UNIVERSITY OF COLORADO BOULDER

ARTS & SCIENCES

2022–2023

Earth in the Balance

LEADING EXPERTS PUSH OFF THE TIPPING POINT

College of Arts and Sciences

UNIVERSITY OF COLORADO **BOULDER**

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EARTH IN THE BALANCE

This edition of the Colorado Arts and Sciences Magazine *outlines a few of the many ways experts from our college and university strive each day to tip the scales on climate change and environmental issues. Whether it's grappling with appropriate policy responses, mitigating climate change's potential damage or educating the next generation of scholars, this edition reminds us of the resources we have and how much we have to protect.*

In December, CU Boulder co-hosted the Right Here, Right Now Global Climate Summit with the United Nations, which focused on human rights and climate change. We're immensely proud to have supported that summit and pleased to present this complementary snapshot.

This magazine is printed on 30% recycled paper.

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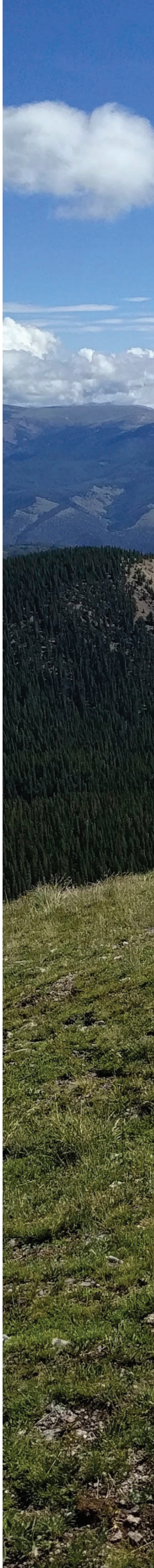

Right: Dan Doak (foreground), an environmental studies professor, and graduate students conduct fieldwork on Niwot Ridge, which is above timberline near the University of Colorado Boulder's Mountain Research Station. Photo courtesy of Dan Doak.

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BY GLEN KRUTZ

Breaking the stalemate on environmental policymaking

As a teacher, scholar and citizen who has spent considerable time researching climate change policymaking, I understand why people are frustrated at the pace of change—if it happens at all. I've seen that slow pace firsthand having worked as a staff member on Capitol Hill in Washington, D.C., prior to becoming a professor and, this year, joining the University of Colorado Boulder.

However, I have also seen that progress is possible.

I worked on environmental issues for Sen. Richard H. Bryan (D-Nevada). Later, as a graduate student and professor, I conducted research on environmental policymaking in Congress and the bureaucratic structure of federal environmental rulemaking.

That experience and my time in higher education taught me to consider the challenges and opportunities in U.S. environmental policymaking. As explored in a feature story inside ("Why does climate policy lag climate science?" Page 6), perhaps the greatest challenge to prompt policy action on climate change in the United States is the massive degree of institutional fragmentation in the U.S. system.

Our country's founders created a policy gauntlet, what with division of powers (shared authority between the federal government and the states), separation of

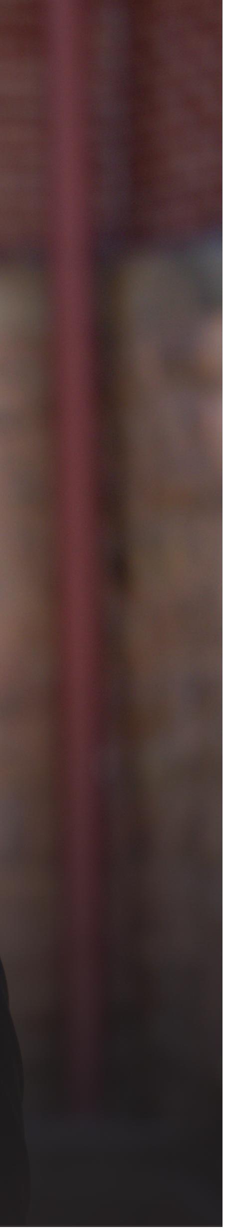


Photo by Glenn Asakawa/
University of Colorado Boulder.

powers between branches of the government (executive, legislative, judicial), and bicameral (two-house) legislatures.

Moreover, environmental issues crosscut or intersect with many other policy areas, meaning that it is common for environmental issues to be taken up in multiple legislative committees and in multiple government agencies (who can get in each other's business).

In the U.S. political system, there are myriad ways to block policy change. To enact new policy, however, significant effort is needed to coordinate across the system. Supermajority requirements for the passage of bills and treaties in the U.S. Senate, the representational setup of which (two senators per state) means that a group of legislators representing a small minority of the U.S. population can block policies favored by the vast majority.

Working on Capitol Hill in the early 1990s, I saw these anti-majority tendencies emerge on legislation that Sen. Bryan introduced on fuel efficiency standards, which was supported by 58 out of 100 senators, passed the House, and which President George H.W. Bush vowed to sign. However, two senators threatened a filibuster. With 60 votes needed to overcome the potential filibuster, the majority leader shelved the legislation. A similar bill finally passed more than 20 years later, in 2012.

While the American political system has much fragmentation, there are benefits to our structure. For one, with so many different levels of government, branches, committees and agencies involved in environmental policy, there are many places from which new ideas and innovation can occur.

Those different institutions can also serve as testing stations for new policies to see if they will work well before they spread. Finally, given that there are so many institutions to which citizens and groups may bring their ideas, our structure is more accessible to a diversity of opinions than more top-down governmental systems.

Still, the veto-points problem is real; there are many hurdles that can stall new and innovative policies. Yet there is no real possibility of constitutional reform to quicken climate change policy, be it reforming the Senate or lowering the threshold (two-thirds) needed to enact a treaty.

A positive chord may nonetheless be sounded on the possibilities for policy change despite our institutional fragmentation. My research has explored key institutional changes that occurred in the American national government without formally changing the Constitution—changes that facilitated major innovations.

"A positive chord may nonetheless be sounded on the possibilities for policy change despite our institutional fragmentation."

In the legislative process, to circumvent committee jurisdictional battles, House-Senate skirmishes and endless presidential veto threats, Congress began to use omnibus legislation to enact many major policies. Omnibus bills are massive bills with a popular nucleus (often a budget package) and containing numerous policy "riders" from various policy domains that on their own might struggle to pass through all the veto points in the process.

Budget reconciliation is an omnibus process that has been increasingly popular to use because these bills often have wide support and also because senators may not filibuster these bills. In the area of international agreements—so important for fighting climate change in terms of striking international accords—gaining a two-thirds majority in the Senate to consent to a proposed treaty is often not in the partisan cards.

Though sometimes controversial, the use of executive agreements by presidents instead of treaties (the implementation legislation for which requires only a simple majority in the House and Senate) has become quite popular. The Iran nuclear deal was codified as an executive agreement.

While not cure-alls, these types of innovations show some creativity by political actors to find ways to get things done in the presence of a very complicated set of institutions. Through channels such as these, the nation might ultimately realize climate change policy innovation.

Glen S. Krutz

BY CLAY BONNYMAN EVANS

Why climate policy lags behind science

Despite the Inflation Reduction Act, U.S. progress on climate change remains stuck in a climate conundrum, experts say, hampered by politics, complexity and the scope of the problem

Illustration by Marko Matovic

The climate is changing quickly—that much is clear. And yet, despite recent gains, climate policy seems to move at a glacial pace.

In 2021, the average temperature of the surface of the Earth, both land and water, was 1.51 degrees Fahrenheit higher than the average for the 20th century, according to the National Oceanic and Atmospheric Administration.

It was also the 45th consecutive year that global surface temperature rose above the average for the last century. And the nine years since 2013 are all in the top 10 warmest years ever recorded, with 2020 and 2016 tied for the warmest ever.

Meanwhile, the number and length of heat waves has grown every decade since the 1960s, snowpack seasons have decreased by an average of 18 days in 86% of sites measured, and the rate of flooding on the East and Gulf coasts has increased since the 1950s and continues to accelerate, according to the U.S. Environmental Protection Agency.

The August passage of the $369 billion Inflation Reduction Act, laden with funding for climate solutions, is widely seen as an important step in addressing the acceleration of harmful impacts, even if some, like the environmental group Earthjustice, bemoan that its "troubling giveaways to fossil-fuel interests will cause undue harm."

Even so, the United States' pace in taking mitigating climate action remains well behind the rest of the Western world. According to two academics from the University of Colorado

"We need to be working on democracy and the way we have civil discourse in Congress. ...But I don't think we have to fix democracy before we alleviate the negative impacts (of climate change). We need to be doing both in tandem, and a whole lot more."

Boulder, the reasons for the lag are varied and complex, from an outdated political system to money in politics, lobbying by industry, a fractured media landscape, the global nature and vast time scale of climate change, and even the COVID-19 pandemic.

For Srinivas C. Parinandi, assistant professor of political science at CU Boulder, the problems start at the very founding of the nation, decades before the invention of the internal-combustion engine, much less the problem of global climate change.

"One of the biggest obstacles is the nature of the American political system, specifically that the Senate gives small, rural states outsized political power and the ability to derail legislation they don't like," he says.

"As it turns out, an act of God or whatever you want to call it, most fossil fuel deposits happen to be in smaller, predominately rural states."

Parinandi notes that fossil fuel companies have had more than a century to build political relationships in small-population states such as Wyoming, West Virginia or Alaska, "and those don't deteriorate overnight."

Max Boykoff, CU Boulder professor of environmental studies and author of *Creative Climate Communications: Productive Pathways for Science, Policy and Society,* agrees that "intensive lobbying by carbon-based industry" has contributed to a political culture "that has not been conducive to coordinated action."

Industry groups have for years funded shadow groups, think tanks and even advertising campaigns to promote their interests and "slow down, distract and delay" action, Boykoff says. Which isn't all that surprising, he notes, quoting muckraking writer Upton Sinclair: "It is difficult to get a man to understand something, when his salary depends on his not understanding it."

Boykoff cites lobbying, the influence of money in politics, gerrymandering and skewed budgetary priorities as impediments to political reform. But while some argue that real action on climate change won't be achieved in the

Congressman Joe Neguse (left) and former Speaker of the House Nancy Pelosi (right) address members of the media after their roundtable meeting at the National Center for Atmospheric Research in Boulder, Colorado, to discuss how the Inflation Reduction Act will affect scientific research and innovation. Photo by Helen H. Richardson/The Denver Post/Getty Images.

absence of major political reform, he believes both can—and should—be tackled at the same time.

"We need to be working on democracy and the way we have civil discourse in Congress," he says. "But I don't think we have to fix democracy before we alleviate the negative impacts (of climate change). We need to be doing both in tandem, and a whole lot more."

"When I teach a bunch of 20-year-olds, I use the analogy that you should eat a salad rather than a cheeseburger, so that you won't have a heart attack in 30 years. You can't wait until cholesterol is clogging your arteries. It's the same logic with climate change."

For Boykoff, the scale and complexity of a problem whose effects literally span the globe and won't be fully realized for centuries—he calls it "possibly the most complex environmental policy negotiation ever undertaken"—make it difficult for a political system oriented toward short-term election cycles to address. Politicians must cater to voters, who often do not even consider the dangers of climate change unless they have been directly affected, he says.

Parinandi agrees, noting the vexing fact that the human brain is notoriously limited in its ability to react to long-term threats.

"Many voters tend toward obstinacy because they don't see how it is going to affect them," he says, adding that many in the public also struggle to grasp the time scale involved in climate change.

"When I teach a bunch of 20-year-olds, I use the analogy that you should eat a salad rather than a cheeseburger, so you won't have a heart attack in 30 years. You can't wait until cholesterol is clogging your arteries," he says. "It's the same logic with climate change."

Parinandi believes that two-plus years of the COVID-19 pandemic have exacerbated problems of partisanship: "The pandemic isolated people, encouraging them to go home, close the door and not interact with other people. And when you are not used to hanging out with people different from you, or people, period, you lose the ability to connect and compromise."

Max Boykoff, an environmental studies professor, speaks to a climate delegation from the European Union in May 2022. Photo by Glenn Asakawa/ University of Colorado Boulder.

Srinivas Parinandi is an assistant professor of political science at CU Boulder. Photo by Timothy Grassley.

He sees a shift from "evidence-based arguments to group affiliations" and notes that many Americans who appear to be doing objectively well are "successful and angry, swayed by (partisan) media." He faults partisan media, especially media that advance "nativism," for turning away from science and becoming openly disdainful of education, which renders some voters skeptical toward data about the dangers at hand.

Boykoff concurs, citing a "fractured media environment, which means many aren't hearing the data and reality" about climate change.

Still, Boykoff and Parinandi are encouraged by the Inflation Reduction Act, which contains scores of provisions, from electrifying the U.S. Postal Service fleet to investing in clean-energy technology, designed to reduce emissions by 40% by 2030 and improve the economy.

"The Inflation Reduction Act was smartly designed to also address jobs and produce well-paying green jobs," Boykoff notes.

Passage of the bill fell along party lines, requiring the approval of U.S. Sen. Joe Manchin, Democrat of West Virginia, despite heavy pressure from coal and petroleum industries.

"Manchin's willingness to collaborate was a great sign. I think (members of Congress) are starting to recognize that the status quo is not sustainable forever," Parinandi says.

He is also encouraged that major energy companies are beginning to pursue their own, more climate-friendly, policies independent of Washington politics.

"Green energy is taking off," Parinandi says, citing the example of Xcel Energy, which provides electricity to millions of customers in Colorado, Texas and New Mexico. "They are one of the largest, and they weren't always behind green energy. But they are behind it now, and they are able to finance their preferred candidates."

Despite the obstacles, Boykoff says he's buoyed by shifts in public discussion over climate change in recent years.

"Discussing climate change in the here and now is proving very effective, rather than talking about distant time or distant places, and I really think that has changed dramatically over the last two years," he says.

"This isn't a single issue; it's a set of intersected challenges that influence how we live, work, play and relax every day. It's not just a thing to debate on the stage of the Democratic National Committee."

Tom Veblen, Distinguished Professor emeritus of geography, on the Centennial Trail. Photo by Casey Cass/University of Colorado Boulder.

BY CLAY BONNYMAN EVANS

Beleaguered forests are losing ground

CU Boulder scientist's 40-year census research finds that climate change has tripled tree mortality and forestalled regeneration

Criticizing the Biden administration's $3.5 trillion Inflation Reduction Act, a U.S. Senate candidate in Georgia singled out funding to plant and protect trees.

"They continue to try to fool you that they are helping you out. But they're not. Because a lot of money, it's going to trees," GOP candidate Herschel Walker said while stumping at a fundraiser. "We got enough trees—don't we have enough trees around here?"

A 2015 study in *Nature* estimated there are 3 trillion trees on the planet. Whether or not that's "enough," the survey also found that "the global number of trees has fallen by approximately 46% since the start of human civilization."

And according to a University of Colorado Boulder scientist who has been monitoring the health and number of trees in the Colorado high country for more than four decades, climate-driven changes in temperature and drought have not only tripled tree mortality rates in the past two decades, but also significantly undermined tree regeneration rates.

And that matters.

"If we are losing forest cover, we are going to lose a variety of ecosystem services," says Tom Veblen, Distinguished Professor emeritus of geography, who has been tracking changes in thousands of trees on Niwot Ridge west of Boulder since 1982.

Declining tree cover results in damage to watersheds as debris flow and flooding increase, and in the loss of habitat for certain species. Perhaps most destructive, the loss of "above-ground biomass" removes a vital source of carbon storage, which further fuels climate change.

"In most simulation models of ecosystem impacts of climate change . . . the trees grow back after fire. But we're not seeing that as documented for montane forests in Colorado," Veblen says. That results in "one of those nasty, somewhat unexpected positive-feedback loops that speeds up climate change because there is more carbon dioxide in the atmosphere. Even a politician in Georgia will potentially be affected by that."

Veblen came to CU Boulder in 1981 after six years of research in Chile and New Zealand, which taught him the value of establishing plots where trees could be observed long-term.

"We are not going to be able to prevent large, severe fires, so we need to be much more strategic in investing our resources to avoid or delay some of the worst outcomes of climate change."

"I knew from my research experience in the Southern Hemisphere that I wanted to put in permanent forest plots, which are essential for understanding long-term changes in tree populations," he says. "There is no substitute for that."

With money from a short-lived program funded by the state of Colorado, he and his students established 40 "long-term monitoring plots," marked 8,000 trees

While tree mortality rates remained low and stable until 1994, they have tripled since then, even in higher elevation Englemann spruce and lodgepole pine forests.

"That's not at all surprising . . . given increasing temperatures and increasing drought," Veblen says, noting that researchers have reached the same conclusions at locations across the western United States.

Meanwhile, new trees are not filling in the gaps.

Former CU Boulder graduate student Robert Andrus, now a postdoctoral researcher at Washington State University, harvested about 1,000 juvenile trees to determine their establishment dates and found that new trees grew in "pulses of single years, cooler, moister years, based on late spring and summer weather conditions," Veblen says.

But the occurrence of such years has plummeted by two-thirds in the latter half of the seven-decade record Andrus examined.

"Without cool, moist years, we're not getting establishment" of new seedlings, including after fires, Veblen says. "That's an indicator of what is likely to continue with warming temperatures."

"If we want to have forests after fires, we need to not rely on natural regeneration. We need to invest heavily in artificial regeneration."

Even lodgepole pines, famous for colonizing burned areas—the tree's cones open after exposure to fire—are failing to regenerate in some places. In areas torched by severe fires in 2002 in the Routt and White River national forests that have been repeatedly sampled over a 15-year period, there are only sparse and patchy seedlings of this fire-adapted species, which usually take root within a year or two.

Those trends have convinced Veblen and other researchers and forest managers that Western forests need a helping hand from humanity, particularly after destructive wildfires.

"If we want to have forests after fires, we need to not rely on natural regeneration. We need to invest heavily in artificial regeneration," the cultivation and planting of seedlings in strategic areas, Veblen says.

Andrus agrees. "We have bark beetle outbreaks and wildfires that cause very obvious mortality of trees in Colorado. But we're showing that even in the areas that people go hiking in and where the forest looks healthy, mortality is increasing due to heat and dry conditions alone," adding: "It's an early warning sign of climate change."

Veblen and the fire management community broadly agree that "living with fire" is increasingly challenging, as shown by modeling projections that say, "Exceptional fire seasons like 2020 will become more likely, and wildfire activity under future extremes is predicted to exceed anything yet witnessed."

In Wildland Urban Interface areas, so-called "red zones" that are abundant throughout the West, Veblen has recommendations: Property owners must still establish "defensible spaces." Building codes should be used to require less-flammable building materials. "Fuels reduction" through a combination of tree cutting and prescribed fires should be prioritized near settled areas to give firefighters a foothold.

However, Veblen says, in more remote areas, mechanical thinning alone is not effective and not practical. Instead, he says, managers are increasingly emphasizing the value of letting wildfires do the work of reducing fuels and buffering against future fire potential.

"Agencies previously tended to strongly emphasize mechanical thinning to reduce fuels, but under the kind of extreme weather conditions that promoted the 2020 East Troublesome fire, no practical amount of fuel management can fully protect homes and communities," he says.

Instead, he'd like to see resources currently dedicated to remote-area fuels reduction redirected into seedling cultivation and planting in selected, suitable areas.

"We are not going to be able to prevent large, severe fires, so we need to be much more strategic in investing our resources to avoid or delay some of the worst outcomes of climate change," he says.

Right: Then (1897) and now (2022) photos of Dakota Ridge and Sunshine Canyon. Photos courtesy of BHS S-1208, JB Sturtevant (top) and Tom Veblen (bottom)."

BY DANIEL LONG

To save a sinking city

Recent CU Boulder graduate proposes solutions for a disappearing Jakarta

"I want to restore urban systems by using resilient infrastructure to combat climate change and pollution, and to address social and spatial injustices that are occurring in contemporary society ... to create a bright future."

A taxi is trapped by a 2015 flood on Grogol Street, Jakarta, Indonesia. Photo from iStockphoto

Right: Mike Mei is a graduate student at the University of Colorado Denver. Photo provided by Mike Mei.

If you heard that Jakarta, Indonesia, was sinking, you might have no idea what to do about it. Yikang (Mike) Mei (AsianSt, EnvDes'22) has three.

Jakarta has been described as the world's most rapidly sinking city and is expected to sink up to 15 feet by 2050, which would result in one-third of the 990-square-mile metropolis becoming submerged. Climate change, ineffective governance and eroding shorelines are all part of the problem. However, one especially potent cause, says Mei, who researched this for his senior capstone project, is the unregulated pumping of groundwater caused by inequitable water distribution.

Such inequities, Mei argues, can be traced back to the early 17th century, when Jakarta was known as Batavia, Dutch East Indies.

"The European colonizers separated themselves, Chinese merchants and Malaysians from Indigenous Javanese by constructing canals and bridges," Mei explains. One consequence of this separation was unequal access to clean water.

As the city expanded, Mei says, these water inequities became part of the city's fabric, its infrastructure, and have lasted to this day.

"Less than one-third of Jakarta's estimated 12 million residents have stable access to piped water in their household," he says. Without piped water, which is clean and regulated, these residents are compelled to pump directly from the aquifer, thus depleting the very thing upon which Jakarta rests.

But if bad infrastructure is the problem, Mei says, then better infrastructure—or, as he calls it, "resilient infrastructure"—could be the solution.

Based on his research, Mei believes such infrastructure would include:

- **Living Shorelines** Rather than preventing high-tide flooding using concrete barriers, which break down and are expensive to repair or replace, Mei proposes living shorelines of mangrove trees. Such shorelines, he says, can protect vulnerable communities and help receding shorelines grow back through sedimentation.
- **Permeable Pavement and Retention Basins** Concrete pavement restricts water, keeping it from seeping into the ground and replenishing the aquifer. But permeable pavement and retention basins allow water to pass through, thereby replacing water lost through pumping. By implementing retention basins and permeable pavement, water can infiltrate the land, instead of just flooding," Mei explains.
- **Natural Channel Design** Mei suggests redesigning river channels in a way that works with, rather than against, water, a change that would reduce flooding and water damage. One way of creating such channels, he says, is with lots of greenery. "The dense vegetation can stabilize soils and create habitat for urban wildlife."

Mei began thinking about this topic in Asian Studies 4500: Urban Asia and continued working on it for his capstone project in Asian Studies 4830: Senior Seminar in Asian Studies, both of which were taught by Lauren Collins, program director of the Center for Asian Studies.

"Mei's project was particularly interesting because he applied principles of environmental design and nature-based solutions to trying to solve a variety of issues with flooding and access to clean water that residents of Jakarta face," Collins says.

The Indonesian government itself, Collins adds, is looking to handle the issues of a sinking city in another way.

"The issues related to the sinking of the city are so bad that the Indonesian government is planning to move the capital from Jakarta to a new city to be built on the island of Borneo in the province of Kalimantan."

Mei believes moving the capital would be a mistake. Not only would it fail to fix Jakarta's problems, but it would also force the native tribes of the Borneo Jungle to relocate.

"It's a rainforest with one or two Indigenous tribes," Mei says, "and the government went there and said, 'Hey, let's construct an entirely new capital city.'"

That approach clashes with Mei's reasons for studying environmental design, first as an undergraduate at the University of Colorado Boulder and now as a graduate student at the University of Colorado Denver.

"I want to restore urban systems by using resilient infrastructure to combat climate change and pollution, and to address social and spatial injustices that are occurring in contemporary society," he says. His ultimate goal: "to create a bright future."

"It is such a cliché," he says. But that, in his view, doesn't make it any less worth pursuing.

Bill Bowman works with a student up on the tundra. Photo by Patrick Campbell/University of Colorado Boulder.

BY CAY LEYTHAM-POWELL

‘Classroom in the sky’ inspires generations of researchers, students

As the Mountain Research Station celebrates turning 100, a look back on its history—and toward its future

The sky was a perfect crystal blue as 50 undergraduate students from the University of Colorado Boulder spent their Saturday clustered around grasshoppers atop a mountain.

Plastic cages scarcely taller than the swaying golden grasses lay scattered about—some excluding the insects, others preventing their escape—all to see how the creatures responded to the vegetation within.

Rather than assist with the research, which was being conducted by a postdoctoral student from the University of Oregon, these general biology students hiked up a narrow, rugged path amid dense pine and yellowing aspens to this break in the trees, called Elk Meadow, to learn about research—both its legacy and its future almost 10,000 feet above sea level.

Just north of Nederland, about 26 miles from Boulder, is CU Boulder's "classroom in the sky"—the Mountain Research Station. It is the university's highest research facility and is home to some of the world's longest-running alpine research, from how trees respond to increasing wildfires, to the charismatic little pikas and chickadees that call these slopes home, to the changing composition of the soil itself.

Graduate students and some undergraduates in the natural sciences find their way here. And yet general biology students have rarely had the opportunity to visit and learn about the facility—until now.

"You usually see graduate students or faculty or staff up there, but undergrads are rarer," explains Warren Sconiers, an associate teaching professor in the Department of Ecology and Evolutionary Biology (EBIO) at CU Boulder and the trip's organizer.

"We want them to know what opportunities there are in research, and as soon as they realize it, and as soon as they want to (participate), get them out here as a part of the research at Boulder."

The Mountain Research Station's legacy

The Mountain Research Station has long been a pilar of support for alpine research and education. And that legacy is clear in the make-up of the place itself—from classrooms and offices to a dining hall and living spaces to bird-nest boxes used to study hybridization hanging on pine trees.

The Mountain Research Station, originally known as Science Lodge and Science Camp, was built in 1920 on what once was federal land. It is one of the oldest alpine field research facilities in the world, and one of the best, argues Bill Bowman, the station's former director and a professor emeritus in EBIO. Bowman says that is in large part because of the staff that make this place run and the expert leadership of John Marr, who became the station's director in 1950.

Marr founded many of the programs the station is now known for, like the Mountain Climate Program, and provided the scientific groundwork for the current Niwot Ridge Long-Term Ecological Research (LTER) program, which is funded by the National Science Foundation and researches how mountain ecosystems are transforming in response to climate change. It is the only LTER spot focusing on alpine environments in North America and is one of the original LTERs, continuously funded since 1980.

Additionally, through the Mountain Climate Program—created to evaluate the relationship between climate and the major ecosystem types of the Front Range—the station is home to the longest continuous record of greenhouse gas measurements in the continental United States, found above timberline at around 11,500 feet, and the second-longest in the world, behind only the station on Mauna Loa in Hawaii.

"It's really been one of the main places on the planet where we've learned about long-term changes in climate and mountain ecosystems," says Scott Taylor, the station's director and an associate professor in EBIO. "The long-term data that's been collected here is really priceless, and I think being at a place that's contributed so much to our understanding of long-term change in climate and ecosystems is really special."

"It's really been one of the main places on the planet where we've learned about long-term changes in climate and mountain ecosystems. ... The long-term data that's been collected here is really priceless."

In addition to the LTER program and Mountain Climate

General biology students and Warren Sconiers (farthest away) listen to a research presentation by a University of Oregon postdoctoral student in Elk Meadow. Photo by Ethan Geiger.

Ernie Wahlstrom, former vice provost, lecturing at the field station in 1946 to a crowd that includes John Marr, the station's director.
Photo credit: University Libraries.

Program, the Boulder Creek Critical Zone Program and the National Ecological Observatory Network (NEON) also conduct research near the station.

"We wouldn't be able to do half of what we've done at the Mountain Research Station if it weren't for (Marr's) efforts," Bowman says.

Taylor agrees, adding that the Mountain Research Station is "really unique. . . . Lots of places have research stations, but not a lot have this kind of history."

That history, though, extends past just data to the people who have found their way here through the decades.

Generations of care

Bowman became involved with the station in the 1970s as an undergraduate in environmental, population and organismic biology (now EBIO and integrative physiology). At the time, Bowman worked with a graduate student in the lab of Professor Emeritus Jeff Mitton, who was studying forest genetics and needed help getting pine needle samples to run genetic analyses on them. Bowman, who loved to hike and snowshoe, volunteered.

Fast-forwarding through multiple graduate degrees, Bowman found himself back in Boulder, but this time as a professor. He was invited to participate in the LTER program, which at that time was more concerned with physical-environment conditions than with biology. Through his participation, Bowman began researching plant ecology and what factors determined which plants occurred where, how communities came together to alter the diversity, and how that influences ecosystem functioning.

"We wouldn't be able to do half of what we've done at the Mountain Research Station if it weren't for (Marr's) efforts."

It was through Bowman's lab that Katharine Suding, now the principal investigator for the LTER program and a Distinguished Professor in EBIO, became involved in the program, then as a postdoctoral researcher.

Construction of the alpine laboratory—now called the John W. Marr Alpine Laboratory or Marr Lab. Photos from the University Libraries.

“Climate change is a factor that’s going to become more and more important in how the station operates.”

In 1990, a few years after Bowman began his alpine research, he became the station’s director and stayed there for 30 years, until his retirement in 2021.

During his tenure, many repairs were completed on the station, including upgrading infrastructure and building the Moores-Collins Family Lodge and Kiowa classroom, which is across the parking lot from the Marr Lab, where the main offices are housed. He also helped start or expand several large research programs, which provided data for something that Bowman saw firsthand for decades: the effects of climate change on the station.

“I’ve clearly seen climate change come and establish itself as being something that we recognize and we can see symptoms of,” Bowman says. “Climate change is a factor that’s going to become more and more important in how the station operates.”

Additionally, under Bowman’s leadership, the Research Experiences for Undergraduates (REU) program, funded by the National Science Foundation, was established at the station. For more than 20 years, that program has brought undergraduates, including Sconiers, from across the United States and the globe to Colorado during the summers.

“It’s gratifying for the faculty who set those (REU) programs up to be able to see the investment come to fruition and see it passed on,” Bowman says. “That’s one of the most satisfying things that I’ve gotten while being director of the Mountain Research Station.”

Inspiring those to come

Sconiers was a student at the University of California, Irvine when he learned about the station. At the time, he was interested in research and graduate school but knew he needed to join a lab to do that. He began contacting faculty around campus, and one of them, Suding, then at UC Irvine, said yes—and recommended he pursue an REU.

He applied and was accepted by the program at the Mountain Research Station. While there, he helped collect data detailing how the alpine landscape had been altered in response to climate change.

"The REU was critical for my career," Sconiers says. "It was my first opportunity to devise a project from scratch, so come up with my own ideas and have it fit into a research interest, and then I got to collect all of the data, so I got to carry it through. In class, you're just learning how this works or doing small versions of things, but this was the first chance I had to do everything."

After graduating, Sconiers was a lab tech for Suding for a year before going on to graduate school for entomology. He eventually became a professor at the University of the Ozarks in Arkansas and stayed there for a few years.

It was about that time that he ran into Suding, who told him about an opening at CU Boulder.

That brought him back to the university, this time as a teaching professor and a researcher with the Institute of Arctic and Alpine Research—which runs the Mountain Research Station—where he studies how plant species composition affects insect diversity at high elevations.

By bringing his general biology students to the station, he hopes to introduce the next generation of scholars to its possibilities.

"The idea of the trip was so the students can talk with the faculty who do research there and potentially just be up there for research and other things, so really just to take this resource that's unique to CU Boulder and introduce it to students," Sconiers says. "Let them know that you can have an interest, and that's enough to get involved."

Taylor, who hopes to use his tenure as director to make the station more visible and inclusive for everyone, is thrilled.

"There's the scientific legacy of the station, but then also there's one of inspiring generations to care about alpine ecosystems and mountain ecosystems," Taylor says.

"That's partially why I love field stations. They have such a big impact—a disproportional impact."

An aerial photograph of the Mountain Research Station. Photo by Patrick Campbell/University of Colorado Boulder.

BY SARAH KUTA

Large or small, nuclear war would wreak havoc on the ocean

New study finds that the ocean could never fully recover if a nuclear war were to break out

Scientists have a good idea of what would happen after a nuclear war on land: Soot would fill the atmosphere and block the sun, leading to worldwide crop failures and famine. But, until recently, they've understood less about how nuclear weapon detonation would affect the oceans, which cover more than 70% of the Earth's surface.

A recent study in the journal *AGU Advances* helps fill in the gaps: Nuclear war would wreak havoc on the world's oceans, causing them to cool rapidly and become choked with sea ice. Ocean marine life would die out, and marine ecosystems would take decades—possibly even longer—to recover.

"This research suggests that the consequences of nuclear conflict can be quite dire," says Nicole Lovenduski, one of the paper's authors and a University of Colorado Boulder associate professor in the Department of Atmospheric and Oceanic Sciences (ATOC) and the Institute of Arctic and Alpine Research (INSTAAR).

"Because the ocean moves slowly, when you change or perturb the ocean, it takes a long time to recover back to its initial state. The ocean would be affected for decades to hundreds or thousands of years, depending on the process. And in our experiments, it really never recovered," she says.

There are about 13,000 nuclear weapons around the world under the control of nine nations. While a few thousand weapons are waiting to be dismantled, the United States and Russia each has roughly 4,000 deployed or spare weapons—90 percent of all active nuclear weapons—while other countries have much smaller arsenals.

India and Pakistan each has 150; China, Britain and France have roughly 200 each; Israel has 100; and North Korea has an unknown number, according to Brian Toon, one of the paper's authors and a professor at ATOC and the Laboratory for Atmospheric and Space Physics (LASP).

Nicole Lovenduski is one of the paper's co-authors.

To understand what might happen to the oceans after nuclear detonation, scientists ran a series of simulations that modeled major nuclear conflicts, such as what could occur between the United States and Russia, as well as smaller wars, such as those between nations like India and Pakistan.

No matter the location or magnitude of the war, the researchers found that soot would quickly clog the stratosphere, preventing sunlight from reaching the oceans' surface for roughly a decade.

"Once soot gets up there, there are very few natural processes by which it can leave, so it hangs out there for a while," Lovenduski says. "It gets mixed all around and forms a cloud of soot around the Earth, which leads to a cooling of the climate system."

After a nuclear war between the United States and Russia, they project that global average surface temperatures at sea and on land would decline by 10 degrees Celsius (18 degrees Fahrenheit) in the three years after the conflict, triggering what researchers have called a nuclear winter.

Ocean temperatures would also drop dramatically, creating a new "ocean state for the lifetime of many organisms, including humans" long after the conflict ends, the researchers write. The colder temperatures would allow sea ice to proliferate, which would block shipping routes and major ports.

"We find an extension of sea ice even in a simulation of what you might consider a regional or smaller nuclear conflict," Lovenduski says. "Even a small conflict can have large consequences for the climate system."

The sunlight-blocking soot cloud would also make it difficult, if not impossible, for phytoplankton to photosynthesize and stay alive. Since phytoplankton, also known as microalgae, form the basis of the marine food chain, their demise would set in motion a chain reaction that would likely devastate fish and other marine wildlife populations.

"If the algae go, everything else goes, too."

On land, scientists predict that nuclear conflict would lead to disastrous crop failures. And if the world's population had hoped to replace those crops by turning to the oceans for food, they likely wouldn't find much to eat there, either.

"If the algae go, everything else goes, too," Lovenduski says. "The ocean essentially starves as a result of these nuclear conflicts."

Other takeaways

Scientists from a dozen institutions around the world collaborated on this project. And although they began their work long before Russia invaded Ukraine in February 2022, the timing of the paper's publication amid the heightened threat of nuclear war has generated increased interest in their work.

"Certainly, our study came out at a time when a lot of people are thinking more about the threat of nuclear conflict than they have in the recent past, so it's very timely, unfortunately," Lovenduski says. "The fact that our project is becoming more relevant is depressing and terrifying."

The scientists hope their nuclear war projections never become reality, but, in the meantime, they're using this line of research as an opportunity to learn more about the ripple effects of other potentially damaging events. For instance, what would happen after a massive volcanic eruption, which would also send sunlight-blocking materials and chemicals into the stratosphere?

The findings are also helpful for considering one proposed solution to climate change: artificial cooling of the planet.

"There's a lot of talk about geoengineering the climate because we made it warmer, so why don't we fix it by making it cooler?" she says. "Some of those geoengineering solutions are in line with this kind of simulation, where you loft aerosols into the stratosphere to cool the planet. This gives us an understanding of how the Earth system might respond to these types of manmade cooling events."

They also hope their paper raises awareness among the general population that any nuclear conflict, even a relatively small one, could have calamitous worldwide consequences.

"Even if there is a small, regional nuclear conflict far away from you, you can also be affected," she says. "People are coming to realize how interconnected our global society is, especially after the pandemic, and even a small conflict that occurs on one day can have huge implications for the entire Earth system for

A mushroom-shaped cloud and water column rise above Bikini Atoll from the underwater Baker nuclear explosion of July 25, 1946. Radioactive sea spray caused extensive contamination. Photo by Bill Gustafson.

BY TIM GRASSLEY

Why must we protect nature? Because we can, philosopher says.

In the book *The Wild and the Wicked,* Benjamin Hale argues that because people have the unique capacity to care for the environment, they have a moral obligation to do so

The year 2016 was especially hot. A strong El Niño event spiked global temperatures and made the year one of the Earth's warmest on record, yet the heat did not inspire action from Congress, whose skeptical majority claimed that climate change was a hoax meant to diminish freedom and disrupt a stable economy.

In December of that year, while many environmentalists were producing studies of the economic costs and benefits of conservation, Benjamin Hale's book *The Wild and the Wicked* presented an entirely different reason to care for the natural environment.

Hale contends that economic and value-based approaches to environmentalism—claims about nature's beauty, intrinsic worth or market value—can provide a morally precarious basis for environmentalism. These arguments often assume that nature is inherently valuable and lovable—a portrayal that ignores the ways in which nature can harm humans and that much of humanity's history has been spent keeping nature at bay.

"I am challenging what you might consider to be the status quo in the pro-environment discourse," says Hale, an associate professor of philosophy at the University of Colorado Boulder. "Not because I'm anti-environment at all, but because I think that, to an extent, we in the environmental community fall easily into turns of phrase and ideas that otherwise go uninterrogated just because they are commonplace within our community."

Instead, Hale argues, people should care for nature because they are uniquely capable of doing so. When human beings are environmentally conscientious, they live up to one facet of their moral potential as human beings.

"I'm trying to re-inflate a commitment to critical thinking and, ultimately, to democracy by suggesting that the burden is on us to offer justifications for taking actions," Hale notes, adding, "whatever they may be."

When nature is wicked

Hale's argument took shape when he worked as an environmental activist. While camping with other environmentalists, he heard many enthusiastically praise vistas and forests, as if this alone were the primary reason to protect nature. The praise, though, felt incomplete to Hale because he also thought about the harshness of nature—of mountain lions, forest fires and the steep drop of cliff faces.

At roughly the same time, he studied natural resource policy at the University of Arizona and worked on water policy in Washington, D.C., at the Congressional Research Service in the Library of Congress. Hale was disheartened to see that the democratic process boiled down to the pushing of individual agendas.

Those experiences helped him see the problem of environmentalists' seeking to persuade members of the public to protect nature either because it is sublime or contains valuable resources.

In 2004, he earned his PhD in philosophy from the State University of New York at Stony Brook and dove into research integrating the practical observations he'd made while working in environmental policy with the much more abstract conceptual insights in ethical and political theory.

Some of these observations grew into *The Wild and the Wicked.* In the book, Hale asks readers to observe the ways that nature can upend people's lives by noting a series of natural disasters and bad events, some from his life and others more generally.

In the book's first section, he sets the horrific 2004 Boxing Day Tsunami in the Indian Ocean beside the 1945 nuclear bombing of Hiroshima, Japan. Hale notes that both events caused equivalent, devastating human loss and economic damage, but to say they are the same ignores that the latter event was human-caused.

The distinction is important because, as an

Benjamin Hale, an associate professor of philosophy, is the author of *The Wild and the Wicked.* Photo by Benjamin Hale.

act of humans, Hiroshima can be understood as morally right or wrong. When environmentalists try to defend nature using value-based arguments (e.g., that conservation offers some economic gain or is fundamentally "good"), they overemphasize instruments of measurement.

Hale writes in his book, "If we think that we can pass judgment on an action simply by appealing to the end state of the world (or even the expected end state of the world), we become little more than moral mathematicians, assigning values of good and bad, better and worse, to possible outcomes. … The human project of ethics is reduced, then, to a simple actuarial project of crunching the numbers. If that's the case, the mathematics of morality must be a funny math indeed."

Hale steadily builds a case that human beings are uniquely able to care for the environment. Because they have the capacity to make judgments and decisions with clear justifications, people have a moral obligation to protect nature.

"The book's punchline is that the reason we should protect nature is because we are able to," Hale argues. "It places the burden on the shoulders of each one of us to offer clear justifications to one another when making decisions about what to do. We need to have a clear discussion about what's permissible and what's not permissible."

Hale says he believes this shift in thinking would change environmental discourse. Rather than forming policies by weighing the intrinsic, extrinsic or instrumental interests of individuals or groups, people could choose the best policies through democratic processes, guided by a moral compass.

"I'm laying groundwork for some form of democratic decision-making to take priority or precedence over economic decision-making, which is one of the preferred ways in which policy is set nowadays, and particularly environmental policy," Hale says. "What should have precedence is that discourse, that democratic discourse, and not the spreadsheet or the ledger of costs and benefits, which is the way that we often do it now."

By emphasizing discussion and the capacity of communities to come to shared understandings, people can work democratically to bring about positive change. For Hale, this is a far more optimistic outlook on humanity's ability to make morally right decisions. Rather than insisting that all people are inherently selfish, he says he believes they can come together and make decisions that improve their communities.

"It's a problem to believe that democracy, well done, is just aggregating the wants of every person," Hale says. "To be living in a democracy like we live in now, we should be making decisions about what's good for the community, even if it flies in the face of some of the things that we want."

"We need to act with reason that is good and justified."

BY DOUG MCPHERSON

Scholar turns righteous anger into climate action

How PhD student Brigid Mark joined the fight for environmental justice after spending four years battling a pipeline that she says fouls water, worsens climate change and erodes Native treaty rights

In 2017, Brigid Mark felt an anger like she had never experienced before.

She was at a U.N. climate conference in Bonn, Germany, listening to Pacific Islanders describe how sea-level rise threatened their islands and lives.

She recalls Marshall Islands poet Kathy Jetnil-Kijiner reading her poem, called "Butterfly Thief," which places blame for rising sea levels on fossil fuel companies, explaining the dramatic cultural and physical losses of her island, and calling for action: "You can't save this (island). But you've gotta save the rest."

"I felt angry at the injustice that, though the elite in the Global North are largely responsible for global climate emissions, the marginalized in the Global South are affected first and worst," says Mark, now a University of Colorado Boulder PhD student studying sociology. "I felt inspired by Pacific Islands' call to action."

Mark says she knew she needed an outlet for her anger. And she found it at the College of Saint Benedict in St. Joseph, Minnesota. There, she joined a climate action club and took a class where a professor, Corrie Grosse, explained that the marginalized often lead the fight against environmental harms that disproportionately affect them.

Grosse also introduced her to a movement resisting a tar sands pipeline, Line 3, right in her backyard. This pipeline carries more than 750,000 barrels of oil a day from the Alberta tar sands in Canada through northern Minnesota to Superior, Wisconsin.

"I care about the pipeline because Line 3 threatens clean water and worsens climate change," she says. "But the reason I care the most is that it violates Native treaty rights. The pipeline . . . crosses Anishinaabe treaty territory, jeopardizing their ability to exercise rights to hunt, fish and gather wild

CU Boulder PhD student Brigid Mark (left) joins a protest at a Gichi-Gami gathering to stop Line 3 in September 2019. Photo courtesy of Brigid Mark.

Mark (right) joins friends at the Treaty People Gathering in northern Minnesota in June 2021. Photo courtesy of Brigid Mark.

rice; a spill could demolish the parts of the land that hold cultural and material importance to Anishinaabe people."

Mark learned from Anishinaabe leaders that the movement against Line 3 is part of a continuing effort to confront colonization.

"We prohibit this (pipeline) from going through our homelands. . . . We want to heal and live in peace; we want to create a better world. . . . The time is now to honor those treaties," Mark recalls Dawn Goodwin, an Anishinaabe leader, explaining. "Our Earth cannot take any more. This (pipeline) is a risk for spills, and, we all know, water is life."

Inspired, Mark joined the Minnesota chapter of 350.org, a climate-justice nonprofit, and began collaborating with many others to organize resistance events against Line 3, some attended by nearly 2,500 people. She also co-published an article on the pipeline's injustices in an international journal.

Mark attributes much of her passion and achievements to the mentorship and teachings of strong women, beginning with her mom. She says during her childhood in a suburb of Kansas City, Kansas, her mom instilled in her "a deep understanding of and dissatisfaction with" injustice.

"She would often read the newspaper aloud to me, and the broken parts of our world would bring her to tears. She passed along her confidence that the brokenness in the world can and must be addressed."

It was also during her childhood that Mark fell in love with nature.

"When I was a kid, you would find me climbing the two gnarled willow trees in my backyard and catching roly polies from underneath rocks. Everything in the more-than-human world amazed me."

Mark adds, "My understanding of environmental issues began as saving the trees and the polar bears. But climate justice scholars and activists shifted my view to see environmental issues as social, where environmental problems are deeply entangled with injustices like racism and colonialism."

Despite resistance to the pipeline, it began operating in October 2021. Mark says she'll continue to fight to for its closure.

"President Biden could shut it down," Mark says. "But also, the work would not be finished. The goal of the movement to stop Line 3—and also my goal—is to see a just transition away from all fossil fuel infrastructure, to a socially just, renewable energy future. That kind of transition requires simultaneously addressing the root causes of climate crisis and social injustice."

BY KELSEY SIMPKINS

CU professor treks to the top of the world to share urgent message on wildlife

In May 2022, ecologist Joanna Lambert met with world leaders and hiked up the world's highest mountain to speak about how climate change is increasing human and wildlife conflict around the world

On a sunny day in May at almost 18,000 feet, rumbles echoed through the Himalayas as giant chunks of ice peeled off the Khumbu Glacier and crashed into the rocky valley below.

A couple hundred feet above this rapidly melting ice flow, on which Mount Everest's historic South Base Camp is situated, Joanna Lambert delivered the Inaugural Everest Address on Wildlife and Climate at the "World's Highest Climate Summit" in Nepal to a small group of brave guides, scientists and filmmakers.

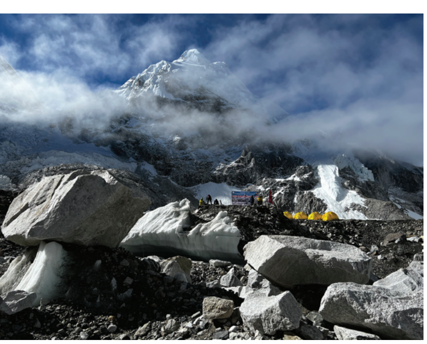
Her goal? To all but shout from the mountaintop about how climate change is increasing human and wildlife conflict around the world, harming not only people, but snow leopards in Tibet and Nepal, lions in India, and bears in the American west.

"There is nothing bigger than Everest," says Lambert, professor of environmental studies and affiliate professor of ecology and evolutionary biology at the University of Colorado Boulder. "This expedition was part of a very conscious decision to engage in something that I thought would get attention in a much bigger public way than a scientific journal article."

Lambert was joined by Colorado State University's Joel Berger (PhDBio'78). He led a presentation on Nepal's legacy on biodiversity, focusing on snow leopards and wild yaks, as well as noting the growing loss of glaciers and the effects of global warming on biodiversity.

The summit, held May 29, marked both the 69th anniversary of Edmund Hillary and Tenzing Norgay's historic summit of Mount Everest and the 75th anniversary of U.S.-Nepal diplomatic relations. The expedition was funded by the Nepal Ministry of Forest and Environment, sponsored by the Nepalese Mountaineering Association and organized by the World Record Holders Society.

Lambert and Berger were the only Americans invited to the international event, and Lambert was the only woman on the team of 20. After arriving at Lukla Airport, considered the most dangerous airport in the world, they joined local guides, Nepali scientists and a film crew—but before ascending the mountain, they squeezed in



Photos from Joanna Lambert's trip to Mount Everest, including (left to right) the climate summit setup; Lambert holding up a CU Boulder flag at Everest and meeting Nepal's vice president; and Colorado State University's Joel Berger (left) and Lambert hold flags from their respective universities in front of a graffitied rock marking the elevation of Everest's South Base Camp (17,598 feet). Photos courtesy of Joanna Lambert.

Lambert and Joel Berger of CSU stand in front a sign that says "World's Highest Climate Summit - 2022" at Mount Everest's South Base Camp. Photo courtesy of Joanna Lambert.

a rare 1.5-hour meeting with the vice president of Nepal, Nanda Kishor Pun, at the presidential palace in Kathmandu. Pun was keen to discuss how climate change was impacting his country.

By the time the team finished its 134-mile, 12-day trek to Everest's South Base Camp at 17,598 feet, Lambert had recovered from severe food poisoning, broken her toe in a freak accident and become the team's main medical expert—as the two doctors on the trip came down with altitude sickness and had to bow out. But there was never a moment when Lambert wanted to leave.

"Until the day I die I think I will always be seeking adventure," Lambert says. "This is one of the greatest, most epic, extraordinary experiences that I've ever had."

This one-of-a-kind international conference may also be the last time people ever stay at this historic base camp on the world's highest glacier, as the quickly thinning ice has become too dangerous for the 1,500 mountaineers, tourists and staff who set up camp there each year. Nepal plans to move the site down and off the glacier by 2024.

Humans and wildlife in conflict

Lambert, whose work in evolutionary biology examines how animals such as wolves, coyotes, baboons and chimpanzees adapt to different environments with and without human development, is keenly aware of the conflicts between humans and wildlife created by the growth of cities and people's desire to live near wild places.

"Humans are increasingly in conflict with wildlife for resources that are becoming scarcer and scarcer," Lambert says. "And that is a consequence of global warming and climate change all around the world, including in the Himalayas and in Colorado."

In the high-altitude habitats of Tibet, Nepal, Bhutan and Afghanistan, solitary snow leopards roam in search of prey. As climate change affects their prey's food supply and location, the snow leopards must change their ways to follow them. This has brought tahr (mountain goats) and blue sheep into agricultural areas irrigated by humans, which then draws snow leopards close to villages where they might eat a domesticated animal instead. The snow leopard is then likely killed, having become a threat to local livelihoods.

Extreme drought and wildfire can also draw large wildlife into human settlements, resulting in human and wildlife deaths alike. Asiatic lions looking for water in India are drawn into towns to drink, sometimes killing people. Wildfires reduce resources available to black bears in the Rocky Mountains, driving them to look for food from bird feeders and trash bins in town.

Appreciating the awe of nature

At such a high altitude, you think about every single step, Lambert says. She brought that sense of mindfulness back to Boulder.

"Somewhere above 16,000 feet, landscapes get truly awesome in a way that almost paralyzes you with beauty," Lambert says. "Every mountain around me was between 22,000 and 29,000 feet. There were times when I just couldn't talk. Part of that was because I couldn't catch my breath, but part of it was just that there were no words to describe what I was seeing."

While not everyone can visit Everest, she hopes more people are able to experience similarly "truly awesome" moments of appreciation for nature, which can occur in Colorado's Rocky Mountain National Park or while watching a butterfly or bird in one's backyard. For Lambert, these moments of awe inspire feelings of grace and compassion toward others and the world around her.

"We need to be reminded of how much we have, and how much we have to lose," she says.

BY BRADLEY WORRELL

Seeing environmental issues through a camera lens

In her latest research, a contemporary art history professor examines where art and environmental activism connect

For Brianne Cohen, assistant professor of contemporary art history at the University of Colorado Boulder, art is much more than an aesthetic: It can offer powerful commentary on the issues of the day and galvanize public opinion.

One such issue, ecological devastation, is the focus of Cohen's latest research into photography and video from Cambodia, Vietnam and Singapore that highlights the need for renewed attention on the kinship between humans and nature.

"These artists are having their works shown around the world in major art shows, but there's still not much being written about their wonderful work," Cohen says. "The kinds of things they are doing right now is particularly pressing and timely in terms of environmental destruction in the region and thinking about larger questions of ecological sustainability."

> "This is how we think about the world today—through a flood of imagery. And to be able to think critically about the main issues of the day through art, it's just so fascinating, and it really draws students in."

The intersection of art and the environment is not a new topic for Cohen, who teaches art, climate justice and ecology courses at CU Boulder. Now more than ever, she says, art offers an invaluable window to the world.

"This is how we think about the world today—through a flood of imagery. And to be able to think critically about the main issues of the day through art, it's just so fascinating, and it really draws students in," she says. "I think it's a great kind of language to think about how we live in today's world."

Art also has the power to be transformative at the personal level. In Cohen's case, she grew up modestly in Dallas, Texas, but was able to take a two-week trip in high school to visit major art museums in London, Paris and Italy that inspired her to make art history her life's work.

Another transformative moment came while taking an art class as an undergraduate student.

"The first time that I realized that art history could tackle contemporary issues was in college, when I took a class with an art critic from L.A.—and she exposed us to all this vibrant art-making in the city and in the region," Cohen says. "Whereas, in the past, when I was a younger scholar, it seemed art history pretty much ended in 1960 or 1970. So, to be exposed to that world was really exciting, and that made me want to study contemporary issues through art and through a visual lens."

That belief was only deepened when Cohen attended the Courtauld Institute of Art in London to obtain her MA degree and then spent three years researching and teaching in Belgium while on a postdoctoral fellowship.

The time she spent in Europe was formative in the development of her forthcoming book, *Don't Look Away: Art, Nonviolence and Preventive Publics in Contemporary Europe,* set to publish in spring 2023, which examines contemporary European art as it grapples with thorny topics such as immigration, xenophobia and Islamaphobia.

It was also during that period that Cohen began taking periodic trips to Southeast Asia, where she discovered the vibrant, compelling art created there.

"I'd say in the past 10 years I became much more interested in environmental issues as artists there were tackling them," she says.

Above left: Khvay Samnang, *Popil* (2018), video still.

Above center: UuDam Tran Nguyen, *The Long Serpents* (2015), photograph.

Above right: Nguyễn Trinh Thi, *Letters from Panduranga* (2015), video still.

Below: Khvay Samnang, *Rubber Man* (2014), photograph.

All photos courtesy of Brianne Cohen.

"I was thinking about how, especially artists in the U.S. and Europe, get so much more publicity within art history and visual culture in terms of the environment, whereas we're not even thinking about . . . artwork from around the world where they are most affected by climate change—and where devastation is even larger and more unequal in terms of who suffers these effects and who is least responsible for them."

She adds, "The work coming out of Southeast Asia grapples with these questions and deserves to have more of a voice in that discussion."

Many people are familiar with issues like deforestation, habitat loss and global warming, but Cohen believes art can nonetheless make a difference on those important topics.

"There is a question of compassion fatigue. If we're barraged with all these images of atrocity and war and so forth, can we actually move as a public to effect change? So, that's the big question for me. Can they do that?" she says. "I think that (the images) can."

Still, Cohen says the efforts from artists in the region will take time to bear fruit.

"These artists are looking to longer-term, Indigenous philosophies from their local regions—philosophies that have a more sustainable way of living with the environment, of being in relation with the environment through notions of kinship or familial relations," she says.

"This is really important in the work that they do—and not thinking about the environment as objects to be exploited, but as family, as persons in some sense to live with and to care for."

Cohen's research is supported by fellowships from the American Association of University Women and CU Boulder's Center for Humanities and the Arts.

By the numbers. environmental highlights

89,111

Publications from CU Boulder faculty on environment-related subjects since 1897

(Source: Dimensions research information dataset)

$119M

Total in CU Boulder-sponsored research in geosciences, atmospheric sciences and ocean sciences since 2020

(Source: National Science Foundation)

129

College faculty members whose research focuses on the environment, ecology or sustainability

(Source: CU Faculty Information System)

2

American Geophysical Union fellows from CU Boulder

3

Faculty fellows of the Ecological Society of America

38

Number of times CU Boulder environmentally focused researchers have been named **Highly Cited Researchers,** which designates the most influential research, since 2000

9

CU Boulder research institutes and centers **focused on the environment**

34%

Solid waste diverted from landfills by **CU Recycling**

#1

Ranking of CU Boulder in Earth sciences

(Source: Shanghai Ranking of World Universities)

30%

Reduction in planned energy use per square foot at CU Boulder by 2035

(Source: CU Boulder Energy Master Plan)

#18

Ranking of CU Boulder among global universities for work in the environment and ecology health

(Source: *U.S. News & World Report,* 2022–23)

#2

Ranking of CU Boulder in atmospheric science

(Source: Shanghai Ranking of World Universities)

#1

CU Boulder was the first university to:

1970: Create a student-led Environmental Center

1976: Launch a student-led campus recycling program

1991: Provide students with a comprehensive bus pass

2000: Purchase renewable energy credits

100%

Planned clean energy use at CU Boulder by 2050

(Source: CU Boulder Energy Master Plan)

END NOTE

Earth in the balance

As our researchers, scholars and artists show, solving a global problem will require a world of effort

If we are to blunt the environmental and human toll of our swiftly changing climate, our response must be as deep and wide as the challenge—which is to say, huge. That is why many have suggested that the world needs a new version of the Manhattan Project, the massive World War II research and development program to build and test nuclear weapons.

Indeed, the Manhattan Project was vast, employing 130,000 people and costing some $26 billion in today's dollars.

But a Manhattan Project for climate would need to be gargantuan. Energy use is a major driver of climate change, and world energy expenditures in 2022 are projected to be about $13 trillion, representing about 13% of global gross domestic product, according to Thunder Said Energy, a research firm. And while burning fossil fuels drives climate change, so do deforestation, soaring livestock farming and rising use of fertilizers.

The Manhattan Project analogy can be useful in that it prompts people to think big and aim high. But the Manhattan Project's challenge was primarily technological: how to build a bomb so terrifyingly destructive that it could stop the war. To that extent, those who worked on the Manhattan Project tackled an engineering problem.

The climate crisis is greater. Better engineering is a key part of the solution and is, of course, already being developed and deployed. As the stories in these pages suggest, though, surmounting the challenge will also require that scientists and engineers work alongside economists, philosophers, social scientists, government leaders, policymakers, artists, activists, entrepreneurs and innovators from the academic, public and private sectors.

Our energy systems, consumption habits and culinary preferences are fundamental to our economies, and they are continually reinforced by our social and political attitudes. They are in a heated feedback loop. Any successful effort to lessen humans' destruction, therefore, will need help from legions of people from all walks of life. Effecting that kind of change means embracing more than new technology; it means adopting a new shared mission.

"We know how to solve the climate crisis, but it will only be possible if we rise to the challenge and embrace the opportunities together."

That's the spirit we aim to celebrate in this edition of the magazine. We have shared a few stories representing the range of our faculty and students who conduct notable research, scholarship, art and public service. Their stories show that our disciplinary diversity is our strength—one that only grows with numbers.

The U.N. Environment Programme alludes to this fact when it states, "We know how to solve the climate crisis, but it will only be possible if we rise to the challenge and embrace the opportunities together."

If we truly seek a grand project to prevent Earth from crossing key tipping points, we will be wise to make our efforts universal.

- Clint Talbott

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Scott Taylor, Will Weider and Katie Suding look down from CU's 'Classroom in the Sky' toward the Green Lakes Valley and the city of Boulder. Photo by Nancy Emery. See story on Page 18.

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