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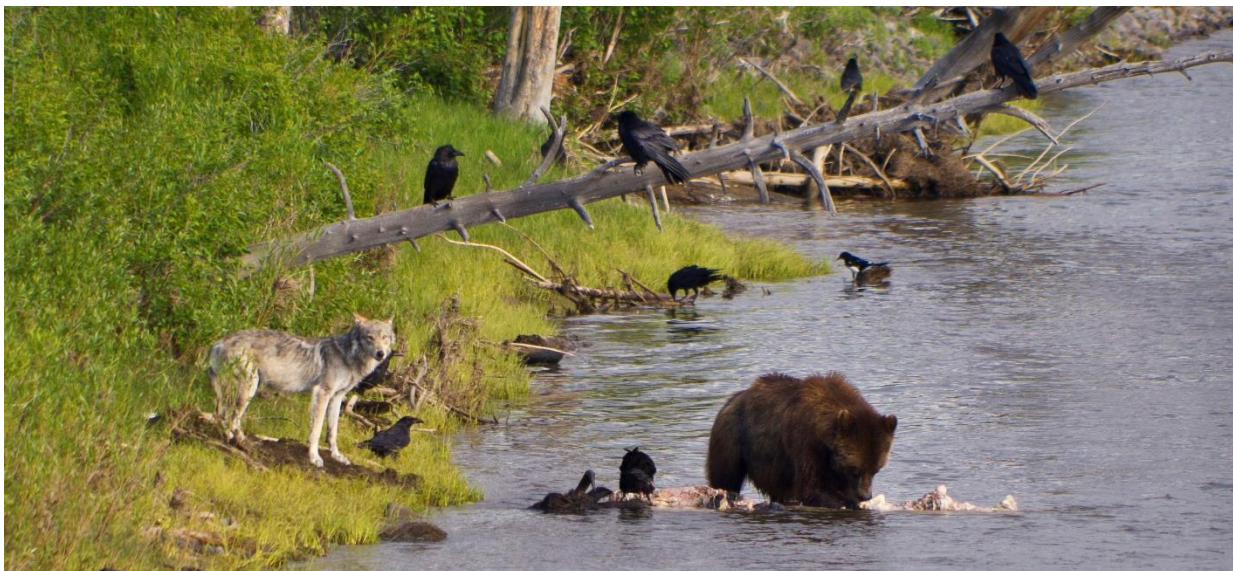
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To address the climate crisis, conservation needs a paradigm shift. Trophic rewilding says wildlife may have the answer.

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Today, most nature-based climate solutions center on conserving plants and soil to promote carbon capture, but new research says practitioners need to set their focus farther up the food chain. An emerging approach to conservation called trophic rewilding places wildlife, from whales to spiders, among the world's greatest hopes for avoiding climate collapse. Compared to other nature-based solutions, the approach is cheap, technically simple, and has the potential to be hugely impactful.



Wolf watches Grizzly bear eat a dead bison, Yellowstone National Park. Getty: JREden

Trophic rewilding recognizes the role of wildlife, especially large mammals, fish, and predators, in the carbon cycle. It draws on studies showing the intricate connections between all life and the consequences of an unbalanced habitat. It is part of a larger conservation framework called animating the carbon cycle (ACC), which concludes that ecosystems must be fully intact to have the greatest climate impact.

Trophic rewilding and ACC are not new concepts, but they began to generate buzz in March 2023 after the scientific journal *Nature Climate Change* published an [article](#) suggesting these techniques have the

potential to double the current climate benefits of ecosystem protection and restoration and could make up for more than half the carbon capture deficit still needed to meet international climate targets. The paper’s lead author, Oswald Schmitz, is a professor for the Yale School of the Environment and a pioneer in climate and rewilding research.

Magnus Sylvén—a co-author and founder of the Global Rewilding Alliance, which champions rewilding initiatives around the world—said that focusing in on plants is not sufficient. “We could do so much better if we think much more holistically on how nature works.”

Flora is integral to the fight, but it does its best work as part of a team

The reason plants have taken center stage in climate-focused conservation tactics is twofold. They are vestibules of the carbon cycle, capturing atmospheric carbon and storing it in soil; and they are hugely abundant, [making up](#) 80 percent of the earth’s biomass. In comparison, wildlife makes up less than 1 percent of the earth’s biomass, does not capture carbon directly from the atmosphere, and—in many cases—eats and tramples the plants that do. But animals’ free movement across landscapes puts just the right amount of stress on plants and soils to keep conditions balanced and help distribute seeds and nutrients across vast areas of land and sea.

On land, herbivores graze and trample landscapes, affecting the carbon exchange between the atmosphere and surrounding ecosystem. Their activity compacts soil and sediment, increases the amount of carbon drawn in and stored by plants, spreads nutrient-rich urine and dung, and reduces the risk of wildfires that would release carbon and desecrate landscapes. In April, Schmitz and Sylvén coauthored a second [paper in the journal *Environment*](#), building on the first and applying its concepts directly to conservation. It gives several examples of the inextricable nature of plants, animals, and carbon capture.

The arctic tundra is one example illustrated in the study that shows the nuanced relationship between plants, animals and carbon. In this landscape, caribou and muskox prevent the growth of taller shrubs that would rise above the snowpack and change the color of the landscape. The darker hue of the plants would absorb, rather than reflect, heat and cause earlier snowmelt and summertime permafrost thaw. Since permafrost holds huge amounts of carbon, keeping it frozen is crucial to mitigating climate change.



Muskox in the Arctic tundra. Getty: Wirestock

Schmitz and Sylvén say carnivores are equally important to holistic ecosystem health. Studies published over several decades show that loss of predators—from wolves in boreal forests to sharks in seagrass meadows—can lead to growing populations of terrestrial and marine herbivores. In turn, the abundant herbivores overgraze the land or seascape and reduce its ability to absorb carbon.

Box 1. Predators of all sizes create a “landscape of fear” that triggers a trophic cascade

One of the key differences Schmitz and Sylvén emphasize between trophic rewilding and traditional Western approaches to climate-oriented conservation is that trophic rewilding focuses on animals near the top of the food chain. Predators, which tend to be the least abundant species with the least direct interaction with plants, might seem like a roundabout way of promoting carbon capture, but these alpha species direct the movements of every animal below them. Predators do this by creating a “landscape of fear”, a term that has been widely adopted by the rewilding community of practice, that explains how even the presence of predators changes the behavior of other animals and their impact on the carbon cycle.

When carnivores are present in an ecosystem, prey—that is often herbivorous—is always on the move. Staying too long to graze on even the tastiest shrubbery could be deadly when predators are lurking. This means prey are more active, increasing trampling, and causing lighter and more consistent grazing across swaths of land. These fear-fueled behavioral patterns are more natural and result in healthier vegetation that captures and stores more carbon. This trickle-down effect is called a trophic cascade.

In the United States, one of the most well-publicized examples of a trophic cascade is the [Yellowstone Wolf Project](#). In 1995, biologists reintroduced grey wolves to the Yellowstone region. Earlier in the century, the US government had eliminated the predators from the area and the ecosystem had been thrown out of balance. Without wolves, elk populations grew out of control, putting undue stress on the willow and aspen trees they fed on. As the trees suffered, songbirds lost their habitats and their populations declined along with those of beavers, which use the trees for damming. Along with poor tree health, the hydrologic cycle was [disrupted](#) and soil pack—which plays an important role in carbon storage— was altered. As wolves reasserted themselves in the landscape, elk populations became more balanced, vegetation was revitalized, and beavers and birds returned. While there is some [debate](#) over which external factors contributed to the changes, most research agrees that wolves were a main driver in stabilizing the ecosystem.

It is not only large predators that influence the carbon cycle from above. Sea otters that dine on sea urchins [are integral](#) to the health of kelp forests in North America. A well-functioning otter population can prompt kelp to absorb as much as 12 times more carbon, simply by altering sea urchins’ grazing habits. In grasslands, spiders’ hunting methods can impact the diets of grasshoppers and promote or diminish grassland carbon capture. One study [showed](#) that, in areas where spiders hunt using a “sit-and-wait” strategy, grasshoppers have to contend with more frequent attacks and maintain a state of chronic fear. To keep up their energy, they opt for heartier meals, dining on and depleting the most carbon-rich grasses. Where spiders actively roam and stalk prey, grasshoppers contend with fewer encounters, and are content munching on less carbon-rich grasses. The composition of spider populations with different hunting patterns was shown to account for as much as 41 percent of the variation in soil carbon retention.

Oceans are a well of opportunity, but also face major threats from industry

Marine territory is the most fertile region for realizing the benefits of an animated carbon cycle. Whales and fish are nutrient translocators—they consume prey in one oceanic zone and excrete nutrients in another—stimulating ecosystems to pull carbon dioxide into the water column.

Schmitz explains how whales participate in this cycle in an interview with *BBC News* 5. The mammals dive deep into the ocean to eat krill then come to the surface for air. Along the way, they poop, releasing nutrient rich matter into the photic zone—the water’s surface level where light penetrates—that allows phytoplankton to flourish and become more productive sucking up carbon. When the phytoplankton die, they sink to the ocean floor, depositing that carbon into the sediment where it is stored. If whale populations were restored to historical levels, these mammals could offset the annual carbon emissions of Russia.

“Addressing human entanglements with the more-than-human world (also known as ‘nature’) is a critical component of biological conservation, sustainability and human well-being.” —Heller et al

Similarly, mesopelagic fish—fish that live in the twilight zone, which lies just below the photic zone, between 200 and 1000 meters below the ocean’s surface—are so efficient at transporting carbon, and abundant as a group, that their impact on the carbon cycle is enough to offset twice the annual fossil fuel emissions of all EU27 countries. Migratory fish are also particularly beneficial to the carbon cycle, as their movement spreads nutrients between salt water, fresh water, and riparian ecosystems.

Marine animals continue to transport carbon even after death. When they die, their carcasses sink to the ocean floor, where they decompose, and the body’s carbon is absorbed into the sediment.

Unfortunately, only about 3 percent of the world’s marine ecosystems are unimpeded by fisheries. Sylvén called this area the “last frontier” of truly healthy habitat and said that losing it to industry “would be a disaster”. Restoring marine areas that are already impacted by human activity is also particularly lucrative since they bounce back more quickly than terrestrial ecosystems. “If we can protect and restore these systems, that will have a tremendously important positive impact on climate,” said Sylvén.



Sloane Viperfish are a predatory mesopelagic fish that can be found in deep waters around the globe. Getty: diegograndi

Trophic rewilding is a cross-sector lift

To cash in on the full benefits of trophic rewilding, society needs to be all in. Turning the tide on climate change will mean addressing the biodiversity and climate crisis simultaneously and Sylvén said several organizations must synergize their work and the message they send to the international community. The United Nations Convention on Biological Diversity, the United Nations Convention on Climate Change, and the newer United Nations High Seas Treaty on Biodiversity Beyond National Jurisdiction are key players in this shift. The UN's global commitment to protect 30 percent of land and sea by 2030—known as 30x30—is the basis for the ACC framework, and including ACC as a nature-based climate solution could help achieve the related target of halving humanity's greenhouse gas emissions by 2030. Along with these groups, it will take the work of individual scientists, professors, and media who have the greatest power to mainstream the framework.

“We have a big task ahead of us ... but we see nature as a very powerful ally.” —Magnus Sylvén

Sylvén and two close colleagues have been leading this movement for several years. In 2020, he worked for the WILD Foundation, based in Colorado. The organization was planning a world wilderness congress and asked him and a colleague to draft a charter framing, describing, and guiding people on how to practice rewilding. The congress never happened, due to the COVID-19 pandemic, but the Global Charter for Rewilding the Earth was published and signed by 40 organizations. Within a few months, that number doubled. Heartened by this enthusiasm, Sylvén and his colleagues rallied the signatories and formed the Global Rewilding Alliance, which is now an independent association with about 150 members putting rewilding into practice on six continents.

The alliance already has plans to build on the momentum spurred by the *Nature Climate Change* article. The group—which now has a staff of four, including Sylvén—partnered with Schmitz to create a model for practitioners to implement the rewilding framework in whatever ecosystem they are protecting or restoring. Sylvén said the framework is nearly complete and will be released soon.

Rewilding does not displace people or economies — it strengthens both

The concept of rewilding and the extent of its benefits are not new to biologists. Rewilding and other similar approaches began emerging in conservation practice in the 1980s and many successful initiatives across the world are based on this philosophy. Until recently, it was [impaired by](#) murky vocabulary, misconceptions that it would displace human communities, and perceptions of climate mitigation and wildlife restoration as competing interests.

“This mentality that land can only be enclosed or exploited has been the Achilles heel of biodiversity conservation.” —Heller et al.

In the past, wildlife was seen as needing to be protected from climate change, rather than as a solution for mitigating it. Practitioners whose aim was climate-change mitigation rarely centered animals in their projects and saw improvements in wildlife health as a collateral benefit of their work. Restoring and protecting wildlife held its own value but was not thought to have a significant impact on carbon capture.

Language for discussing rewilding also suffered from being ambiguous and often synonymous with human displacement. Without the ACC framework, it was unclear what ‘wild’ meant and how much space was needed to achieve a wild environment. Emerging data helped answer those questions but shows that it varies by region. In general, large mammals—those that weigh more than 15 kilograms—need 10,000 kilometers “devoid of humans and infrastructure” to achieve wildness. With this as a guideline, there is not enough available space to rewild the substantial area needed to meet climate goals without displacing people.

Box 2. The struggle to redefine nature and wildness is not universal

Not all communities have put up the same philosophical wall between people and nature. Where Western science is working to dismantle fears that rewilding means displacing humans, many Indigenous communities already understand that people will heal alongside nature. In South Dakota, the Rosebud Sioux Tribe is celebrating bison’s return to their lands, according to an article written by Elizabeth Miller and [published](#) by the Smithsonian’s *American Indian Magazine* in spring 2022. The bison were displaced along with Native Peoples during colonialization and bringing them back restores ecosystem wholeness, traditional knowledge, culture, and spirituality. Miller writes that “returning bison to Native lands ... can help not only restore a species but reinforce tribal sovereignty.”

In Canada, the Indigenous Circle of Experts report, *We Rise Together* describes this view of interconnectedness more broadly. It explains that:

Land and water are inextricable from Indigenous cultures; they cannot be separated from Indigenous ways of life, identities, values, spiritual practices or knowledge systems. Similarly, elements of nature are indivisible. Land cannot be considered separately from the air, wind, water and complex biodiversity that make up a natural system. Therefore, any discussion of land and Indigenous cultural values is one of interdependent systems within which we are all embedded.

Humans, the report says, are not viewed as being separate from the land. They share an “unbreakable and sacred connection” to it. Where Crown-protected areas in Canada often aim to separate humans from ecosystems, Indigenous conservation “is achieved when the relationships and uses that have conserved the lands and waters for thousands of years remain intact or are re-established.

The ACC framework rejects the western assumption that wildness cannot exist where humans are present. It defines wildness as conditions that allow a species to live autonomously according to its evolved biological natures and poses that it is only when human ways of life interfere with that autonomy that the two become exclusive.

Much of the Global Rewilding Alliance’s work focuses on restoring human relationships with plants, animals, and land. The authors call on conservationists to shed their identity as land managers and embrace their role as land stewards. Where traditional western conservation preserves existing value out of fear it cannot be replaced, stewardship supports an environment where new value is continuously created and self-replenishing (see box 2).



Part of a series celebrating biodiversity across the United States, this 2009 USPS postal stamp depicts sea otters lurching on sea urchins off the coast of central California, where the aquatic mammals are integral to kelp-forest health. Getty: Ken Wiedmann

Individual altruism will not be enough to realize a paradigm shift in conservation. It will take a cross-sector effort to redesign society to meaningfully animate the carbon cycle. “You can’t work in isolation on this,” said Sylvén. “As we have highlighted over and over again you need to work with the people that manage the land or the sea.” That means creating models for carbon financing and other financial schemes to make stewardship lucrative (see box 3).

Box. 3 Tired of footing the bill for climate change the insurance sector is finding green solutions — like an insurance policy for a coral reef

In 2018, a coral reef in Quintana Roo, Mexico, became the world’s first natural asset protected by an insurance policy. The reef is integral to the region’s coastal infrastructure, as it reduces the energy of waves that hit the shore by as much as 97 percent. Without it, the coastline, its businesses, and its community would erode and storm damage to buildings could [triple](#). But the reef has been under increasing stress from hurricanes that damage the ecosystem and put both the reef and surrounding infrastructure in peril.

The coastal community needed a system for restoring damage to the reef immediately after storms to stanch further degradation of the habitat and damage to the coastal economy.

The Nature Conservancy, the Government of Quintana Roo, the National Commission of Protected Areas, and the insurance company Swiss Re stepped in with an unexpected tool: insurance. The policy is based on a parametric system, meaning pre-determined payments are triggered by a specific type of weather event. In this case, winds must reach 100 knots in the insured region for the policy holder—the Nature Conservancy— to cash in. When a triggering event occurs, and the insurer verifies damage, the Nature Conservancy has funds on hand to respond rapidly and minimize long-term impacts.

Policies for protecting natural resources are only one way the insurance sector can contribute to trophic rewilding and ACC. In 2022, the Geneva Association released its report *Nature and the Insurance Industry: Taking action towards a nature-positive economy*, which outlined why and how the industry can lead the charge. Insurers already have models for determining asset value and valuing risk reduction. Their research is being applied to nature-based solutions and used to project the increasing cost of non-action against climate change. These models can be leveraged in carbon-credit markets and other schemes for blue-green financing. Insurers can also provide affordable policies for initiatives that promote nature-based solutions, biodiversity conservation, and climate-change mitigation and can invest directly in funds, companies, and industries that promote sustainable development.

The industry’s green innovation is not pure altruism, it is a response to its own collapse as a result of the climate crisis. In May of 2023, the New York Times [reported](#) that State Farm, the largest insurer in California, is no longer offering new policies anywhere in the state. The cost of rampant and devastating wildfires meant too many policy holders were cashing in on coverage and the company could no longer make a profit. A similar issue has been playing out for decades in the southeastern US, where private insurers began fleeing states like Florida and Louisiana as hurricanes grew more frequent and severe. Razed and flooded buildings are a blatant threat to insurers, but the Geneva Association report notes that climate change is fueling disease spread, damaging crops, and decreasing business profits around the world. If it does not pivot to address the underlying issues already crippling it, the entire insurance industry will erode.

Rural areas where large swaths of landscape are lightly developed enough for large mammals to live autonomously alongside people have significant potential for trophic rewilding. These [are also](#) often areas where employment is sparse and homogenous. This is an opportunity for the conservation and finance sectors to collaborate to monetize stewardship, transforming it into a self-sustaining industry.

“So much public money goes into sectors like farming or fisheries or fossil fuel production,” said Sylvén. If some of that funding can be reallocated toward stewardship, the alliance’s goals will be attainable. He doesn’t expect society to shift enough for this work to be fully self-financing, but he does see a future where many existing “aversive” subsidies are exchanged for “good” subsidies.

Like farming, fishing, and fossil fuel production, stewardship is work. Like produce, meat, and energy, a functioning ecosystem is a product. When the inputs and outputs of stewardship are valued this way, it becomes possible for human communities to coexist with—and even become integral to—rewilded areas.

“Almost all the work that is done by the alliance is done in landscapes or seascapes where people live. And all the work I know of, at least, [is] very good at taking the human dimension into account,” said Sylvén.

The Global Charter for Rewilding the Earth outlines some of the changes each sector can make. Organizations with existing ecosystem services and biodiversity offset systems can adopt rewilding as a key principle of their work. Banks can offer financing for rewilding initiatives. The agricultural sector can end subsidies that promote ecologically harmful practices and support changes in agricultural land use that will allow it to contribute to the map of rewilded areas. The fishing industry can tighten regulations to enable rewilded marine areas. Land trusts can offer payments for ecosystem services and coexistence funds for farmers who lose livestock to native predators and insurers can acknowledge rewilding as a method of risk reduction.

The charter does not leave anyone without a meaningful role. In an appendix, it outlines the unique responsibilities of 37 sub-groups representing six sectors and including individuals in urban, rural, and Indigenous communities.

“We have a big task in front of us,” said Sylvén. “But we see nature as a very powerful ally.” Where many emerging climate-change solutions leverage expensive technology that is complicated to create and implement, trophic rewilding is low-cost and self-sustaining. “It’s absolutely much better to mobilize nature. And if we mobilize nature, it’s also good for people, it’s good for many other services that nature provides, and it’s good for the planet.”

One of the human benefits it offers is a sense of optimism to break through the gloom of climate statistics rolling over society. “Rewilding provides kind of a positive framework for hope,” said Sylvén. “To turn around the negative narrative we all are bombarded with on a daily basis into something positive.” He believes society can heal nature, “and animating the carbon cycle is part of [the] solution.”

Box 4. Can ‘good’ stewardship be measured?

A group of researchers from the Santa Cruz Mountains Stewardship Network (SCMSN) is exploring ways to modernize, and even measure ‘good’ stewardship, by including it in ecosystem health assessments. In a piece [published](#) by the journal *Nature Sustainability* in April, they argue that human and natural systems are symbiotic, but that traditional western conservation and colonialism have constrained that relationship and confused many societies into viewing them as conflicting. “Addressing human entanglements with the more-than-human world (also known as ‘nature’) is a critical component of biological conservation, sustainability and human well-being,” write the authors. “This mentality that land can only be enclosed or exploited has been the Achilles heel of biodiversity conservation.”

Part of this rift stems from how conservationists frame their work. People and communities identify stewardship in unique and individual ways, but it is typically connotated with a humbler, more ethical approach to conservation. “When people are conceptualized as ecosystem managers, they tend to be imagined as external to ecosystems, in a top-down fashion, and as interlopers engaged in science-based, ideally temporary, interventions ... to steer systems back towards autonomous non-human wilderness.” In contrast, land stewards are viewed as “vital participants” in an ecosystem and see their work as perpetual, rather than bounded.

The SCMSN is piloting a method of valuing stewardship without constricting communities’ diverse approaches to land care. It uses three lenses of landscape health: ecosystem integrity, ecosystem services, and stewardship support. These are identified by a variety of indicators that value ecosystem integrity, cultural and social needs, and ethical stewardship approaches. In a number-based world, the ability to measure and map stewardship is integral to its mainstream viability.

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