Aspens Return to Yellowstone, With Help From Some Wolves

To grow a healthy stand of aspen trees, you need a pack of wolves. That's the conclusion of two researchers who have been studying aspens (*Populus tremuloides*) in Yellowstone National Park. The trees, which are long-lived clones that endure for centuries and possibly millennia, had not regenerated in the park for more than a half-century but are now returning in some areas. Their recovery, the researchers say, is not simply because the wolves are hunting the aspens' archenemy, the elk (*Cervus elaphus*); it's also because the wolves have reintroduced the fear factor, making the elk too nervous to linger in an aspen grove and eat. The study adds to other research linking the 1995 return of the park's key predator, *Canis lupus*, to a more biologically diverse and healthier ecosystem. It also lends strength to the notion that the loss of top carnivores leads to degraded environments overall.

"This is exciting because it lends support to a prediction made a decade ago that the aspen in Yellowstone would recommence growing" after the gray wolf was brought back and began to reduce the elk population, says Michael Soulé, an emeritus ecologist at the University of California, Santa Cruz. But that is only part of the story, say ecologist William Ripple and forest hydrologist Robert Beschta of Oregon State University, Corvallis. Their study, which focuses on the aspens in Yellowstone's Lamar Valley, appears in the August issue of *Biological Conservation.*

Trophic cascade. Reintroducing key predators, like the wolf in Yellowstone National Park, can reestablish healthy ecosystems.

CREDIT: PHOTOS.COM

Beschta recalls being "just aghast" when he first saw the Lamar Valley in 1995. "I used a very emphatic, unprintable word," he says. "This valley lies in what is supposed to be the crown jewel of our national parks, and it was being eroded away" as the Lamar River flooded annually, washing away soils that had taken thousands of years to accumulate. The reason: There were hardly any bushes or trees to keep the soil in place. Back at Oregon State, Beschta presented his mystery: Why were the aspens, cottonwoods, and willows in Yellowstone disappearing? Beschta lacked the time to begin such a study, so his colleague, Ripple, and a graduate student, Eric Larsen, took on the job in 1997.

By examining tree rings, Ripple and Larsen found that the park's aspens had stopped regenerating soon after the 1920s—almost exactly the same date that the U.S. government eliminated the gray

Published by AAAS

Safe enough? Earthquake forces on the Kashiwazaki-Kariwa nuclear plant were greater than nominal design loads; a transformer caught fire, but reactors were undamaged.

CREDIT: 9TH REGIONAL COAST GUARD HEADQUARTERS, KYODO/LANDOV

structural engineer at Chiba University. Nevertheless, buildings are safer thanks to a better understanding of how structures can hold up against horizontal forces. "It is not right to judge structural performance by the acceleration amplitudes of ground motion alone," Otani concludes.

The fact that buildings at Kashiwazaki-Kariwa withstood higher-than-anticipated loads indicates they were designed and constructed well, says Tomotaka Iwata, a geophysicist at Kyoto University's Disaster Prevention Research Institute. "But no one knows just how safe they are," he says. The more immediate issue, Iwata and others say, is the obvious design flaws of the damaged piping systems and secondary structures, which have put Kashiwazaki-Kariwa out of operation for at least a year.

–DENNIS NORMILE

wolf from Yellowstone. "It just boggled my mind to think that wolves could affect a river system," says Beschta. "But the trees were clearly being overbrowsed by elk. To stunt a cottonwood or aspen, all an elk has to do is browse the leader," or the plant's main shoot. Now that wolves were back in the park, Beschta and Ripple teamed up to watch this natural experiment unfold. Would the carnivores' return change the valley's vegetation?

The wolves—which kill an elk every few days—did lower the herbivore's population, as other researchers have documented. And as the elks' numbers dropped, the willows and cottonwoods began to return; the aspens, which elk find especially tasty, are taking longer. "It was only last summer when we stumbled on aspens that are over my head," says Ripple, who is 1.8 meters tall. These clones grew in the riparian parts of the Lamar Valley; aspen clones the scientists measured on nearby upland areas remain stunted and have yet to regenerate. In some places, some trees had recovered, whereas others only a few meters away had not. Why the patchy recovery, when aspens in both locations have suffered equally from overbrowsing?

"We think it's due to what we call 'the ecology of fear,' " says Ripple. "There are just some places now in the riparian zone that are too risky for the elk; a wolf may be lurking nearby." Along the river, the newly thick mix of willows, cottonwoods, and aspens may block an elk's escape route or its view, making the animal too nervous to linger over a long aspen-based lunch.

It's unclear why the aspens in the upland areas are not faring well. One reason is that "they are still getting hammered" by the elk, says Beschta.

That remains a "disappointment," says Soulé. "From a conservation perspective, aspen are a foundation species. When they recover, so do many others, including breeding songbirds."

Still, Beschta and Ripple are optimistic that the upland aspens will return, noting that the degraded Lamar River is also far from recovered. "It's likely just a matter of time," says Beschta. "The park was without wolves for 70 years, an absence that changed its ecosystem. Now, in the presence of wolves, the dynamics are changing again—in ways we can't always predict." Fear may just be the newest factor.

–VIRGINIA MORELL

Virginia Morell is a writer in Ashland, Oregon.

Stem Cell Research, China Style

BEIJING—China is hoping to make up lost ground fast on stem cell research. Sources say Beijing plans to spend roughly $1 billion over 10 years to establish an international center for stem cell research and regenerative medicine.

Six U.S.–based Chinese scientists—including Xiangzhong Yang of the University of Connecticut, Storrs, and Ray Wu of Cornell University—proposed the center in a letter to the government last September. Yang argues that China can soon reach the vanguard in stem cell research because the country is not encumbered by religious concerns about cells derived from embryos. "The challenge now is to find the right people," adds Wu. An official at China's Ministry of Science and Technology declined to confirm approval of the center, which has not been made public, but he says details are being worked out and the center would be under the ministry. The center would carry out both basic and clinical research, with the ultimate goal of developing therapies, Yang envisions.

–HAO XIN

U.S.–India Deal Nears

NEW DELHI—India's time in the nuclear doghouse may soon be over. After 2 years of sometimes tortuous negotiations, India and the United States have reached agreement on a landmark nuclear pact. The proposed deal would allow India to purchase equipment and fuel for its civilian nuclear program, ending 3 decades of isolation after India exploded a nuclear device in 1974. Talks hit an impasse last spring over issues such as India's demand to reprocess spent fuel (*Science*, 25 May, p. 1112). But after negotiation last week in Washington, D.C., the two sides released a joint statement noting that "the issue" has been referred to the two governments for "final review."

Details of the agreement remain closely held, but top Indian nuclear scientists say that India has offered to set up a $100 million plant for reprocessing spent fuel provided by the United States and make the plant subject to inspections by the International Atomic Energy Agency (IAEA) to monitor the potential diversion of extracted plutonium. The deal also avoids an automatic nuclear fuel embargo if India were to conduct a future nuclear test, a previous sticking point. If the two governments sign off on the agreement, IAEA and the international Nuclear Suppliers Group will then weigh respective accords on protecting nuclear materials and commerce with India.

–PALLAVA BAGLA

Published by AAAS