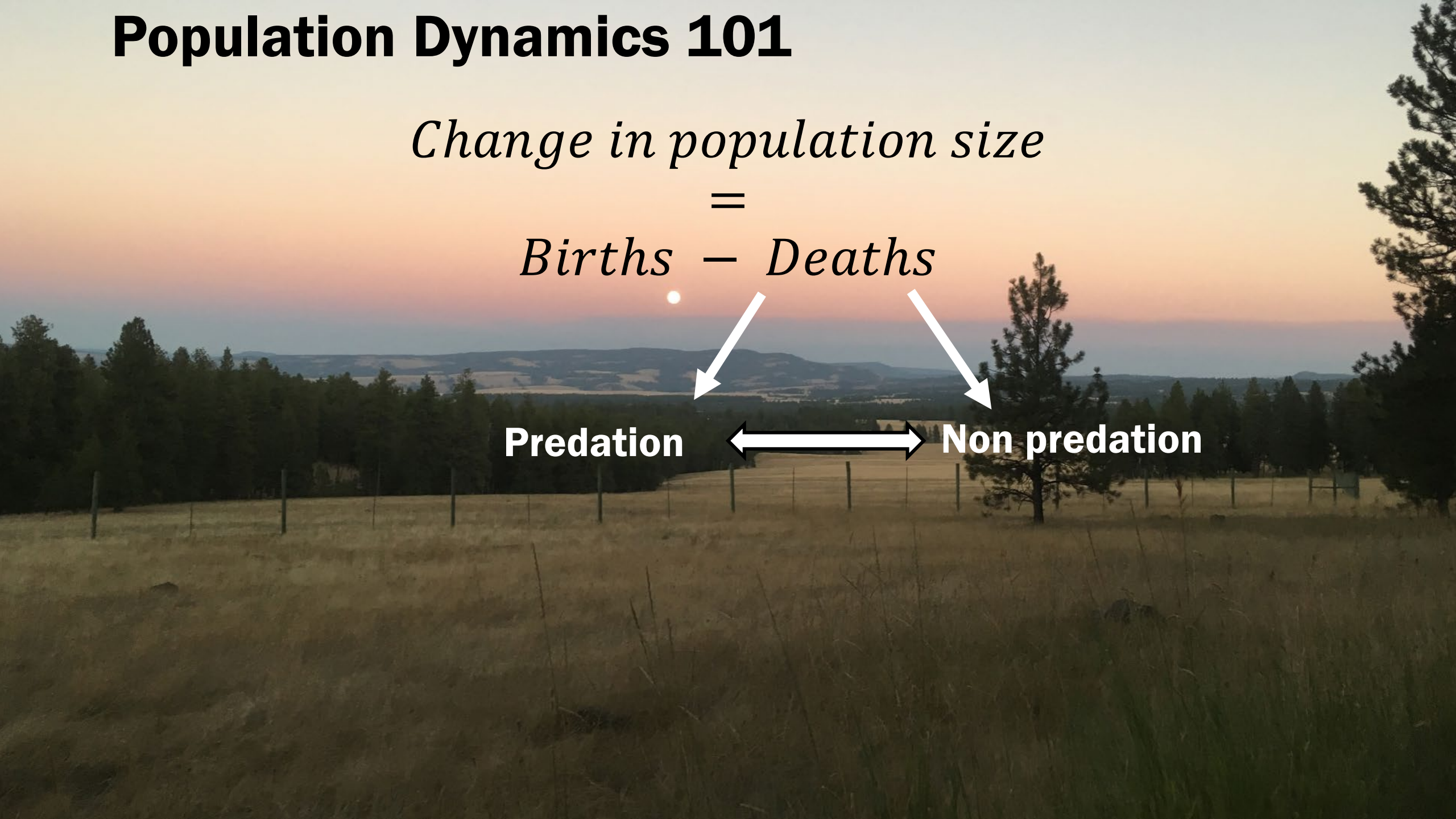
Population Dynamics 101

$$Change\ in\ population\ size = Births - Deaths$$

For a population to remain stable, each female needs to recruit one female offspring into the population

Population Dynamics 101

$$Change\ in\ population\ size = Births - Deaths$$



Population Dynamics 101

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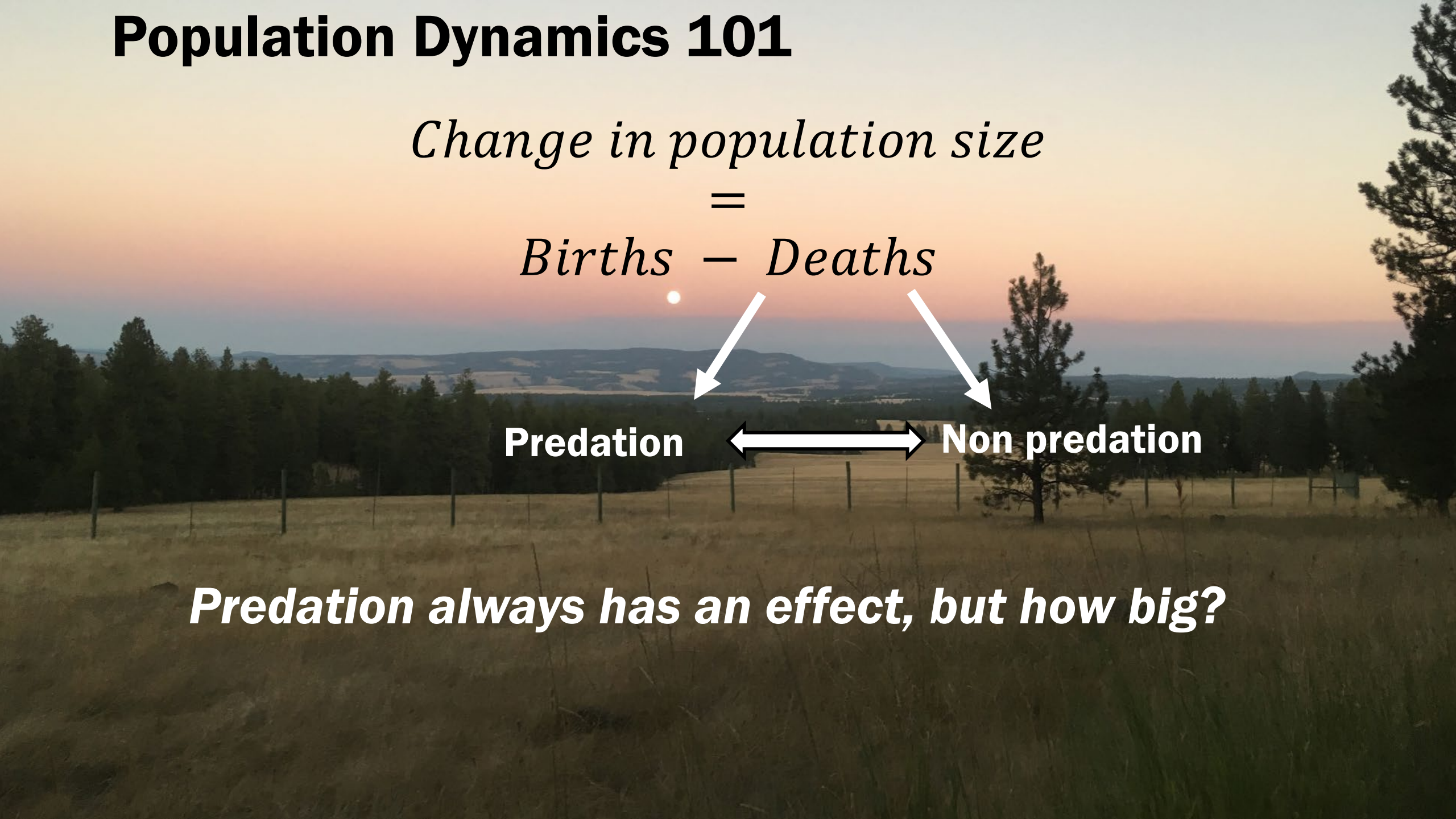
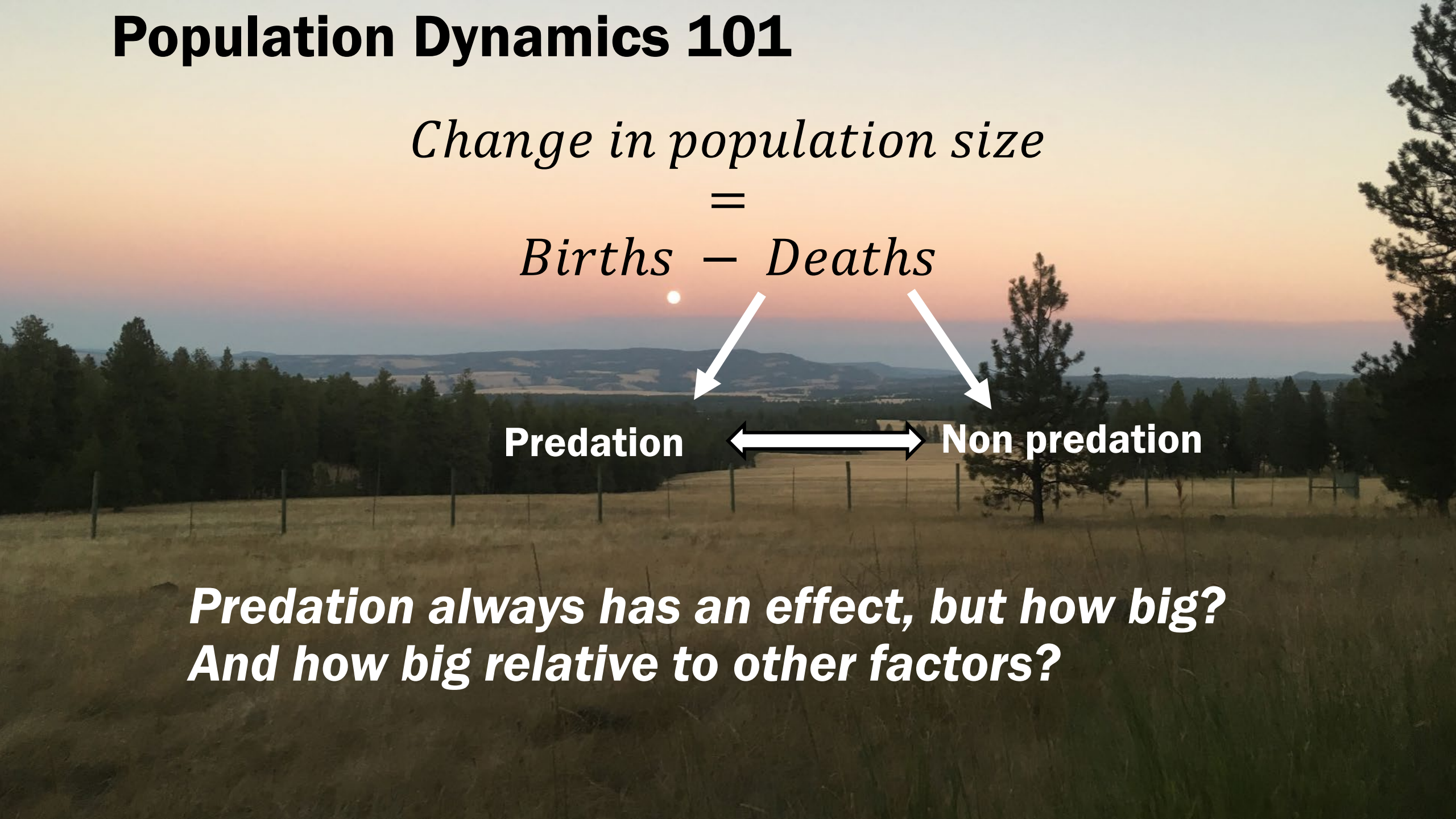


Predation always has an effect, but how big?

Population Dynamics 101

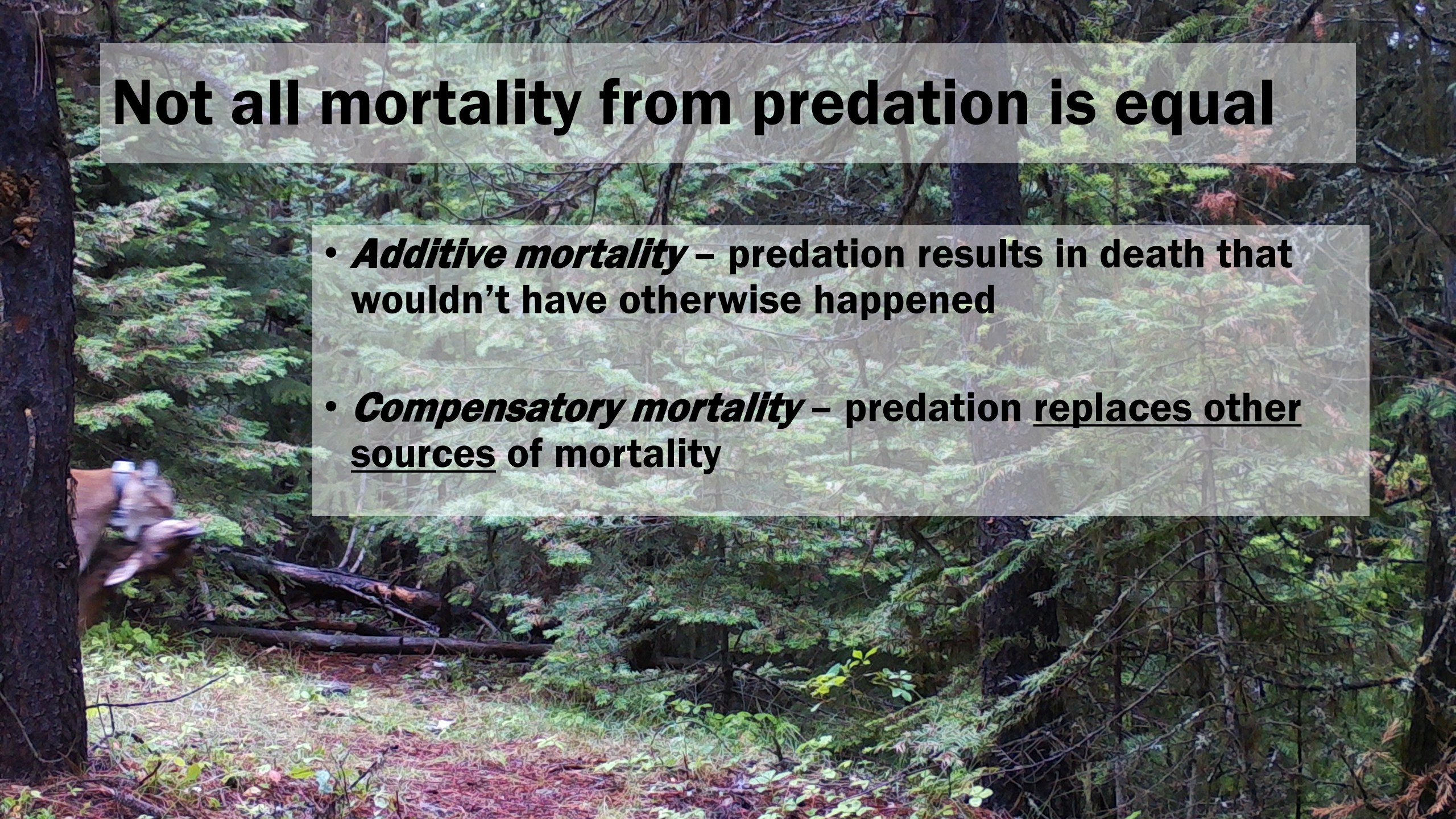
$$Change\ in\ population\ size = Births - Deaths$$



Predation always has an effect, but how big?
And how big relative to other factors?

Not all mortality from predation is equal

- ***Additive mortality*** – predation results in death that <u>wouldn't have otherwise happened</u>



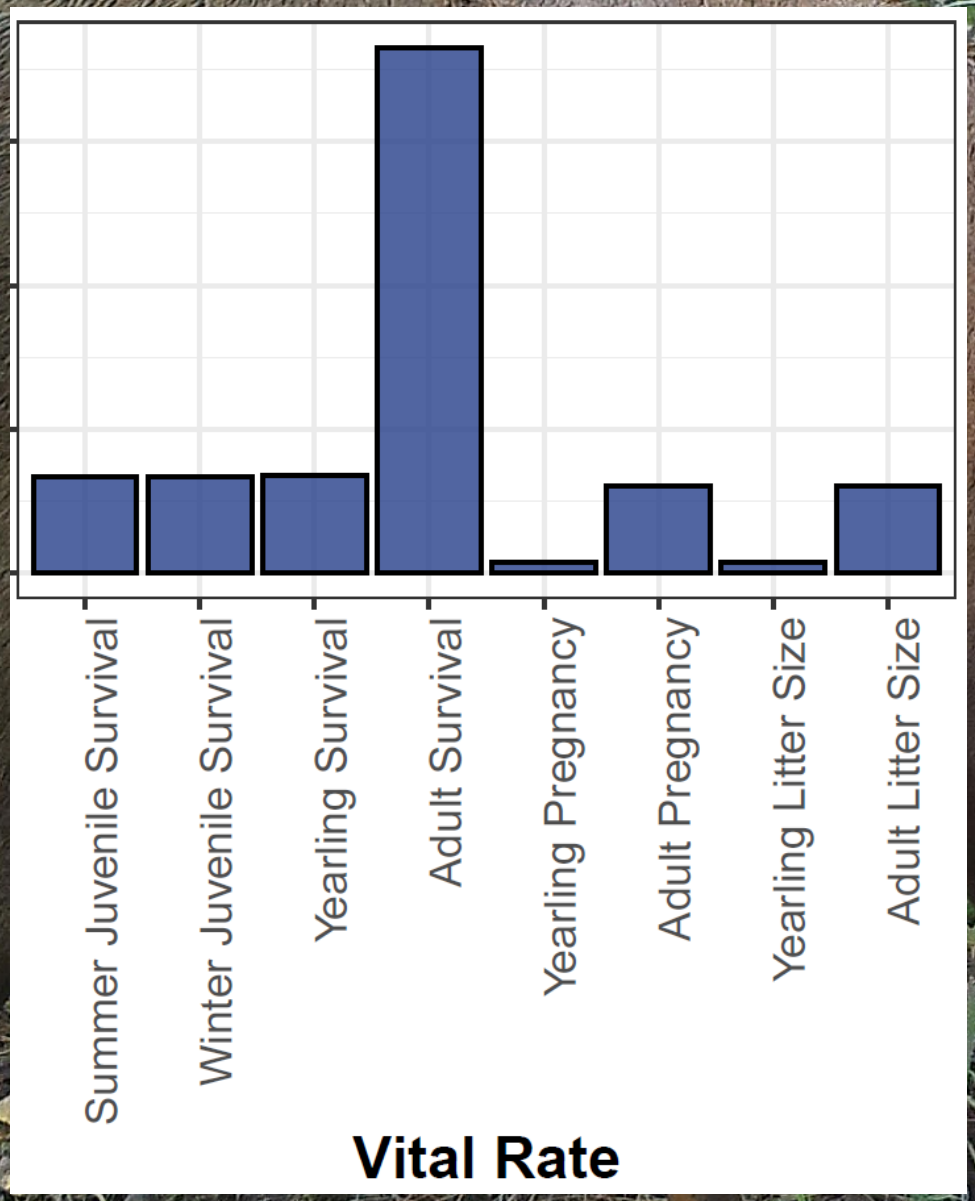
Not all mortality from predation is equal

- ***Additive mortality*** – predation results in death that wouldn't have otherwise happened

- ***Compensatory mortality*** – predation replaces other sources of mortality

Not all prey life stages are equal

Not all prey life stages are equal

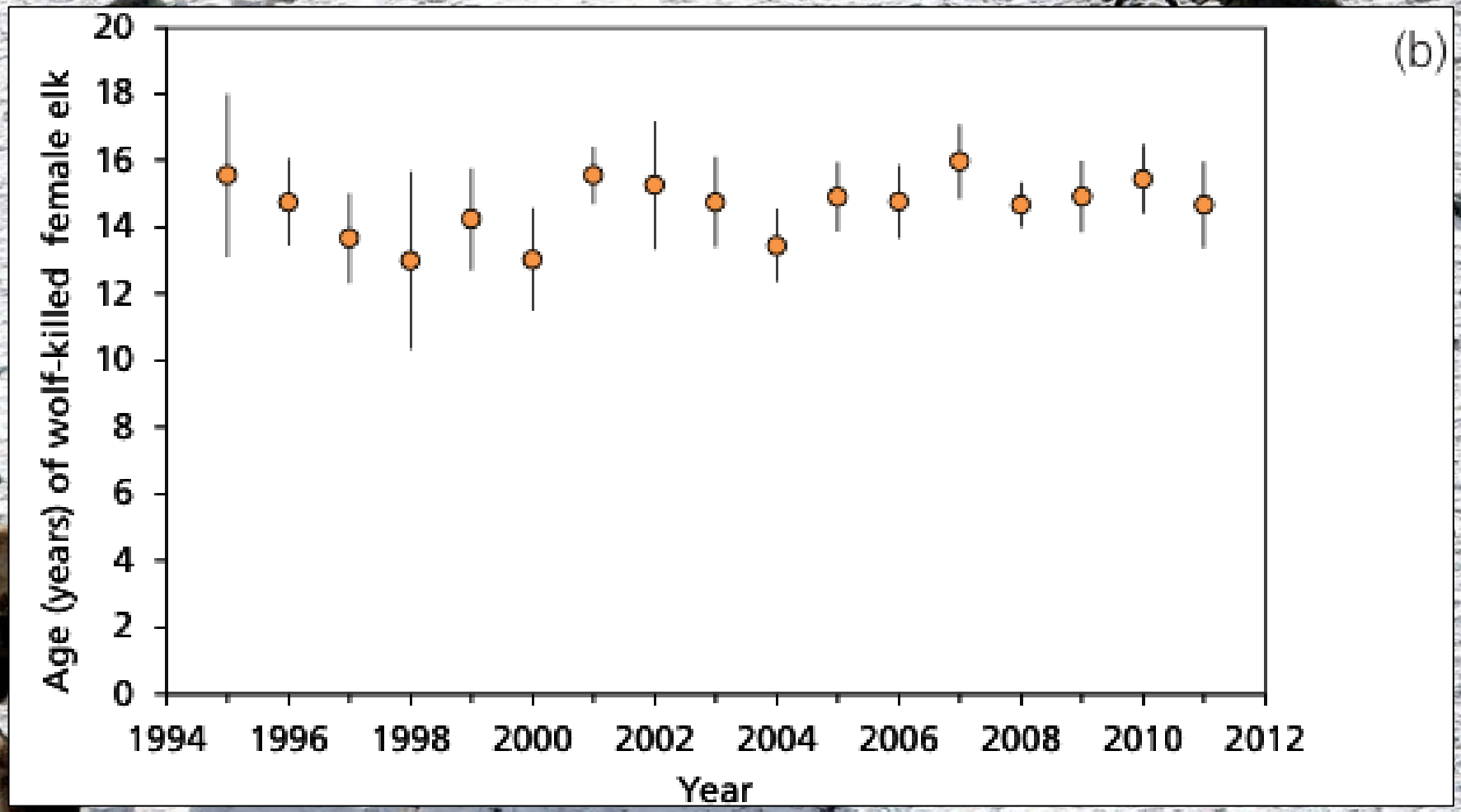


Changes to adult female survival have the largest effect on ungulate populations

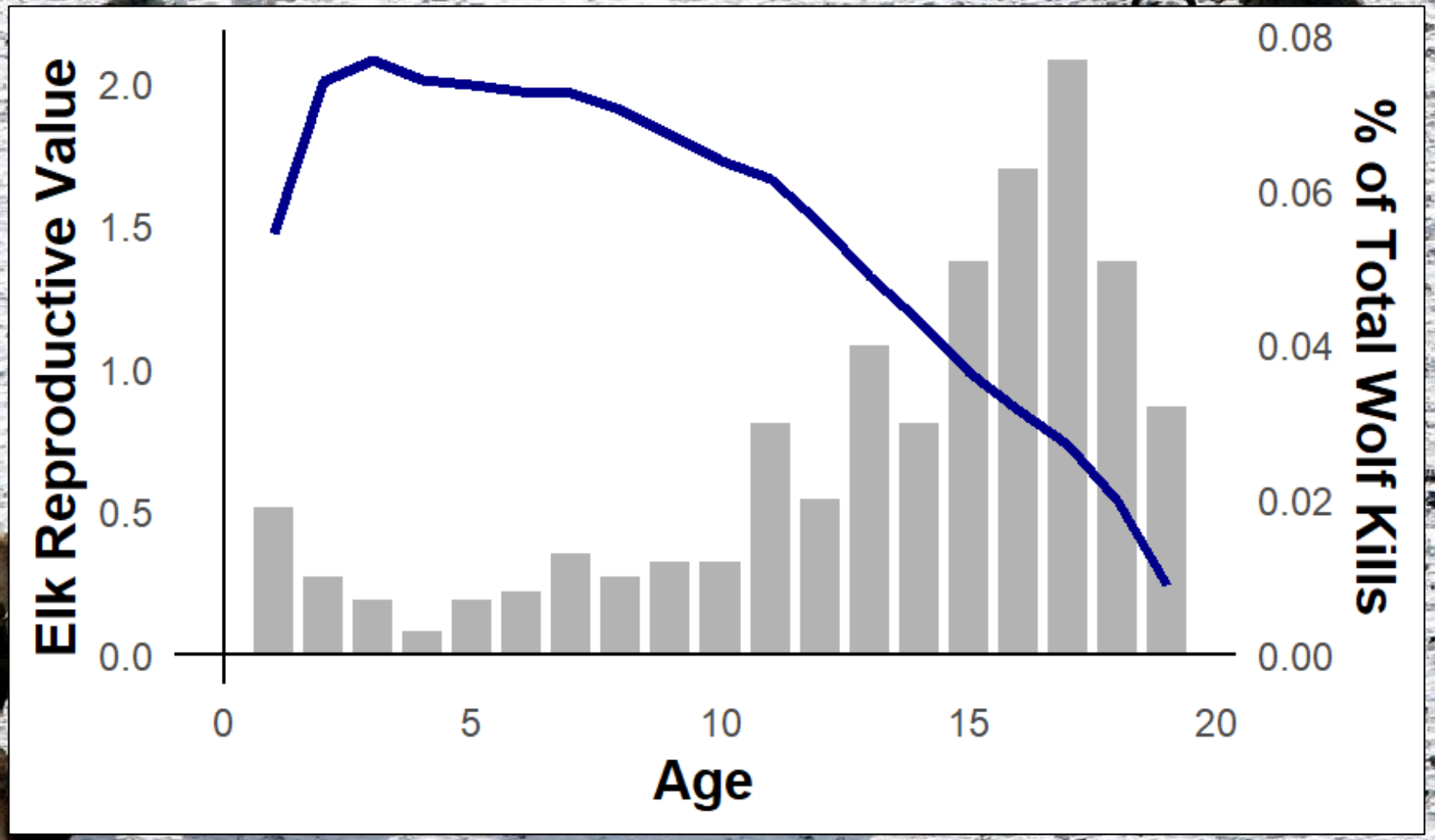
Not all prey life stages are equal

- Young and old individuals have low reproductive rates
- But loss of prime-aged adult females is very consequential

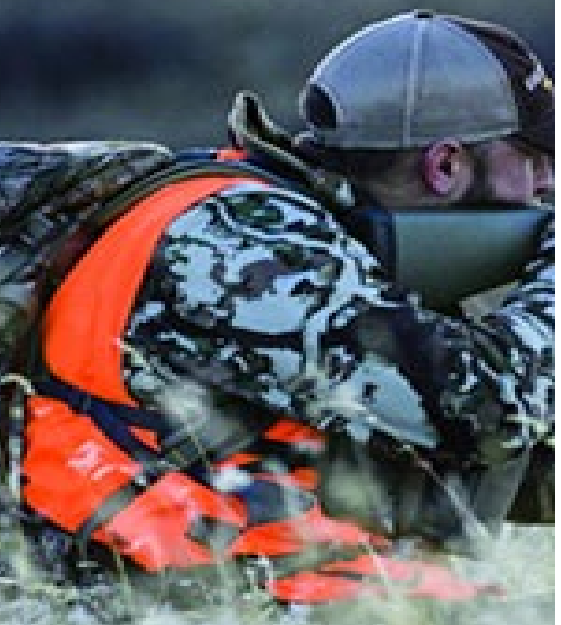
Average age of wolf-killed adult elk in Yellowstone is 15

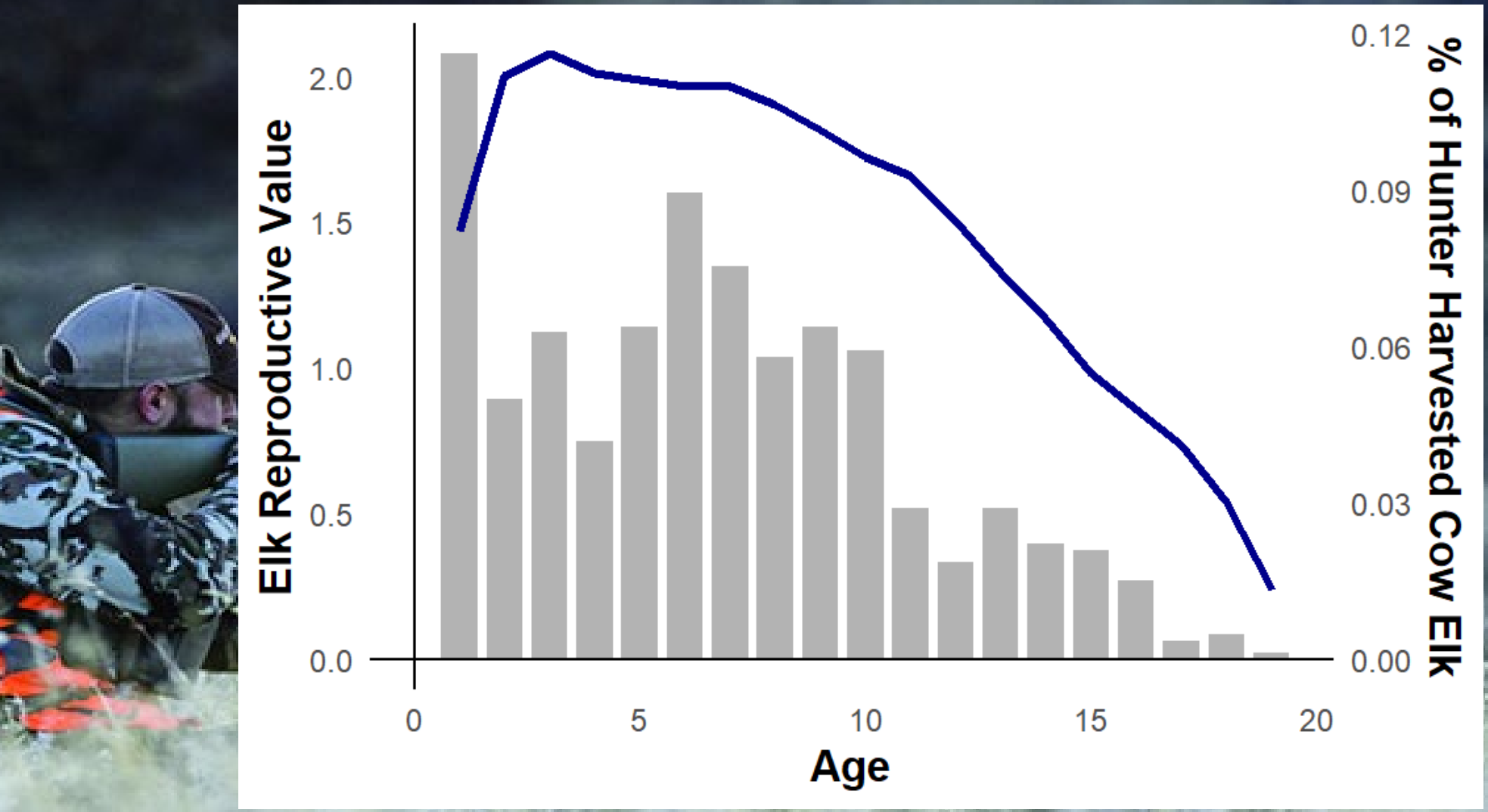


Wolves generally kill elk of lower reproductive value

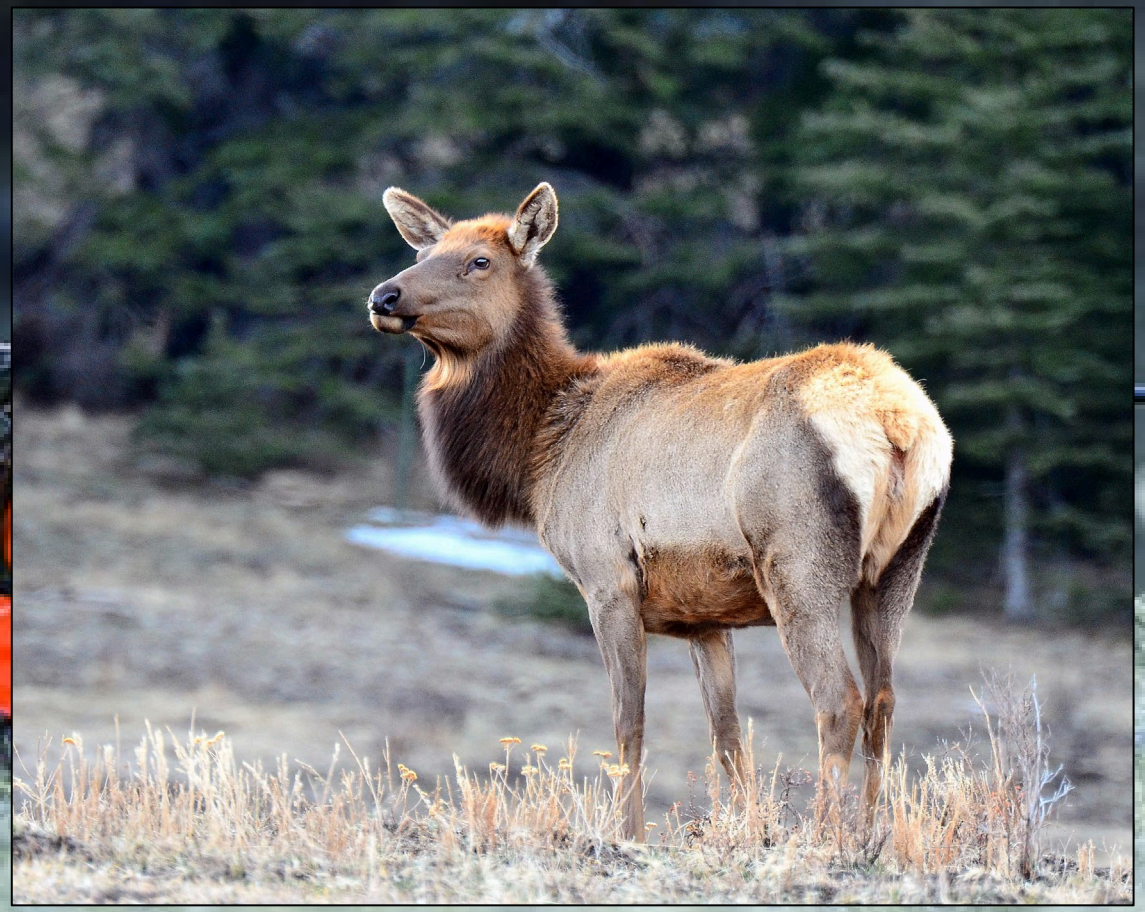


Hunter harvest generally targets animals of higher reproductive value





Mortality is *additive* when it affects healthy, prime aged females



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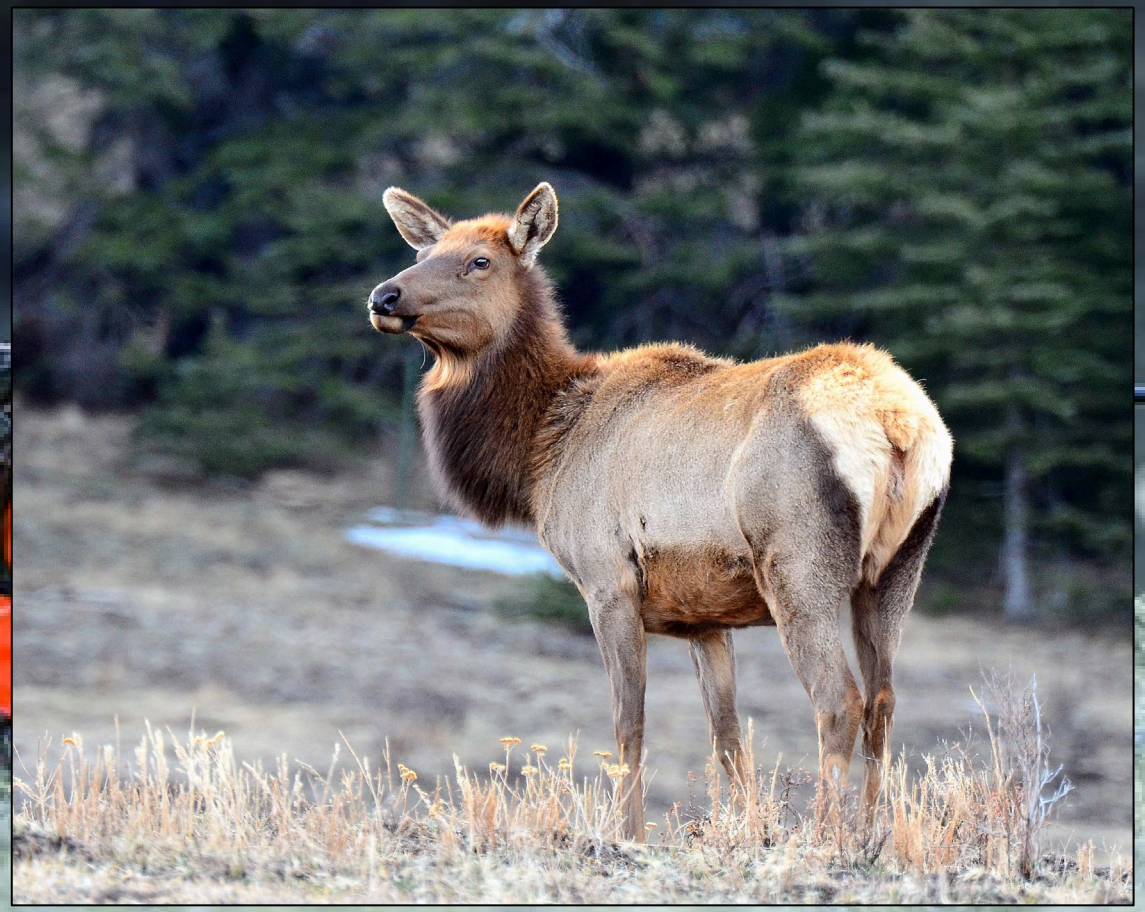


Mortality is *compensatory* when it affects prey of low reproductive value

Predator characteristics – Hunting modes

Coursing Predators

Predator characteristics – Hunting modes

Coursing Predators

Ambush Predators

Prey vulnerability shaped by predator abilities

- **Black bears: < 1 month**

Prey vulnerability shaped by predator abilities

- **Coyotes: < 1 month, adults in some conditions**

Prey vulnerability shaped by predator abilities

- **Cougars: all ages (fawns/calves often selected for)**

Prey vulnerability shaped by predator abilities

- **Wolves: young or very old elk**

Prey characteristics influence predation risk

Defensive abilities

- Age
- Size
- Antlers

Prey adaptations influence predation risk

“Predator swamping”

Other factors influence predation risk

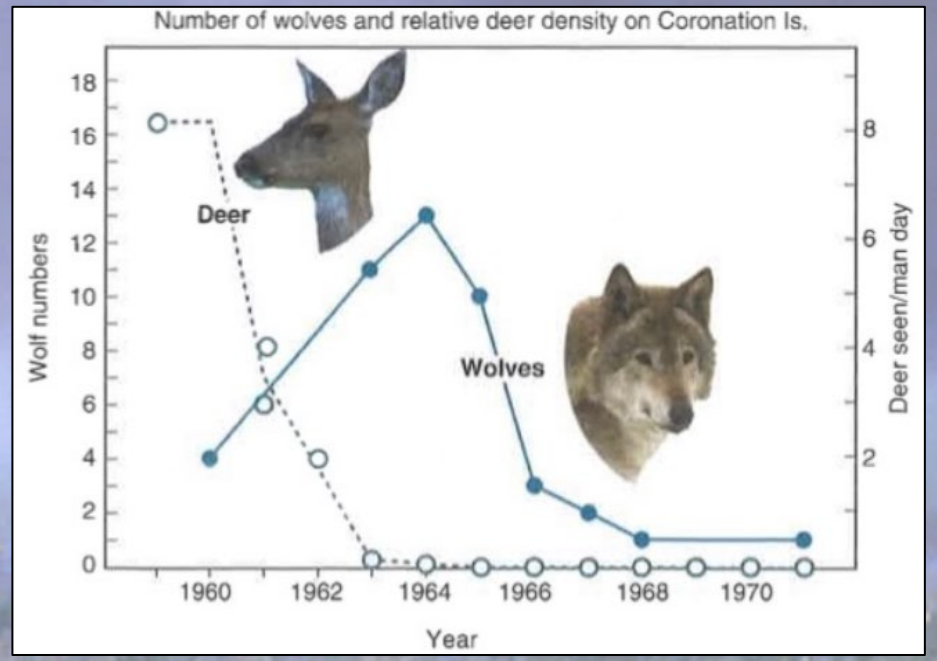
- Security cover
- Escape terrain

Nutritional condition influences predation risk

- Inability to defend themselves
- May forage in riskier areas
- Importance of good habitat!

When is predation likely to cause significant declines in prey?

- **Prey do not have adequate escape terrain**
  - **Islands**



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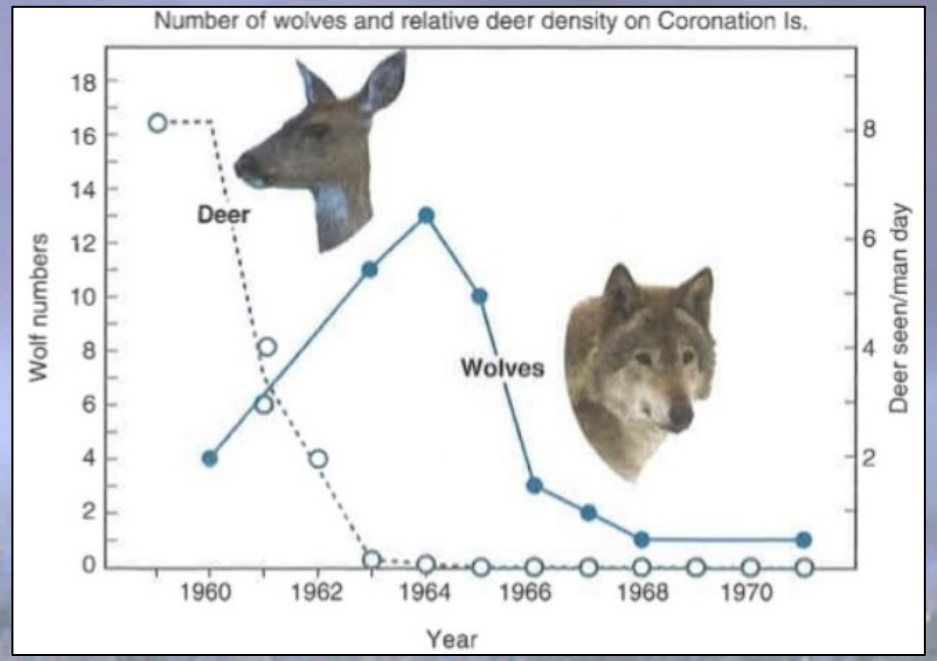
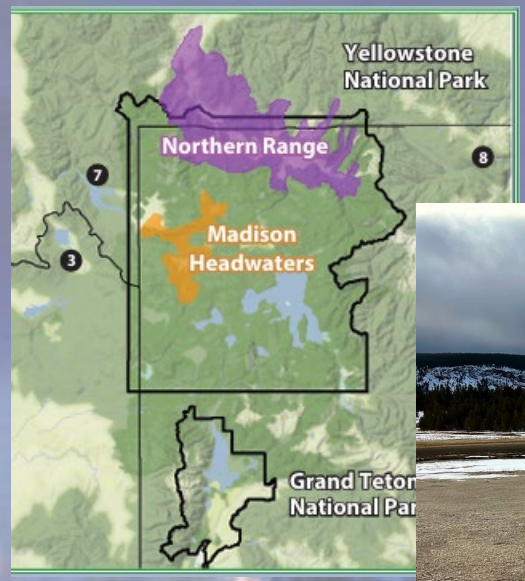


Madison Headwaters elk herd

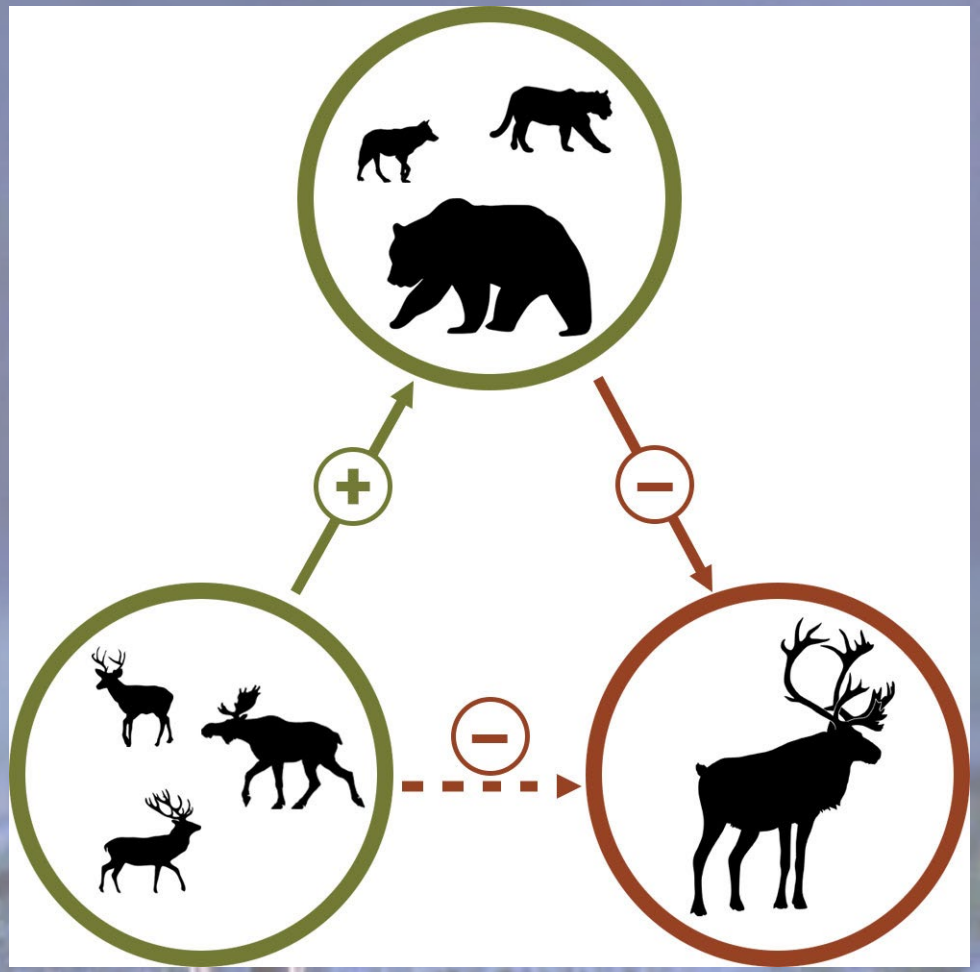


When is predation likely to cause significant declines in prey?

“Apparent Competition”

- **An abundant prey species indirectly affects a rare prey species**
- **Mediated through shared predator**

(more later)

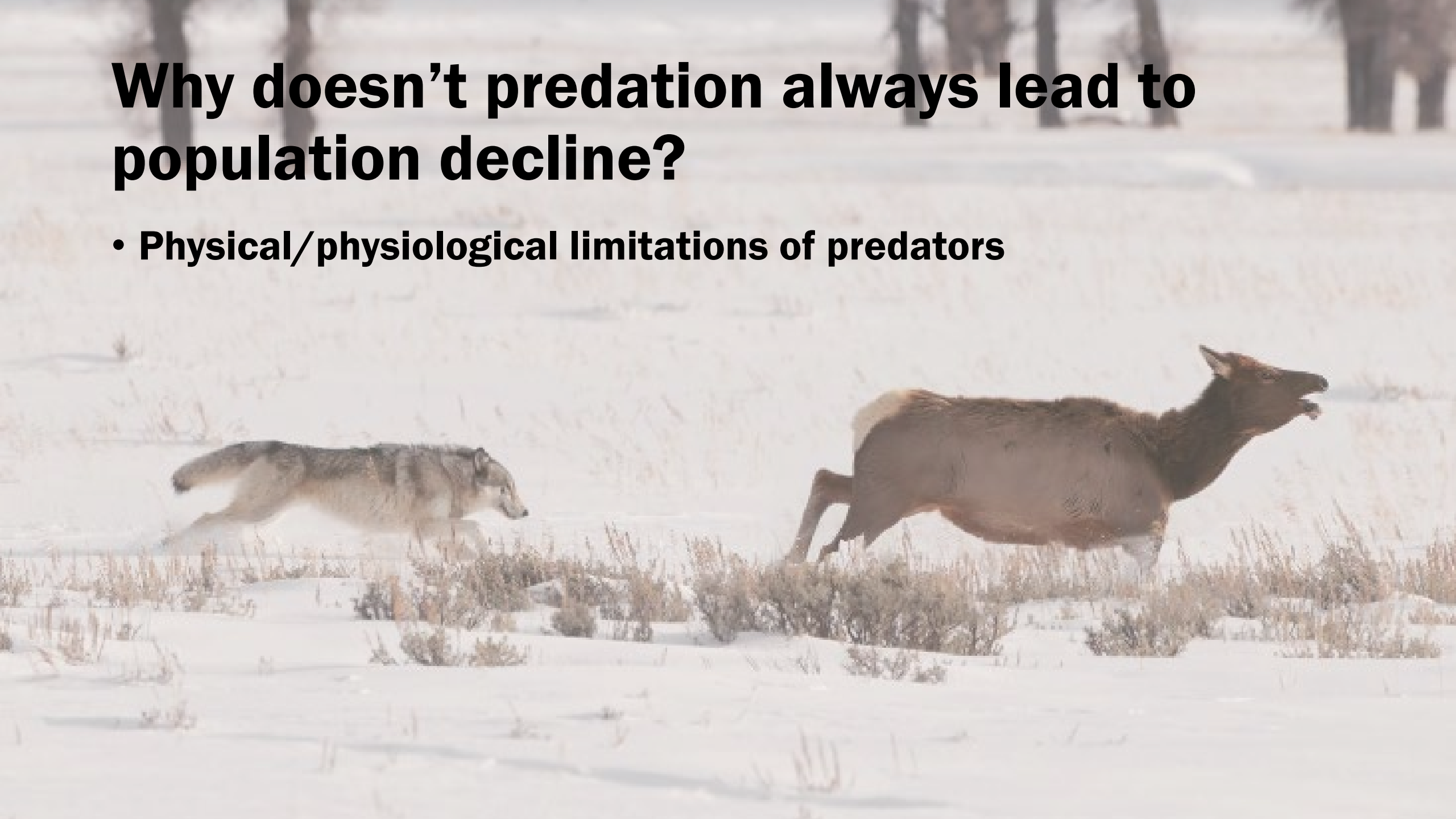


Why doesn’t predation always lead to population decline?

- Predation is risky

Why doesn’t predation always lead to population decline?

- Physical/physiological limitations of predators



Why doesn't predation always lead to population decline?

- It takes time to find, capture, kill, and consume prey
- Scavenging

What about predator control?

- Review of 62 predator removal experiments
- Overall, prey population size improved by 13% over the course of the experiment

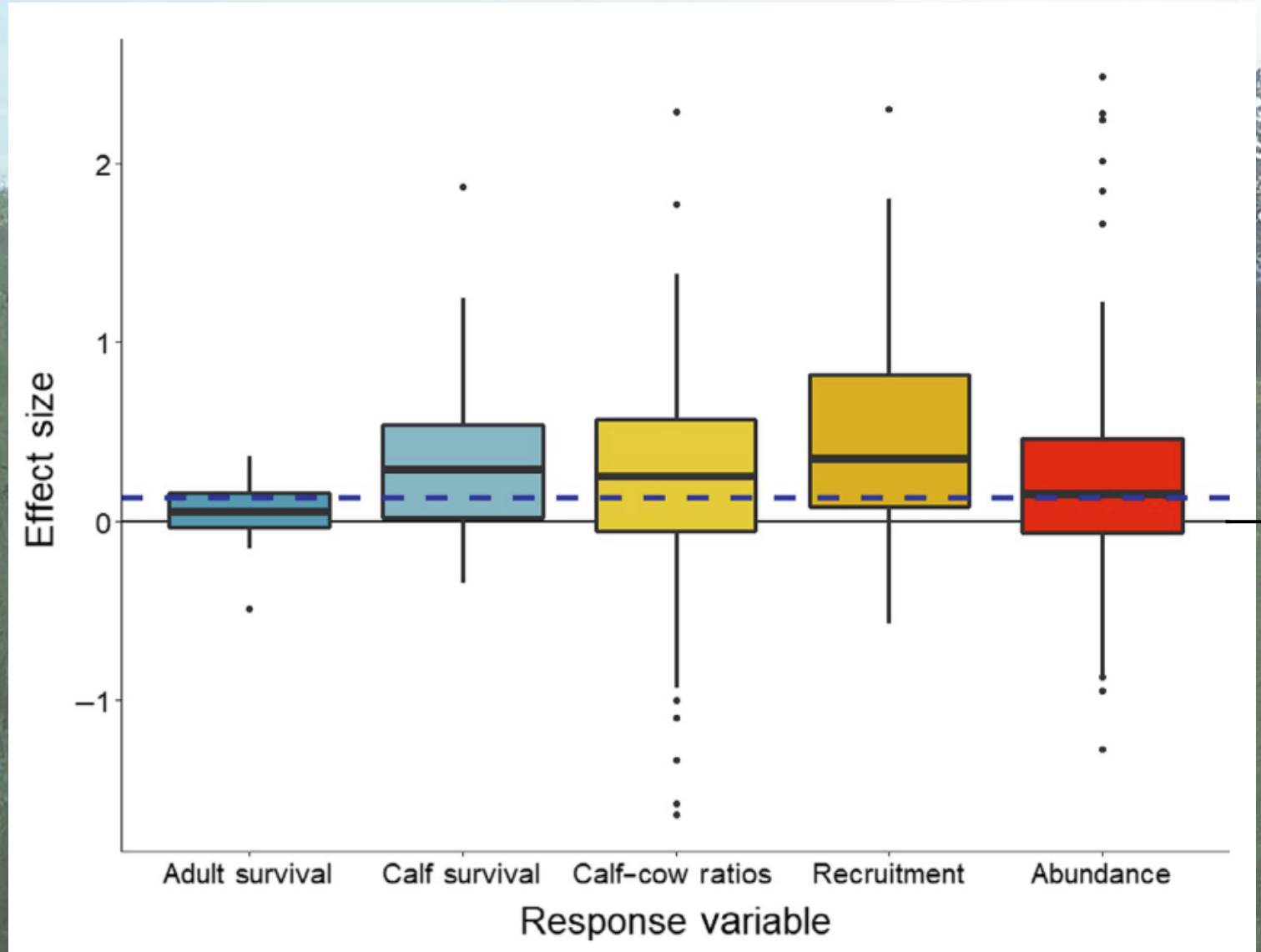
RESEARCH ARTICLE

Journal of Applied Ecology
BRITISH ECOLOGICAL SOCIETY

Predator control may not increase ungulate populations in the future: A formal meta-analysis

T. J. Clark | Mark Hebblewhite

Predator control – sometimes it works, sometimes it doesn't

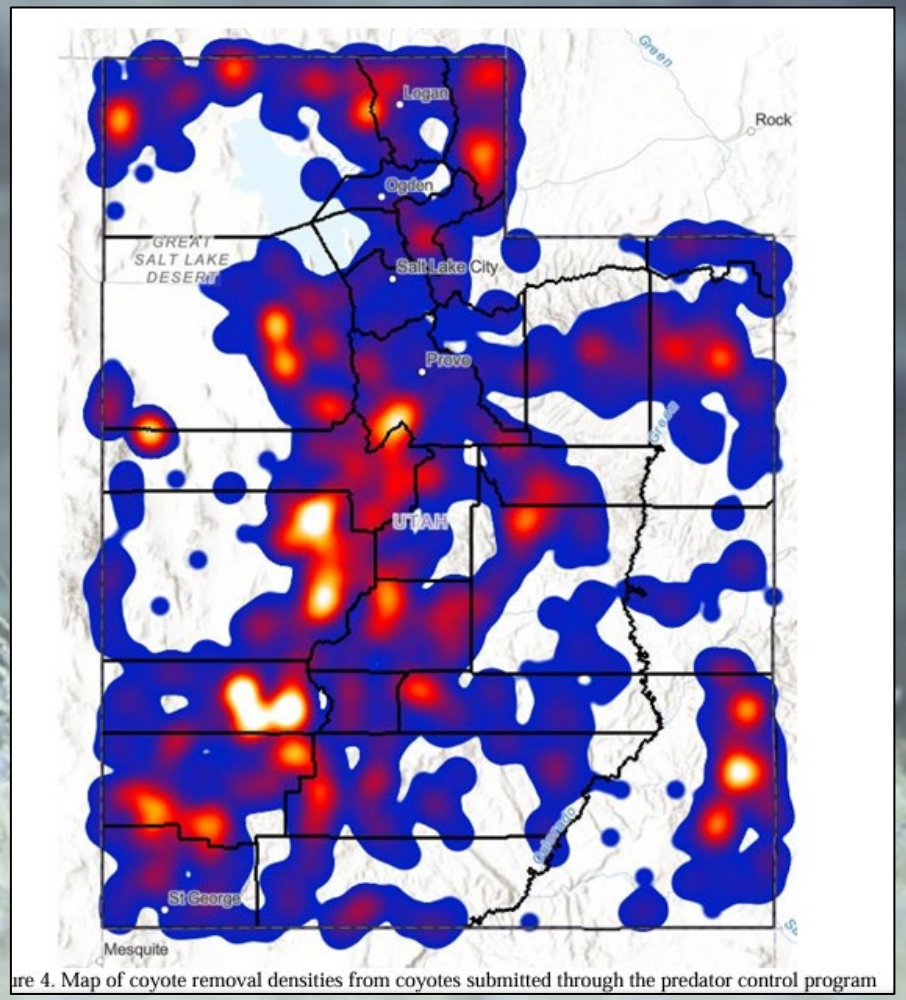


Positive effect on prey population

Negative effect on prey population

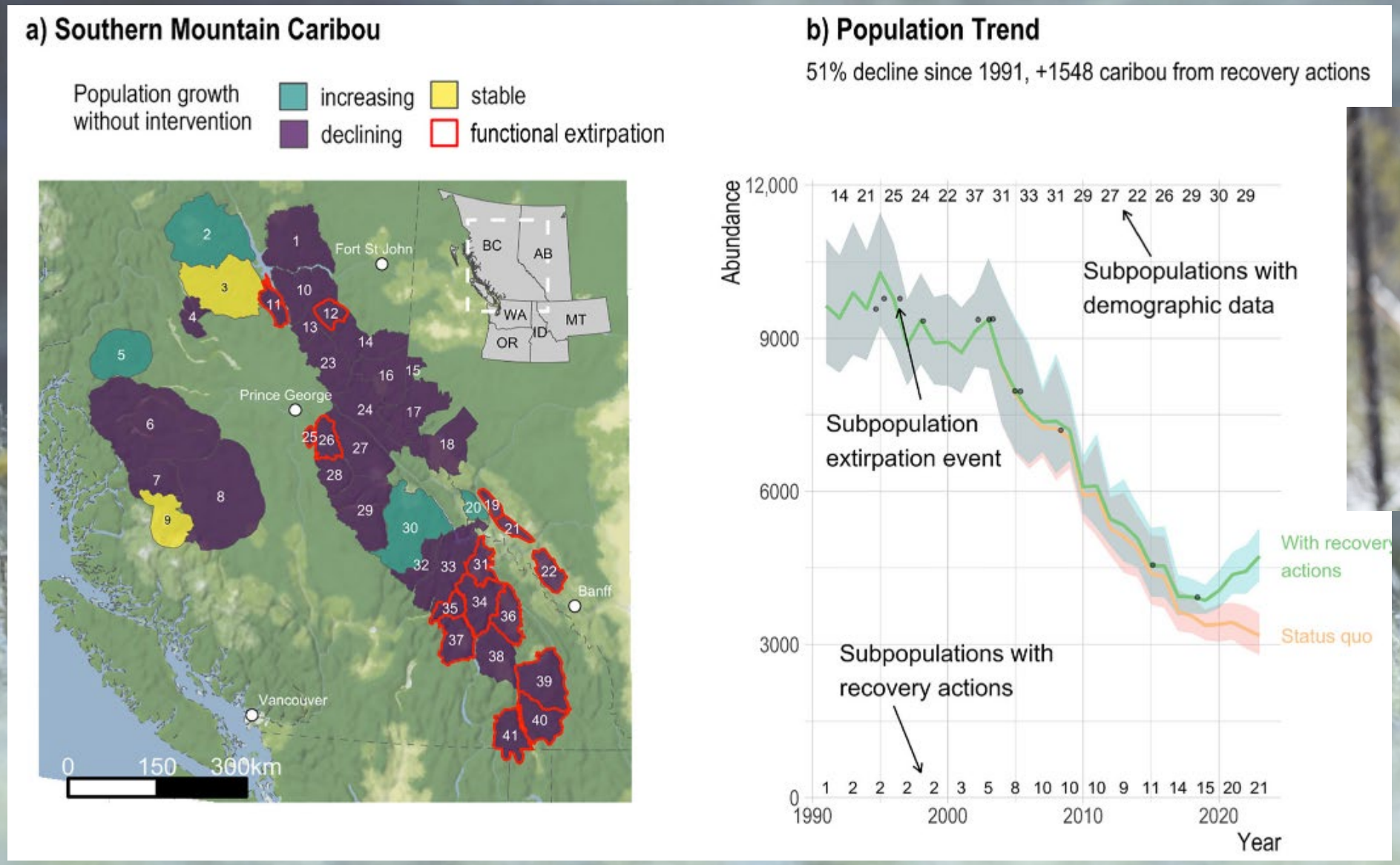
Why doesn’t predator control always work?

- Needs to occur at high intensity
- Long time periods
- Multiple predator species may need to be targeted



ıre 4. Map of coyote removal densities from coyotes submitted through the predator control program

When is predator control necessary?



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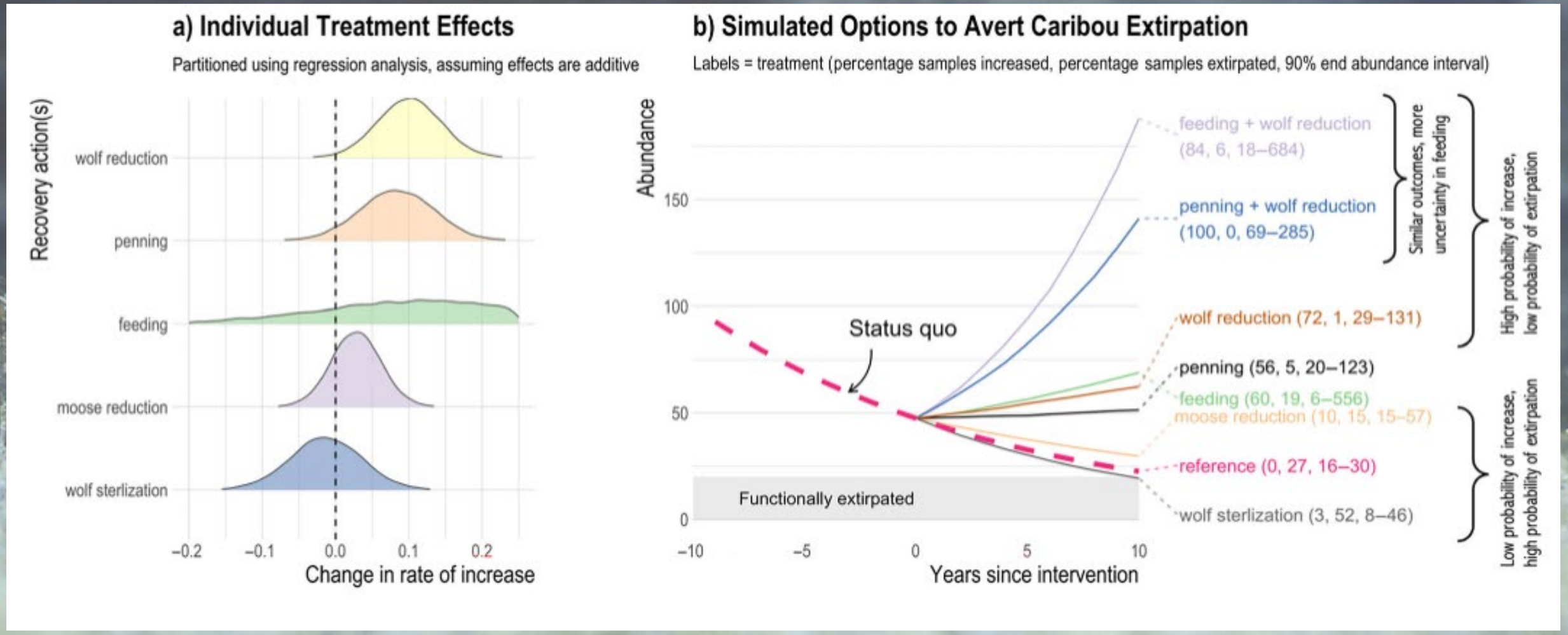


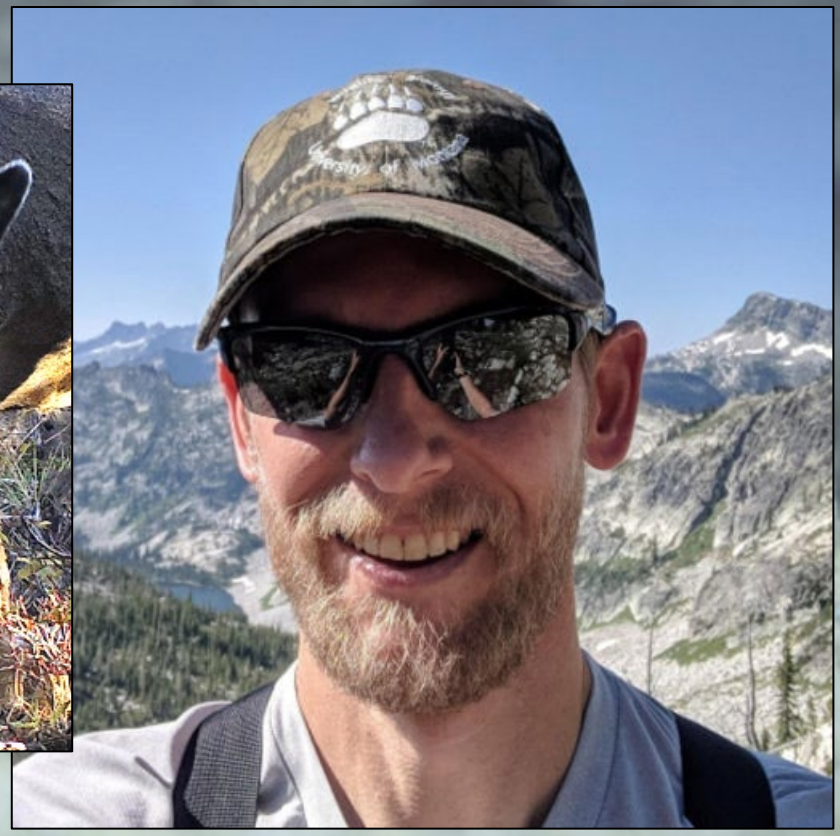
Predation vs Nutrition in Mule Deer

Idaho Predator Control Study

Conducted cougar and coyote removals, did not alter nutrition

Colorado Nutrition Study

Improved deer nutrition, did not alter predation

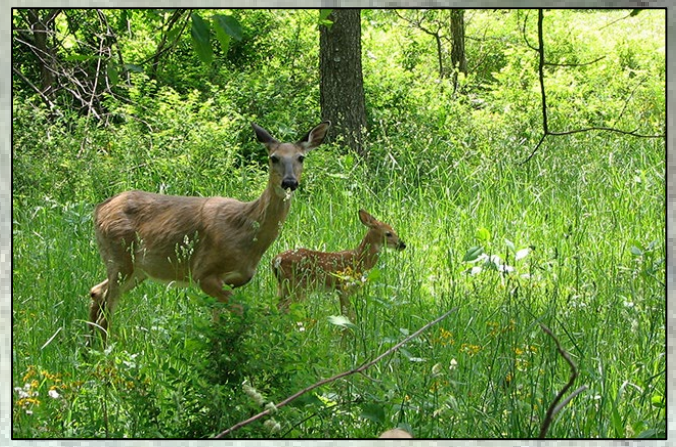


Predation vs Nutrition in Mule Deer

Idaho Predator Control Study

- Juvenile mortality did not improve
- Adult female survival increased by 3 percentage pts after cougar removals
- Overall, population growth did not improve (mortality was compensatory)

Colorado Nutrition Study

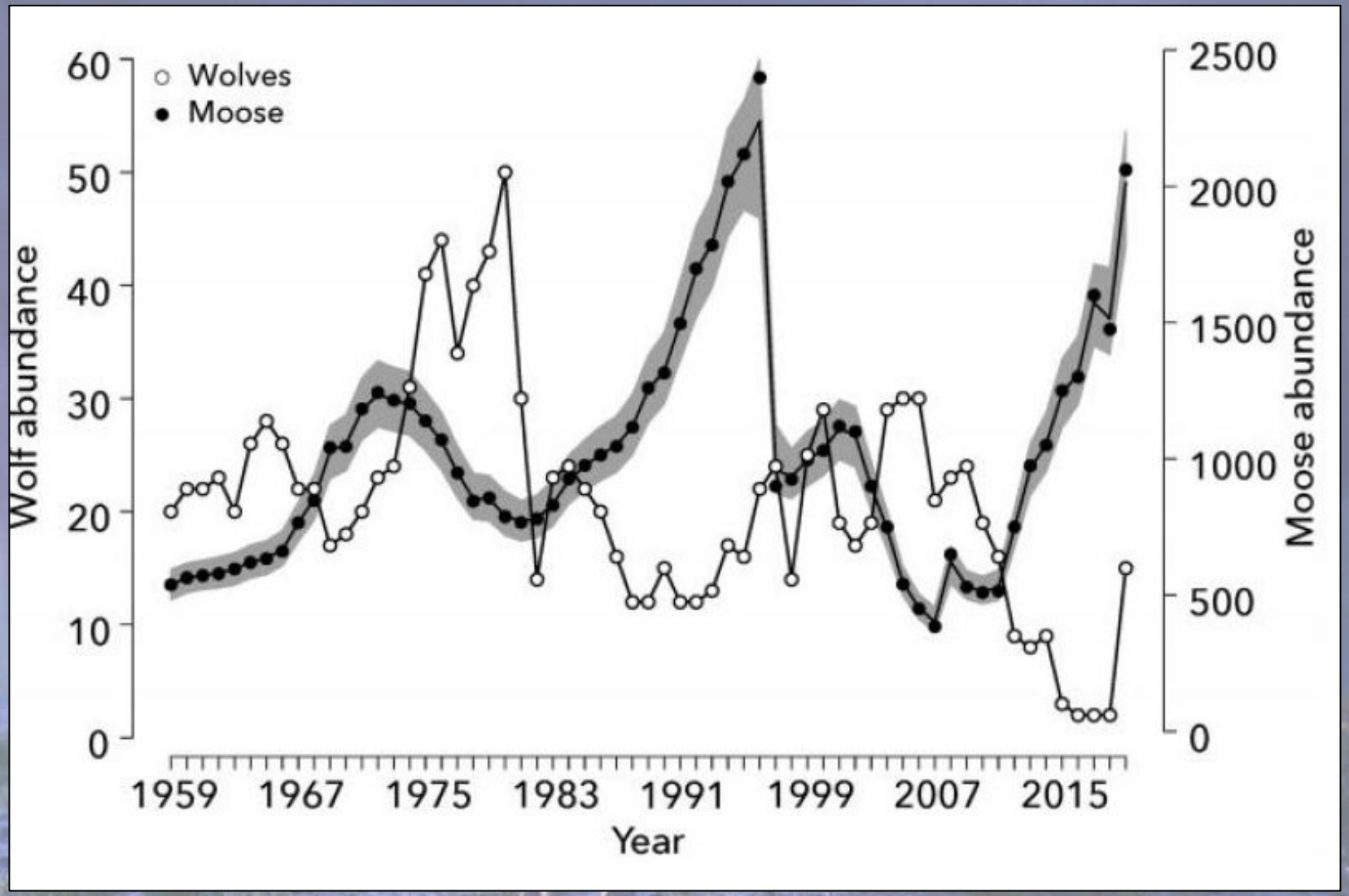


- Juvenile survival increased by 23 percentage pts
- Adult female survival increased by 5 percentage pts
- Population grew from 3% increase/year to 17% increase/year

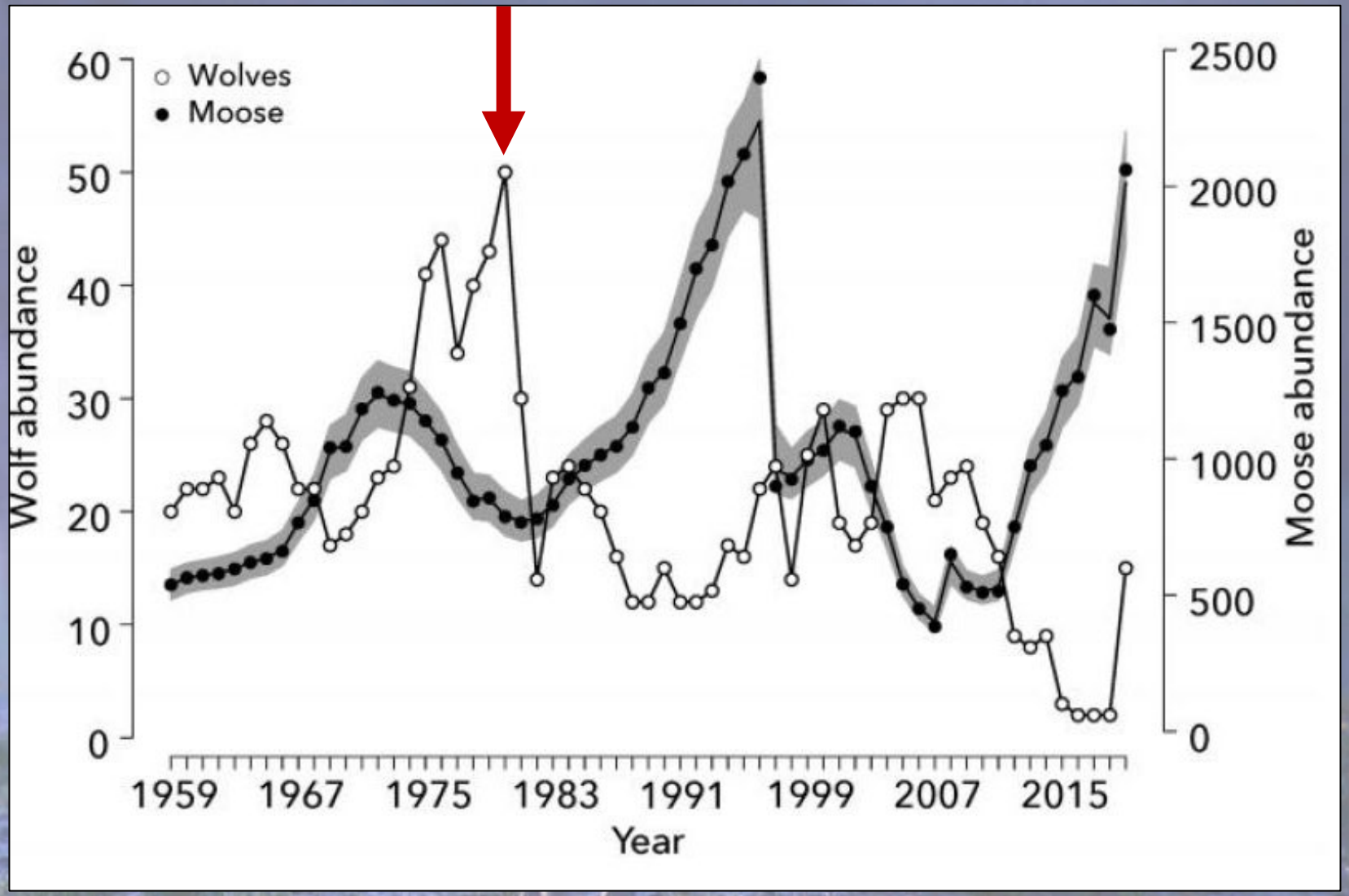
Predation vs Nutrition

- Improving nutritional condition benefits prey in multiple pathways
  - Reducing mortality from malnutrition AND predation
  - Increasing reproductive output

Top down vs bottom up control



Top down vs bottom up control



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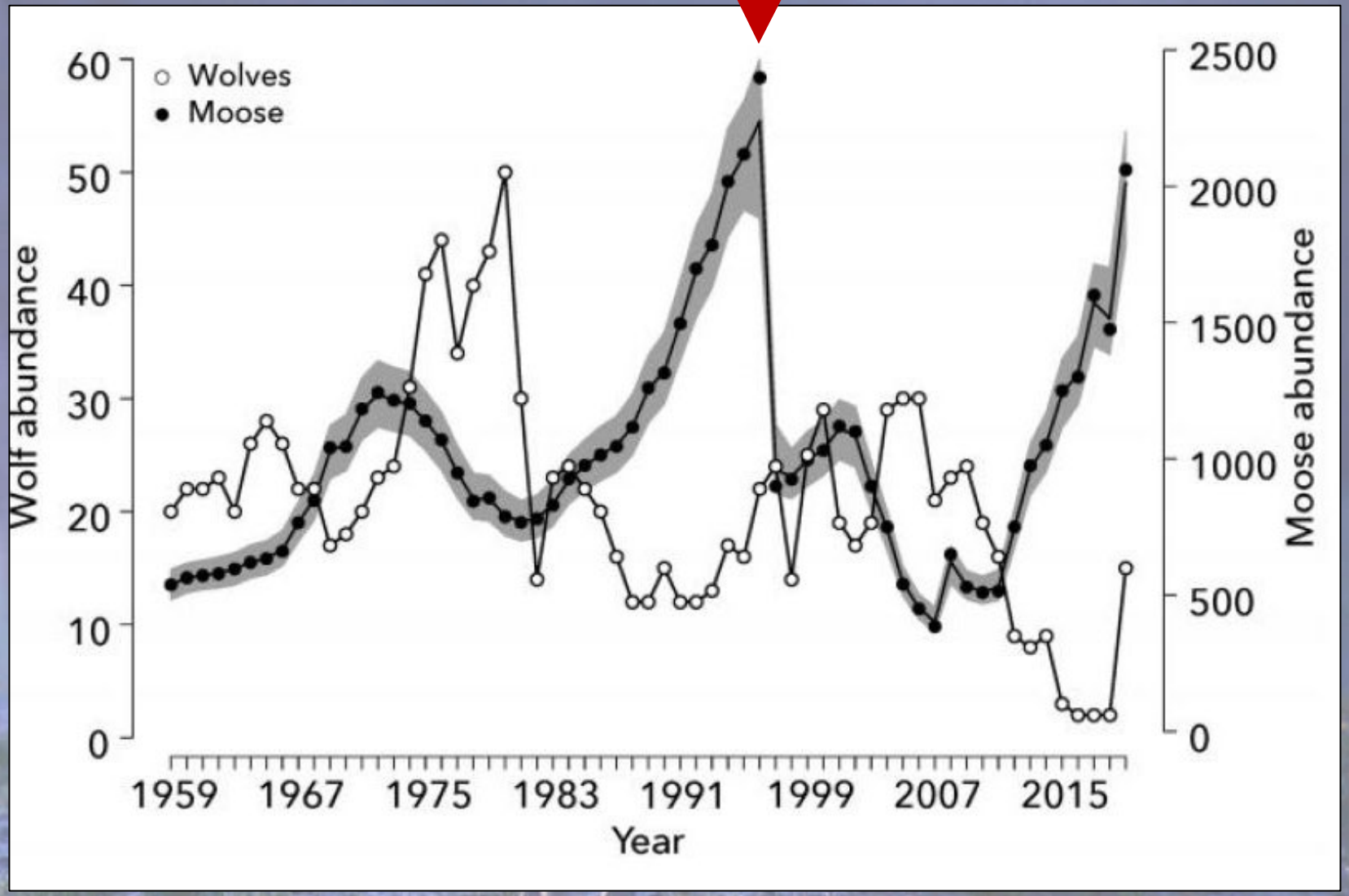
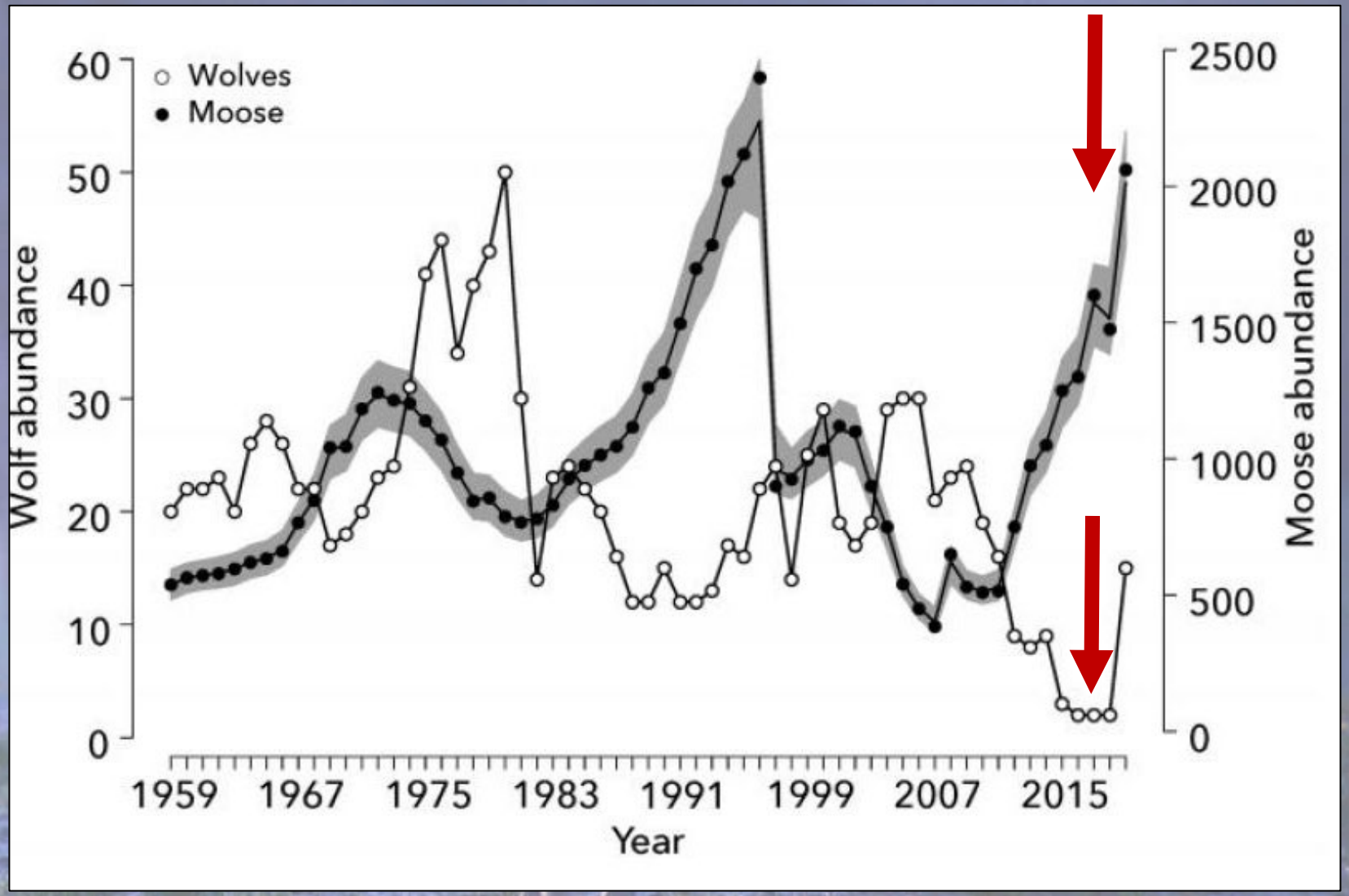
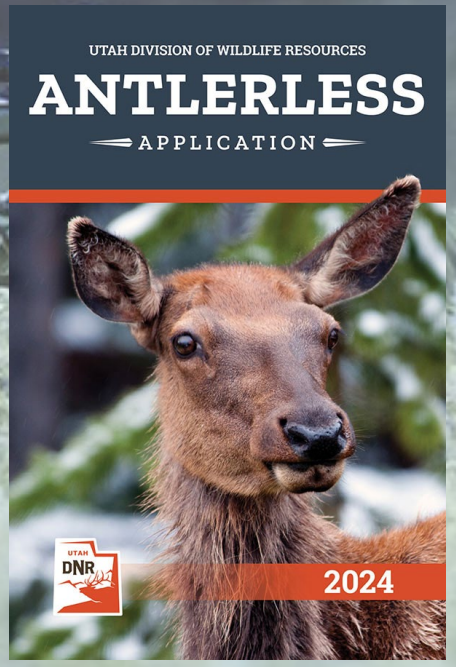


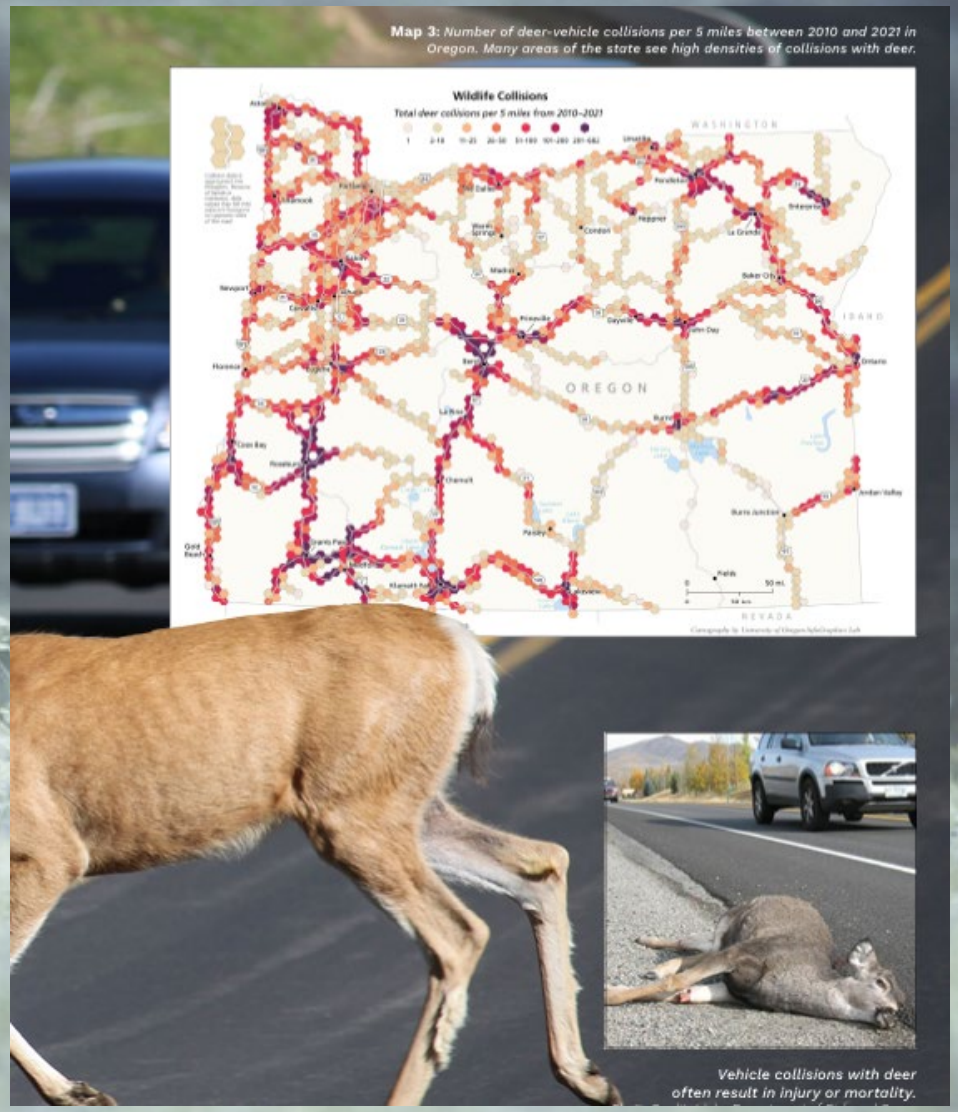
Top down vs bottom up control



Mortality from non-predation sources

- Vehicle strikes
- Human harvest of adult females
- Extreme weather events





If these factors significantly reduce adult female survival, reducing predation may not help