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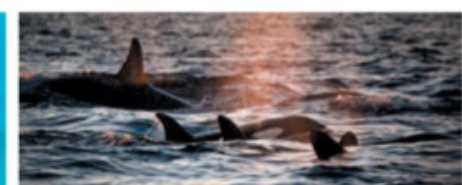
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No Grand Gestures Necessary

On the way to drop our kids off at school one recent morning, my husband spotted a skunk lying limp on the side of the road. Yet another roadkill, we thought. But on the way back, he noticed it was still alive. It was a workday, we both had places to go, deadlines to deal with. But after a brief moment of hesitation, we stopped and walked over to the furry creature.

Wary of being sprayed, I crouched two feet from the skunk while my husband raced home to grab some moving blankets and a box. I couldn't see any surface injuries but it was shivering uncontrollably and its eyes were gummed shut. It wasn't hurt, but was clearly, miserably, miserably sick.

I sat there knowing in my heart that its chances of survival were dim, but also knowing that I wouldn't be able to live with myself if didn't at least try to get it some help.

At the wildlife hospital we carried it to, the medics took one look and diagnosed canine distemper, a fatal disease with no known cure, this viral infection affects domestic and wild carnivores including dogs, cats, skunks, foxes, and raccoons. The skunk would likely have to be put down, they said as they whisked it away. That was that. One more life gone.

The incident left me saddened. But it also has me pondering how we tend to react so promptly to harms that are clearly visible, that seem treatable, like the skunk's illness, versus ones that we know are occurring, that can affect many direly, but that aren't quite as in-your-face.

The slow sickening of our entire biosphere as the world warms surely falls into the latter category.

All of us are feeling the impacts of climate change at some level by now.

Just in this issue we have a dispatch from Sri Lanka that shows how in poorer, developing nations, increasingly unpredictable rainfall is breaking up families ("Hollowed Lands," page 45). And a cover story from California that highlights how ocean warming is making it harder for already struggling species, like several native abalone, to pull back from the brink ("Holding Fast, or Failing," page 18). And a feature about the Nilgiri Mountains of India where warmer weather is complicating efforts to restore a unique grassland ecosystem ("An Uphill Task," page 26).

The full list of climate impacts is depressingly long, but because of their slow onset, and because direct connections are hard to establish, even when we learn about them it doesn't spark a sense of urgency in most of us. However, as Kate Olson describes in "Dis-ease" (page 50), in many of us these changes do cause "a shift" in the gut, "an awareness deep down that something is not right."

It's easy enough to push that uncomfortable feeling the to back of our minds as we rush about our daily business of living, loving, and making ends meet. And when we do pay attention, the scale of the problem seems overwhelming. Here's the thing though — unlike that poor skunk, the world still has a fighting chance of recovering. But only if we stop to help.

That help doesn't have to be some grand gesture. As social anthropologist Helena Norberg-Hodge says in Conversation (page 41), "start small and local. It's a wonderful entry point into a multipronged and mutually reinforcing path to health and happiness." ■



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Letters to the Editor

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Wake Up!

I live in Hawai'i and love it with all my heart. Everyone should read "Toxic Drift" (Winter 2020) and share their knowledge about pesticide pollution in Hawai'i in understandable terms with those who may not be able to comprehend the magnitude of the egregious and unbelievable situation here. What were the legislators thinking when they allowed Monsanto to destroy our precious Mother Earth? It is like a horror movie or nightmare you want to wake up from, but this is real, people. Wake up!

Carmie Spellman

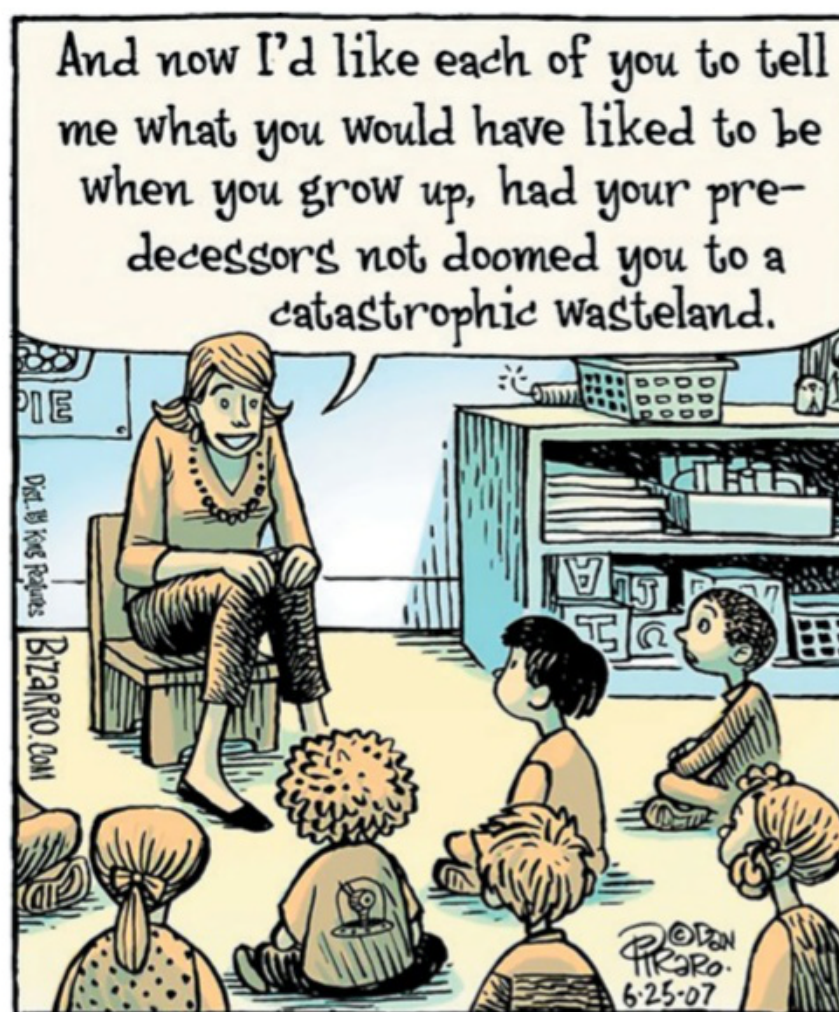
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A Fine Point

Journal Editor Maureen Nandini Mitra got a fine closing point of view on all current world trends in her letter to the readers ("In Community Lies Our Strength," Winter 2020). On the verge of seeing the world falling into despair, we can still look around and find some hope even though the center no longer holds. We don't want the last strength, which lies in community, to be crushed and repressed violently by any system. Those who are voting for and implementing laws to repress pacific activism are clearly community killers.

Patrice Assiongbon Sowwanou

Garden Valley, TX



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Feeling Heartened

I just wanted to say how much I appreciate all that you do with the *Journal*. I was reading the latest issue (Winter 2020) last night before bed and felt heartened. So thanks much! The short piece "A Feast for the Beasts" (1000 Words, Winter 2020) was great. I'd never heard of photographer Claire Rosen but immediately looked her up. This is super creative work and I'm glad you brought it to my attention.

Betsy Howell

Port Townsend, WA

Staying Wild

I loved reading "Wildlife Tracking 2.0" (Autumn 2019) about the use of AI technologies to track wildlife. I am a wildlife biologist who works with conservation detection dogs for Rogue Detection Teams. The detection dog method is another noninvasive tool for researchers to consider when researching their subject animal. Detection dogs

can sniff for a variety of odors. Most commonly they are deployed to sniff out scat, which holds the same information that one would get from darting an animal and taking blood samples. Furthermore, we've been called the poor man's telemetry unit because the feces shows where an animal has been, what it has eaten, where it has slept, etc., all things that researchers hope to learn from using radio collars. A detection dog team never sees, interacts, or otherwise engages with its research subject. Wild animals stay wild. ■

Jennifer Hartman

Rice, WA

CORRECTION

Our Winter 2020 cover feature, "The Town that Refuses to Drown," incorrectly stated that the El Zapotillo water project would siphon off up to 120 cubic meters of water from the Rio Verde a year. It would siphon off up to 120 million cubic meters of water.

UPWELL

Flourishing Fisheries?

Now here's a study that goes against the grain. Key fishing grounds in Europe, South America, and Africa are in better health than assumed, it finds, and many fish populations are recovering as a result of effective management practices.

The study, an international project led by the University of Washington (UW), is based on an analysis of data from fisheries around the world. The researchers paired information about fish stocks with recently published data on fisheries management activities in about 30 countries. Their findings, published in the *Proceedings of the National Academy of Sciences* in January, concluded that more intense management led to healthy or improving fish stocks, while little-to-no management led to overfishing and poor stocks.

"There is a narrative that fish stocks are declining around the world, that fisheries management is failing and we need new solutions — and it's totally wrong," says the study's lead author Ray Hilborn, a professor in the UW School of Aquatic and Fishery Sciences. "Fish

stocks are not all declining around the world. They are increasing in many places, and we already know how to solve problems through effective fisheries management."

But Hilborn — who has been criticized as an "overfishing denier" in the past for his controversial views on overfishing and his opposition to marine protected areas — might be overstating the case a bit. The good news only goes so far. There's little information out there about the status of fish stocks in South Asia and Southeast Asia that aren't being scientifically managed, especially in countries like India, Indonesia, and China, which alone represent 30 to 40 percent of the world's fish catch.

And as demand for seafood continues to rise worldwide, it's very likely that the fisheries in these regions are being overexploited.

"Many of the countries that have made progress domestically still import from countries where the situation isn't as nice. That is something else we should be conscious of," Beth Fulton, a marine

scientist with the Commonwealth Scientific and Industrial Research Organisation (CSIRO) in Australia, who was not involved with the new study, told the publication *Chinadialogue Ocean*.

The study's authors admit that there are still major gaps in the data that are difficult to fill. "This is because the available information on smaller fisheries is more scattered, has not been standardized, and is harder to collate, or because fisheries in many regions are not regularly monitored," says co-author Ana Parma, a principal scientist at Argentina's National Scientific and Technical Research Council.

But, the researchers say, their findings show that fisheries management works when applied and offers a solution for sustaining worldwide fisheries. They also pointed out that there's no "one-size-fits-all" management approach and that management practices should be tailored to fit the characteristics of the different fisheries and the needs of specific countries and regions.



FINDINGS

Dye Disparity

The beauty industry enjoys a long leash within the US regulatory system. Cosmetics companies can use virtually any chemicals they like, they don't have to provide toxicity information to customers, and in the case of products used in professional salons, they don't even have to provide ingredient lists. These regulatory gaps may have some significant health implications for hair dye enthusiasts, implications that are not borne equally by all.

New research indicates that using permanent hair dye increases black women's risk of breast cancer by 47 percent. Using the dye more frequently increases that risk even further: Black women who dye their hair every five to eight weeks have a 60 percent greater risk of breast cancer. By comparison, permanent hair dye use increases breast cancer risk by 7 percent in white women.

The study, published in the *International Journal of Cancer* in December, tracked nearly 48,000 American women over eight years. During that period, 2,794 breast cancer diagnoses were made.

Only 4,087 of the women in the study, however, were black. Alexandra White, head of the Environment and Cancer Epidemiology Group at the National Institute of Environmental Health Sciences and one of the report's authors, notes that the small number of black women leaves some uncertainty about the findings.

"The take-home message is that these risks are potentially important, but we know that a lot of different

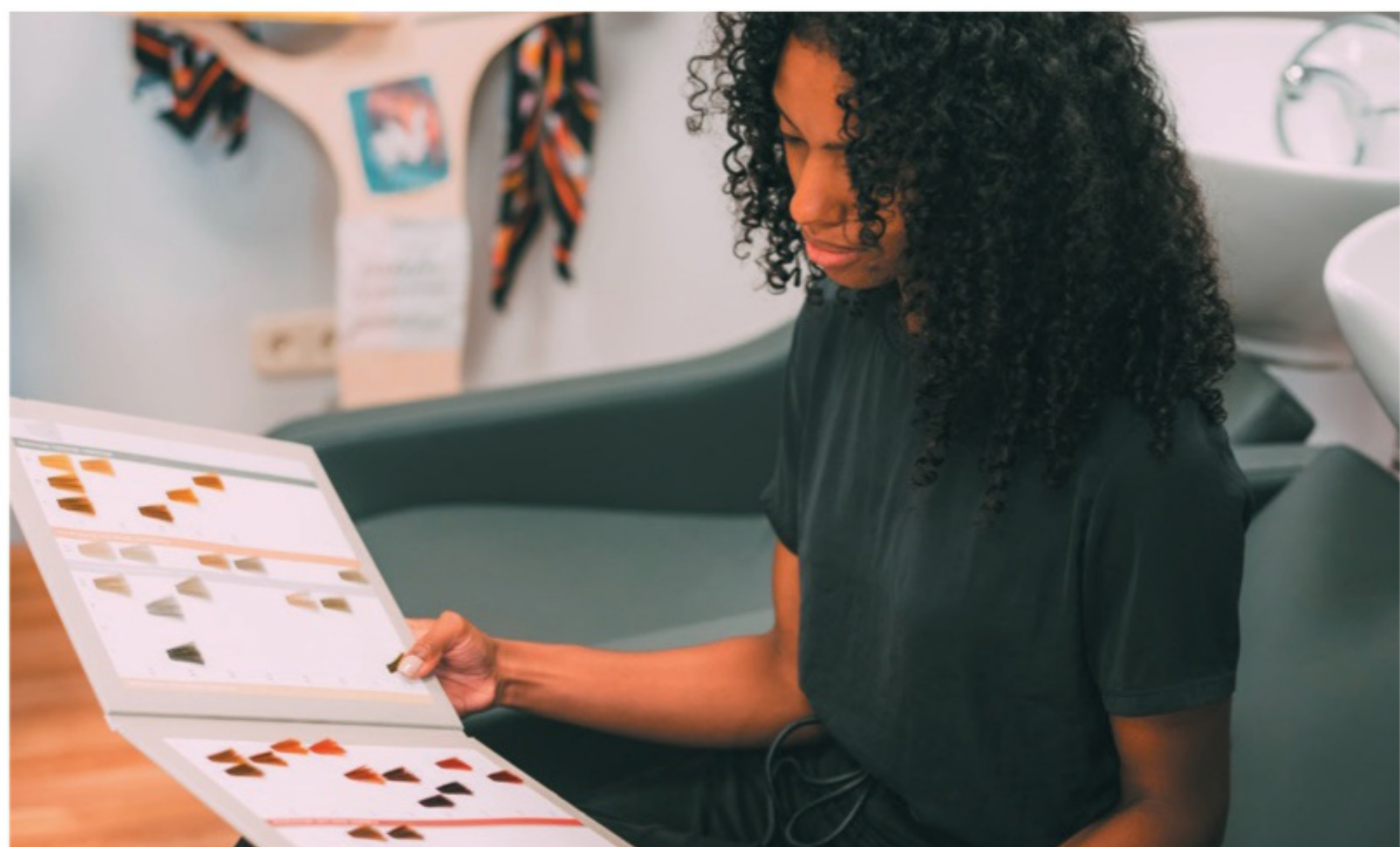
factors contribute to a woman's risk of breast cancer," she said in an interview with *The New York Times*.

There's at least one possible explanation for the discrepancy between the cancer rates in black and white women: Previous studies have found that cosmetic products designed for and marketed to black women have more endocrine disrupting chemicals, which have been linked to a variety of medical problems including

an interview with *The Guardian*.

The researchers also found that regular use of chemical straighteners increases breast cancer risk by 31 percent, regardless of race. Even there, however, black women are at greater risk, as they are much more likely to use such products than are white women.

The disparities don't end there. Whether cosmetics contribute to their breast cancer or not, black women diagnosed with the disease have a 40



A new study has found that permanent hair dye use increases breast cancer risk by 47 percent in black women compared to 7 percent in white women.

cancer. These can include things like formaldehyde, parabens, and lead compounds, which are not included among the mere 11 chemicals banned or curbed in cosmetics products in the United States. (The European Union bans closer to 1,300.)

"The current standards are ineffective and inadequate, and it's especially bad for black women because products marketed to them are the most toxic," Janet Nudelman, director of Breast Cancer Prevention Partners' Campaign for Safe Cosmetics, said in

percent higher mortality rate than white women.

The research team says there's not enough information yet to make a firm recommendation around permanent hair dye and chemical straighteners, but that avoiding them might be one more thing women could do to reduce cancer risk. Or here's another thought: Rather than place the burden on consumers, we could put it on the \$90 billion US cosmetics industry to clean up its act, and on the federal government to keep Americans safe.



FINDINGS

Poison Out, Poison In

Thanks to decades of regulation, childhood exposure to heavy metals like lead and mercury, which are highly toxic to the developing brain and nervous system, is on the decline in the US. The bad news is that another group of harmful pollutants, still in use, is significantly contributing to IQ loss in our kids.

Flame retardants and pesticides, which are the target of far fewer restrictions, have now surpassed heavy metals as the biggest cause of intellectual disability in the US, according to a new study by researchers at New York University's Grossman School of Medicine.

The researchers found while IQ loss from the toxic chemicals analyzed in their study dropped from 27 million IQ points in 2001 and 2002 to 9 million IQ points in 2015 and 2016, there was a concerning shift in which type of chemicals represented the greatest risk. They discovered that among toxin-exposed children, the proportion of cognitive loss resulting from exposure to chemicals used in flame retardants, called polybrominated diphenyl ethers (PDBEs), and organophosphate pesticides increased from 67 percent to 81 percent during the same study period.

"Our findings suggest that our efforts to reduce exposure to heavy metals are paying off, but that toxic exposures in general continue to represent a formidable risk to Americans' physical, mental, and economic health," says Abigail Gaylord, lead investigator of the study that was published in the journal *Molecular and Cellular Endocrinology* in January. "Unfortunately, the minimal policies in place to eliminate pesticides and flame retardants are clearly not enough," says Gaylord, who is a doctoral candidate in the

Department of Population Health at NYU Langone.

The substances the researchers analyzed are found in household products from furniture upholstery to canned tuna fish, and can build up in the body and cause damage to organs. Experts say exposure at a young age to any of these toxins can cause learning disabilities, autism, and behavioral issues.

The researchers found that everyday contact with these substances during the 16-year study period resulted in roughly 1,190,230 children affected with some form of intellectual disability. They estimate that overall childhood exposures cost the nation \$7.5 trillion in lost economic productivity and other societal costs over the study period.

Americans can avoid exposure to these toxins by avoiding the use of household products or foods that contain them. "Frequently opening windows to let persistent chemicals found in furniture, electronics, and carpeting escape, and eating certified organic produce can reduce exposure to these toxins," says senior study author Leonardo Trasande, who is chief of environmental pediatrics at NYU Langone's pediatrics department. But he noted that the impact of these chemicals may be worse than the study captured since there are far more hazards that affect brain development than the four toxins highlighted in the investigation. There are also other potential consequences beyond IQ loss.

"All the more reason we need closer federal monitoring of these substances," he says.

UPDATE

Keeping Up Appearances

Remember the US Bureau of Land Management's big decision last year to shift headquarters from Washington, DC to a building in Grand Junction, CO that houses offices of several oil and gas companies? Well, it appears that while the move has been confirmed, the bureau is struggling to fill staff positions there.

According to *E&E News*, at least 14 senior positions — more than half the estimated 27 positions BLM says will occupy the Grand Junction headquarters — are technically vacant and have not been permanently filled. The bureau has been trying to fill these positions over the past few months, formally advertising them on USAJobs.

In the meantime, in order to give its new headquarters the appearance of life, the bureau has temporarily reassigned about a dozen of its existing employees in Colorado — including staffers from the Southwest District Office and Colorado River Valley Field Office in Silt — to the Grand Junction office. Both the district office and the field office are more than 60 miles from Grand Junction. The employees were told they would be moved back to their original offices when the new headquarters is fully operational this spring.

"The temporary local staff move is a minor misuse of tax dollars and probably also a minor disruption to normal workflow, but I think noteworthy for the deception," a BLM employee told *E&E News*. "It does, however, allow BLM to truthfully say HQ staff are already working in Grand Junction."

The move to populate the empty head office comes amid increased congressional

scrutiny over the merits of moving the BLM's headquarters, as well as another 220 or so DC-based positions, to state offices across the West. The Government Accountability Office, at the request of House Natural Resources Chairman Raúl Grijalva, is investigating the relocation, focusing especially on the number of staffers leaving the bureau.

BLM has defended the relocation as an opportunity to put bureau officials closer to the land they are responsible for, and — ironically, given the new office space is in the same building as oil companies like Chevron and Laramie Energy — farther from special interests. It now says it moved field staff into the Grand Junction office to "help identify any needs we may have to make this facility a well-functioning, efficient headquarters."

The anonymous employee told *E&E News*: "It is unclear to me who this charade is supposed to impress." It's unclear to us as well.

TEMPERATURE GAUGE

Stable State

Need an upbeat spin about our massive carbon emissions? Apparently, the world's energy-related CO₂ emissions held steady at 33 metric gigatons (Gt) in 2019 despite the global economy growing by 2.9 percent, the International Energy Agency (IEA) reported in February.

The agency cited several factors for this, including "a sharp decline in CO₂ emissions from the power sector in advanced economies, thanks to the expanding role of renewable energy sources (mainly wind and solar PV), fuel switching from coal to natural gas, and higher nuclear power output." Milder weather and slower economic growth in several emerging markets also played a part, it said.

"We now need to work hard to make sure that 2019 is remembered as a definitive peak

in global emissions, not just another pause in growth," IEA Executive Director Fatih Birol said in a statement. "We have the energy technologies to do this, and we have to make use of them all."

The largest declines in emissions were seen in the developed world, the report says, with the US having cut the most CO₂ on a per-country basis, "down almost 1 Gt from their peak in the year 2000, the largest absolute decline by any country over that period." Much of this decline was due to a 15 percent reduction in the use of coal.

In the European Union, Germany reported the most significant drop in emissions, "by 8 percent to 620 Mt [megatons] of CO₂, a level not seen since the 1950s, when the German economy was around 10 times smaller." This again, was due to drop in the use of coal for power generation. The developing world, by contrast, saw an increase in CO₂ emissions of 400 metric Mt, of which 80 percent occurred in Asia.

On the flip side — this isn't the first time the IEA has made such claims about global emissions flatlining. It made a similar statement about emissions holding steady from 2014 to 2015. As *Forbes* reports, the Paris-based agency that gathers statistics on the global oil and energy industries has been criticized in the past for producing optimistic reports that favor the oil and gas industry.

It's not clear whether the figures the IEA is citing indicate an actual drop in greenhouse gas emissions in the real world. Research by the National Oceanic and Atmospheric Administration has so far shown no easing of atmospheric CO₂ concentrations. In fact, a day before the IEA report was released, global carbon dioxide levels hit a new daily high of 416.08 parts per million (ppm), up from 411.97 ppm a year ago, according to data collected by NOAA's Mauna Loa Observatory in Hawaii.



Endurance swimmer Lewis Pugh swam one kilometer in an East Antarctic subglacial river in January to draw attention to our climate emergency.

TEMPERATURE GAUGE

Polar Plunge

In January, British-South African endurance swimmer and ocean advocate Lewis Pugh went where no human has gone before — and where few would probably want to follow. He swam one kilometer in nearly freezing water in a subglacial river under the Antarctic ice sheet. Pugh, 50, was in the water for just over ten minutes.

If that doesn't make you shiver, this fact might: If the rapidly melting "doomsday" Thwaites glacier, also in East Antarctica, melts completely, global sea levels are predicted to rise by nearly 3 feet. Just a week after Pugh's swim, scientists were startled

by the discovery that water under the glacier, one of the fastest melting in the world, was two degrees above freezing temperature. This "warm" water could further speed up the glacial melting process.

Pugh took the plunge to draw attention to our climate emergency. He's also pushing for the creation of a marine protected area in the region, which, as he says, "will protect this last wilderness from the industrial overfishing that has devastated all the oceans of the world, and crucially make this region more resilient to the climate crisis."

FRONTLINES

Nightmare Initiative

Brazilian President Jair Bolsonaro has long been saying he planned to open Indigenous reserves to development. In January, he submitted a bill to Congress that would do just that. As *Mongabay* reports, the legislation, if passed, would permit mining, oil and gas exploration, new dam projects, tourism, cattle ranching, and agriculture in protected areas where they've been prohibited for decades.

"The Indian is a human being exactly like us," Bolsonaro said. Because of that, he added, they will welcome development on their land. Indigenous populations would still have a right to consultation, but in most cases would have no means to reject development projects. Bolsonaro has described the proposal as a "dream" initiative.

Marco Santilli, a former head of Brazil's Indigenous affairs agency FUNAI, has a different take. The legislation will "not promote the economic development of the Indians, but guarantee the exploitation by third parties of their natural resources," he says. "It would encourage Indians to live from royalties while watching the dispossession of their lands."

PHOTO KELVIN TRAUTMAN



New research links climate change to bumblebee declines, particularly in warming southern areas like Mexico and Spain.

CALL OF THE WILD

Bad News for Bees

The news keeps getting worse for insects. Colony collapse disorder is wiping out honeybees. Habitat loss is decimating monarch butterflies. Overall insect mass is declining from Puerto Rico to Germany. Now, it seems, we have one more bit of bad news to add to the list: As the climate warms, bumblebees are struggling to hold on.

A new report published in *Science* finds that bumblebee populations are facing steep declines in North America and Europe. Researchers, who mapped where bumblebees used to live compared to where they are now, found that the likelihood of a site being occupied by the insects declined by a striking 46 percent in North America and 17 percent in Europe in less than a single generation.

"It was the weirdest thing ever," Jeremy Kerr, a coauthor of the report and a biologist at the University of Ottawa, told *Sierra* magazine. "We were going over our numbers, and we realized that actually what we were looking at over the course of half a generation of humans was the progressive mass extinction of a taxom ... I mean, it's an astonishing rate of change."

The researchers looked at 66 different bumblebee species, comparing bee observations between 1901 and 1974 with

those between 2000 and 2015, by which time the impacts of climate change could be observed. They found bee declines were most pronounced in warming southern areas like Mexico and Spain that are experiencing higher temperatures related to climate change, and where bumblebees are already living at the edge of their temperature range.

"Bumblebees thrive in cool, temperate climates," Dave Goulson, bumblebee expert and a biologist at University of Sussex, told *Inside Climate News*. "They are scarce in warmer regions where they tend to overheat in hot weather. It seems likely that a rapidly warming future climate may be the final straw for many of them."

What's bad for bumblebees is also bad for a range of plants, including both wild species and food crops like berries, tomatoes, and squash. Bumblebees have a longer pollination season than most other insects, beginning earlier in the spring and continuing further into the fall, due to their tolerance for cooler climates and capacity for longer flights.

The researchers hope their finding will inform bumblebee conservation work, which must include climate mitigation measures as well as habitat preservation. They also believe their methodology to predict extinction risk could be applied to a wide range of other animals, including reptiles, birds, and mammals.

"Predicting why bumblebees and other species are going extinct in a time of rapid, human-caused climate change could help us prevent extinction in the twenty-first century," Kerr says.

AROUND THE WORLD

Flight Risk

In January, amid a spurt of environmental rollbacks, the Trump administration handed industry yet another win when it proposed a new regulation pertaining to the Migratory Bird Treaty Act (MBTA). Under the new rule, companies would not be fined for “incidental takes” — or accidental killings, in non-legalese — of migratory birds.

As David Yarnold, president and CEO of Audubon, put it on Twitter: “The Trump Administration’s Bird Killer Department, formerly known as the Department of the Interior, just gets crueler and more craven every day. And today they are doubling down despite the fact that America did not elect this administration to kill birds.”

The proposed policy would cement a legal opinion issued by the Department of the Interior in 2017 that said the act — which allows for fines of up to \$15,000 per bird death — only applied to intentional killings. Under the new rule, businesses would no longer be held responsible for unintentional deaths, such as when birds get stuck in uncovered oil pits, struck by wind turbines, or bulldozed by construction crews. Environmental groups, some of which have already sued over the policy change, says businesses will be less incentivized to take even simple precautionary measures like installing red lights on communication towers or removing bird nests before building atop important habitat.

Here are just a handful of the hundreds of migratory bird species likely to be impacted by the change.

SOURCES: AMERICAN BIRD CONSERVANCY, AUDUBON, CNN, HIGH COUNTRY NEWS, THE NEW YORK TIMES, US FISH AND WILDLIFE SERVICE.

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1 Black Skimmers

Even before the administration proposed the official rule change, Interior policy was being informed by the 2017 opinion, to the great detriment of birds, a *New York Times* investigation points out. In one telling example, the state of Virginia had been planning to mitigate the effects of a major bridge and tunnel expansion project in the tidal waters of the Chesapeake Bay. The nesting grounds for some 25,000 migratory sea birds, including black skimmers, gulls, and royal tern were to be plowed over for the project. But the state was considering building an artificial island that would mitigate the loss. In 2018, the Department of the Interior stepped in, informing the state that such mitigation was no longer required under department policy. The state subsequently abandoned the artificial island project.

2 Whooping Crane

Scientists estimate that anywhere between 12 and 64 million birds are killed every year due to collision with or electrocution from power lines. Whooping cranes, and particularly juvenile cranes, are especially vulnerable — power lines are the greatest source of mortality for the young birds. Today, there is only one self-sustaining population of whooping cranes in the world — the roughly 500 birds that migrate from Northern

Canada to Texas each winter. The best way to prevent such deaths is to build new power lines underground. Where that’s not practical, outfitting lines with devices that make them more visible can help, which is what utilities have done in certain important stopover grounds in Kansas. Utilities will no longer be incentivized to take such measures under the MBTA, though in the case of the federally listed whooping crane, at least, Endangered Species Act protections will still apply.

3 Mallards

Uncovered oil pits and ponds, as well as oil spills, often attract and trap insects, which in turn, attract birds and other animals that can become stuck in the oil and die of exposure or starvation. An estimated 500,000 to one million birds die in this manner each year in the US. Oil companies have been subjected to significant fines for such deaths under the MBTA. For example, in 2009, ExxonMobil pled guilty to “taking” 85 birds — including mallards, ibis, owls, and more — in uncovered pools in five states. The company was fined \$600,000, and was required to take measures to prevent future deaths, such as covering the ponds with netting.

4 Golden Eagles

An estimated 140,00 to 328,000 birds are killed by wind turbines every year. Eagles appear to be particularly susceptible — a

significant number of golden eagles in particular have been killed by wind farms in Western states. Researchers have studied a variety of ways to decrease turbine-related bird deaths, including brightly colored blades, bright lights, and even artificial intelligence technologies that recognize approaching birds and slow or stop turbines to avoid collisions.

5 Black-Footed Albatross

The black-footed albatross, listed as near threatened on the International Union for the Conservation of Nature RedList, faces a variety of threats, including climate change, plastic pollution, and invasive predators in nesting habitats. Like many sea birds, they are also vulnerable to entanglement and drowning in gillnet and longline fisheries. (Globally, an estimated half-million seabirds die in gillnets every year.)

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TEMPERATURE GAUGE

Greening Himalayas

Normally, when you hear that plant life is expanding in a region, it portends a positive trend. But when that region is the upper reaches of the Himalayas where vegetation has typically been sparse, it can be cause for concern.

A team of researchers have discovered that the Himalayan mountain range, which is home to the world's highest peak, Mount Everest, is witnessing an increase in plant growth in its subnival regions — the area between the treeline, which is the edge of the habitat at which trees are capable of growing, and the snowline. Little is known about these remote, hard-to-reach ecosystems that cover between 5 and 15 times the area of permanent glaciers and snow. The only plants that thrive here tend to be grasses and shrubs.

Using satellite data from between 1993 to 2018 to measure the extent of plant cover between the treeline and the snowline, University of Exeter researchers measured plant growth in four height brackets — from 4,150 to 6,000 meters above sea level — and found “small but significant

increases” in vegetation across all four brackets. The biggest increase in plant cover was in the 5,000 to 5,500m bracket.

The study, which was published in the journal *Global Change Biology* in January, doesn't examine the causes of the change, but its findings are consistent with modelling that shows an increase in areas where temperatures are warm enough for plants to grow across the Himalayan region due to global warming.

It's unclear what this greening means for the Himalayan ecosystem but the researchers say we need to invest in further studies to figure that out quickly.

“Snow falls and melts [in this region] seasonally, and we don't know what impact changing subnival vegetation will have on this aspect of the water cycle — which is vital because this region (known as ‘Asia's water towers’) feeds the ten largest rivers in Asia,” says Dr. Karen Anderson, a geographer at the University of Exeter who led the study.



CALL OF THE WILD

Grandmas Rock!

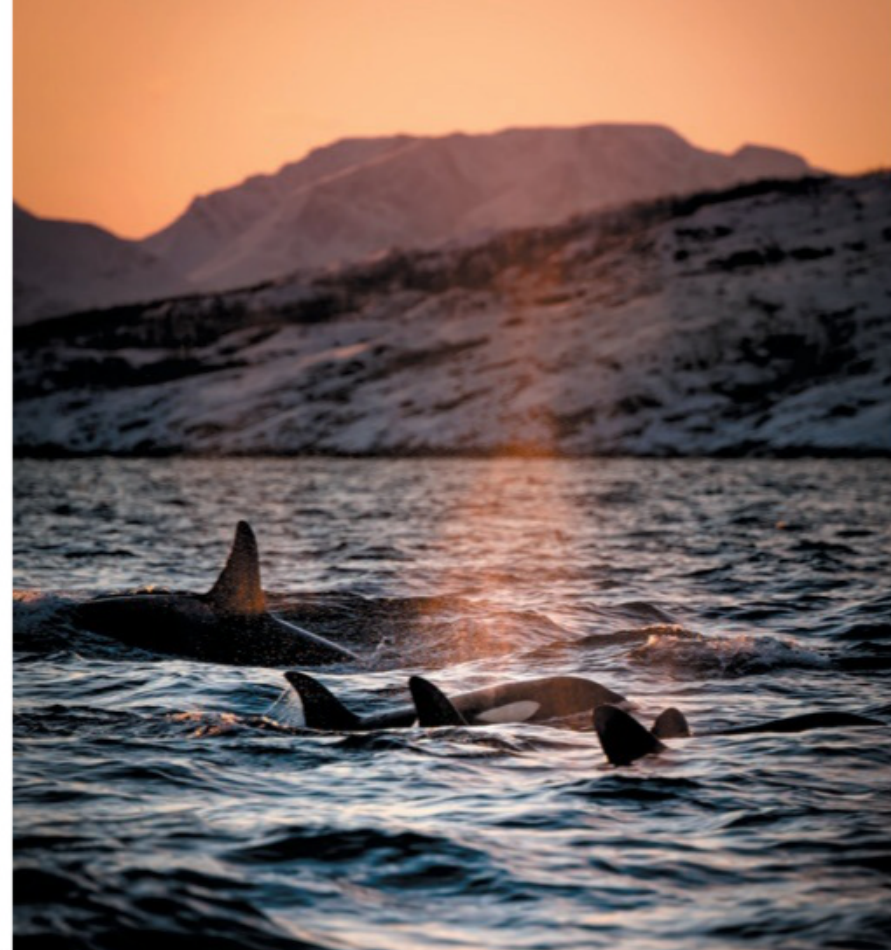
We humans have at least a few things in common with whales. For starters, we're both mammals. We're also the only mammals known to go on living well-beyond our reproductive age. And according to new research, we may share at least one more thing in common, too: We benefit big-time from having grandmas.

According to a study published in the *Proceedings of the National Academy of Sciences*, orca matriarchs help their grand-calves survive, particularly during difficult times of food scarcity. The so-called "grandma effect" has only been documented in one other animal: elephants, for whom menopause isn't really a thing.

As senior study author Daniel Franks of the University of York sums up the findings: "This is the first nonhuman example of the grandmother effect in a menopausal species."

The researchers based their findings on 40 years of data on two killer whale groups, including 378 orcas known to have maternal grandmothers. Those whose grandmas died had a significantly higher mortality rate, about 4.5 percent higher, in the two years following her death than those with living grandmas.

The grandmother effect could come down to a few factors. Menopausal orcas are known to lead their pods to foraging grounds, particularly when salmon — the studied orca groups' primary food source — are harder to come by. They also help other whales hunt,



Young whales with living maternal grandmothers have a higher survival rate than those without, new research suggests.

share food with young relatives, and may, scientists think, babysit young relatives.

The study offers yet more evidence that orcas' advanced social structure "is extremely important in the survivorship of the population," Bradley Hanson, a team leader for the marine biology program with NOAA's Northwest Fisheries Science Center, told *The Washington Post*. This new information, he adds, could prove valuable in efforts to recover endangered orca populations in the US and Canada.

TABLE TALK

Going, Going ...

Environmental, labor, and public health activists celebrated a victory in February when Corteva, the largest US-based producer of the toxic pesticide chlorpyrifos, announced that it would no longer manufacture the product. Scientists have linked the pesticide — which is widely used on crops like strawberries, almonds, and citrus — to neurological problems in children and respiratory problems in adults, especially farmworkers and their families.

"We definitely see this as a win," Marisa Ordonia, a senior associate attorney for the environmental group Earthjustice,

which has sued the US government to ban chlorpyrifos, told *The Washington Post*. "But we are still in the fight for a full ban, so that children and farmworkers will no longer be exposed to it."

The Obama administration announced a federal ban on chlorpyrifos in 2015. But before the ban went into effect in 2017, the Trump administration reversed it.

Corteva, formerly Dow Agrosiences, made its announcement on the same day that a California ban on the pesticide — which is also banned in the European Union, Hawai'i, and New York — went into effect. In a statement about the decision, the company made it clear that the choice was motivated by reduced demand, not concerns about health risks.

The pesticide is still manufactured by several other US-based companies.

"The science on chlorpyrifos is clear and unambiguous, and it has no place on our food or in our fields. With this announcement, the writing is truly on the wall," Senator Tom Udall (D-NM), who is among more than a dozen senators backing a ban on chlorpyrifos, said in response to the Corteva announcement. "The only question now is whether the Trump administration will finally stop doing the bidding of big corporations and start putting the health and safety of our children and farmworkers first." ■

The Pacific Declaration: 20 Years Later

by Anna Lappé

When my father, Marc Lappé, died in 2005 at the age of 62 from glioblastoma, he left behind a wife, five children, two stepchildren, and an unfinished manuscript. In the wake of his death, while struggling to make sense of a world without him, I holed up in a writers' retreat on the rocky coastline of Provincetown, Massachusetts to see if I could transform his rough ideas into something presentable — and publish what would have been his 15th book.

I never succeeded. But the central idea of his book has stayed with me all these years. Drafted at the dawn of the age of genetic engineering — long before the development of CRISPR technologies and new ways to alter life as we know it — the book's message was simple: We've developed frameworks within and across nation states for protecting environmental integrity for future generations (think the US Endangered Species Act). Now, as we attempt to alter the genetic makeup of living beings, we need new strategies and frameworks for protecting the planet's genetic integrity for future generations. He was writing as a scientist, an ethicist — and a parent.

I have been reflecting on his insight from so many years ago on the 20th anniversary of "The Pacific Declaration," a statement of the ethical principles for this era of genetic engineering that my father and two dozen scientists, ethicists, and authors crafted on another rocky coastline in Bolinas, California and published in October 1999.

The Declaration states: "In recognition of the fundamental

importance of our planet's natural genetic heritage and diversity, and in acknowledgment of the power of genetic engineering to transform this heritage, [we] believe that the proponents and practitioners of genetic technologies must adhere to the principles of prudence, transparency, and accountability."

The document was fundamentally a call to apply the precautionary principle to our collective approach to genetic engineering. The authors noted that the burden of proof must be on those promoting genetic engineering to show that these technologies "contribute to the general welfare of consumers, farmers, and society." And that they do so, importantly, "without compromising the viability of traditional agricultural practices, including organic farming."

The Declaration was also a call to bring democratic deliberation to decisions about regulation and research priorities: "In democratic societies, any decision to deploy powerful new technologies must be made with full public participation and accountability," the Declaration states. And it was a demand for "food sovereignty," the concept developed in the 1990s by the global peasant movement, La Via Campesina, that calls for farmer and community power over what food is grown, where, and how.

The month after my father and others gathered to write this Declaration, I found myself getting tear gassed in the streets of Seattle. At the time, I was a graduate student at Columbia University, studying trade

policy and globalization. Participating in the global action against the World Trade Organization — the so-called "Battle of Seattle" — felt like an appropriate extracurricular activity.

The Seattle action was also intimately tied to the work of my father and his colleagues. For the massive demonstrations in November 1999 against the new global trade regime were also about the future of food and how genetic engineering would affect farmers and eaters all around the world. In the streets, I heard as much from the Teamsters and environmentalists as I heard from Mexican farmers calling for protections of their corn markets in the face of American genetically engineered corn imports.

Since the Pacific Declaration was penned in 1999, commodity agriculture in the US has been remade by genetic engineering. The majority of US corn and soy grown today has been genetically engineered — most of it to be resistant to the toxic herbicide Roundup. And the impacts of genetic engineering can now be felt in communities around the world burdened with exposure to toxic pesticides used in concert with these crops, including the tens of thousands suffering from cancers thought to be linked to the weedkiller Roundup — with lawsuits pending against its producer, Bayer (which bought Monsanto in 2018). Today, despite the urging of scientists like those who penned the Pacific Declaration, there are no precautionary principles in the US regulatory system for these technologies.

When my dad and his colleagues wrote the Pacific Declaration, it was a call for all of us to ask big questions of this new genetic age: *Who benefits? Who is harmed? How do these decisions affect future generations?* Twenty years later, these questions are just as pressing. ■



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1000 FOUNTAINS:

Ditch the Bottle

It's Saturday afternoon, and my wife and I are out on an urban walk in San Francisco. Our destination: The Palace of Fine Arts — a scenic Roman-style monument that attracts locals and tourists alike year-round. We've been walking for about 15 minutes when we start to get thirsty. I shake my head when I realize we both forgot to carry our water bottles. "Not to worry," I say, "I'm sure we'll find a drinking fountain on the way."

We don't pass one on the way. When we arrive, it's a busy day at the Palace — people are strolling around the lake, taking pictures of the awe-inspiring structure, or reading books on park benches. We've been walking for almost 45 minutes now, and we're quite parched. Unfortunately, we still don't spot a water fountain (On a later trip, I did discover one fountain tucked away at the far end of the park.)

As we left the Palace, I thought to myself, *Why is it so hard to find a drinking fountain in the city?*

The answer is actually pretty simple. Since the emergence of single-use plastic water bottles, the prevalence of water fountains has been declining in San Francisco and in most cities across the country. In particular, well-funded marketing campaigns by the beverage industry in the past few decades scared the public into believing bottled water is safer than municipal water. The tactic may be sinister, but it worked. Today, 77 percent of the public is concerned about the safety of the water coming out of their taps, and since 2016, bottled water has been the best-selling beverage in the United States. Sales



continue to grow every year, and sadly, plastic bottles are now the third most common item found in marine debris.

If we're serious about stopping, and reversing the plastic pollution trend any time soon, we need a comprehensive approach that involves multiple solutions. One of those is tackling plastic water bottles.

The most important step in that regard is to help people regain trust in their public drinking water. That is a tall order, especially given serious water contamination crises — including lead contamination in Michigan, and PFAS contamination across the country — that have rightly worried residents. Federal, state, and city governments must invest in water infrastructure in every corner of our country and ensure it meets the highest safety standards and rebuilds public trust. Anything short of that won't be sufficient.

But fear is not the only reason people buy bottled water. Even in San Francisco, a city that boasts some of the safest and best-tasting water in the country, people often opt for bottled options — an estimated 285 million single-use plastic water bottles were sold in the city in 2017. That's an average of about 220 bottles per person.

Why is that? Research shows that those who buy plastic water bottles don't really want the plastic, but they do want the convenience. People want to be able to have a drink of water when they get thirsty. Not everyone

has bought into reusable bottles, and even those who have sometimes forget to bring them. (Guilty!) Our solution at 1000 Fountains takes care of both problems. If we build enough drinking fountains, no one will ever need to buy a bottle of water again. Simply put, we intend to make public drinking fountains the most convenient choice for anyone who gets thirsty in the city.

Specifically, we plan to install 1000 fountains on sidewalks and in parks in every San Francisco neighborhood within the next ten years. The fountains will also help save money — people spent a total of almost \$500 million on bottled water in 2017 in San Francisco alone. And these fountains will be built to accommodate everyone, including people in wheelchairs, children, and even people with a thirsty pet.

Getting this done will not be easy. Drinking fountains are expensive to install and maintain. We need to show our elected officials that there is strong demand for these fountains, and convince them to fund this project. That's where we need your help. If you support this effort, please go to 1000fountains.org/pledge to sign our pledge, follow us on social media, and share this article with your networks. ■

— ALEXIS VAN GELDER

Learn more about this Earth Island project at 1000fountains.org

WOMEN'S EARTH ALLIANCE:

Women Fighting the Climate Crisis

Magaly Santos and I both unlatch our charm necklaces and gently set them in a circle of other keepsakes offered by 21 women from around the country. For the opening ceremony of a four-day immersive learning experience, which wrapped a four-month leadership program, we had all brought with us an item representing our work as environmental and social justice activists. Now we are encouraged to tell the story of what brought us into this room in Northern California — a room full of women who are advancing grassroots climate solutions from Alaska to Guam.

Santos' chain holds a charm with Mother Mary, and mine a butterfly, which we both explain are symbolic of what keeps us motivated to advocate in times of political chaos, human rights abuses, and an intensifying climate crisis. Santos is 16 years old and from a California farming community of mostly immigrants. Many of her friends and relatives are being exposed to a toxic cocktail of pesticides while working in shifting and increasingly difficult climate conditions. In my work as a communicator, I frequently hear the stories of people moving around the world, many of whom are seeking reprieve from droughts, floods, hurricanes, wildfires, and other natural calamities that are all becoming more intense as our world warms. The climate crisis is taking a toll on the economies of their homelands and their livelihoods.

As we make our way around the circle, all 21 participants describe the item they've brought. The themes embedded in their explanations strike me as recurring. In telling their own

stories, all of the women allude to a bigger, global effort: the fight to save the planet that sustains us, and to secure justice for the communities that are struggling in the face of existential changes to homes and ways of life.

These women — and so many others — have fought passionately, innovated thoughtfully, and lifted up their communities as they tackle their environmental realities. And in many

policy-making and governance when compared to their male counterparts. According to a 2017 report in *Forbes*, a minuscule 0.2 percent of philanthropic funds are channeled to women-led environmental solutions. This cultural and systemic under-investment in women on the frontlines stymies their efforts to scale up successful solutions to the global level where they are desperately needed.



Tosha Phonix, a food justice organizer for the Missouri Coalition for the Environment, was among the 21 women who participated in the US Climate Accelerator program this past fall.

ways, they have been wildly successful. Throughout the accelerator program we hear stories about the betterment of people and places — including from one woman who is notified during our four-day gathering that her city government has adopted a climate action plan. Her organization had been paving the way for this type of policy for years.

Yet, women have not had an equal opportunity to participate in climate

In an attempt to address this issue here in the United States, the Sierra Club joined with Women's Earth Alliance (WEA) last year to launch the US Climate Accelerator program to give women activists working on a range of environmental challenges a catalytic boost. This program builds on the work of WEA, which was founded with the vision that bringing the world's women together could truly advance a

just and sustainable world. For over a decade now, WEA has worked alongside women leaders like Santos, fighting to elevate their knowledge and grassroots solutions.

Both organizations have consistently heard the same needs expressed: Women need increased capacity, better paths for knowledge and information sharing, more funding, improved tools for advocacy, and more robust alliances to fight climate change. Finding a way to make these resources more accessible can provide huge benefits to communities dealing with the very real

sessions, participants sharpened their lobbying, communications, digital, and fundraising skills. The program wrapped with an in-person immersive session, hosted by the Occidental Arts and Ecology Center, where the participants convened to finalize their project proposals and share their visions with partners and funders.

The first cohort to pass through the program included women who are using data to advance progressive climate policies, teaching urban agriculture methods to their communities facing food insecurity,

change and injustice. The truth is that, from Alaska to Louisiana to North Dakota, women are the ones leading on climate adaptation. They're piloting community clean-energy programs, sustainable disaster-response efforts, and filling the role of community leaders, while at the same time managing to feed and shelter their own families in the aftermath of severe natural calamities.

The first US Climate Accelerator cohort joins the ranks of women around the world who are building a diverse and just movement of women's environmental leadership and unleashing solutions that will shape our collective future. And as future cohorts complete the program, in the years to come, the network will continue to grow and strengthen.

Santos, the youngest of the cohort, and Corrina Gould, an accelerator team member and Ohlone leader who taught us about traditional knowledge that has been passed down in her family for centuries, are both planting the seeds we need to fight this existential crisis. Both women are on the front-lines of our changing planet, suffering the damage we continue inflicting on it, but persevering and organizing for environmental justice.

I will never forget their stories. They offer a glimpse of why initiatives like the US Climate Accelerator are necessary as part of our collective effort to build a world that is more equitably confronting the climate crisis. ■

Courtney Bourgoïn is communications coordinator at the Sierra Club.

Learn more about the accelerator program at: bit.ly/WEA-accelerator



Ohlone leader Corrina Gould (right) shared with Beyond Organic Design founder Monica Ibacache and others her community's fight to protect their sacred lands against development.

impacts of the climate crisis.

The four-month accelerator program was designed by team members who have lived through these struggles themselves and want to create a ripple effect of support for women on similar journeys. With their experience and knowledge in mind, the US Climate Accelerator includes skill-building through group and individual sessions. Through many

plugging their neighborhoods into clean and decentralized energy sources, bringing together interfaith Earth stewards, and much more. These are the kinds of solutions that have lasting environmental and societal benefits.

We recognize that women, and women of color in particular, are underrepresented and seldom acknowledged for this work despite being disproportionately affected by climate

THERE ARE DOZENS OF CONFOUNDING
ELEMENTS WORKING AGAINST
ABALONE RECOVERY ON THE CALIFORNIA COAST.

HOLDING FAST, OR FAILING?

by Dominick Leskiw

I HAVE ONLY HELD AN ABALONE ONCE. The giant marine snail, plucked from the white laboratory tank to which it was glued, gripped my hand as if holding onto the California seafloor just beyond us. I looked at its ear-shaped shell, coated in a galaxy of algae — its tentacles probing the above-water world, its eyes moving about curiously in their tubular sockets. After a few moments, its grip tightened, and the grooves on its underside, resembling a palm or a fingerprint, began to fill in the lines on my own hand. Soon, it felt like there was no space left between us.

When I recall this experience months later, it is as if the abalone is still in my hand, cool like seawater, but alive, and pulsing, and holding me just as much as I was holding it. The feeling, so nearly tangible, affects me like a phantom-limb.

For years, abalone have been in serious decline in California. While abalone shells persist, molded into sidewalk benches, nailed onto signposts, and laid on countless tribal gravestones, the animals themselves — seven species of which inhabit California waters — all continue to dwindle from their kelp forest homes. This stark reality is the result of decades of abalone overharvesting and climate disruption, the impacts of which have been amplified by trophic cascades.

When I held that living abalone, I felt more than just its grip. I felt the fastening of myself to another being. For a moment, I became a link between the stories of my species and those of another.

Abalone stories span the entire length of human habitation in California, and hold artists, surfers, scientists, watermen, Native tribes, and countless other coastal cultures in their breadth. Losing abalone would mean losing one of California's oldest and most widespread connections to the natural world.

We are now at an inflection point in the history of these mollusks, where nascent restoration efforts are struggling against various ecological, technological, and cultural barriers to recovery. But a cohort of researchers is pushing through these obstacles, devoted to finding out if abalone can recover, or if their future is leaning inexorably toward extinction in the wild.

THE COMPLICATED HISTORY of abalone in California requires a good deal of time to recount, says Dr. Paul Dayton. His colleague at the Scripps Institution of Oceanography in San Diego, Dr. Ed Parnell, agrees, adding

ABALONE *of* CALIFORNIA

UNITED STATES - WEST COAST
CALIFORNIA

POINT CONCEPTION TO POINT SUR

SOUNDINGS IN FATHOMS



1. *H. fulgens* - GREEN ABALONE (INT.) 4. *H. rufescens* - RED ABALONE (LIVE) 7. *H. sorenseni* - WHITE ABALONE
2. *H. walatensis* - ELAT ABALONE 5. *H. fulgens* - GREEN ABALONE 8. *H. corrugata* - PINK ABALONE
3. *H. kamtschatica* - PINTO ABALONE 6. *H. cracherodii* - BLACK ABALONE 9. *H. rufescens* - RED ABALONE

that the story sounds better between bites of freshly-baked pie. And thus, we find ourselves in the so-called “Pie Room” at Scripps, where assorted office chairs line a weathered wooden table covered with plates, forks, and flecks of light scattering off the midday Pacific as it dances beside La Jolla.

Scripps is the first of nearly 30 stops my advisor, Benjamin Neal, an assistant professor of environmental studies at Colby College, his two young children, and I will make on a 600-mile road trip up the California coast from La Jolla to just north of Bolinas, tracking down abalone devotees from all walks of life. While opening the box of peach pie, then the apple, I mention the particolored campervan that will rattle us along to each of these stops. Parnell and Dayton laugh, saying they could see it from a mile away.

Dayton, professor emeritus at Scripps, can boast a lifetime’s worth of experience in ocean research, much of it spent beneath the waves. He can also describe, in remarkable detail, the sea as it was many eras before his own. “Let’s go back to pre-contact with humans,” he says, to around 15,000 years ago, when the waters off Southern California were bulging with kelp, fish, sea otters, and yes, abalone, too. Though not without natural fluctuations, Dayton notes, this late-Pleistocene kelp forest ecosystem was well-balanced.

Then, around 7,000 years ago, Native peoples began harvesting abalone- and urchin-munching otters for meat and fur. Released from some natural predatory pressure, abalone and sea urchin populations began to swell. Beginning in the 1500s, the Spanish colonists devastated Indigenous populations with violence and diseases, and, along with other Europeans, took over the fur trade. Abalone populations swelled further.

Around the time California gained statehood in 1850, the snails could safely mosey out from under protective rocks and crevices to find more kelp and other food. With ample abalone out and about, voracious sea urchins — which, when unchecked, overwhelm and strip the seafloor clean — couldn’t stick their tubular feet to the ground. “The abalone outcompeted the urchins for space,” Dayton says, describing how one of the abalone’s key ecological roles is placing a check on urchin populations.

As abalone gained a stronger foothold in the Pacific, rumors of gold brought shiploads of people to California,

including Chinese immigrants seeking to escape the political unrest, poverty, and opium addictions plaguing their homeland. When gold became scarcer, these immigrants were scorned by white miners and forced into more marginal occupations such as coastal fishing. Soon, they discovered the remarkable abundance of abalone that had proliferated in the absence of harvesting by Indigenous peoples and otters. Chinese fishers used traditional techniques to gather, dry, and export abalone meat to Asia — particularly black abalone, which was easiest to gather from intertidal aggregations — and also began selling the animals’ exquisite shells as ornamentation. By 1879, this fishery had already reached its peak.

Within a few years, however, xenophobia and discriminatory laws put an end to Chinese fishing operations. Japanese and Euro-American divers seized the abalone industry in the early 1900s and used new hardhat technologies to harvest

subtidal species from previously inaccessible depths. Small boats could overfill and nearly sink themselves with two tons of abalone per dive, plucking them away from living assemblies up to a dozen animals thick. When anti-Japanese sentiment spiked around the Second World War, Euro-Americans took over

the industry, now with more mobile and efficient scuba gear, despite early warnings of abalone decline.

As thousands of large adult abalone were pried off the seafloor, divers were noticing more and more urchins crawling about. That’s because all this time, as abalone were declining due to overharvesting, so too were moray eels, lobsters, sea bass, and other kelp forest animals that helped maintain the ecosystem’s balance.

In the 1990s, as their numbers dwindled drastically, fisheries for each abalone species began to close, one after the other. By the turn of the century, all that was left was a strictly regulated, free-dive only recreational harvest of red abalone along the intimidating Northern California coast. Then, in 2018, that fishery closed, too — and for the first time in the thousands of years of human occupation of California, no wild abalone could be legally harvested anywhere along the coast.

In late 2018, the statewide moratorium was extended to 2021. But it might have come too late. By then, all seven species were struggling to hang on. White abalone and black

.....

'One reason the abalone and everyone are in trouble is there's no food.'

.....



All seven abalone species in California, including red abalone (pictured) are struggling to hang on. The state has banned wild abalone harvesting until at least 2021.

abalone had already been listed as federally endangered, and pinto, pink, and green abalone had been listed as “species of concern.” Flat abalone populations contracted to the point where the species was no longer common in California waters, and red abalone became more abundant on abalone aquaculture farms than in the wild ocean.

DAYTON EXPLAINS THAT, fundamentally, abalone faced a population density problem. As “broadcast spawners” — animals that breed by casting sperm and eggs out into the sea — abalone need to be within mere meters of each other for successful fertilization. Intense harvesting broke up the aggregations of abalone that were key to their reproduction. Any remaining large, fecund individuals are now effectively sterile given the ever-widening distance between mates.

Overfishing of other kelp forest species like black sea bass and other large-bodied predatory fish hasn’t helped either. Octopus — another major source of abalone mortality — have

proliferated in the absence of predators. Diseases, too, such as the nefarious withering syndrome that affects abalones’ digestive organs, periodically kill off enormous portions of abalone populations. Moreover, carpets of purple urchins, sometimes with up to 100 individuals per square meter, eat every kelp in sight, since abalone no longer occupy great swaths of seafloor from which to exclude them. “I’m worried about the kelps,” Dayton says. “One reason the abalone and everyone are in trouble is there’s no food.”

And then there’s climate change, which further threatens the kelp forests on which abalone depend. In Southern California, intensifying El Niño and “warm blob” events bring unusually high ocean temperatures, and limit the dissolved nutrients that *Macrocystis*, commonly known as giant kelp, needs for growth. Farther north, when *Nereocystis*, or bull kelp, aren’t being chewed down by urchins, they’re likely to be torn away by increasingly harsh winter storms.

“It’s a sad story of serial screwing-up of the ecosystem,”



One of the abalone's key ecological roles is placing a check on sea urchin populations. When left unchecked, urchins can overwhelm and strip the seafloor and kelp forests clean, as is happening now in California's coastal waters.

Parnell says wistfully. “You have a trend where abalone food supply is decreasing at the same time that they’ve been hammered by warm water, associated diseases, and overharvesting.”

I look from the empty pie boxes to Dayton and Parnell. We sit quietly for a moment as the sea outside shifts in the afternoon sun. Parnell leaves for a bit and comes back with a handful of small shells, some numbered, others half-covered in wax — remnants of a juvenile abalone recovery project. This experiment, long abandoned, served as a predecessor to what is quickly becoming one of the most important components of abalone restoration today — outplanting.

A SMALL, SUN-WEATHERED building situated amidst the ceaseless industrial stir of Terminal Island — a primarily artificial slab of land more or less divided between the Port of Los Angeles and the Port of Long Beach — seems like a strange place to raise endangered marine invertebrates. Yet,

that is exactly what Director of Marine Operations Heather Burdick and her team at the Santa Monica Bay Foundation have set out to do.

“We’ve been doing captive spawning here in our lab with greens and reds, and now we’re starting to work with white abalone,” Burdick announces from the parking lot, over a thrum of shipping trucks and ocean freighters. She leads us into her lab, which burbles with the sound of filters, while water in trough-shaped tanks glints with UV-light from overhead. Peering around, I see a handful of tiny pink and olive shells clinging to the tank walls. These are critically endangered baby white abalone, Burdick’s colleague, Armand Barilotti, says.

These young mollusks are the result of a hydrogen peroxide spawning method that has worked to induce in-house reproduction nearly a dozen times in the “Ab Lab.” Essentially, an enzyme naturally activated by low levels of hydrogen peroxide causes the abalone to produce the reproductive hormone

prostaglandin endoperoxide, and spawn. This method has enabled semi-predictable spawning in the lab and has generated juvenile white abalone for eventual release in the wild. Leaning in to look at the minuscule animals attached to the walls of the tanks, Burdick goes on to mention a newer “deck spawning” technique that is also already being practiced. This method involves spawning adult abalone aboard research vessels, releasing them immediately afterward, and going on to raise the larvae back in the lab. In other words, researchers facilitate reproduction while reducing disturbance to wild adult abalone, who don’t ever have to leave the vicinity of their home reefs. Efforts akin to those made by the Bay Foundation are now in motion across the state, all with the goal of raising abalone in captivity, for eventual outplanting back into the sea.

“There are so many people involved, and everybody sort of has a niche,” Burdick says. “We’re going to be the staging center for outplanting. Bodega Bay [in Northern California] is leading the captive breeding program, and then you have people at NOAA going out and trying to find existing white abalone so we can learn more about their habitats.”

These efforts are an important start for abalone restoration, and they are backed by passion and momentum. But the program is still nascent, and it lacks the funding required to conduct operations consistently and on a scale large enough to combat the dozens of confounding elements working against abalone recovery today.

Not to mention that dependably breeding and raising abalone in captivity is no easy feat. For one thing, abalone reproductive cycles can be difficult to time properly in lab settings because abalone do not breed at regular intervals. Their gametes are also often lost down the drain, as broadcast spawning requires constant, sweeping water flow to work. Even if all goes well and baby abalone are born, no one is sure what levels of light, temperature, and filtration best suit their long-term growth while in captivity.

Outplanting also brings challenges. Scientists do not yet know the best locations to outplant, since the entire California coast is experiencing harsh fluctuations in temperature and food levels due to changing climate. Predators and people, too, often slow the process — like the octopus who has no idea how resource-laden and politically vested its meal is, or the poacher who wants to make a few hundred dollars by selling

a recently-outplanted abalone illegally on the black market. Young abalone also hide for a few years when first settled onto reefs, so it can be impossible to gauge outplanting success at the outset, adding an additional challenge for researchers trying to assess outcomes and fine-tune their efforts.

For instance, following an outplanting project conducted in 2015, in which 800 baby green abalone were placed in net-covered PVC pipes to protect them from predators, Barilotti recorded extremely low numbers of survivors for the first year-and-a-half. Then, their numbers appeared to resurge. “Abalone counts went from the low teens to 40, then 70, then up to about 150 animals within a 10 by 10 meter site,” he says, indicating that outplanted abalone may actually thrive given the right conditions and enough time.

Abalone behavior after outplanting poses yet another uncertainty. Because most of the abalone in labs have never seen a wild environment, researchers

do not know how they will react to threats like sea stars or other predators once outplanted. Is predator response for these animals, which have no obvious brain structure, innate? Must it be learned? If so, are captive abalone capable of being “taught” typical behaviors like hiding or twisting their shells back and forth until predators are shaken off?

These questions are still being worked out by researchers like Melissa Neuman, Abalone Recovery Coordinator for NOAA Fisheries, who has just begun testing predator responses by placing sea stars atop captive abalone and observing how the snails react.

Despite these challenges, the organizations and people working with abalone are determined not to give up. Jessica Brasher, animal husbandry manager at the Ocean Institute in Southern California’s Dana Point, puts it simply: “We don’t know enough yet to say that we shouldn’t keep trying.” Right now, she explains, “success” does not mean recovery, but rather proving we can figure out the methods necessary to get there.

Consultation and collaboration with Indigenous stakeholders could facilitate this effort. But so far, to the frustration of many coastal tribes, abalone science and data collection in California have largely not involved Native peoples.

The absence of Native voices does not reflect a lack of interest from the tribes. Hillary Renick and Javier Silva of the Sherwood Valley Band of Pomo Indians are immensely

'We don't know enough yet to say we shouldn't keep trying.'

concerned about the abalone's plight in California, and have persistently voiced their need to be heard alongside other groups working on abalone declines. "Discussion should always begin with people indigenous to the land, wherever you are," Renick asserts. "You're talking about our habitat and ecology and the cultural significance that goes along with our foods, our plants, our medicines, our homelands, our aboriginal ties to the landscape."

Silva acknowledges that there is no hard-and-fast answer, no one solution that traditional ecological knowledge — whether from the Pomo people or any other Native tribe — will provide as abalone populations continue to decline. But deliberate and progressive co-management between tribes and other groups involved in abalone recovery would only strengthen restoration efforts.

BODEGA MARINE LABORATORY sits on a foggy, heath-colored headland a mile or so outside the sea-worn village of Bodega Bay, just about an hour-and-a-half drive north of San Francisco. On a damp July afternoon, with droplets of marine layer in my hair and the tang of fresh-caught crab lingering in my nose, I enter the lab to find a small white office where Laura Rogers-Bennett, research associate for the University of California, Davis and senior environmental scientist for the California Department of Fish and Wildlife, has built her life around abalone. She is perhaps more involved than any individual in efforts to recover the sea snails today.

Rogers-Bennett tells me she is raising critically endangered white abalone. The most recent population models estimate that only 3,600 white abalone remain in the wild — just 1 percent of what their population was 20 years ago. With a natural mortality rate of 12 percent each year, the entire species will almost certainly reach quasi-extinction if outplanting is not implemented within the next few years. "The only thing we can do with this species is captive rearing and putting them out there," she says. Rogers-Bennett is more prepared than anyone to do so — there are over 50 times more white abalone in her lab than there are left in the ocean.

In the meantime, the team at Bodega Marine Laboratory has been outplanting red abalone as a proxy for whites, reestablishing wild red populations where possible, and along the way learning what techniques might be applicable to white abalone outplanting in the future.

Yet, white abalone recovery only makes up about 40 percent of the work Rogers-Bennett and her team do. The rest, she notes enthusiastically, focuses on urchin management, kelp recovery, and restoration possibilities for the other imperiled abalone species of the California coast. Abalone cannot

recover just through outplanting; if whites or any species of abalone are to make a comeback, we must concurrently work toward restoring the entire coastal kelp forest ecosystem, Rogers-Bennett explains. She, along with Dayton and many others involved in abalone recovery, consider the establishment and enforcement of Marine Protected Areas one of the best ways to do this. There are currently more than 120 Marine Protected Areas covering some 850 square miles of California's coastal and ocean habitat. Many of these — like the San Diego-Scripps Coastal State Marine Conservation Area and the much larger Richardson Rock State Marine Reserve off San Miguel Island — already provide relatively safe havens and ecological recovery zones for abalone, kelp, and myriad ocean life.

Education also offers an opportunity to change perceptions around abalone, Rogers-Bennett says. Given the moratorium on harvesting, we have the rare chance to adjust how people view these animals, a chance to teach new generations to see abalone less as a commodity and appreciate them as fellow beings, organisms that must be treated with respect and care especially when we choose to interact with them consumptively.

The Ocean Institute in Dana Point, which receives around 100,000 visitors each year, half of which are young students enrolled in marine-related school programs, is doing just that. Students learn and contribute to ocean research through activities such as dissecting squid, identifying animals in tidal pools, and exploring the ocean on a traditional sailing brig to count marine mammals. The institute has now taken steps to incorporate abalone into their programs, too, including the one which grazes slowly around a tank at the entrance, greeting children and adult visitors alike. It often pauses to rest right up against the glass of the tank, photogenically posed on the rim of another, long-passed, abalone's shell.

THIS PAST AUTUMN, I was given a boxful of abalone shells to use as models for some natural history illustrations I'm working on. One, found many years ago half-buried along a beach in Cambria, a small seaside town on the central California coast, came from a red abalone; it's almost the size of a dinner plate. I pick this shell up in my left hand, the same hand that remembers how it felt to hold, and be held by, a living abalone. Its outer surface is coarse, pocked with four open respiratory holes and ridged by countless, intricate calcium carbonate accretions. Pink and green concentric growth lines, each one matching the color of algae the animal had been eating at the time, ripple across the shell's surface like rings on a tree trunk. Old



Biologist Laura Rogers-Bennett, who is raising critically endangered white abalone at the Bodega Marine Laboratory, says “the only thing we can do with this species is captive rearing and putting them out there.”

tube worm cases, long abandoned, are affixed to it, as are the sun-bleached remains of tiny bryozoans. These aquatic invertebrates are hitchhikers, and serve as reminders that in the vast, mysterious ocean, even a single abalone can become the world to other lifeforms.

I flip the shell over to inspect the iridescent interior. Every tilt of my hand reveals a new palette of shimmering hues — violet, brown, blue-green, silver. A hint of orange reminds me of the bright, shiny waders I saw aquaculturists wearing while gathering kelp for their abalone below a dim wooden pier in Monterey. Their sustainable storefront is doing well for now, but rising sea levels may result in its closure in a few years. Dark purple, deep in the shell’s apex, is reminiscent of the urchins, crawling, eating, and clearing the sea floor. “Urchins are not the enemy,” I recall Silva saying during our conversation a few weeks earlier. “They’re changing, and trying to survive, too.” Somewhere between turquoise and olive green, I catch a glimpse of the kelp forest itself, the once-countless fronds which are sparse now, but still swaying and reaching up to the surface.

These colors are real reminders of our ties to a deceased animal, and a potentially dying species. Every long-vacant, ear-shaped abalone shell rings with an opalescent plea, begging us to listen to, and learn from, the plight of these shellfish. Abalone will almost certainly fail to see any significant recovery without human intervention. What ends up happening to these sea snails will reveal our capacity to reinstate and nurture the ecological and cultural complexity of our world that we continue to destroy. ■

Dominick Leskiw is a young writer, photographer, and illustrator currently studying English and environmental science at Colby College in Maine.

This article was conceptualized by Dr. Benjamin Neal, a marine benthic ecologist at Colby College in Waterville, Maine, who is also Leskiw’s research advisor.

FROM THE TOP OF A HILL just a short drive outside Ooty, a small city nestled in southwest India's Nilgiri Mountains, grassland washes over the landscape like a spilled can of emerald paint. It pools around clusters of stunted, broccoli-like evergreen trees known as "shola" forests with which it has struck an ecological balance that has lasted for more than 20,000 years. The landscape's bright and inky

greens seem to pop even more against August's relentless gray monsoon rains, as though the grasses and trees know they have to try a bit harder to splash color across the rolling ground.

It is impossible for an untrained eye to discern in the middle of a downpour, but the Nilgiri Mountains contain a unique variety of life. More than 3,000 flowering plants make their home in the region, including a shrub called

neelakurinji (*Strobilanthes kunthiana*) that blooms every dozen years, bathing the hillsides in bluish purple. According to some accounts, these mountains are named after the flower: *Nil* = blue, *giri* = mountain. More than 500 species of birds sing in these hills, flying alongside about 300 types of butterflies. Leopards and tigers slink around trunks of the evergreen sholas, while the few remaining lion-tailed macaques ruffle

• AN •

UPHILL TASK

by Colin Daileida

the canopies above. The goat-like endangered Nilgiri tahr trot through the open grasslands, unaware that soon they may not have much open space left to roam.

WITH PEAKS AND PLATEAUS ranging from 1,700 to 2,600 meters above sea level, the Nilgiri massif, which connects the two mountain ranges on either side of the Indian peninsula — the Western Ghats and the Eastern Ghats — is among the highest mountains in southern India. Over 5,000 square kilometers of the Nilgiris and its surrounding environments were declared a UNESCO Biosphere Reserve in 1986. Several Indigenous communities call the region home.

The plateau's high altitude limits tree growth, making the native grassland-shola mosaic possible. Typically, these shola forest clusters have an overstory of small trees, including a variety of threatened and endangered species endemic to the Western Ghats, such as *kattu shanbagam* (*Magnolia nilagirica*), and *kaatu karruwa* (*Cinnamomum wightii*). The understory is frequently thick with endemic mosses, shrubs, and ferns, several of which are also endangered, such as the shrub *Strobilanthes lanata*. Grasses such as *Andropogon polyptychus* and *Eriochrysis rangacharii* spring from the open terrain that washes around the sholas, and their existence, too, is in peril.

When British foresters first came upon these ancient grasslands in the 1800s, they mistakenly believed Indigenous communities had destroyed what were once forests by burning, logging, and buffalo-grazing. They spent a century trying to “reforest” the area with exotic tree species such as eucalyptus, pine, and acacia (black wattle) that they hoped to use for

timber. The colonists also set up vast tea bush plantations on the higher slopes of the mountains. After independence, the government of India continued with commercial tree-planting, adding more acres of eucalyptus, acacia, and pine. These non-native trees have since flourished, conquering a huge amount of grassland in the Nilgiris and similar nearby ecosystems — 23 percent just from 1973 to 2017, according to a 2019 study published in *Biological Conservation* — endangering what little grass remains in this mosaic of montane

climb. Non-native shrubs like scotch broom (*Cytisus scoparius*) and lantana (*Lantana camara*) — a flowering shrub the British brought to India in 1807 — have grown so thick in parts of South India's montane grasslands and woodland savannas, respectively, that they choke off space for animals to move. Lantana, in fact, has already begun to creep as far north as the warming Himalayas.

In the Nilgiris, foresters and ecologists have tried to rebalance the landscape for decades, but conflicting

In India's Nilgiri Mountains, ecologists are working against time to undo colonial forestry practices that have damaged this unique landscape.

forest and open terrain. Invasive trees now threaten many endemic plants and animals that rely on these grasslands. They're also eroding a watershed that feeds several South Indian rivers, including the Kaveri, on which millions in Bengaluru, Mysuru, Chennai, and other cities rely for drinking water, and on which farmers depend for irrigation.

In the Nilgiris, acacia has proven especially voracious, and is likely to become more so. According to a study by three ecologists from the Bengaluru-based National Centre for Biological Sciences that was published in the *Journal of Ecology* last year, acacia is poised to sprout even faster as the world warms.

This ecological threat at the intersection of climate change and lingering colonial ineptitude is just one such danger that could take a huge toll on India's ecosystems as temperatures

ideas about how this should be done, and the complexities of the ecosystem itself, have hampered much of the effort. Atul Joshi, coauthor of the *Journal of Ecology* paper, says there's still no clear way to control acacia. One of the only things that's certain — as another of the paper's coauthors, Jayashree Ratnam, says — is that beating back these trees won't be enough.

“We know grassland restoration is not as simple as removing the invaders,” she says.

BEYOND THE MARBLED ARCH that marks the entrance to the National Centre for Biological Sciences campus, one comes upon what appears to be a forest left to run wild in the city. The trees are tall and thick enough that a visitor might be forgiven for squinting at Google Maps while driving up, thinking maybe he had accidentally

tapped in the address of a park.

Behind those trees, in an open-air cafeteria, ecologists Ratnam and Joshi sit sipping coffee with their study coauthor, Mahesh Sankaran, on a late July afternoon. Joshi and Sankaran speak softly, and Ratnam often takes long pauses before responding to a question, silences that suggest she's wary of making the science seem simple.

Grassland temperatures in the Nilgiris often drop much lower than in the region's forests, according to their *Journal of Ecology* study. Frigid temperatures kill off tree seedlings and stop them from taking hold in grasslands, sustaining the tropical montane ecosystem of the Nilgiri

intimately tied to it, such as the Nilgiri pipits — little golden-brown birds with dark streaks at the crown, which eat grass seeds and build cup-like nests on open ground — and the endemic Nilgiri tahr; only about 100 of these endangered ungulates remain in the region that gives them their name. Though roughly 1,900 Nilgiri tahrs live elsewhere in South India, the species may go locally extinct as invasive trees push into grassland on which they graze. "It doesn't have any place to go," Joshi says.

Non-native trees have also warped the water table. Eucalyptus sucks huge amounts of water from the ground, and according to the initial results of separate research conducted in

wrote in an email. "This has obvious effects on how much water is available for human consumption, including power generation."

In wet months, too, acacia causes problems that native trees don't. Initial results of research Bhalla and others are working on shows that acacia soak up less water than native shola trees during brutal downpours like the one the Nilgiris saw in August, which are likely to become more frequent as the area heats up. By retaining more rainwater during a downpour and releasing it slowly, shola forests keep the surrounding soil moist and ensure a more prolonged stream of supply to local waterbodies. By absorbing less water and releasing it faster, acacia allows precious freshwater little

time to percolate into local watersheds before making its way down the mountains and out to sea. Drier watersheds mean smaller streams for rivers such as the Kaveri, which supplies water to farmers

across South India and drinking water to millions of people in Bengaluru and Chennai, cities that are increasingly suffering from acute water shortages during the dry season every year.

RAIN RATTLES OFF THE ROOF of the Nilgiris South district forest office in Ooty like a stream of trucks rumbling over a metal grate. People darting from buildings to cars are immediately soaked. Just outside the front door of the office, a puddle is swelling into a lake. The office has an open layout, pale green walls, and wooden desks weighed down by tall stacks of paper stuffed into crinkled manila folders. The district forest officer for Nilgiris South, Guruswamy Dabbala, mustachioed and soft-spoken, has only been in charge here

Grasslands restoration is much more complex than bringing back a crop of trees.

plateau. Acacia, they tell me, has upset this balance because it doesn't mind the cold as much as native trees. Now, it's also poised to spread more quickly in the warmer years to come. The ecologists studied how invasive acacia took root in artificially warmed plots of land and saw its survival rate soar close to 100 percent.

The jump in acacia survival rates is an existential threat to a traditional livelihood of the Toda, an Indigenous community whose people have long grazed buffalo on the Nilgiri grasslands. As open space shrinks, they've abandoned the practice in favor of growing vegetables such as carrots and potatoes, and have found work in local tea plantations.

Shriveling grassland is also squeezing animals whose lives are

part by Jagdish Krishnaswamy, an ecohydrologist studying the region, acacia is "definitely depressing the dry season streamflow in the Nilgiris." This affects any animal looking to quench its thirst, and Krishnaswamy says it lowers the level of water in local streams and rivers, squeezing fish into tighter spaces.

The combination of sun, heat, eucalyptus, and acacia can also drain reservoirs that sustain local and downstream residents through the dry months, leaving them worryingly low. "We believe that exotics have significantly reduced the total amount of water that is discharged into our streams," Ravinder Singh Bhalla, an ecologist with the Tamil Nadu-based Foundation for Ecological Research, Advocacy, and Learning who is also studying the hydrology of the Nilgiris,



As the Nilgiris have lost grasslands, they have also lost animals that depend on this unique habitat, including the endangered Nilgiri tahr.

for four months. He says the forest department will probably ship him off to an unknown destination in another four. That leaves him just enough time to simply continue with the acacia-clearing that the department has practiced since the 1970s, and no opportunity to test or implement any new landscape restoration programs.

Government foresters focus on a few acacia-overrun zones at a time on state-owned land in the Nilgiris, and treat the trees like an army would treat enemy soldiers. The department cuts them down, then stamps out any new acacia in these parts for two years, while attempting to establish native grasslands in its place. When asked if these efforts had helped eliminate acacia from those patches, Dabbala grimaces and shakes his head.

“When I go to the field, I can see it is again coming up,” he says.

That’s probably because the foresters’ plan is incomplete. Ripping out acacia is a start, but Dabbala says they don’t go after the plant’s seedbeds or try to establish a blend of native

grasses hearty enough to outcompete the acacia.

Government attempts to replant shola forests have also failed because foresters lacked basic knowledge about the ecosystem they were trying to revitalize. According to Godwin Vasanth Bosco, a Nilgiris restoration expert and founder of the ecosystem revitalization group Upstream Ecology, foresters tried to plant shola trees in areas that had long been grassland, where the already-established grasses gave trees little chance to survive. Bosco says he has propagated around 4,000 shola trees, though various factors including frost and prolonged dryness make it hard for these natives to thrive. For both him and the government, grassland restoration is a greater priority than shola reforestation in the Nilgiris.

Ecologists have tried to reorient the government’s acacia-tackling policies for years, but it’s hard to establish new practices when district forest officers are always rotating. “Anyone trying to work in grassland restoration is

going to have to work with the forest department, and it depends on if the authorities are friendly or not,” says Bob Stewart, a grassland restoration expert who has worked in the Nilgiris for years. “They’re not really used to working with grasses. They’re all tree people.”

Grassland restoration is much more complex than bringing back a crop of trees, say Stewart and Bosco. First, it requires a lot more plants. Bosco says he uses 5,000 to 8,000 plants per acre of grassland, whereas five acres of forest would require maybe half that many trees. Nilgiri grasslands also contain roughly 110 types of grass, according to Bosco, whereas shola forests comprise around 90 species of trees.

“To try and recreate the complexity of grassland is almost impossible from scratch,” Stewart says. Doing so might not be much use in the Nilgiris either, given that the region’s combination of native grasses has done little to stifle the creep of acacia. Still, there are several hardier grass species that can



Years of grassland restoration efforts on privately owned land in the Nilgiris have shown that beating back invasive trees like acacia is possible.

outcompete acacia, and Bosco believes he's come up with a mix of native grasses that might be able to hold off their much taller adversaries. These grasses are big, by grass standards, and their roots take up a lot of space, crowding out acacia seedlings.

Years of restoration attempts on privately owned land in the Nilgiris have shown that beating back acacia is possible with, as Stewart says, “a lot of labor” and time. Restorationists start by ripping out acacia from a patch of ground, plucking the tree's seedlings, and replacing them with native grasses, a strategy Bosco echoed. Then come years of visiting the site several times a week to collect any new acacia seeds that have found their way to the designated plot, though Bosco said the amount of landscape intervention after the initial acacia-clearing “does taper down drastically over the years.” By year six, Stewart found that the restored patch needed to be checked only once a week to make sure the invasive tree wasn't sprouting fresh roots.

Of course, six years is about three times longer than the forest department

ever spends on physically maintaining the roughly 9 percent of the Nilgiris that is state-owned — yet another gap between policy and what science shows is necessary to eliminate acacia and clear space for grassland.

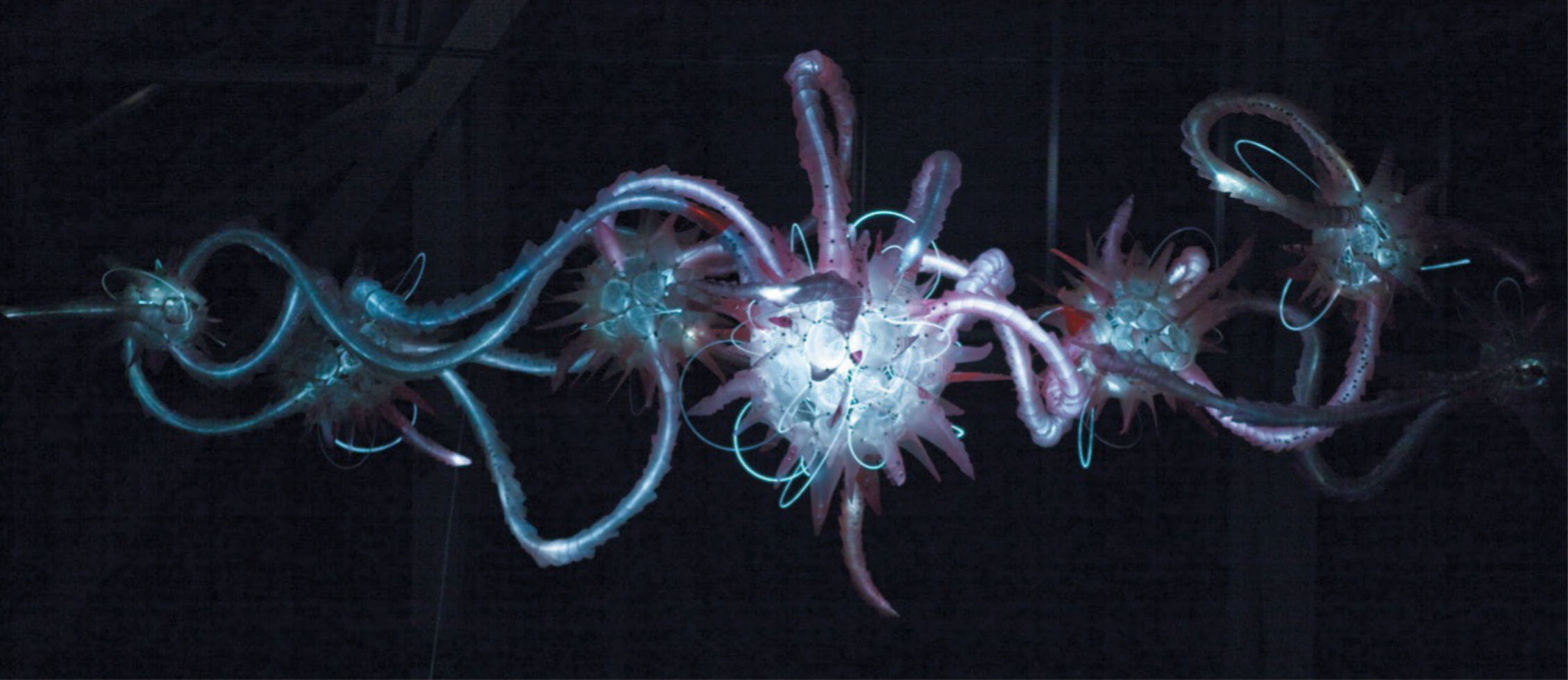
Frustrated by these bureaucratic inefficiencies, Bosco spent years working independently, but started advising the forest department last year through a court-appointed team tasked with halting the spread of invasive species in the Nilgiris. (Tamil Nadu's high court set up the expert team to advise the state on how to tackle invasive species in the Western Ghats in January 2019 following a series of lawsuits by environmental groups seeking to restrain the cultivation of eucalyptus and acacia for commercial purposes.) Bosco now plans to work with foresters on a 20-year effort to remove acacia and eucalyptus from the Nilgiris and the nearby Palani Hills, and replace these trees with grasslands and shola forests. The project will be undertaken in phases, roughly 250 acres at a time. “This scale and this type of work hasn't been done,” Bosco says.

Nobody can guarantee that this plan will work. More than 20 district forest officers could rotate through the Nilgiris over the next two decades, and there will certainly be some who are less dedicated to the project than others. Governments will flip back and forth every election season, and so will the projects those governments believe are important. Even if the work remains a priority, over the past half century, much of the Nilgiris has morphed into a fundamentally different ecosystem. Even with dedicated restoration efforts in the coming years, it is unlikely that this landscape will ever return to its pre-colonial state.

Still, looking out over the rivers of grass that even now seem to run endlessly around islands of bunched shola forest, it's clear that this kind of public-private partnership is vital to the survival of not just the Nilgiris, but all threatened landscapes. Fusing the expertise of conservationists like Bosco and Stewart with the state's resources and manpower could help transform the efforts of an often-misguided forest department into a vast and purposeful machine.

Given the immense terrain of the Nilgiris, the only restoration efforts that will prove successful are the ones that take the long view — plotted over decades, capable of surviving different governments, researchers, stakeholder conflicts, and whatever other unforeseen problems make it easy to shelve such projects for a later day. If anything about environmental restoration in the twenty-first century is true, it's got to be that the only way forward is to try things that have little precedent. ■

Colin Daileida is a journalist living in Bengaluru, India, who often writes about climate change and environmental degradation.



Quality of Mercy, Plastic debris, tinted polycrylic, solar powered fiber-optics, stainless steel aircraft cable

Upcycled Art

Aurora Robson's sculptures are eye-catching, to put it mildly. Their clean lines, bright colors, and unique shapes spark joy. And though not obvious at first glance, they are also made entirely out of plastic that's been intercepted from the waste stream. That's a big part of the point.

"A lot of creative industries in cities all over the world create, just for our entertainment as a species, an incredible amount of waste," says Robson, who knew she wanted to be an artist from a young age. "I didn't want to make more stuff, or use more resources or fossil fuels, to express my creative ideas."

Emboldened by well-known artists who were making their own unique choices in the 1990s — like Tom Friedman, who was sculpting with toothpaste, pencils, and pasta — Robson turned to plastic waste as a material that would allow her to create while easing her guilt about creating more waste.

Artistically, the decision to use plastic wasn't really a compromise. Its virtually infinite shelf life, or as Robson says, its "archival quality," is unquestionably "terrible for the planet." But that same quality also makes it "fantastic for art."

She also hoped that by working in the space between the two truths — by showing that a troublesome product can also become something beautiful — she'd be able to highlight the problem with plastics in a way that was still "art first."

Robson's sculptures certainly manage to get that message across. Using anything from detergent bottles to industrial laundry barrels to highway safety drums — all lovingly cleaned, and transformed into raw materials — she creates giant sculptures like *Kuleana*, a stark-white work that seems to grow from the Earth, and *Ding Dang*, a mesmerizing installation currently on display at Goucher College in Baltimore, and smaller, playful sculptures like *Synesthesia* and *Hotrodicus* which manage to remain lighthearted despite the heavy message their materials convey.

Over the course of Robson's career, plastic has only become more ubiquitous. Confronting all this waste can be taxing. Which is part of why, in 2009, Robson formed Project Vortex, a collective of artists, designers, and architects working with plastic debris, or as she describes it, "a support network for other artists" tackling plastic pollution.

Robson also finds some peace in the process of collecting plastic materials from others, easing the burden of their waste, and keeping some small amount of plastic out of our landfills.

"Most people are living in the tyranny of the moment," she says. "They don't have the time or the money to have a zero-waste lifestyle ... I love the idea of helping facilitate that in my own little way, in my own practice, as much as I can." ■

— ZOE LOFTUS-FARREN

Learn more about **Aurora Robson's** work at www.aurorarobson.com

More Online: See a slideshow of the artist's work at earthislandjournal.org



Hotrodicus Symbioticus, aluminum rivets, nontoxic water-based paint, plastic debris on aluminium, plastic

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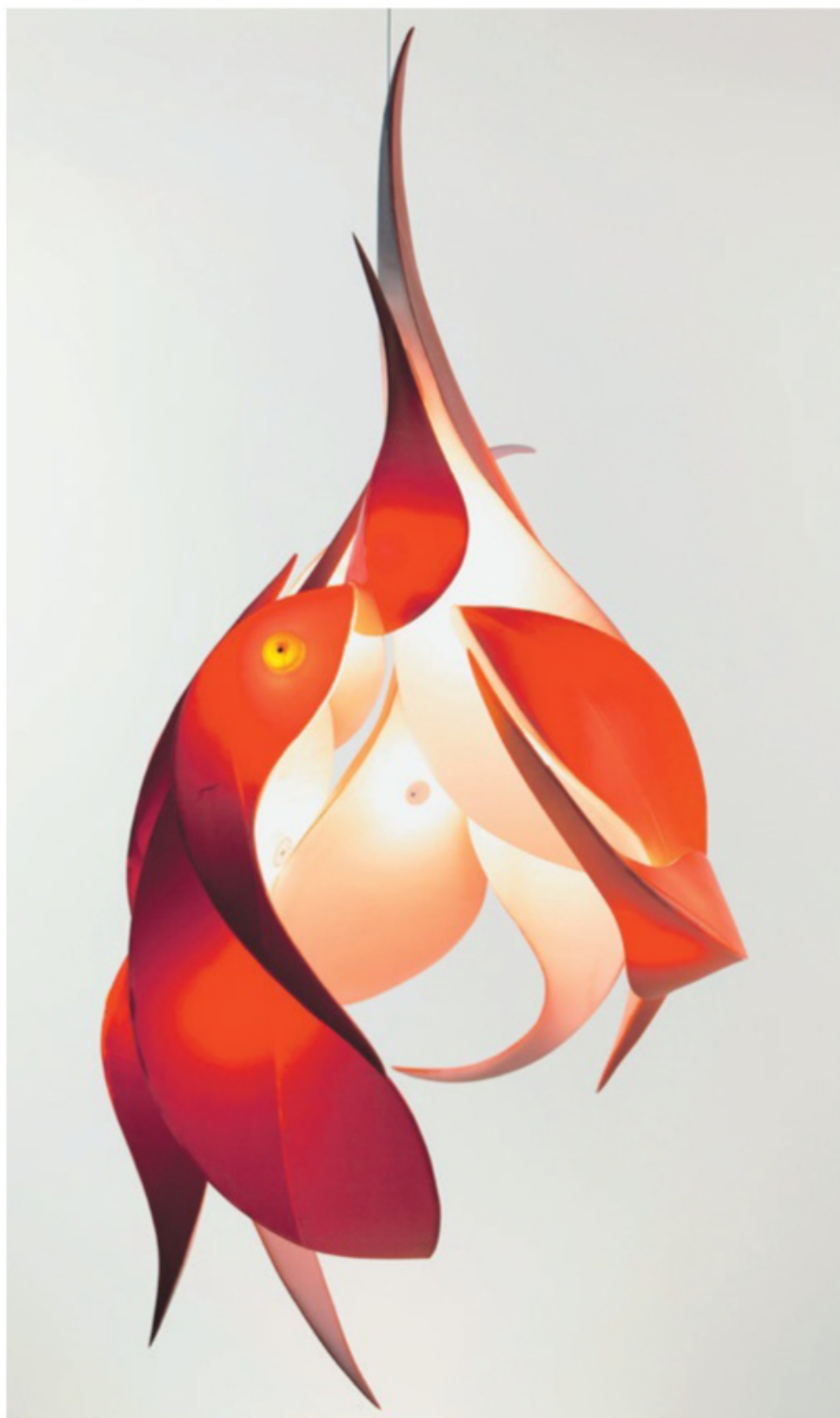
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Clockwise from left:

Pick of the Litter; decommissioned highway safety drums and industrial detergent barrels

Ding Dang, welded plastic debris, hardware, LEDs, solar panels

The Great Indoors, Plastic debris, paint, solar powered LEDs, hardware





Indigenous Karen volunteers document fauna within the 550,000 hectare Salween Peace Park.

the *Revolution*

IT IS BEFORE DAWN WHEN WE PASS the last checkpoint perched above the Salween River, along the border between Thailand and Myanmar. As we wind north through a sparse woodland up an unpaved track, the first signs of daylight begin to appear. It is the end of the dry season, and most of the trees in the forest around us are leafless, allowing us to catch glimpses of the giant river below, a rushing torrent even now at its lowest ebb.

As the sun rises, we scramble down a steep embankment and board a longboat piloted by a teenager in army fatigues. After plying rough currents upriver for hours — threading powerful eddies that threaten to throw us off course — we reach a different type of checkpoint. It is manned not by Myanmar government border patrol, but rather by soldiers of the Karen National Liberation Army (KNLA). We are cleared and enter the area that local communities have declared as the Salween Peace Park, a refuge for the

last holdouts of the Karen revolution, the longest-running ethnic insurgency on earth.

“Welcome to pure Indigenous Karen territory,” says Saw Mabu Htoo, 40, a Karen who works with an environmental rights group here called KESAN. “We have left Thailand, but we are not in Myanmar,” he notes. “We are in Kawthoolei.” He is using the Karen name for their ancestral land, which once covered a large swathe of southeast Myanmar and western Thailand, running down the Salween River basin south to the Andaman Sea.

For more than 70 years, since shortly after the country formerly known as Burma gained independence, a low-boil insurgency has fought for Karen self-determination, promised first by the British and then the Burmese. Over the intervening decades, far from granting the Karen meaningful rights, the Myanmar military has waged a grinding war of attrition against them.

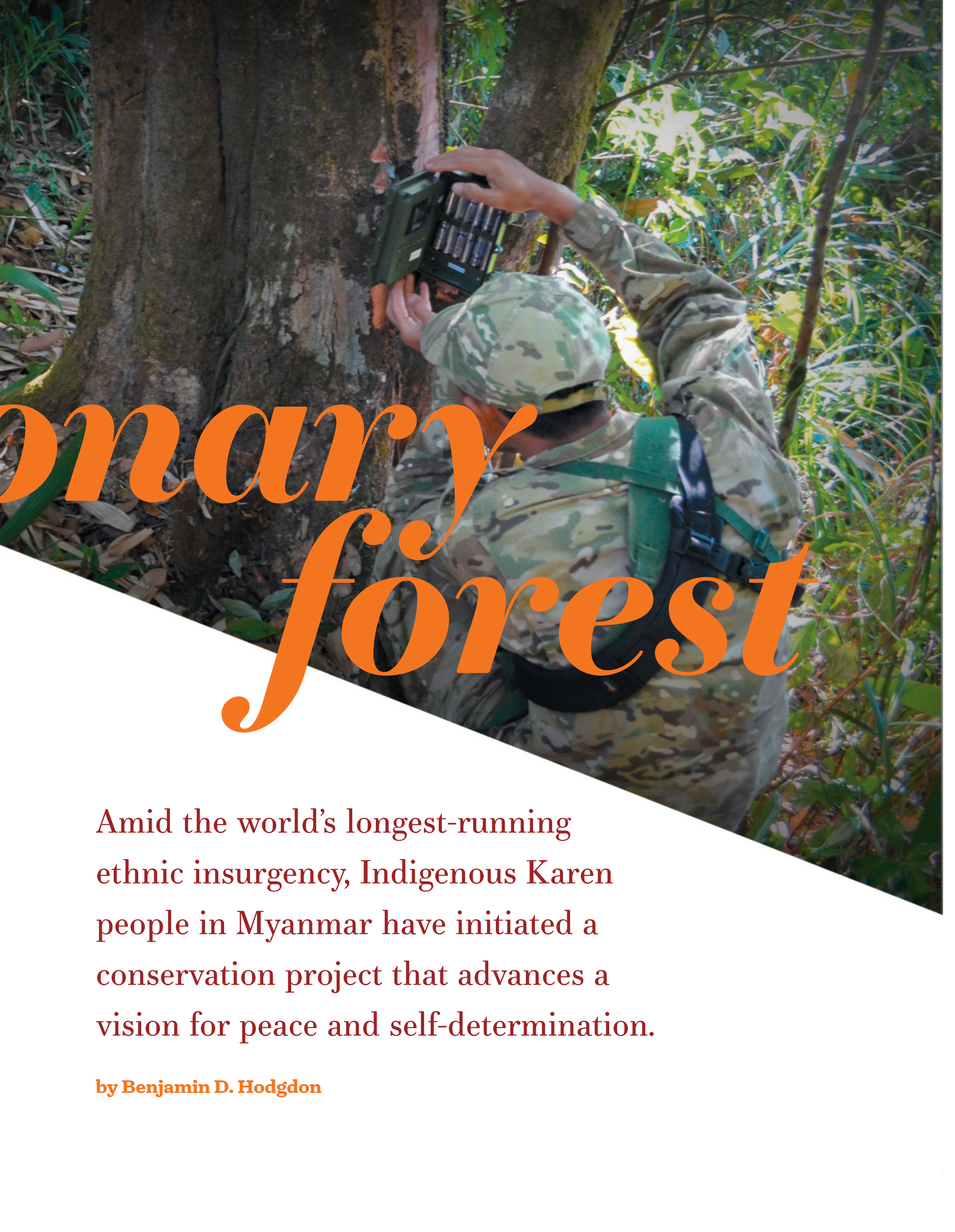
It has been devastatingly successful.

Thousands of Karen communities have been displaced, and more than 200,000 Karen have fled the country. Multiple efforts to negotiate peace have failed. Meanwhile, the area under Karen control has dwindled to a small fraction of what it was when the revolution began in 1949. As a result, many Karen have accepted that autonomy will never be realized.

But others continue the struggle, some utilizing new, non-violent strategies of resistance. The Salween Peace Park is central to this agenda. Covering more than 550,000 hectares — nearly twice the size of Yosemite National Park in California — the park is located in a remote corner of Myanmar’s Kayin State, which is internationally important for biodiversity conservation.

Although it is called a park, it is not your typical protected area. Rather than focusing strictly on nature preservation, the reserve’s backers promote Indigenous land management

PHOTO COURTESY OF KESAN

A person wearing camouflage clothing and a cap is shown from the side, holding a handheld electronic device against a tree trunk. The device has a grid of small, glowing blue lights. The background is a dense forest with green foliage and tree trunks. The title 'Primary Forest' is overlaid in a large, orange, cursive font.

Primary Forest

Amid the world's longest-running ethnic insurgency, Indigenous Karen people in Myanmar have initiated a conservation project that advances a vision for peace and self-determination.

by **Benjamin D. Hodgdon**

systems like traditional swidden agriculture and forest management. To that end, the park — which Karen have proclaimed as a self-governed, independently administered territory within Myanmar — puts development into Karen hands while conserving the forest that generations have called home.

It is a vision that is in line with international trends towards increased recognition of Indigenous peoples' rights to conserve forests, safeguard

of the Karen environmental rights defender Saw O Moo, who was a leading advocate for the park.

Meanwhile, a rapidly changing political environment in Myanmar has opened the door to land grabbing for investments in mining, large-scale agriculture, and hydropower development, much of it with Chinese and Thai capital. As a result, deforestation rates have skyrocketed in many parts of Karen territory. Pressure is starting to push into even the most

are Buddhist, some are Christian, and many still follow animist traditions. Over time, many Karen, especially in the lowlands and in the larger towns, have assimilated to Burmese ways; some no longer identify as Karen. Tens of thousands of others who have fled conflict to Thailand and beyond have adopted new identities, names, languages, and ways of living.

To the extent that there is a pan-Karen ethnic identity, it has been forged in response to external forces. As the British moved to annex Burma as a province of India in the nineteenth century, they capitalized on old enmities between the Burmese and other ethnic groups — many of whom the Burmese had long enslaved — arming the Karen to support British colonization. Colonial policy, while not kind to any group, gave some priority to the Karen.

World War II and Burma's independence only deepened divisions. Aung San, known as the father of Burmese independence, saw the Japanese occupation as an opportunity to rid the country of the British and initially sided with Japan. The Karen, meanwhile, stayed loyal to the British.

For their loyalty, British military leaders had promised the Karen their own autonomous state once independence was granted. But when the war was over and negotiations began around a Burmese state, Karen delegations to London were met with a cold shoulder. In 1948, a campaign of ethnically motivated attacks on Karen villages and the removal of Karen from posts in the new government led to the founding of the Karen National Union (KNU) and its armed wing (the KNLA), and to the armed conflict that continues to this day.

That conflict grew increasingly violent with the ascent of General Ne Win and the military junta that would

A rapidly changing political environment in Myanmar has opened the door to land grabbing.

biodiversity, fight climate change, and enable locally driven development. This approach rejects strict preservation as a Western model that has not only failed to halt deforestation in most of the tropics, but that has been used by governments to dispossess Indigenous groups, not least in Myanmar, through “green land grabs.” Indeed, KESAN, which helped conceive the park, is keenly aware of many examples from Latin America — in places like Mexico, Guatemala, and Peru — where local communities have taken control of their forests and are achieving better outcomes than preserves that are off-limits to communities.

But it remains far from clear that the Salween Peace Park will become another such example. The Myanmar government does not recognize the park. The military continues to operate scores of camps in the area, in violation of a ceasefire agreement. Incidents of violence have increased over the last few years, including the 2018 murder

remote forest areas around the park, aided by military road building.

As we travel upriver, I ask Mabu what chance the park really stands to succeed. “It is not a question of whether the peace park will be officially recognized by the government, or by anybody else,” he says, gesturing to the unbroken forest all around us. “In the most important sense, our vision has already been realized. Karen communities here have spoken. We have established the Salween Peace Park. So we are already succeeding.”

WITH A POPULATION OF around 7 million, the Karen are the second largest ethnic minority in Myanmar, and one of the biggest Indigenous groups in mainland Southeast Asia. But they are by no means homogenous. The term “Karen” actually refers to a diverse range of ethnicities including S'gaw, Pwo, and Pa'O, whose languages are often mutually unintelligible. Some

come to rule Myanmar for the better part of 50 years. Under Ne Win, the Karen and other ethnic armed groups were the target of near-ceaseless offensives by the Myanmar military (known as the Tatmadaw), including regular attacks on civilians and the destruction of whole villages.

After multiparty elections in 1990 — won by Aung San’s daughter, Aung San Suu Kyi, but nullified by the junta — the KNLA gave shelter to dissident Burmese student leaders. Tatmadaw campaigns against them increased further. By the 2000s, more than 200,000 Karen had fled to Thailand and were living in refugee camps; many more were internally displaced.

Things seemed to begin looking up during the 2010s with the introduction of a series of ostensibly democratizing reforms introduced by the junta. Optimistic that they might finally be able to broker a real peace, the KNU signed a ceasefire agreement with the military in 2012. Nationwide negotiations with the country’s armed groups a few years later raised the prospect of increased autonomy for the Karen within an eventual federal union.

Yet many in the KNU remained skeptical. They were right to be. The good faith efforts that rebel groups put into Suu Kyi’s new civilian government have not been repaid. The peace process has not advanced. The military still holds de facto control over the country. It also has a controlling interest in nearly all of the development investment that has transformed the country over the last decade, including those in mining, oil and gas exploration, hydropower, plantation development, and real estate.

Many Karen don’t believe that the military is interested in allowing true democracy to take hold. A 2018 report

published by the Karen Peace Support Network, an activist group, asserted that the Tatmadaw is interested in reforms only to “further entrench military rule and expand their control into ethnic areas.” Observers point to the military regime next door in Thailand — recently legitimized by elections — as the guiding inspiration for what the Tatmadaw wants in Myanmar.

Meanwhile, faith in Suu Kyi and her civilian government to negotiate a fair deal for the nation’s ethnic

a place the holdouts are trying to keep “illegible.” Yet the project of taming the periphery advances unabated. Contrary to the ceasefire agreement, scores of military camps are tactically spread out within the peace park. Skirmishes have increased over the last few years, with KNLA regulars resisting military road building and associated development. The conflict continues to claim civilian lives.

“Karen people have experienced enough hardship to know that peace,



The park recognizes Indigenous land rights and traditional resource management systems.

groups has waned given the Nobel Peace Prize winner’s defense of the military’s campaign of ethnic cleansing against Rohingya Muslims in western Myanmar. Suu Kyi’s support of the military rattled international observers, but it did not surprise many Karen who see the Myanmar government’s project of state-making as one concerned above all with making peripheral areas “legible” and quashing their struggles for self-determination.

As we plied upriver into the heartland of what Mabu calls “pure Karen Kawthoolei,” we were entering

even if it can be achieved, may not be in our favor,” says Saw Paul Sein Twa, 47, who founded KESAN with Mabu and other Karen nearly 20 years ago. “At the same time, we cannot ignore the reality: We will not win this fight with bullets. We need a different strategy.”

THAT STRATEGY BEGAN TO coalesce in the late 1990s in a Karen refugee camp called Mae Lama Luang in Thailand. Paul and Mabu, who fled their villages in 1995 during the waves of attacks by the Tatmadaw, began working together



There are more than 350 communities within the peace park that adhere to the Indigenous Karen land governance system known as *kaw*.

on environmental issues inside the camps. They founded KESAN in 2001. Initially, their work focused on illegal logging and deforestation in Karen territory, recording whatever evidence they could “back in the days of film cameras,” recalls Mabu. The exposés they produced brought some much-needed attention to the environmental dimensions of the conflict, but nothing changed.

So they began working directly with communities. They mapped ancestral boundaries, undertook wildlife surveys, and established local committees to monitor forest incursions. In a remote forest area, next to a village of displaced Karen, they built a training center. They set up demonstration plots for agroforestry development, created a seed bank to conserve traditional Karen rice varieties, and trained locals in GPS use and GIS mapping.

Still, they dreamed of something bigger. A place where Karen land rights would be recognized and traditional livelihoods could be practiced without the threat of encroachment. “Given that the Tatmadaw continued to violate the fragile ceasefire, we wanted to build something proactively showing our true vision for peace,” says Paul. But it needed to be big, so that it would be “hard for the decision makers to ignore.” The idea for the Salween

Peace Park was born.

The vision had its detractors. Parks have not been kind to ethnic groups in Myanmar. A range of efforts meant to strengthen nature conservation in the country — many led by big international NGOs like the Wildlife Conservation Society and Flora & Fauna International — have been accused of aiding and abetting central government agendas of violence and forced displacement. As a result, “park” and “reserve” are dirty words to many Indigenous rights activists.

To build consensus for a different kind of protected area, KESAN undertook consultations with communities within the proposed park boundary, which initially covered around 300,000 hectares. Over a period of four years, they discussed the idea of a Karen-operated reserve, one that would respect local land rights and recognize age-old natural resource management. Support was so overwhelming that the proposed park size nearly doubled as word traveled about the initiative.

Key to gaining community support was the message that the park’s main aim was to recognize the Indigenous Karen land governance system known as *kaw*. Maintained for generations in the face of conflict, *kaw* is a physical space as well as a social system, integrating ecological knowledge,

wildlife management, forestry, swidden agriculture, and conflict resolution mechanisms. More than 170 *kaw* occur within the park — typically forested common properties shared by up to 20 communities.

“Part of what we are doing here is demonstrating to the national government and others how greater autonomy in Indigenous territories can function,” says Paul. “We know that if we wait for a political settlement, there might not be anything left.”

“The Myanmar government has promised to lead the country toward a devolved, federal democracy,” adds Mabu. “We Karen are not waiting idly for this. The Salween Peace Park shows what we believe a federal democracy should look like. It is Indigenous self-determination and community protection of natural and cultural heritage in action.”

In December 2018, the Salween Peace Park was formally launched at a ceremony in Mutraw District, a border region that is the heartland of Indigenous Karen territory. Over three days, communities came together to launch the park charter, a formal document painstakingly developed through grassroots engagement with communities throughout the park area. The charter lays out the goals, objectives, and governance system

agreed for the park's management, from the bottom-up.

As the staccato notes of a traditional Karen harp rang out in the background, multiple speeches reiterated the vision of the park: "Instead of massive dams on the Salween River, we see small hydropower and decentralized solar power. Instead of large-scale mining and rubber plantations, we call for ecotourism, sustainable forest management, agroforestry, and organic farming. Instead of megaprojects that bring conflict, we seek a lasting peace and a thriving ecosystem where people live in harmony with nature."

patchwork of Karen agricultural plots, fallows, and forests in various stages of managed succession across the landscape. After clearing another KNLA checkpoint, we switchback down into one of those valleys. The winged fruits of dipterocarp trees litter the forest floor around us.

The Salween Peace Park is over 85 percent forested and home to some of the richest biodiversity remaining in Asia. It lies at the heart of the Indo-Burma hotspot, one of 36 areas in the world that Conservation International has prioritized for conservation. It remains little studied. A 2008 KESAN

by the KNU. It lies along one of the Salween River's biggest tributaries, the Yunzalin. In midafternoon, a dry heat is blown through town by lashing winds coming up the river valley.

We are welcomed by the district leadership into a wooden house on stilts. Like most structures in this part of Southeast Asia, it is mostly open-air, the roof hewn from dried tree leaves. The incongruous signs of both insurgency and bureaucracy are visible: military grade walkie-talkies on top of an old file cabinet, a typewriter under the Karen independence flag.

A group of men sit cross-legged on Thai-style plastic mats, clad in camouflage cargo pants and traditional Karen shirts. They chew betel nut as I ask about the peace park, what it will take to protect the area, and how they think Karen territory will look in 100 years. Saw Ten Der, the district chief, does not hesitate: "For hundreds of years, since long before the days of the British, we have managed these lands. Through decades of attacks by the Tatmadaw, [and] rich outsiders stealing our timber, mining our soils, we have stood up. We will not give up now. In the Salween Peace Park we are defending Kawthoolei, for the Karen people."

SAW TEN DER'S RESOLVE is striking given the many pressures on the Karen and the park. Perhaps most threatening at the moment is the wave of investment that has come in since the military began opening the country, investments that are quickly transforming Karen territory, and Myanmar's forest frontier at large. Although the country's forest area — totalling more than 29 million hectares — is still the biggest in mainland Southeast Asia, its deforestation rates are among the highest in the world.

The Salween Peace Park is home to some of the richest biodiversity remaining in Asia.

THAT VISION COMES TO LIFE ONCE Mabou and I finally clamber out of the longboat, the heat sweeping over us in waves. We hike up to a ramshackle trading post stocked with a bizarre array of items: purplish mottled eggs, canned energy drinks, fishing nets, car batteries, a Chinese-English dictionary.

A stripped-down pickup arrives and we climb in. We drive up an impossible slope, throwing off plumes of dust in our wake. As we ascend, the Salween River reappears, in our rearview; the trees of sloping dry forest surround us.

The shift to evergreen is sudden. The temperature drops and the air becomes humid. The soil profile changes from sandy browns to blood red and orange. Reaching the top of the ridge, a cool mist blows from the north. The view west plunges down into folds of lush forest, cut by river valleys and a

wildlife survey likened it to "the dark side of the moon." Biodiversity assessments undertaken by KESAN and partners have found significant populations of endangered species like tiger, Asian elephant, gaur, banteng, Phayre's leaf monkey, and Hoolock gibbon, as well as multiple endemic bird species. There is also an abundance of flora — by some estimates, the hotspot is home to as many as 25,000 different plant species, half of them endemic. This flora — including some of the last remaining stands of natural teak on Earth, endangered orchids, a variety of edible and medicinal plants, and more — is critical for the 70,000 Karen who live within the park, spread out over some 350 communities.

Deh Bu Nor is the largest of those communities, and the seat of Mutraw District, which is largely administered

Since 2011, Global Forest Watch data indicates that Myanmar has lost more than 2.2 million hectares of forest. Around 15 percent of that loss has occurred in Karen territory.

“There is a perfect storm driving deforestation on Karen lands right now,” says Dr. Kevin Woods, a senior analyst for the Washington, DC think tank Forest Trends who has worked in Myanmar for 20 years. Woods was co-author of a 2017 article in *Conservation Biology* that identified four types of political and economic transitions that have historically led to “profound environmental consequences” in countries around the world: war to peace, democratization, decentralization, and market liberalization. All four are being faced simultaneously in Myanmar presently, the article notes. This has resulted in significant new pressures in resource-rich borderlands like Karen territory, where Woods has documented “waves of counterinsurgency development” backed by the central government, a phenomenon he has dubbed “ceasefire capitalism.”

Such development is on stark display in the southern part of Karen ancestral lands, in the region known as Tanintharyi. There, more than 725,000 hectares of oil palm concessions have been awarded, “often to companies with close ties to the former military regime,” notes a 2017 report published by a group of local NGOs and the Environmental Investigation Agency.

Although such widespread conversion has not yet reached the Salween Peace Park, it is fast approaching. On the southern fringe of the park, over the last ten years, nearly all of the Thee Tha Blu community’s forest has been lost to land grabs by groups tied to the military, but for a small area that KESAN helped demarcate as a community reserve.

In the face of this, the Salween Peace Park stands as a kind of last hope for the Karen revolution. “The park is significant because it inverts the power relationship between Karen and the state, and it embodies the Karen vision of self-determination and political federalism that are championed as the hallmarks of peacebuilding for and by the Karen people,” notes Woods. Still, to date, the Myanmar government has yet to even acknowledge the existence of the park, although it has reportedly been mentioned in parliamentary proceedings.

The KNU, for its part, currently has no agreed strategy for negotiating official recognition of the park. Riven internally by its own factionalism, which has dogged the organization since its founding, some powerful KNU leaders remain ostensibly committed to the derailed peace process and do not want to be seen as going rogue. Others, like Mutraw’s district leader Saw Ten Der, appear not to trust the military or the civilian government to negotiate in good faith. For them, there is no need for official recognition. Karen communities declaring the park as theirs is all the recognition that is needed.

KESAN’s head Paul Sein Twa strikes a more balanced tone. For him, while the question of negotiation with the government “will come at the right time,” a key near-term strategy is attracting more international support for the park. “We know that groups around the world are working towards the same vision in their own Indigenous territories,” he says, noting that he has spent the past few years crisscrossing the planet to learn about allied initiatives, while pitching the peace park to donors. “The Salween Peace Park is linked to a powerful global movement that cannot be ignored.”

AT NIGHT, BACK ALONG THE Yunzalin River, it is finally cool. After a meal of river fish, bamboo shoots, and upland rice, Mabu and I walk down to the riverbank. On the far side a silhouetted stand of hundred-year-old teak throws shadows in the moonlight.

We are joined by a village elder, Saw Tha Say, from Lay Bu Der, a small community not far from KESAN’s training camp. He opens our meeting by chanting rites to Karen forest spirits, passing around a bamboo cup with shots of rice wine (called *thee*). A companion from his village adds a Christian prayer and the sign of the cross. More *thee* goes around.

Saw Tha Say is exactly as old as the Karen revolution. He first took up a gun when he was still a child, and has lived through almost constant conflict and uncertainty all his life. He has been shot at. He has fled his village multiple times, living in hiding with other displaced Karen, eating only wild foods in the forest. He has returned home. Through all this, he notes with a wry chuckle, he has never worn shoes.

I ask him what he hopes his village might look like in another 70 years. “During my life we have had to live always avoiding violence,” he says. “I believe that in the future, thanks to the peace park we are building, the children of my village will be able to live differently. They will be able stay home, and to live in peace.” ■

Benjamin D. Hodgdon is a forestry specialist who has supported community forest management initiatives worldwide, including the Salween Peace Park, for more than two decades. He lives in Oaxaca, Mexico.

On Radical Cultural Change



Ever since I was an undergraduate two decades ago, I've been inspired by political thinker and activist Helena Norberg-Hodge's books and films. Serendipitously, I met Norberg-Hodge in person in England recently. She knows, perhaps better than anyone I've encountered, how to connect re-localization, the reclaiming of the Commons, and the importance of direct participation in community with the transformation of big corporate dominance. She also spent decades working and living with Indigenous people in Ladakh, India, and is a pioneer in integrating traditional and Indigenous worldviews into a coherent critique of techno-industrial society, politics, and finance.

Norberg-Hodge speaks eight languages and was educated in Sweden, Germany, Austria, England, and the United States. She specialized in linguistics, including doctoral studies at the University of London, and at MIT with close mentor Noam Chomsky. She founded and directs the groundbreaking nonprofit Local Futures, and is now on an international tour leading conferences on the penetrating documentary she produced, *The Economics of Happiness*.

This conversation, which began in Norberg-Hodge's Totnes, England home and continued via Skype, conveys both her keen intellect and personal warmth.

— WILLIAM POWERS

What is globalization? What's wrong with it?

Globalization is a process of deregulating global traders who already have near-monopolistic power, stretching all the way back to colonialism and slavery. These are big companies creating wealth on a scale that has increasingly made it nearly impossible for local or national businesses to compete. And since the mid-1980s, a whole series of new trade treaties, both bilateral and multilateral, have continued this process, and it's become more of a relationship between giant, mobile transnationals and nation-states than a relationship between countries.

In short, we've ended up in an absurd situation where — because we're not shedding light on it — we as individuals are more and more squeezed for taxes along with small- and medium-sized regional businesses, and those taxes are used to basically subsidize global monopolies. One of many ways we subsidize is by building up a global trade-based infrastructure, including ever bigger ports and airports.

So, the deregulation of global transnationals has been accompanied by ever-greater regulation of local and regional businesses?

Yes, and this is a vital issue because from our point of view what's happening is that the smaller businesses are becoming

more and more angry at government because of what they see: over-taxation and overregulation. And as a consequence, they vote into the hands of neo-fascist leadership because they have been persuaded that the *laissez-faire* free trade economy is the way out of our situation, not understanding that there is this greater injustice that began centuries ago, and kicked in, in a much more extreme way, since the mid-1980s.

They then keep voting for smaller government, not realizing — and this is where progressives really need to help us out — that *yes*, we do need to look at what some of these regulations mean and how virtually impossible it is to survive as a small business in this unfair playing field. We need to spell out how and why it's unfair because we need government to regulate and tax the giants. We need, urgently, new trade treaties that are about re-regulation instead of deregulation.

Imagining a genuine alternative to corporate globalization is difficult for people who have only known a "modern" way of life.

Yes, it is a bit like trying to imagine a new color. People who have their eyes open to seeing another color are usually those who have had multiple experiences, particularly those with exposure to less modernized, less urbanized, less technologized and industrialized ways of living, and — and

this is key — also at least some exposure to living in the heart of the urban, speedy, competitive industrial world. That's the sort of experiential base that helps people look at a more life-affirming culture and start understanding how destructive this urban-industrial way of life can be.

What about people who haven't had such cross-cultural experiences?

There are other entry points. Great suffering, for example, like losing a child, or other deep, deep suffering that forces people to go inward can be dramatically eye-opening in terms of questioning the dominant path, which we also have to recognize centers on a fundamentally unsatisfying consumer identity.

Another entry point is a deep experience of nature — perhaps very profound relationships with animals, people who have farmed and know the language of nature — where one begins to recognize how this consumer path, this so-called “modernizing” path, is taking us away from nature.

What about people who live in cities, far from daily contact with nature?

Urban experiences sometimes force folks to start deeply examining what has meaning for them, leading to a search. The archetypical urban industrial high-rise experience can generate a thirst for connection because it's nested in a consumer path which is fundamentally alienating from nature and community. ... If it weren't for the fact that we're still allowing big global financial interests to continue to escalate the current economic-development path, I'd feel quite confident that we'd be instinctually moving back towards a balance with nature and recovering community.

What do you say to people who feel the change you are talking about is just too huge?

Recover sanity and joy and physical health and emotional health by staying right where you are, but explore how to consciously connect more deeply to others and to nature. In my work with Local Futures, we help to create this through our ongoing “Economics of Happiness” conferences, bringing together like-minded and mature people in your proximity with whom you start a process of reconnection. We create settings where people can be more vulnerable, to be more deeply honest about their deepest fears and move away from the mask of perfection undergirding consumer culture.

What do you mean by a mask of perfection?

We've been taught to pretend: *I'm absolutely fine*. That is the mask of perfection, and it keeps us isolated and separate. It's particularly painful to see it among young people where they are isolated into their peer groups; it's one of the crueler structures that we create. The fact that I might suffer from anxiety, or I have an eating disorder, or I'm still wounded by my relationship with my mother is something that I cover up. Some of us, in our commercialized and rather individualistic way, try to gain some help through therapy, but it's not the deep help that we need.

There's more and more coming out about the number of people who've had immense benefits simply from being sure that they have activity on the earth — like outdoor exercise and gardening — rather than on asphalt. Another aspect is a very conscious attempt to rebuild deeper intergenerational relationships.

In the conferences you have been hosting in places like Vermont, Ohio, and New Mexico, and also globally, what would you say has been a take-home message for participants?

What we hear quite often is people saying, “Thank you for this bigger picture which puts things together into a way that I haven't seen before, one that feels uplifting.” Another take-home is that people are not realizing the extent to which — not just in the mainstream but also in alternative and progressive circles — there is this dominant sense that *human nature is all wrong*. In other words, that it's in our nature that we all are greedy and aggressive. That is a deeply depressing message, and I do see a lot of people, especially people my age, saying that they've given up on humanity, alas, that we deserve to extinguish ourselves.

No, there is actually a cultural story here. It's not human nature, but rather *the culture into which we've been subtly manipulated*, to the point where we cannot see that recovery from this sad and addictive culture can be surprisingly rapid. We face climate chaos, too, and things that are very alarming, and of course there's great reason to be concerned. But there's simultaneously a deeply uplifting message in realizing that not only can recovery happen faster, but it is happening.

Your views on technology have been controversial ...

It's really been only over the last couple years that I have come to see that we must speak out on technology. You see, in the 1970s large numbers of people and organizations pushed governments to decentralize renewable energy, and governments started making these changes. But sadly, there wasn't



Norberg-Hodge spent decades working and living with Indigenous people in Ladakh, India. Her work there helped crystalize her understanding of the need for decentralized political and economic structures as well as holistic knowledge of local ecologies.

enough awareness of the heavy propaganda for computers as “the” way to help us decentralize. Computers and later the Internet being championed as the way to [decentralize] perversely helped co-opt large movements of people who wanted a more generally decentralized, and more nature-based, culture and development path, people who basically wanted to go back to the land, to leave the big cities.

If you had to sum it up, what’s the message you’d like to share in terms of technology?

It’s too big for a soundbite. But for now, think of how the barcode on every product is linked to the needs for a firm like Walmart, in using satellites and fleets of lorries, to not even have a warehouse, and how this is linked to destroying local businesses. We should be talking about what is essential in an economy: the ways people use nature and other people to make ends meet, and basically, it should be about providing for our needs, not about a system that artificially *creates* needs.

Using psychological manipulation to encourage people to consume was tied to economists arguing that the only way to avoid another economic depression was to integrate economies around the world, in other words to create one global system. This amalgamation was linked to the creation of the EU and so on, to the idea that to avoid another war we need one single system.

Most people see the EU as a relatively benign force and often as the only counter-pole to the American system. But actually, it was an attempt to amalgamate and integrate to suit the needs of big business. Big business wanted to grow

beyond national boundaries, and they didn’t want to have to deal with different languages, different ways of measuring, with some people driving on the left side of the road and some on the right. They needed standardization, and the computer and the Internet were an integral part of that.

How would you change the situation?

To paint it dramatically: *What would it be like to ban multinational companies from using the Internet?* (Laughter) Okay, maybe that would be a challenge. But multinationals using the Internet are basically impossible to tax. Look at Apple, at Google. And these technologies are linked to massive manipulation, not just in terms of manufacturing needs, but even [in terms of] the voting behavior in different countries. Ideally, the change toward democratizing the Internet would be in incremental ways.

Using satellites and the Internet for climate monitoring, for emergency needs, and so on makes sense; having built up that infrastructure and having those tools, it would be unwise not to make use of them for many purposes. But, again in an ideal world, we’d be looking at the way that the whole weapons race is linked to the race into space, and we would be putting an end to that. We would be looking at the ecological and social effects of mineral use in technologies. We would be talking about slowing down and shrinking our use of the Internet for global business, the way that several European countries have done with bans on advertising.

With things like driverless cars, and artificial intelligence, there's an emerging critique that men are the ones promoting such paths, not women.

Many of my young male colleagues are absolutely convinced about blockchain, 3D printing, driverless cars, and so on, whereas almost every woman I talk to does not share such passion for these tools. I think part of the big shift that we need is a better balance between masculine and feminine — finding a more deeply interconnected, nurturing side. But that requires time.

A genuine appreciation of the other, a genuine appreciation of the plants, the animals, and the sun requires free time we cannot get through the speed that these new technologies are imposing on us. You might ask yourself: What happens to us — as individuals, as communities — under the time pressures that nearly all of us experience today?

What could men do, more concretely? Meditation? More hiking? Or do you mean deeper initiation in nature?

Certainly those, and also what they are doing already in several microtrends, like getting more involved in childcare. To see fathers carrying babies on their chest, that's a wonderful and important leap into the feminine. By the way, to this day, many young boys growing up in pre-modern cultures carry siblings on their backs. That kind of nurturing and care is even linked to changes in their hormone structure, a deep biological effect of being involved in nurturing.

Slower caregiving is necessary, and it is something hard to deliver in a system that is so driven by speed. Take steps right now as an individual to explore what it means to be a balanced, nurturing person, but one of the steps that I hope you'll make is to get the word out about the broader picture and help build up more collective power to change things.

How are we to find the courage to take the sort of contrarian stances you are advocating?

I'm a woman saying this, but I think it's really true of men too, that the first step is to identify like-minded people, or at least one or two. To be the contrarian alone is pretty daunting, and we can best do it if we're part of a group.

A main reason our leaders are taking us faster and faster in the wrong direction ... is the desire to belong. Belonging is one of our deeper needs that was borne of the way we evolved for 99.9 percent of our time on this planet. And when alternative voices are nowhere to be heard or seen — since the tools of the master technologies are in the hands of deregulated capital and they continue to promote this isolating, competitive,

and speed-based path — then the leaders are desperate to be in the herd. They're told by peers: "If you don't go along with this, you'll be left behind." That's been particularly true with adopting technologies, which, as leaders blindly accept every new multinational technology that comes along, ironically takes those same leaders into an unwanted position where they have ceded their own real power to corporations.

The first step is to connect with like-minded people, and then collectively start questioning the dominant assumptions. Part of that is to listen to what really makes your heart sing. Where were you and what were you doing when you experienced moments of deep contentment and happiness? Listen to the answer and use it as a guide.

Increased confidence, then, provides the resilience to speak truth to power?

Those with audacity to play the contrarian tend to be deeply secure people, and that's why I'm so keen to encourage people to connect to others: It can inspire the confidence of feeling appreciated for who you really are. Deepening the relational sense of self helps provide the confidence to also take on mainstream assumptions. Everything that I'm saying is part of a whole kaleidoscope of complementary aspects, about being part of a systemic shift where there are various interlocking changes.

That's why our societal path has to be one that works *with* the natural world, not one that continues to control it. Part of confidence-building is having the ability to make something with our hands. There are so many beautiful projects. Just helping in a community effort to build a clay oven, and then baking pizzas in it, is a fine joint project. Simply being able to do that little bit of building and cooking, that too inspires confidence. Many studies show what happens to your brain when you do that, and the benefits to your whole body.

So I say: Start small and local. It's a wonderful entry point into a multipronged and mutually reinforcing path to health and happiness. ■

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This interview has been edited for length and clarity.

“THERE IS NO WATER,” Udayanthi says. “My husband used to work in our paddy field, but he cannot cultivate anymore.” Udayanthi is from Bakmeegama, a small village in northeastern Sri Lanka’s Trincomalee district where small brick homes nestle into surrounding vegetation. “Without paddy, there is no money. That is why he had to go to [Sri Lanka’s capital city] Colombo to find work,” explains Udayanthi, who, like other villagers here, would give only her first name. Her husband sends money from Colombo, but it is barely enough for her to run the household and buy food.

A wooden fence separates Udayanthi’s home from the village road, and clothes are strung up to dry on wires that run alongside it. Her only son, about three years old, clutches a tiny cricket bat and a ball, pounds the bat on the road, and laughs with excitement. Palm trees line the horizon and provide shelter from the harsh sun that burns down on the bare earth, the fields, and trees nearby. Farther ahead, in the brown and yellow-green fields, women and children go about barefoot, and a few men in sarongs tend to the crops.

Yes, some of the plants look discolored. White layers of sodium cover the soil, and water levels in village tanks seem low. But if you are not from here, you might not be able to tell that this region is in a drought.

The drought is real, however, and it persists. Like many other villages in Sri Lanka’s dry zone — which covers more than 75 percent of this pear-shaped tropical island nation’s land area — Bakmeegama was still recovering from a severe drought that hit the region in 2016 and 2017 when it was subjected to another season of below-average rains in 2019. In August, major reservoirs in the country were at 19 percent capacity, compared

HOLLOWED LANDS

IN SRI LANKA’S RURAL HINTERLANDS, THE SLOW-ONSET IMPACTS OF OUR WARMING WORLD ARE FORCING FAMILIES APART.

by Dennis Mombauer



to 33 percent during the same period in 2018. The low rainfall followed by another long spell of dry weather has impacted drinking water access as well as the agricultural livelihoods of more than 600,000 people in the country.

Nandasiri, another farmer from Bakmeegama, stands in front of his small brick house with a red terra cotta roof, just down the road from Udayanthi. He is back from Colombo for a short time to visit his family, and tells a similar story: “My wife, my

during *Maha*, and to the west and southwest during *Yala*. Dry zone farmers depend on water collected during these monsoons to grow rice, the nation’s staple food that is cultivated across some 700,000 hectares of farmland, as well as commercial crops like tea, rubber, and coconuts.

In recent years, however, both agricultural seasons have produced diminished or no harvests due to unreliable rainfall. For farmers who are still working the land, the water

the next village, to get clean water.

With rising temperatures and extended periods without rain, the wells dry up and the water turns muddy. The health impacts of drinking unclean water are visible in the red and yellow eyes of the people, a sign of kidney disease, which is more and more common. Poverty exacerbates these and other health issues. In Nandasiri’s family, medical expenses pose a huge challenge: “My daughter is not well at all; she has had five surgeries [for a brain-related illness]. I migrated to Colombo to find work at a construction site, and I use that money for my daughter’s medicine and clinic visits, but we do not have enough to live day by day.”

He’s not alone. Farmers struggling with poverty and the after-effects of the nation’s 26-year civil war that ended in 2009 have been leaving their homes in search of higher incomes for years. Now, confronted by alternating droughts and floods that will only get worse with progressive climate change, even more are leaving their homes in search of secure livelihoods. They are moving across districts, across provinces, and even across international borders.

“What climate change means for the people of Sri Lanka is that their life has been disturbed,” says Anura Dissanayake, who was secretary to the Sri Lanka’s Ministry of Mahaweli Development and Environment at the time of the interview, prior to the country’s presidential election in late 2019. “We do not see it because the roads and schools are all there, but people are moving away.”

ACROSS THE WORLD, deteriorating environmental conditions caused by global warming are forcing a rising number of people to abandon



In recent years, the country’s two agricultural seasons have produced diminished or no harvests due to unreliable rainfall.

daughter, and I lived together in this house. I am a farmer. I own one acre of paddy land, but because it did not rain, I have not cultivated for the last two years.”

Sri Lankan agriculture revolves around two seasons, *Maha* (major), which runs from September through March, and *Yala* (minor), from May to August. These seasons coincide with the two monsoons that travel across the country from different directions, bringing rain to the east and north

shortage means that where they used to harvest 70 bags of rice from one acre of paddy fields, they are now getting just 30.

The failing rains affect more than just the harvests. For many households, drinking water comes from deep wells and rivers. In Trincomalee district, fewer than half the households have access to tap water. Nandasiri’s family, for example, has no pump in their house. People without a well have to walk long distances, sometimes even to

their homes. By most estimates, the number of climate refugees will reach 100-200 million people by 2050. Some estimates are as high as one billion.

When we think of climate displacement, however, the images that come to mind are often dramatic: a hurricane hammering an island, a landslide washing away a village, raging tropical storms. We envision long treks of refugees along flooded roads, families crammed into trucks, or people living in tent encampments. These images deserve our attention. But as the plight of the Sri Lankan farming families indicates, there is a quieter type of climate migration happening as well, one that has been poorly documented so far. It is the departure of adult, able-bodied family members from rural areas to cities in search of work as the slow-onset impacts of our warming world — soil degradation, saltwater intrusion, water scarcity, crop failure, ocean acidification — make subsistence fishing and farming livelihoods no longer viable. It is a movement that tears families apart and hollows out rural communities.

In South Asia, as in other parts of the world, this type of climate-driven migration has remained largely invisible because migration itself is not new to the region. As a 2016 Action Aid report points out, migration due to various “push factors” such as poverty, land access, and conflict, as well as “pull factors” such as seasonal labor opportunities, kinship, and access to healthcare or other services has been occurring since “long before climate change became an issue.”

But as the region grows more prone to extreme droughts, heatwaves, heavy rainfall, cyclones, landslides, floods, and the impacts of rising sea levels, climate is increasingly becoming a key factor driving people from their homes.

The region’s large population — South Asia comprises the nations of Afghanistan, Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan, and Sri Lanka — and relative poverty make it exceptionally vulnerable to the impacts of climate change. Most of the countries in this group are middle or low-income nations, where the greater part of the population struggles to meet basic needs. As a result, they are more vulnerable to weather-related changes that can make daily staples unaffordable. The World Bank estimates that changing weather patterns will directly impact more than 800 million people in the region by 2050.

At the same time as Sri Lanka faces the impacts of climate change, it has also been transforming into an upper middle-income country. Cities like Kandy, Galle, and Jaffna are rapidly growing in population. The nation’s economy has grown on average 6.2 percent a year since the end of the civil war, and is transitioning from being predominantly rural and agricultural to focusing on urbanized manufacturing and services, and is growing in popularity as a tourist destination.

Still, agriculture continues to be the country’s most important source of employment with millions of families engaged in smallholder farming. In

Sri Lanka’s average temperature could rise by 1 to 2 degrees Celsius by 2050.

IN SRI LANKA, which is surrounded by ocean, increasing average temperatures and changes in seasonal rainfall patterns are already taking a toll on the country’s 21 million citizens. The small island nation experienced major floods in 2010, 2011, 2014, 2016, and 2018, and went through the worst drought in 40 years in 2016-17. A 2018 World Bank study estimates the country contains “hidden hotspots” — areas that are economically at risk from climate change and where living standards are expected to decline as a result. It notes that by 2050, the country’s annual average temperature could rise by anything from 1 to 2 degrees Celsius, putting the 19 million people (more than 90 percent of all Sri Lankans) living in these locations at risk.

some places, the local economy is entirely dependent on it. This means that the declining predictability of rainfall puts immense pressure on the fabric of village life. “There is not much difference in the total annual rainfall, but high rainfall intensity causes floods, while non-rain periods grow longer in certain parts of the country,” explains R.P. Samarakkody, additional director general of the country’s Disaster Management Centre.

Under drought conditions, whole families survive off a monthly income of less than 10,000 rupees (\$55 US), relying on their kitchen gardens and the roof over their heads to survive. Some try to cope by reducing their food intake, pawning their jewelry or other assets, or borrowing from banks. Others receive benefits such as

Samurdhi, a government relief program that provides food stamps, loans, and other services to poor households, or help from family and neighbors. But it is difficult to make ends meet.

Migration is always the last resort, a choice many unwillingly make once these options are depleted. In a 2019 survey of Trincomalee farmers carried out by SLYCAN Trust, a Sri Lankan think tank working on climate change, less than 6 percent named “abandoning agriculture” as a possible climate adaptation strategy. Their roots in the villages run deep. Leaving means abandoning the only way of life they know. They will no longer be able to visit their neighbors, their Buddhist temple, their *kovil* (Hindu temple), mosque, or other local gathering places and institutions. They will not be able to keep their cows or their chickens. Besides, it is unlikely they will find jobs in urban areas that fit their skillset.

“Our family bonds are very strong. People do not want to move from their villages. If a proper resilience mechanism can be established, they will stay,” Samarakkody says.

AS WITH MOST OTHER countries, Sri Lanka’s internal migration patterns lead from rural to urban areas like Colombo, Gampaha, and Kandy, though there is cross-border migration to countries like Saudi Arabia, Qatar, and the United Arab Emirates as well. One in four people in the urbanized Western Province has migrated there.

However, because many maintain strong connections to their homes the number of new migrants is difficult to record. Many migrants tend to return home for short periods every month or two, or during harvest season to help out in the fields.

Another survey by SLYCAN Trust found that 80 percent of respondents

across several Trincomalee villages had a migrating family member, almost always the working-age male. Though a growing number of women are migrating as well, it is still overwhelmingly men who leave in search of work.

“The cultural concept is that the breadwinner of a family is the man,” says Priyantha Kulathunga, Sri Lanka program officer for the United Nations’ International Organization for Migration. “Basically, who leaves first tends to be the males in the family, either the main breadwinner or other male family members.” Kulathunga’s colleague Rangitha Balasuriya adds that “individuals between the age of 19 and 50, usually 30 to 35, are most likely to migrate. Men are looking for unskilled jobs in the construction sector or skilled opportunities such as carpentry or masonry. Women leave home to work in the garment industry or the domestic sector,” usually as housecleaners.

“What the workers earn in the city is very marginal, but they make sure they send some money back,” Kulathunga says. “What they send would not be sufficient for investment, just to sustain the family at home. They save to send the children to school, to buy some food.”

If migration due to the slow-onset impacts of climate change hasn’t been receiving much attention in South Asia, the impact it’s having on those being left behind, especially women, is receiving even less. What research does exist suggests the impact is significant.

In the 50 households SLYCAN Trust surveyed across Bakmeegama and three other villages, 40 families had at least one member who had left. Of the 42 total migrants, 36 were men. The departure of working-age men from villages places an additional burden on women who are left with little regular income. Most of them have to run their household and care for children

(and often elders as well). They may also take on farm work or find other avenues of additional income like selling sesame balls or other snacks at local markets, or sewing, given the money the men send back can be unreliable and sporadic.

M.H. Dinusha Madurangi from Pulikandikulama village, a few kilometers from Bakmeegama, says she has to do almost everything, from housework to farming, herself. “I grow pumpkin and okra for home consumption,” she says. “My husband migrated about a year ago to [the district capital] Trincomalee. He works there as a day laborer and comes home once a month. Our two children are without a father, and I have to do all the work alone.”

Even though the absence of men increases women’s decision-making power on everyday matters, cultural norms, policies, and laws limit their empowerment and access to investment opportunities. In Sri Lanka, as in most of South Asia, even when men are away for most of the year, they are often the de facto household head. A 2018 United Nations report found women headed only 25.8 percent of households in Sri Lanka. “Gender disparity is rampant,” Kulathunga says. “Even if the men are living in other countries, they are controlling the entire network of the family. Of course, some women get a certain amount of power when the husband is not around. They get to decide how to spend the money or what to buy, but the big decisions are either negotiated or coming from the man.”

The women left behind are struggling to cope, but policies in Sri Lanka and the rest of South Asia are failing to account for the scale and impact of this trend, notes the ActionAid report on South Asia’s climate migrants. The report’s authors say promotion



A village tank in the North Central Province. Ancient Sri Lanka used to have a sophisticated network of tanks and canals that collected and redistributed water and served the needs of dry zone areas even in water-scarce months. An effort is underway to revive many of them.

of women's empowerment, as well as women-led planning and disaster response, must be part of the solution to this emerging issue.

THE SRI LANKAN GOVERNMENT recognizes that, in addition to putting in place disaster management measures, the country needs to urgently implement climate mitigation and adaptation initiatives, especially in the agricultural and water-management sector. It is pulling a leaf out of the country's ancient history, in this regard.

Over 2,000 years ago, Sri Lanka used to have one of the finest hydraulic civilizations in the world. Its ancient kings built a sophisticated network of small tanks (surface water reservoirs of varying sizes) connected by canals to large reservoirs that collected and redistributed water, replenished soils, and balanced the needs of entire ecosystems in its dry-zone areas, even during water-scarce months. These unique tank cascade systems, which took advantage of the natural drainage matrix of the landscape, were

maintained by communities that benefitted from them. Over 10,000 such small tank systems still exist in the dry zone, though many of them are in disrepair.

Dissanayake, the former Secretary to the Ministry of Mahaweli Development and Environment, says that the government is building canals to supply these ancient tank systems with water from the hill areas. By the end of 2020, thousands of tanks are expected to be restored. Part of the funding for this work comes from the Green Climate Fund (GCF), the centerpiece of UN climate finance under the Paris Agreement. The GCF and the Sri Lankan government are co-financing a \$52 million project with smallholder farmers in the dry zone. This project aims to strengthen the resilience of up to two million people to extreme weather events like floods and droughts by improving irrigation infrastructure, expanding access to clean drinking water, and investing in early weather-warning systems, flood response, and water management.

While essential, infrastructure investments will only get Sri Lanka part of the way. As the old ways are failing, farmers have to open up to new ideas as well, including making space for women to take up leadership roles in their households and villages.

Speaking to Udayanthi, Dinusha, and all the other women left behind in the villages, their ideas and aspirations seem neither abstract nor unreasonable. They could cultivate if they had a well, they could sew if they had a machine, they could start a business if they had start-up capital. If women like them receive support in their efforts towards self-sufficiency, they can adapt and help to bring positive change in their communities. Enabling them to take on bigger roles in the village ecosystem could be a key step toward a climate-resilient and sustainable future. ■

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DIS-EASE

LYMAN TELLS ME HE IS WORRIED. “I’m glad I’m old,” he says. He’s concerned about the now frequent algal blooms. The sea urchins are gone, starfish, gone, clams in his favorite cove, gone, lobsters moving to funny spots. We talk as I get some eggs down. Five months into pregnancy, I feel the baby shuffle inside my belly. Lyman tells me about Jewell Island, out past Long and Cliff islands in Casco Bay, where they used to watch for the monarch migration. “That’s how we knew the lobsters were ready,” he explains. The monarchs were so thick you couldn’t see the sky. But last year, there were only two monarchs off Jewell Island. “I’m looking around,” he says, gesturing with his fork, “and thinking, where is everybody?” As he talks, his face gets redder and redder. Behind his glasses the wrinkles around his eyes deepen. The corners of his mouth droop. “Real worried,” he says quietly.

We pay our bill and walk outside. Lyman waves and heads down to the wharf, where he keeps his boat. For a moment, I sit in my car, watching the rain hit the windshield. The wipers going up and down, up and down. The place where I am sitting, in my car, next to the diner, will be under water this century. I look out the window, imagining saltwater creeping up around the cars in the parking lot, licking the tops of my tires. I imagine tourists wading through it as they make their way into the diner, street signs floating by as the water reaches the bottom of my window. The baby kicks. I back up and start driving home.

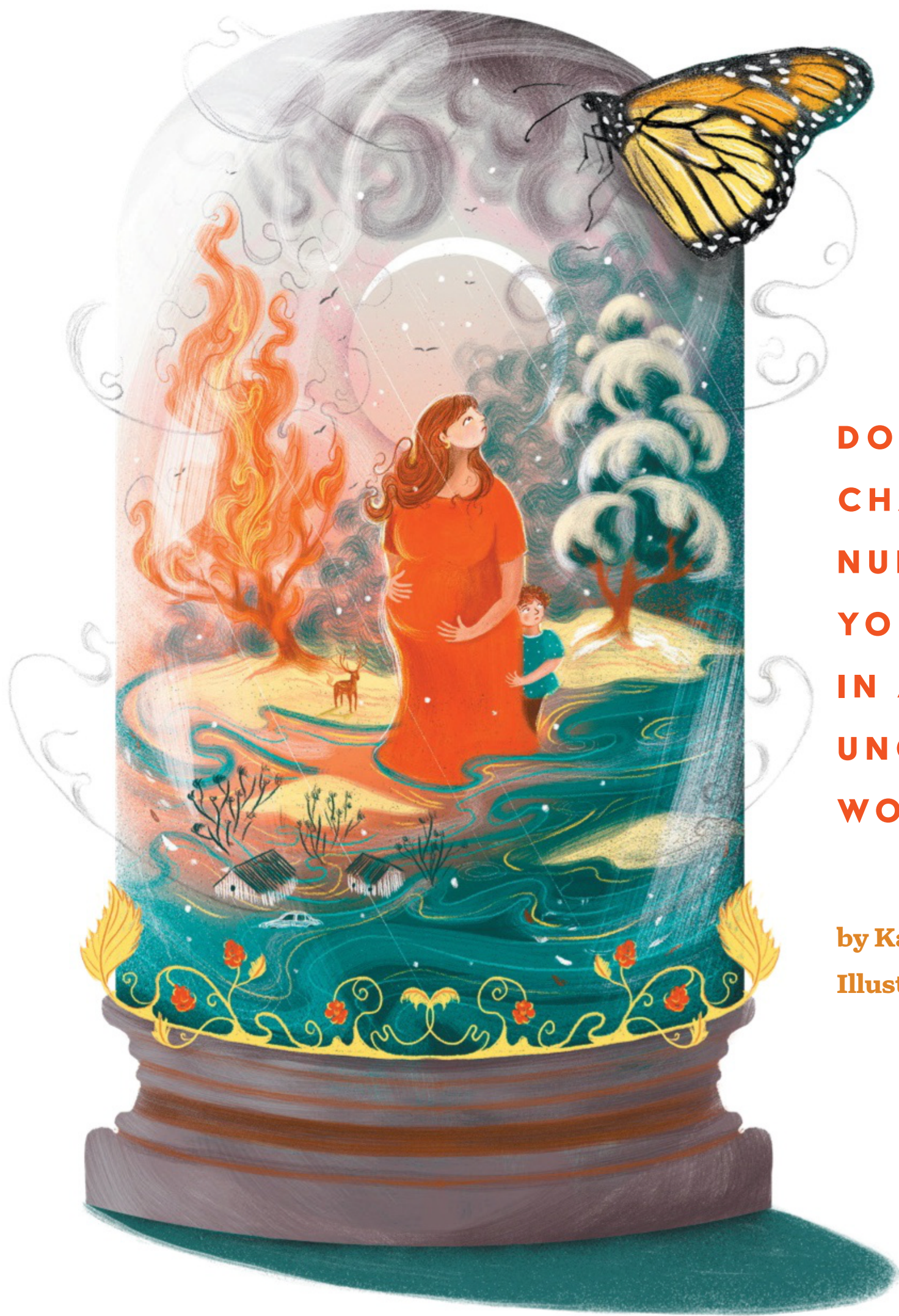
WE BOUGHT OUR FIRST HOME IN MAINE in the fall of 2016, and filled with anticipation, planted raspberries the next spring. We figured the bushes probably wouldn’t fruit that year, but they did, in early September. My husband and I each savored one while we watched our son toss three into his mouth at once. “More, more!” he said. We

did get more, about three weeks later, and again, we marveled at the red berries hiding in the bushy greenery. It was an unusually warm fall, we said, maybe that was why we were still getting berries in mid-October. We forgot about them and moved on to other fall tasks, stacking wood, putting the garden to bed, raking leaves. About a month later, just before Thanksgiving, I was walking through our yard carrying discarded toys when some tiny flashes of red caught my eye. *Raspberries!* I thought. My heart swelled at this sweet pleasure, unbidden on a gray November day. Then my gut clenched. I felt a burning in my throat. *Raspberries?* I thought. *In November? In Maine?*

THE NEXT YEAR, I AM PREGNANT with my second child and suddenly shrouded in illness. Constant, debilitating nausea. Acid reflux. Headaches. Insomnia. It is like that moment before the moment when you vomit, where there is a shift in your gut, an awareness deep down that something is not right. I carry this feeling of dis-ease around with me constantly, day and night. I wake in the night and am unable to fall back asleep, with the churning in my stomach and the feeling moving up through my esophagus and into my throat, one wrong movement away from losing it.

This feeling, not total chaos but the certainty of being unwell, the churning in my gut, eventually gives way. But I still get it sometimes — an unnerving feeling that starts deep in my abdomen and crawls up around my heart and into my throat.

For my dissertation, I am talking to people who work outdoors in Maine — as fishermen, farmers, and foresters — about changes they are observing in their landscapes. Like Lyman, most of them are noticing changes and trying to figure out what they mean. I spend most of my days driving



**DOCUMENTING
CHANGE AND
NURTURING
YOUNG LIFE
IN A CLIMATE-
UNCERTAIN
WORLD.**

by Kate Olson

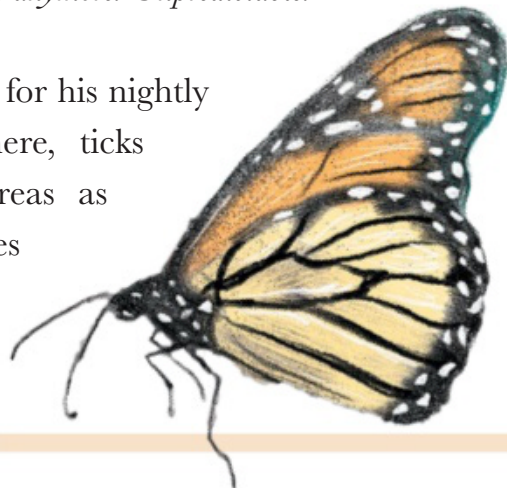
Illustration by Sonali Zohra

to different meetings. Sometimes it's on a dock on Casco Bay, other times a farmhouse, the woods, or a gravel pit off a back road. *What is a typical day like? Why do you like your work? How is the weather changing? Are the fish in the same places as they used to be? How are these changes affecting you?* As the interviews progress, I feel heavier. By the time we finish, I walk to my car unsteadily. I feel a burning deep in my chest, rising up into my throat. My stomach is tense. I drive home, my head full of things lost. *No more bees. Mussels disappearing. No clams. Cannot take these new costs. Drought. Need more irrigation. Too much rain. Not enough rain. Don't know what to expect anymore. Unpredictable. Not sure we can keep doing it.*

I get my son undressed for his nightly tick check. Once rare here, ticks have spread into new areas as their habitat range increases with the warming weather. This means that ticks are active for more days each year, and in places that were formerly inhospitable to them, like my backyard in Maine, the state which now has the highest incidence of Lyme disease in the country.

It's early summer now, and I find ticks on myself almost daily. I sometimes reach up to scratch an itch behind my ear, or on my arm, and find a tick crawling on me instead. I feel revulsion, then rage. I dream of chairs turning into ticks, of ticks in the barn, ticks in the car. I fear finding a tick on me. I fear not finding a tick on me, knowing it could be there, a tiny poppy seed-sized arachnid digging into flesh. I feel resentful of these nightly tick checks. It's hard enough getting a toddler into pajamas, but getting him to stand still while I comb his entire body with my fingers and eyes? He runs around his room, naked, laughing. "Stay still," I say, but no, this is a game. "Chase me Mama," he screams. I turn and look out the window, take a breath. No, this is not a game. This is a very real danger. Yet, however foreboding the motive, here is an opportunity to witness my son and his sweet body, growing and changing so fast. A tiny gift wrapped up in a new ritual of climate vigilance.

WE'VE HAD OUR HOME FOR TWO YEARS, and are experiencing the hottest August on record where



What I am really doing, I now understand, is bearing witness to catastrophe.

I live. Intense humidity that doesn't lessen even at night. I feel like I'm moving through a dense, scorching fog. To cool myself, I head to the ocean, scoot gently down the rocks to the edge of the water, and slide in. The record heat waves keep on coming. It's the second warmest day in recorded history in the Gulf of Maine and the third straight year of drought on land. I talk to farmers who have resorted to feeding their cows hay twice daily, because the grazing lands are too dry to produce healthy grass. The lettuce is bolting due to the heat. "It looks like I'm growing lettuce Christmas trees in my field," one farmer says. "All I can think about is water. Water, water, water. Are we going to have enough? Are we even going to be able to grow lettuce here, in Maine, in 10 years? I'm a glass-half-full kinda gal," the farmer says, "usually. But I think we're all going down the shitter."

When I began this project, I set out to record observa-

tions on the changing climate from the standpoint of those who work the land and the sea. What I am really doing, I now understand, is bearing witness to catastrophe. Every day, I swim through a sea of change. The shoreline is changing. The winters are changing. The bugs

are changing. Every day, I listen to these stories of changes all around us. As the worries and the losses and the fears, and even the denials, pile up, my insomnia worsens. At night, I cycle through the stories I hear during the day. My belly is in knots. My breaths are swift and shallow. I stand up and go to the window. A delicate moon shines lightly on the barn. Shadows of the pines stretch out across the lawn. I put my hands on my belly and breathe in and out.

The baby comes two months later, in October. We nap during the day, awake for only a few hours before the sun drops again. We do not leave the house. We do not listen to the news. It creeps in anyway. Thick descriptions of the coming chaos are released out into the world. I read that when this baby becomes an adult, there will be no Arctic. I read that statement again. "Will live on a planet without an Arctic." I read it one more time. The baby has fallen asleep, rosy and quiet. I ask my mother to take her. I fill a glass of water in the kitchen and look out the window. In the rush of things, I had not properly cleaned up the garden or planted the garlic. The garden beds, now frozen, are still full of wilting kale and

slimy, brown tomato plants. The next day though, it warms up. “I’m going to plant the garlic,” I tell my husband. Instead, I sleep and feed the baby.

Several days pass this way. Finally, I put on gloves. I take the garlic from off of the top of my dog’s crate and head outside. Everything is brown, except for the sky, which is gray. The yard is soggy from too much rain. I kneel down beside the bed that last summer had lettuce. Peeling apart the cloves, I stick each one face up into the ground. It’s wet and frozen in places but still workable. I know I don’t have much time to be out here. I have not taken off my gloves, and they quickly become muddy and wet. I continue this way, taking the cloves and pushing them into crooked rows. I have no idea whether it is too late to plant garlic or not, but it feels good to dig. My back aches from the constant breastfeeding. I stand up, clasping my muddy hands, and lean one way, then the other. I look at the branches of the oak trees, dark against the gray sky.

MONTHS LATER, WE ARE SITTING IN THE KITCHEN. The woodstove is throwing light out into the room as the snow outside turns to rain. I place the baby on a blanket while I work on getting dinner organized, chopping scallions, then garlic. I read today that the Greenland Ice Sheet is rapidly melting. I crack eggs into a bowl to be whisked, putting the shells into the compost. Icebergs are melting into rivers, rapidly changing states and flowing into the sea. I look down and realize that I’ve just cracked the egg into the compost bin and put the shell into my bowl.

Changing states rapidly. The oldest ice in the Greenland ice sheet is one million years old. It contains enough ice to raise sea levels 23 feet if it completely melts. Now it is turning into rivers flowing into the sea. Now the sea rises. Soon the coasts will be uninhabitable, and mass migrations inland will begin. I look down at the baby. She stares at the logs burning in the fire. Then she swings her body onto its side. She is stuck there, breathing through the side of her mouth pressed into the rug. She seems driven to roll. She is happy on her back, looking, but then she starts to roll again. She falls back and starts the roll again. She does not know the outcome. She knows only to try. Again, and again, and again.

Climate change is destabilizing our present by undermining our future. I used to feel like I had a rough idea of the future, because I could extrapolate from the past. The world of my children will be similar to the world now. Climate change has changed that. I can no longer envision a future based on the present. Yet hasn’t it always been that way? We trick ourselves into thinking our lives are predictable, stable, that

we can depend on certain things, among them, tomorrow. But I could die in a car accident tonight or find out I have cancer next week. The false certainty of tomorrow is a veil we willingly don in order to preserve our sanity. The difference is that now, not only can I not count on my own life continuing, but I cannot count on other forms of life continuing. I can no longer count on the planet to continue, in its current form.

There are moments when it all seems overwhelming. Frantic nights falling asleep sitting up with the baby, waking at 3 a.m., then 4, then 5. Stealing moments to read and, ideally, write, during the day. *The forests are burning. The ice is melting. The soils are eroding. The insects are dying.* It feels both urgent that I work and impossible to put my head down and work when the world out there is fraying. My eyes hurt. My head hurts. My heart hurts. I can’t think about this anymore.

Here is the terror and the gift. Climate change reminds us that we cannot know what the days after this day will bring. It reminds us that each moment is one in a string of uncertainties. This is the challenge: Can I let go of my need to know the future and let today be enough? I do not know what my baby’s world will be like. But I do know that today, she is learning to roll over. Today, right this very moment, the garlic cloves that I planted are sprouting up through the soil in the garden. Tenacious, they reach for the sky.

JUST BEFORE THE BABY IS BORN, Lyman takes me out on his boat for the morning. We stop for bait, then motor out into the bay. It is a hot September day. The bay shimmers. I immediately get seasick and have to sit along the edge of the boat, looking at the horizon. Every few minutes I stick my hand into a bucket of seawater and splash my face and neck. I watch Lyman and a sternman pull traps, circle the boat around and pull more traps. They glance at me uneasily. Lyman revs the engine. They twist the rope up and attach it to the winch hanging on the side of the boat, flip a switch, which pulls the trap up. They take out the lobsters, throw them into cones to band later, and pull up the next one. We do this for a while, then begin heading back in. We are motor-ing along when I think I see a butterfly ahead of us. Is that a monarch? I ask. Sure is, Lyman replies. We watch as it jerks up, then down, with the breeze. This tiny butterfly floating above the blue bay. ■

Kate Olson is a PhD Candidate at Boston College and lives with her family in Maine. Learn more about her multimedia project documenting lived experiences of climate change in Maine at www.livingchange.blog and follow her on Instagram and Twitter @livingchangeme.

What Lies Beneath

Underland: A Deep Time Journey

ROBERT MACFARLANE

W.W. Norton & Company, 2019, 425 pages

Long story short: There is an extraordinary world beneath us. Places of severity we can't see and know little about. It is into these dark worlds, deep inside the earth, that author Robert Macfarlane journeys in search of knowledge in *Underland*.

In this sequel to his bestseller *The Old Ways*, nearly ten years in the making, Macfarlane explores our relationship with darkness, burial, and what lies beneath the surface of both place and mind. Like the brilliant professor you had in college, and with an unsparing eye for detail, he explores the subterranean spaces of our 1.9 billion-year-old planet with storybook clarity. But his primary interest is the relationships that exist “between landscape and the human heart.”

The 425-page tome is divided into three sections: Seeing; Hiding; Haunting, and some of the chapters expose a lidar-like map of the underworld that is not an easy read. He guides us to millennial-old burial sites in Britain, a dark matter research station a half-mile below Yorkshire, which is dedicated to understanding the birth of the universe, and remote Arctic cave-art sites on Norway's northern coasts.

Macfarlane examines not only the physical dimensions of this underworld, but also its manifestation in human imaginations — in our mythologies and literature. “In the underworld three tasks recur across cultures and epochs: to shelter what is precious, to yield what is valuable, and to dispose of what is harmful,” he writes.

The blood of the book rises when he goes underground, at times “moving along by squirm, the sense of the rock as a hand pressing down first on the skull, then the back, then the whole of the body, a moment spent briefly in its grip.”

He joins spelunkers pinballing around caves, enjoying a camaraderie that doesn't require words. In other deep places, he joins thought-provoking scientists alive to the idea of living in the moment. “If we're not exploring, we're not doing anything. We're just waiting,” a physicist tells Macfarlane.

In the Epping Forest bordering London, fungal networks divaricate woodland soil, joining individual trees into intercommunicating forests, a cooperative system in which

trees *talk* to one another. At the burial sites in the Mendip Hills of Somerset, where human bodies from the Neolithic era rest, Macfarlane ponders how we are often more tender to the dead than to the living. Traversing the catacombs beneath Paris, he reflects on Victor Hugo's words in *Les Misérables*, “Paris has another Paris under herself.” Limestone quarrying began under the city in the twelfth century — Paris was literally built from its own underland. But the City of Lights also needed to store its dead, so the underworld became *Les Catacombs*.

In the Slovenian Highlands MacFarlane ventures along a deep, mile-long cave system atop glacial ice, which served as “ideal geology for guerilla war” during World War II. “Mountains were seen no longer as solid structures, but as honeycombs that could be opened,” he writes. A good descent was rock fall that didn't hit you, gas that didn't asphyxiate, shoulder-to-the-wall holes that didn't trap you.

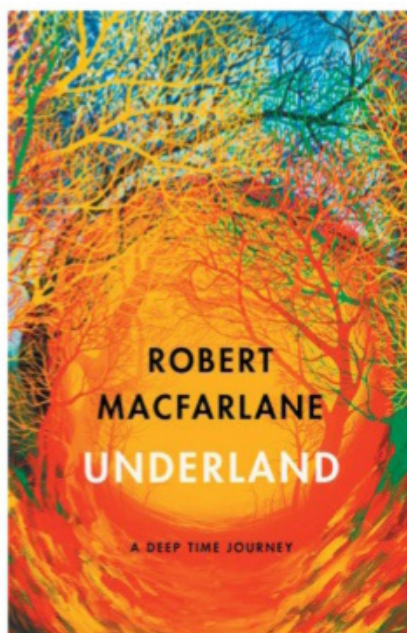
Deep time is the chronology of the *Underland*. The timespans in this realm can stretch millions of years. And yet, geology knows no such word as “forever.” Deep time runs forward as well as back. It's a dynamic earth cycle — mineral becomes animal becomes rock and in deep time supplies calcium for new organisms to build their bodies.

But *Underland* isn't just about inspiring awe about places and histories unknown. It is, in essence, an exploration of the fragility of our existence on Earth. McFarland highlights in the book what he calls “Anthropocene unburials:” Reindeer buried in glacial ice a few lifetimes ago are now turning up replete with anthrax spores; an American Cold War missile base containing toxic chemicals, sealed under Greenland's ice 50 years ago, now moving up towards the surface; heatwaves in Britain causing the imprints of ancient burial barrows to come into view.

These unburials, he points out, reveal the terrible harm we are doing our world. “What will survive of us is plastic, swine bones, and lead-207, the stable isotope at the end of the uranium-235 decay chain,” he writes.

It may all seem a stretch, but there it is. Macfarlane could probably get a free beer in any bar in his native England telling any one of these stories. ■

— GERRY WINGENBACH



Animal Talk

Becoming Wild: How Animal Cultures Raise Families, Create Beauty, and Achieve Peace

CARL SAFINA

Henry Holt and Co., 2020, 384 pages

Ecologist and author Carl Safina asks readers to consider one central question in his latest book, *Becoming Wild: How Animal Cultures Raise Families, Create Beauty, and Achieve Peace*: As we make our way through life on a shared planet, “Who are we journeying with?”

He untangles this seemingly straightforward question by digging into the lives and communities of three other animals, learning about their customs and cultures from the biologists who have spent their lives studying them. He turns to Shane Gero, who has been tracking sperm whales in Caribbean sea since 2005, to learn about the massive cetaceans. He learns about macaws from Donald Brightsmith and Gaby Vigo of the Tambopata Macaw Project, which studies the birds in order to protect them, and he looks to chimpanzee communication and cognition expert Cat Hobaiter to learn more about our primate cousins.

One commonality between the three types of animals jumps to the fore: their *joie de vivre* is in connecting with family, friends, and mates. Whether at sea, in air, or on land, they are part of a group, and thus never lonely.

As Geros explains to Safina, “The main thing I’ve learned from the whales is that your experience of the world depends on who you experience the world with. Who you’re with makes you who you are.”

Much of that experience comes down to constant communication. Sperm whales use more than 80 codas — repetitive clicking songs that can be compared to human words — to identify clan, self, family. Macaws use calls, squawks and screams to communicate, while chimpanzees use noises, gestures, and postures to convey messages and emotions.

Safina’s big idea is that these animal groups have communication-based transmissible cultures, and these cultures change in response to environmental stressors, peer pressures, and even creative urges. Grey whales offer an example. When they were being hunted to near extinction

along the Baja California coast in the 1700s, survivors migrated to Hawai‘i, where they had never previously lived. They continue to live there to this day. He sees this as potential evidence that these whales, knowing the risks elsewhere, decided to move together and keep this new migration pattern.

While this ability is an asset in many cases, it can also put these animals at risk. If we continue to encroach on wildlife habitats, and force species into miniscule populations, they will lose their group culture. Animal culture crashes are a lonely prelude to extinction.

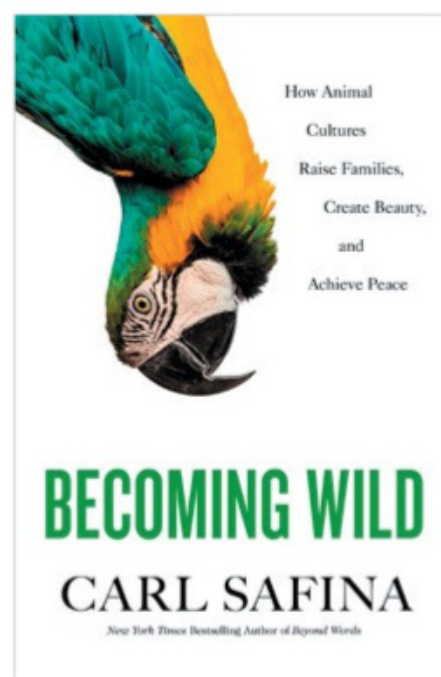
Safina is viscerally distressed by the violence built into chimpanzee culture, but concludes that their capacity for altruism and social cohesion feels especially relevant in today’s political climate. Watching chimpanzees make up after conflict, Safina realizes, “Reconciliation, forgiveness — this is the path *back* from the brink. It’s what holds the center, *creates* peace when peace is needed, and *maintains* peace when peace is in jeopardy.”

The biologists profiled in this book may be creating cross-species Rosetta Stones, but it is slow going. We still lack the fluency to fully understand our animal kin; given the limitations to cross-species understanding, Safina urges us to embrace other species simply because they are. “Beings who’ve succeeded on Earth for millions of years don’t seek, and should not require, our approval. They belong as do we.”

In addition to his modern-day research, Safina has an engaging relish for nineteenth-century observations about animals that feel shockingly fresh. Darwin, for example, knew that primates used tools, that beauty drove natural selection, and that animals had deep feelings. He refers to the 1839 book, *The Natural History of the Sperm Whale*, as a forgotten gem. And from Safina’s vantage point, Herman Melville’s *Moby Dick* is not an archaic, macho classic, but an excruciating exploration of America’s murderous capitalist urges suffused with a tender appreciation for whales, floating us towards co-existence.

If Safina can make me want to read *Moby Dick*, he can make readers want to protect animals and their cultures. ■

— MELINA SEMPILL WATTS



Becoming a Vegan Treehugger

by Jessian Choy

I come from a very “special” family. By “special,” I mean dysfunctional because of intergenerational trauma. My grandparents on both sides didn’t have the happiest of marriages. These are some of the only explanations I have for my parents’ repetitive, bewildering “I-hate-you-don’t-leave-me” and “that-never-happened” messages, and their ugly divorce that dragged on for years. My parents and grandparents didn’t talk about their trauma and I’m not supposed to talk about it either. But I’m telling you a bit about my own wild ride because I hope speaking about it can help heal people and maybe even our planet.

I could write a book about my childhood, but the G-rated, short version is that now when I read my diary — which my mom started editing and inserting her own commentary into when I was five years old — I see that I was like any kid living in chaos: I needed to feel I had control over at least some aspects of my life. So, when I was 12 I began fighting to control how little meat I could eat. I also did it because I learned at the Nature Store at the mall that the Amazon forest was being cut down to raise cows for meat.

Now I eat vegan for the animals — because I saw the *Dairy Is Scary* video (it’s X-rated!) and it’s the top thing I can do to reduce my environmental impact. I haven’t come out as vegan to my dad though. (I’m sorry-not-sorry, Dad! I know you didn’t come to the USA to raise a feminist, vegan, treehugger.)

As a kid and a teenager, I used to be very shy. I never joined clubs or volunteered to speak in class. I now see it was because I was unpredictably punished at home, whether I spoke or not, and

was wary of drawing attention to myself. But in college when I discovered the bus in my neighborhood stopped service at 5 p.m., which made it hard to take night classes at the University of California, Santa Cruz (UCSC), I decided I had to speak up for myself and other students. And once I started speaking up, there was no stopping.

As the only student on a UCSC transportation committee full of administrators, I researched for months about how to have a bigger voice. Then I found the University of Colorado Boulder had what seemed to be the only campus sustainability office with permanent funding for student-led projects in the entire United States. So I had this wild idea to start another one. We brought students, faculty, and administrators together to create a sustainability plan for the University that would do more than improve public transit options. A year later, I received a Brower Youth Award from Earth Island for that work.

It wasn’t until I received that award at age 20 that I learned to not have my whole body shake whenever I spoke up for myself, for others, for animals, and for our environment. But the more I spoke at events and attempted to program people to spend every waking moment trying my fun and draconian tricks for a happy, equitable, green world, the more I found that most people didn’t like to be told what to do.

According to the classes I took in behavior change, negotiation, and user experience, telling people why and how to change does not significantly change behavior. So before I invite someone to try something new, I now always try to make it safe for them to tell me

one-on-one what their first barrier is.

Now that I’ve found my voice — and figured out some effective strategies to communicate my ideas — you can’t shut me up. And, you know what? People, and even some big corporations, have started listening!



Yes, I’m *that* person who mailed her Thinx menstrual leakproof underwear to a professor for testing. He found toxic chemicals like PFAS (which is linked to cancer, never degrades, and is not easily filtered from drinking water). Barely two weeks after my article was published, companies making period underwear called for stricter laws to regulate them.

I hope my story gives you the confidence to speak up for what you care about. Because if there’s one thing I’ve learned, it’s that each of one us has a bigger voice and more power than we might think. ■

Jessian Choy (“she/her” not “guys”) is an Earth Island board member. She co-creates green product policies at SF Approved, and tries to make you laugh in *Sierra’s Ask Ms. Green* column and videos.

PHOTO SAM MURPHY

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