

Wolves

and the Landscape of Fear



Trophic Cascades:

According to Ripple et al. 2016

- 'We propose that trophic cascades specify the effects of <u>predators</u> that propagate **downward** through food webs across multiple trophic levels'
- Trophic cascades can be triggered by consumptive interactions between predators and prey and non-consumptive effects due to perceived predation risk by prey (fear).
- Various 'knock-on effects', initiated by trophic cascades and propagating laterally or upward from the main interaction chain, should not be thought of as part of the trophic cascade

Trophic Cascades

Definitions of Terms (2)

- Direct Consumptive effect: lethal effect of a predator on prey due to predation mortality.
- Indirect Non-consumptive effect: non-lethal effect of a predator on prey due to changes in prey behaviour or other traits in response to perceived predation risk by prey (e.g. fear)

Ripple et al. (2016). What is a Trophic Cascade? Trends in Ecology & Evolution 31:841-848

Trophic Cascades



- Grey Wolf (Canis lupus)
- Became extinct in Yellowstone
 National Park (US) 1926
- Re-introduced in 1995
- Predator likes Elk (Red deer subspecies) Cervus canadensis

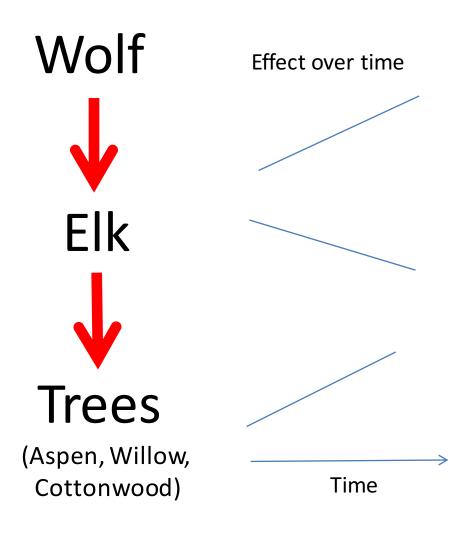


https://www.yellowstonepark.com



Trophic Cascade

(Direct effects of Wolf re-introduction)

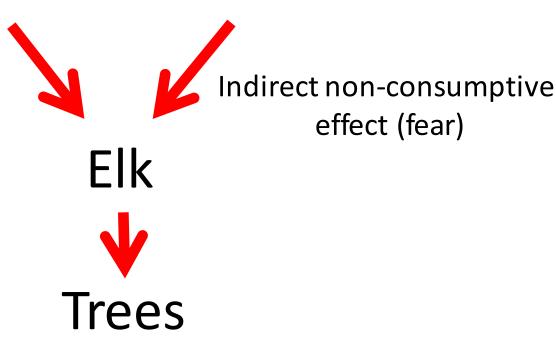


- As wolf population rises the elk population falls due to direct predation.
- Reduced browsing of tree saplings by elk increases number and size of trees;
- Note: Elk (Cervis elaphus)
 are European Red deer
 subspecies

Trophic Cascade

Wolf Reintroduction

Direct consumptive effect



(Aspen and Willow)

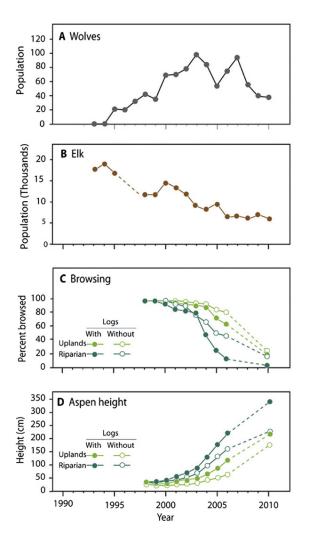
Combined Direct and Indirect effects of Wolf re-introduction

Trophic Cascades

- The indirect effect of wolves creating 'fear' has changed the winter distribution of Elk so that many river valleys and gorges are now 'Elk-free';
- Elk move in to higher forested areas in regions where wolf numbers are high and avoid the valleys;
- This has enabled willows and other trees to be 'released' from browsing pressure and grow taller and have greater biomass.

Trophic Cascade

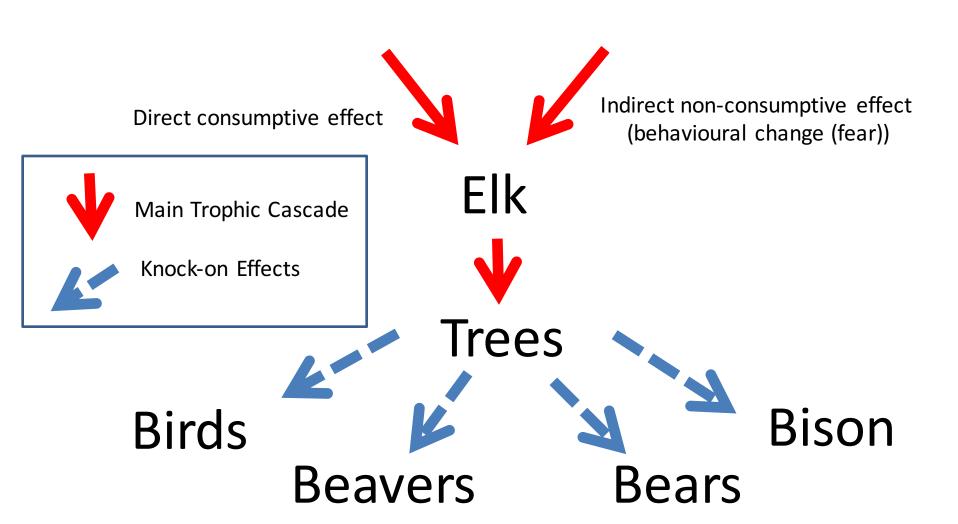
Direct and Indirect effect of wolf reintroduction in Yellowstone National Park



- (A) wolf populations
- (B) minimum elk populations from annual counts
- (C) percentage of aspen leaders browsed
- (D) mean aspen heights (early springtime heights after winter browsing but before summer growth)

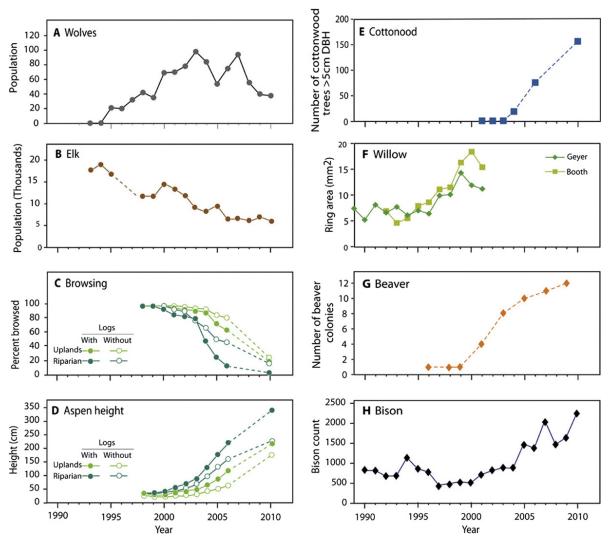
Ripple & Beschta 2012. Trophic cascades in Yelowstone: The first 15 years after wolf reintroduction. *Biological Conservation* 145:2015-213

Trophic Cascade with *Knock-on* effects Wolf Reintroduction



Trophic Cascades and Knock-on Effects

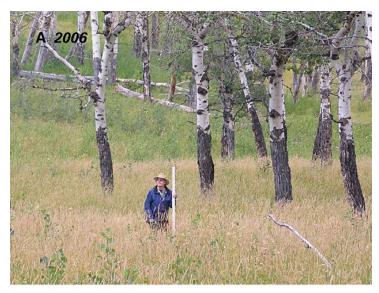
Effects of wolf reintroduction in Yellowstone National Park



Which are direct consumptive effects and which are indirect knock-on effects?

(Ripple & Beschta, 2012)

Elk browsing on aspen





- A: 2006 showing a lack of recent aspen recruitment (aspen <1 m tall) due to elk browsing;
- B: Aspen recruitment (some aspen >2 m tall) in same upland site, due to fewer elk;
- The dark, furrowed bark comprising approximately the lower 2 m of aspen boles represents long-term damage due to bark stripping by elk.



Soda Butte Creek with the Lamar River

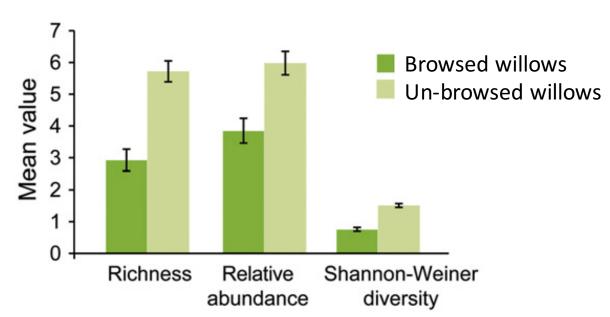
Wolves were introduced in winters 1995-96.

These photos show vegetation since. Examine these photos closely and make a note of any changes





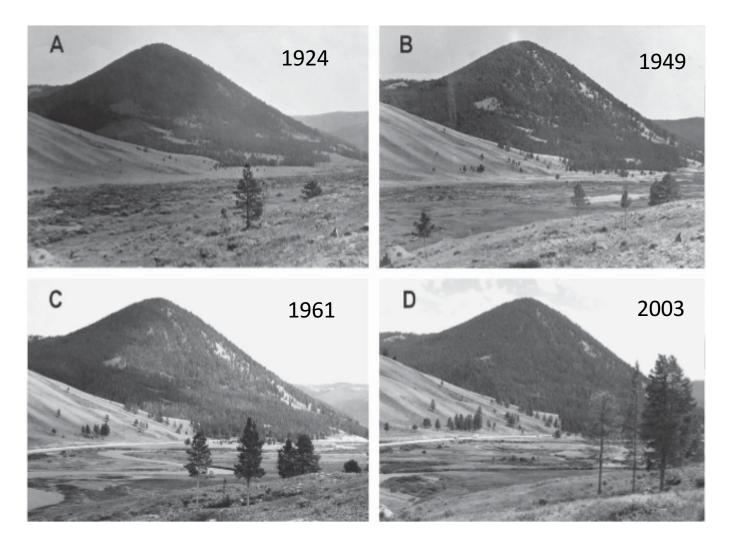
Impact of elk browsing on bird species richness



Bird species richness, relative abundance, and Shannon-Weiner diversity in grazed versus unbrowsed willows in Yellowstone National Park (Baril, 2009). Error bars represent standarderrors.

- Explain in your own words the impact of elk browsing on bird species richness.
- Which comparisons appear to be statistically significantly different?

Have wolves changed rivers?



Wolves returned to this catchment in mid 1990s

Which of any observed differences in the vegetation and landscape features are possibly as a result of wolf reintroduction?

(Beschta & Ripple (2006) Earth Surf. Process. Landforms, 31: 1525-1539)

Conceptual Model of 'top-down' trophic cascades and hydrogeomorphic processes with and without wolves for floodplain riparian systems in the upper Gallatin elk winter range. Yellowstone NP

(Beschta & Ripple (2006) Earth Surf. Process. Landforms, 31: 1525–1539; Bescheta et al. (2018), Forest Ecology & Management, 413, 62-69

Conceptual Model	Wolves Present	Wolves Absent
Predators	Wolves cause mortality and increase predation risk to elk populations	
↓	↓	®
Prey	Elk numbers and patterns of habitat use result in low-moderate browsing of riparian vegetation	Increased elk numbers and/or unimpeded habitat use result in heavy browsing of rigarian vegetation
₩		₩
Plants	Woody browse species in riparian areas able to establish, grow, and reproduce; high levels of above-and below-ground biomass contribute to hydraulic roughness and bank stability	Reduced above- and below-ground biomass of woody browse species causes loss of hydraulic roughness and root strength
	-	-
Channel Morphology	Gallatin River has a relatively stable, meandering, single-thread channel in long-term balance with its flow regime	Accelerated bank erosion results in widespread channel adjustments including widening, incision, and avulsion; some over-widened reaches aggrade
•	•	•
Hydrologic Connectivity	Occurrence of bankfull flows approximately every 2–4 years (on average) in conjunction with high water tables provide soil moisture conditions that sustain riparian plant communities	Occurrence of bankfull flows generally exceed 2–4 years in conjunction with lowering of groundwater levels cause soil moisture conditions that no longer sustain riparian plant communities

Video 4.5 mins

https://www.youtube.com/watch?v=ysa5OBhXz-Q

Great Story - but is it all true?
What else has changed in Yellowstone NP over past
70 years?

https://strangebehaviors.wordpress.com/2014/03/10/maybe-wolves-dont-change-rivers-after-all/