

Cascading Importance

Wolves, Yellowstone, and the World Beyond. A talk with William Ripple.

By Jonathan Batchelor



Figure 1. The maw of a wolf. For some few a source of terror. For an ecosystem, a source of hope.

Wolves are back. At least in Yellowstone National Park. In 1926 the last wolf in Yellowstone was murdered. Following an absence of nearly 70 years, and due to an intensive reintroduction effort, the howls of wolves once again drift across the landscape. These mournful calls have been sorely missed. To the elk, these calls may instill a moment of fear but to the ecosystem as a whole, the presence of the wolf is like a soothing balm. With the wolves having been reintroduced in 1995, it is possible that the eldest of the elk in the park were born during a time of ease and decadence. A time where they had little to fear from predators. A time, when aspen and cottonwood stands were in such a state of decline that many feared they would soon disappear. There were mature aspen in the park and very young and stunted sprouts but no young trees that would be able to replace the mature aspen once they died.

One of those individuals drawn to Yellowstone and the mystery of the declining aspen stands was Dr. William Ripple. Ripple is a professor at Oregon State University and the director of the trophic cascades program. I met up with Dr. Ripple

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in his office and talked with him about what it was that drew him to Yellowstone and the importance of apex predators (such as wolves), not only to Yellowstone, but to ecosystems worldwide. His office is easy to pick out; it is the only one that has several bird feeders suction cupped to the outside windows. Upon entering his office he motions at the small couch in the corner and tells me to pull up a chair. I get the distinct impression that the purpose of this couch is so Bill can steal a few moments of sleep while pulling all-nighters working on a project. You can tell immediately that Bill loves his work. He is the kind of researcher that genuinely gets excited about what he does. I know

this first hand, as I have had the privilege of being out in the field with him and have seen him almost giddy when pilot data points to a promising new research project. As he begins to relay the story of his time in Yellowstone, a story he has told many times to many different reporters, he still conveys a sense of excitement that is contagious.

His research in Yellowstone started in 1997. After having heard about the declining aspen in Yellowstone, Ripple and his then graduate student Eric Larson headed



Figure 2. Dr. William Ripple looking at cottonwood trees in Yellowstone National Park.

out to try and understand what was causing the decline. They took core samples of trees and started counting the rings to try and place the year when the aspen stopped regenerating mature trees. “We looked at fire and fire suppression and we looked at climate fluctuation, nothing seemed to be making sense” recalls Ripple¹.

It wasn’t until they found out that the last wolf had been killed in Yellowstone in 1926 that the pieces began to fit together. Ripple refers to it as the ‘aha’ moment when he and Larson were standing in a Yellowstone gift shop that had a poster for sale of a wolf standing next to a stand of aspen. Standing there almost like a protector of the grove. Bill recalls the thought that went through his mind, “wow, I wonder if there is a connection between the wolves being killed and the aspen stopping their regeneration.”²

Sitting in Bill’s office, I notice a poster on the wall, a poster of an aspen grove in winter with a wolf standing next to it.

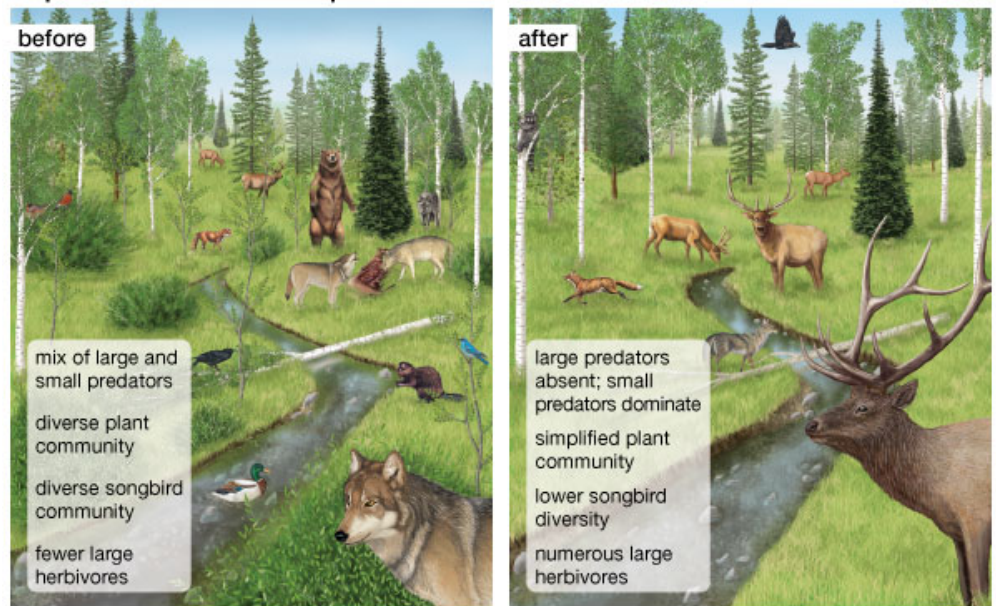
That was the beginning of Ripple’s work with predators in Yellowstone. It all began with trying to understand tree rings. By looking at those rings, Ripple and Larson dated the youngest mature aspens at 70 years old and the only aspen younger than 70 years, were stunted little things under a meter tall³. As the older trees died, there were no young mature trees to take their place. The future of aspen stands in the park was to either wither away entirely, or to enter a suspended stage, where all the aspen present in a stand were under a meter tall and more resembled

shrubs that an overzealous gardener pruned with a dull machete than the delicate and graceful form of a mature aspen.

It seems intuitive enough. Wolves kill elk, and elk eat aspen. Could the wolves be indirectly impacting the aspen? They published that hypothesis in 2000⁴ and it has held up over the years.

Turns out, that it was not only the aspen that hit a proverbial wall when wolves were extirpated. Cottonwoods were also in a state of decline and had an age structure similar to the aspen⁵. Dr. Robert Beschta (now professor emeritus at Oregon State University) began looking at cottonwoods in the Lamar Valley of Yellowstone National Park with Ripple and they found that, here was another woody species whose decline corresponded with the extirpation of wolves from

Trophic cascade scenario: top carnivore removal



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Figure 3. Summary of impacts the removal of wolves may have.

the ecosystem. Aspen and cottonwoods are both long lived species so the mature trees present were able to answer, through tree ring analysis, when

¹ Personal Communication with William Ripple. Feb 2013

² Personal Communication with William Ripple. Feb 2013

³ Ripple, W.J. and Larsen, E.J. Historic aspen recruitment, elk, and wolves in northern Yellowstone National Park, USA. *Biological Conservation* 95, 2000: 361-370.

⁴ Ripple, W.J. and Larsen, E.J. Historic aspen recruitment, elk, and wolves in northern Yellowstone National Park, USA. *Biological Conservation* 95, 2000: 361-370.

⁵ Beschta, R.L. Cottonwoods, elk, and wolves in the Lamar Valley of Yellowstone National Park. *Ecological Applications* 13(5), 2003: 1295-1309.

the stands stopped recruiting mature trees. If both aspen and cottonwoods were so dramatically impacted by the extirpation of wolves, what other species were impacted? Could there be species that disappeared from the landscape entirely?

Elk impact the plants in the system, but what about the impacts the plants have on other species in the system, and on the system itself. With aspen and cottonwood in decline, there became a shortage of forage for beaver. Beaver dams create habitat for many fish species, so with beaver being impacted, fish species also became impacted. Also, many bird species nest in young cottonwood and aspen groves. With the absence of these groves the birds lost critical habitat⁶. Even the rivers and streams themselves were potentially impacted as the riparian vegetation was browsed to nothing and the elk trampled the banks⁷. The streams and rivers were becoming unglued.

The cascade

When humans took out the wolves, there were dramatic and unforeseen effects. What are the mechanics of these effects? Why did the removal of wolves have such a profound impact? Enter Trophic Cascade Theory. The theory is an articulation of how top-down forces can shape an ecosystem. Apex predators at the top impact the system below through the direct predation and population decrease of prey species, and the subsequent behavioral change of prey species. The prey species then impacts lower trophic levels as its population and behavior are impacted. If a prey species, elk in the case of Yellowstone, has a change in population (an increase with the extirpation of predators or a decrease with the reintroduction of those predators), and the

population that remains alters their behavior, then there are going to be impacts on all the species the elk interacts with, and so on down the food chain. Thus the reference to a cascade.

This idea of top-down forces so significantly impacting ecosystems isn't a new one. Back in the 1940's, Aldo Leopold, author of Sand County Almanac and renowned conservationist, started recognizing and writing about the importance of wolves and other predators in ecosystems but it wasn't until the 1960's that the significance of top-down forces in ecosystems was really scrutinized in the scientific community⁸. Up until this point it was generally believed that bottom-up forces were the drivers of how ecological communities shaped themselves.

Ripple does not discount the impacts of bottom-up forces, rather, he is looking at how the Yellowstone ecosystem is responding now that the intense browsing pressure from elk has been relieved. There hasn't been a universal resurgence of growth in aspen and cottonwoods across the park and Ripple theorizes that "The reintroduction of wolves and the top down impacts may allow bottom up cascades to present themselves, such as, individual site productivity, moisture, slope aspect, snow levels, etc"⁹

Yellowstone Renewed

It has been 17 years since the reintroduction of wolves to Yellowstone and to the Ripple, the question has changed from, "why are the aspens in decline?", and has become "Now that wolves are back, are plants going to start growing again?"

⁶ "trophic cascade." Encyclopædia Britannica. Encyclopædia Britannica Online. Encyclopædia Britannica Inc., 2013. Web. 08 Feb. 2013. <<http://www.britannica.com/EBchecked/topic/1669736/trophic-cascade>>.

⁷ Beschta, R.L. and Ripple, W.J. River channel dynamics following extirpation of wolves in northwestern Yellowstone National Park, USA. *Earth Surface Processes and Landforms* 31, 2006: 1525-1539.

⁸ Hairston NG, Smith FE, Slobodkin LB (1960) "Community structure, population control and competition". *American Naturalist* 94:421-425

⁹ Personal Communication with William Ripple. Feb 2013

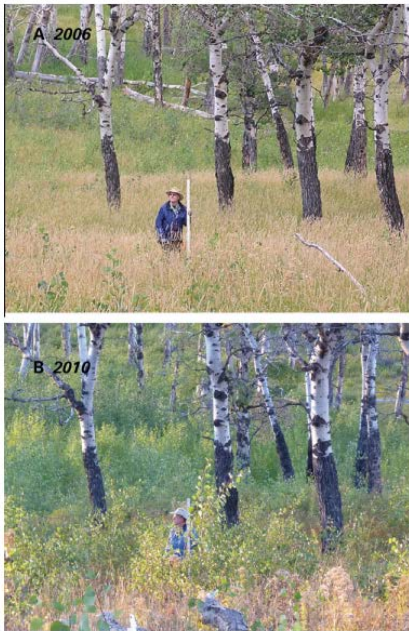


Figure 4. Image of Dr. Ripple standing in an aspen grove to show the amount of growth in 4 years.

There is a growing amount of evidence to suggest that yes, things are indeed growing again. Where in 1995 there was nary an aspen or cottonwood sapling greater than a meter to be found in the Lamar Valley, currently there are whole groves of saplings that top 7 meters and have

reached the point where the term sapling is a bit insulting. “The key here is that these plants are just starting to grow taller now since wolves have come back, and we are at the very early stages of any recovery of plants. Yellowstone was without wolves for 70 years and it has only been 17 years since wolves have come back so we are going to need to have a lot more time play out before we know how this is going to turn out.”¹⁰

With the resurgence of growth in the aspen and cottonwood, other ecosystem elements started to change as well. Riparian vegetation is reestablishing itself in places, there is more forage for beavers and subsequent fish habitat improvement... The full extent of the cascade is still not understood. Who would have thought that with the reintroduction of wolves into Yellowstone,

there might be an increase in song bird populations and better fish habitat?

Beyond the parks gates

The implications of trophic cascades are not limited to the boundaries of Yellowstone National Park. Nor are wolves the only potential initiator of a trophic cascade. Ripple and Beschta have written about how the increase of human traffic in Zion National Park has led to the disappearance of cougars, and a subsequent increase in mule deer, and the subsequent decrease in cottonwoods and other riparian vegetation, and the subsequent... well, you get the idea¹¹.

Outside of national parks, things become much more complicated. According to Ripple it becomes “more complicated when you move outside the national park. Issues like cattle grazing, hunting, and logging make sorting out a trophic cascade signature difficult”¹²

That does not mean, however, that it does not exist. In the Pacific Northwest there are finally wolves returning to the ecosystem. What, if any, trophic cascade will present itself here is unknown and unfortunately it will remain unknown unless the wolves are allowed to reestablish themselves. Ripple does caution that “Trophic cascades are context dependent and are going to happen at different speeds. It is not a universal thing that you get a predator there and everything happens immediately”¹³

Ripple is emphatic that “it is important to think beyond just wolves, or beyond just

“Predators have a profound influence on nature. When we lose these predators it can be a disruption of ecosystem function and ecosystem services that, in the end if we lose enough predators, it will have dramatic effects on humans”

¹¹ Ripple, W.J. and Beschta, R.L. Linking a cougar decline, trophic cascade, and catastrophic regime shift in Zion National Park. *Biological Conservation* 133, 2006: 397-408.

¹² Personal Communication with William Ripple. Feb 2013

¹³ Personal Communication with William Ripple. Feb 2013

¹⁰ Personal Communication with William Ripple. Feb 2013

Yellowstone, and to look at what is happening with many other species in many locations around the world. The wolf story in Yellowstone is just a small piece of what is going on globally and it's consistent with what scientists are finding for all kinds of species around the world" ¹⁴

In the July 2011 issue of Science, Ripple was one of many co-authors for a piece about the loss of apex consumers entitled "Trophic Downgrading of Planet Earth". Apex consumers, not just apex predators, as some of the species looked at were herbivores such as the wildebeest. Twenty three authors contributed to this piece and it is some very illustrious company. In the introduction it states:

"The loss of these animals may be humankind's most pervasive influence on nature. Although such losses are widely viewed as an ethical and aesthetic problem, recent research reveals extensive cascading effects of their disappearance in marine, terrestrial, and freshwater ecosystems worldwide."¹⁵

The article continues to describe instance after instance of how, with the removal of apex consumers, ecosystems started falling apart. Ripple warns that "Predators have a profound influence on nature. When we lose these predators it can be a disruption of ecosystem function and ecosystem services that, in the end, if we lose enough predators, it will have dramatic effects on humans"¹⁶

These issues are bigger than just cottonwoods and aspens in Yellowstone. They are vastly more important than just a question of ethics and aesthetics. Ultimately, humanity is still tied to the ecosystems that we inhabit and as William Ripple points out, "Think broadly and big when considering this issue"¹⁷ because when we

disrupt ecosystem functionality the consequences can be unforeseen, dramatic, and dire.

¹⁴ Personal Communication with William Ripple. Feb 2013

¹⁵ Estes JA, Terborgh J, Brashares JS, Power ME, Berger J, Bond WJ, Carpenter SR, Essington TE, Holt RD, Jackson JBC, Marquis RJ, Oksanen L, Oksanen T, Paine RT, Pickett EK, Ripple WJ, Sandin SA, Scheffer M, Schoener TW, Shurin JB, Sinclair ARE, Soule ME, Virtanen R, Wardle DA. Trophic Downgrading of Planet Earth Science 333, 2011: 301-306 .

¹⁶ Personal Communication with William Ripple. Feb 2013

¹⁷ Personal Communication with William Ripple. Feb 2013