FINAL JEOPARDY

Scientists' warnings to humanity offer stark choices

BY NICK HOUTMAN

In 1997, Bill Ripple and a graduate student, Eric Larsen, traveled to Yellowstone National Park to investigate a mystery. Why were aspen trees failing to regenerate in some areas where they had previously been abundant? That simple question led Ripple and his colleagues to insights about how the loss of a top predator, the gray wolf, echoed through forests, ecosystems and even the course of streams.

Ripple, a distinguished professor of ecology in the College of Forestry at Oregon State University, continues to track the ecological impacts of wolves that were reintroduced to the park in 1995. Like an environmental detective, he has sought connections between wildlife and landscapes through what scientists call "trophic cascades," the process by which animals such as predators influence herbivores, plants and whole ecosystems. He has practiced his trade in the Siuslaw National Forest, the Hart Mountain National Antelope Refuge and Zion and Olympic national parks. He has spent much of his personal and professional life trying to understand the complex clockwork of natural processes.

As if that weren't difficult enough, Ripple has taken on a more ambitious quest. He leads an effort to track the fate of the planet through troves of environmental data maintained by scientific organizations.

At first, he focused on the declining global status of many species of large predators and herbivores. He was shocked by what he found, so he began integrating evidence of ongoing deforestation, greenhouse gas emissions and declining animal populations with other environmental trends. His work has galvanized a global network, the Alliance of World Scientists, to alert people to rapidly changing conditions — what he and others are calling a planetary emergency with serious consequences for humanity.

The work culminated in a 2017 Viewpoint article, written by Ripple and coauthors on six continents in the journal *BioScience*. More than 21,000 scientists cosigned "World Scientists' Warning to Humanity, A Second Notice," which became one of the most widely shared scientific papers of the last decade, according to Altmetric, a publication-tracking service. To their knowledge, the authors wrote in an epilogue, it was the most scientists ever to cosign a scientific paper. Key to the endeavor were two of Ripple's OSU colleagues: Chris Wolf, coauthor on the paper who earned his Ph.D. at OSU and is now a postdoc in the College of Forestry; and Terralyn Vandetta, director of Forestry Computing Resources, who created the website for scientists to cosign the paper.

Nearly 400 news media around the world reported the story, and social media such as Twitter and YouTube lit up with complementary views of the paper's data presentation and its sobering message: "To prevent widespread misery and catastrophic biodiversity loss, humanity must practice a more environmentally sustainable alternative to business as usual. This prescription was well articulated by the world's leading scientists 25 years ago, but in most respects, we have not heeded their warning … time is running out."

Policymakers have taken note. Last June, after presenting with Ripple in Eugene, U.S. Rep. Peter DeFazio of Oregon inserted the paper into the *Congressional Record* and called on his colleagues to act on climate change. Members of the Israeli parliament, the Knesset, and the Legislative Assembly of British Columbia have also added the document to their proceedings.

The picture is not uniformly bleak. The *BioScience* paper notes success in reducing ozone-depleting chemicals through the 1987 Montreal Protocol, which shows that humanity can act effectively to solve a global problem. Added to that are the rapid growth of renewable energy, local reductions in the rate of deforestation and programs to reduce human birth rates. While such efforts are necessary, Ripple and his coauthors wrote, they are not enough.

Data Tell the Story

The first world scientists' warning was written by Nobel Prize-winning physicist Henry Kendall and published in 1992 by the Union of Concerned Scientists, a nonprofit scientific advocacy organization. Among the 1,700 cosigners were OSU alumnus Linus Pauling, OSU marine biologist Jane Lubchenco, astronomer Carl Sagan, theoretical physicist Stephen Hawking and a majority of living Nobel laureates in the sciences. Trends in the atmosphere, oceans, soil, wildlife, forests and human population threaten "vast human misery" if not reversed, they agreed.

Bill Ripple conducts field work in national parks on the responses of vegetation to the presence or absence of top predators. (Photo: Justin Smith)

"To put it simply, the human race is fouling its global nest on an enormous scale," Kendall wrote after publishing the statement. "This will not continue for much longer — our task is to end it voluntarily, gracefully and with urgent priority."

The second notice, coauthored by Ripple and his colleagues, documents where humanity has fallen short. It showed trends starting in 1960 and noted that since the date of the first warning:

- The amount of fresh water available per capita has declined 26%.
- The harvest of wild-caught fish peaked in 1996 and has declined about 14%, despite an increase in fishing efforts.
- The number of ocean dead zones has increased by 75%.
- Nearly 300 million acres of forestland have been converted to other uses, much of it for agriculture.
- Global carbon emissions and average temperatures continue to increase.
- The estimated numbers of wild mammals, reptiles, amphibians, birds and fish has dropped 29%.

All of these measures point to a continuing decline of the global environment. Underscoring them is the rapid increase in human population. In the 25 years between the first and second warnings, the number of humans on the planet grew 35%. Such an increase, noted Ripple and his coauthors, "can overwhelm other efforts to realize a sustainable future."

"Some people might be tempted to dismiss this evidence and think we are just being alarmist," says Ripple. "Scientists are in the business of analyzing data and looking at the long-term consequences. Those who signed this second warning aren't just raising a false alarm. They are acknowledging the obvious signs that we are heading down an unsustainable path. We are hoping that our paper will ignite a widespread public debate about the global environment and climate."

In addition to gaining attention from scientists, policymakers and the news media, the paper continues to be leveraged by climate change activists, such as Stuart Scott, who created a Scientists' Warning website, scientistswarning.org, and a YouTube channel. In Oregon, with the encouragement and support of Roger Worthington, a Bend attorney, the Worthy

The Documentary: *A Second Warning*

OSU Productions, a department of University Relations and Marketing, is working on a feature-length documentary about the scientists' warning to humanity. Interviews with Bill Ripple and other scientists will complement a presentation of the challenges facing the world.

A Second Warning **is the latest in a series that includes *Saving Atlantis*, which focused on the fight to save the world's coral reefs; *Atrias*, *The Next Step Forward*, about the first bipedal robot developed at OSU; and *Ocean Acidification*, an exploration of the increasing acidity of the world's oceans.**

To see trailers of past films and support the production of *A Second Warning*, go to secondwarning.org.

Garden Club has created a similar website, The Ripple Effect, worthygardenclub.com/ripple.html.

For his efforts, Ripple received the 2018 OSU Impact Award for Outstanding Scholarship. In a joint resolution that spring, the OSU Faculty Senate and Associated Students of Oregon State University endorsed the scientists' warning. The Faculty Senate formed the Ad Hoc Committee on the OSU Carbon Commitment to support campus efforts to cut net carbon emissions to zero.

Ripple has given invited presentations in Bend, Eugene, Salem and Corvallis. Last July, he addressed a public meeting in Portland with U.S. Rep. Earl Blumenauer of Oregon and Washington Gov. Jay Inslee on science and environmental policy.

Natural Curiosity

In Ripple's youth, such a course might have been unthinkable. As a student at South Dakota State University in the 1970s, he almost dropped out to avoid taking a required speech class. Self-described as shy, he grew up in the rural town of Lesterville where he worked on his parents' farm and explored grasslands, fields and woods.

His parents sold some of their best cropland to send Ripple and his brother to college. During summer breaks, Ripple worked at Custer State Park, taking landscape photographs, giving campfire talks and accepting tollgate payments (only once did he give chase to someone who drove through the gate without paying the $2 fee). It was there, he says, that his passion for nature blossomed.

"I would play these games in nature, looking at an object trying to understand how it came about," he says. "Why there's a patch of forest here and not over there, or why there's a pond here. Why are these plants growing in a certain place? What brought this all about?"

Such basic questions drove his research as an OSU graduate student. Working with Jon Kimerling and Robert Frankel, Ripple used newly available multispectral imagery to analyze vegetation. After receiving his degree in 1984, he conducted post-doctoral research in the Environmental Remote Sensing Laboratory and later became its director. Today he also directs the Trophic Cascades Program.

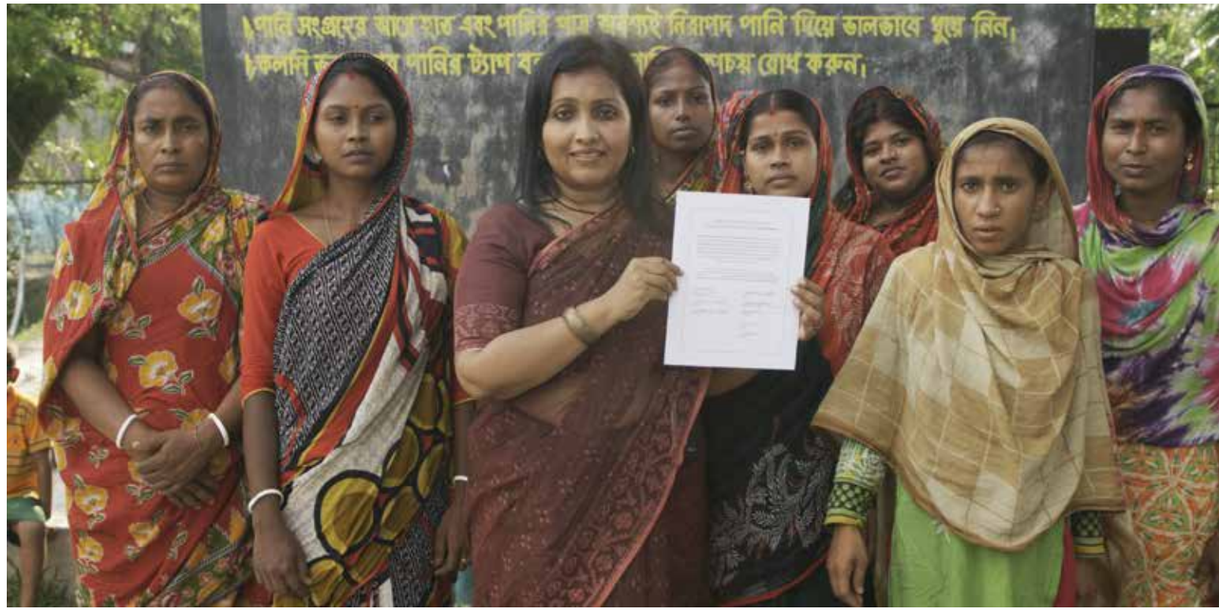
Ripple and OSU colleague Robert Beschta often collaborate in field studies. "We talk about putting on our landscape glasses, viewing the landscape as a process," says Ripple. "In Yellowstone, we ended up studying willows and aspen and the shapes of streams. With Dana Warren in the College of Forestry, we're now looking at how the invertebrates in the streams change due to browsing on streamside willows by elk and bison and then at how their predators, bats and spiders, along the streambanks change. We keep going farther and farther down the trophic cascades trail."

That same determination drives Ripple's global efforts. For example, he leads a team working on a new analysis of annually updated climate-related environmental data. They aim to present a set of metrics that can be tracked yearly to show how human activities are contributing to or mitigating climate change.

Franz Baumann, a former assistant secretary-general of the United Nations, cosigned the scientists' warning paper and credits Ripple's success to an ability to put science into a broad context and to accept suggestions from colleagues. "He sees the larger picture, and he listens and changes his thinking when he is convinced," says Baumann.

A visiting professor at New York University with expertise in political science and economic history, Baumann was attracted to Ripple's appeal for scientists to cosign the warning-to-humanity paper. Since then, the two have maintained a "long-distance intellectual friendship," he adds.

Inspired by the 2017 *BioScience* paper, colleagues in the Alliance of World Scientists (beav.es/ZuW) have already produced a series of similar scientists' warning papers focusing on specific topics: wetlands, wildfire, subterranean ecosystems and microorganisms. Other analyses are in progress, including one on freshwater. An urgency threads through



Scientists' Warning to Humanity signatory Bushra Nishat works on water issues in southern Bangladesh where sea level rise puts pressure on freshwater resources, which especially impacts the region's women. (Photo: Justin Smith)

their work. To help guide policies in the future, they say, scientists need to connect their research to the future of humanity on a changing planet.

Ripple reflects on his own path from doing objective, data-driven science to becoming an advocate for sustainable environmental policies. "We started doing field-based science on trophic cascades. That evolved into the conservation of predators. When I started looking at large carnivores and herbivores around the world, I was just shocked that there were so many of them threatened with extinction. I knew I wanted to do something very different. That's when I decided to do more advocacy and the scientists' warning. How can we just be quiet?" terra

Warning to Action

The authors of "World Scientists' Warning to Humanity: A Second Notice" offer ideas for improving the chances for a sustainable human future. They include:

- **Halt the conversion of forests, grasslands and other native habitats to other uses and restore forested landscapes.**
- **Rewild regions with native species, especially apex predators.**
- **Reduce food waste and promote a shift to plant-based foods.**
- **Support nature education for children and adults.**
- **Devise and deploy new green technologies, especially renewable energy.**
- **Adopt economic policies that reduce wealth inequality, account for the full costs of production and consumption and phase out fossil fuel subsidies.**
- **Reduce human reproductive rates through family planning and education; estimate a scientifically defensible global human population size.**