EARTH MATTERS

The annual bulletin of the Institute at Brown for Environment and Society • Vol 5, FALL 2019

CHRONICLING COASTAL ICE IN THE THREATENED ARCTIC

How ancient lake sediments can inform climate change predictions

Analyzing species interactions to drive more equitable conservation

Imperial China's impact on environmental transformation

BROWN
Institute at Brown for Environment & Society

Empowering People, *Protecting* Places

LETTER FROM THE DIRECTOR

Ruin is the destination toward which all men rush, each pursuing his own best interest in a society that believes in the freedom of the commons.

— Garrett Hardin, 1968, Science, 1243-1248

Garrett Hardin coined the phrase "the tragedy of the commons," intending to illustrate the idea that the degradation of common-pool natural resources is inevitable, unless either privatization or regulation is imposed—a necessary infringement on freedom. More recently, Hardin's vivid expression has been deployed to explain the intractability of anthropogenic climate change. Indeed, the idea of the atmosphere as a commons has become a problem to be solved, stimulating proposals such as tradable permits and taxes on emissions. In many ways, the solution to the commons problem has not only become a means to govern human impacts on climate, but an end in itself.

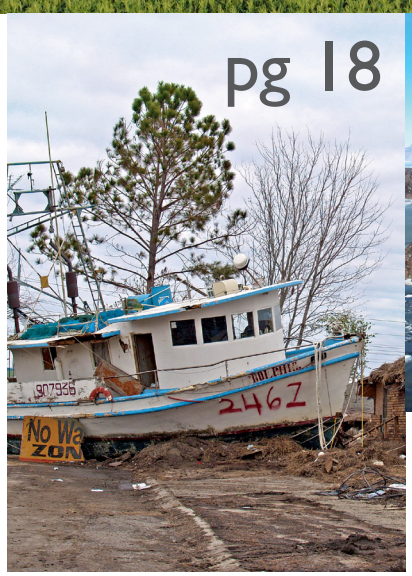
The tragedy of the commons is a motivating symbol, but it is incomplete. Many communities have developed self-governing approaches designed to prevent the degradation of shared resources. Although they have not always succeeded, neither have the alternatives of private or state ownership. Nobel Prize-winning political economist Elinor Ostrom argued that so long as people can or must interact, a set of rules for that interaction emerge—that is, an institution. In Ostrom's view, commons thinking emerges as a foundation for transforming institutions that govern climate change, by encouraging negotiation.

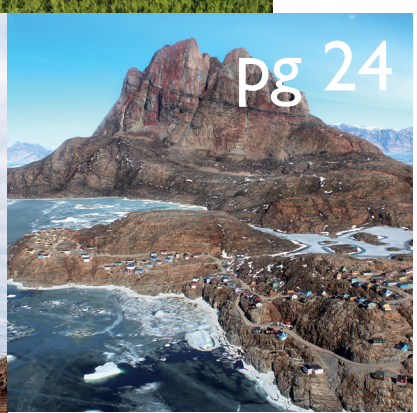
Certainly, the current regimes are insufficient. Whatever emerges as the latest international agreement will not forever inhibit our destructive potential. Democracy in and of itself—consensual, adversarial, or deliberative—is not sufficient. Technological advances will not render all resources limitless. Political debate, dispute, and protest will continue. And, in the face of anthropogenic climate change, no success will be anything but conditional. The ability to continually reconsider and reform institutions depends on our capacity to deliberately argue the alternatives—grappling not just with competing interests but with irresolvable injustices. In this, we do not shy away from the conflict, discomfort, or complexity that is inevitable in relational ways forward. Our commitment is to human dignity.

Amanda Lynch, Director

Contents

features





THEME COLOR CODE

- land change science
- environmental health
- conservation science
- institutions and human behavior
- climate science

UNTANGLING THE WEB OF LIFE

INSTITUTE BIOLOGIST INVESTIGATES HOW SPECIES INTERACT, AND WHY

On the wall above **Tyler Kartzinel**'s desk hangs a picture of a giraffe, hand-drawn for him in black and white by former undergraduate mentee Julianna Hsing, now a graduate student at Stanford University. But there is more to the illustration than meets the eye.

Look more closely, and you'll see that each of the giraffe's delicately penned spots reveals a different pattern of lines, dots, or swirls: a sort of census of the animal's microbiome laid out in ink.

"This is an artistic rendering of our research," explains Kartzinel, now IBES fellow and assistant professor of ecology and evolutionary biology here at Brown. "The molecular, the microbial, and the mega—all in all the same intellectual space."

It's an apt description of the work his lab does, using manipulative field experiments and genetic analysis to better understand how species are connected to each other in the wider web of life, and how those connections change from place to place.

His work is revealing nuances in many conventional ideas about how species interact, especially in regard to antagonistic or predator/prey relationships.

"Ecologists have often treated interactions between species as if they are an immutable property, like: the lions always eat the zebras. But that doesn't jibe with how we think nature really works," says Kartzinel. "We know that lions are more likely to eat zebras in some places than others, and some zebras may be at greater risk than others, but these differences can be really hard to quantify. The problem is that we need to understand who eats what in nature if we're going to conserve it effectively."

Thus far, Kartzinel's work has shown very clearly that animal feeding behaviors can be more complex and important than many people or ecological theories may appreciate.

FINDINGS FROM THE FIELD

On a recent field excursion to Kenya, Kartzinel recalls explaining the purpose of his trip to a customs agent. "I'm here to figure out what elephants eat," he remembers saying.

"She said, 'You didn't have to fly to Kenya. I can tell you: They eat trees.'"

He chuckles as he acknowledges this well-known fact, and explains that his lab is using DNA-based tools to answer a question that is deceptively simple: What *kinds* of trees do elephants eat?

Karztinel lab postdoc Brian Gill and Meimei, a two-year old Eastern black rhino, interact at Ol Jogi Conservancy, Laikipia County, Kenya. Photo: Peter Lokeny, Mpala Research Centre

"Savanna ecologists have known for a long time that sometimes elephants eat trees, sometimes they eat grass, and sometimes they eat a mix of both," he says. "We can figure out exactly which type of tree, and exactly which type of grass. What that allows us to do is figure out how elephants are likely to impact vegetation, and what other herbivores they are likely to compete with. And then we can use experiments to test our predictions.

"This is one way that our work is helping wildlife conservancies figure out ways to protect species like elephants, giraffes, and black rhinos in the same place," he says, "even though these species might compete for food."

And while the Kartzinel lab works to understand the precise details of these patterns of interaction, its researchers sometimes come up with findings that are brand new to academic ecologists.

"Some of the surprises we've found turn out to be things that have been well-known to traditional pastoralists for many centuries," says Kartzinel.

For instance, the Western perspective on ranching professes that "cattle eat grass." But when Kartzinel began to analyze cow dung from the Kenyan drylands, he realized that this story is, at best, incomplete.

"They're eating a lot of plants that aren't grass too," he says. "I started to learn from the teachings of the pastoralists that when cows eat some of these other plant species, they may have better milk production and growth. So this is a case of Western scientists 'rediscovering' traditional knowledge."

CONSERVATION CHALLENGES

Like many Institute scholars, Kartzinel's work aims to place the needs and dignity of the people living in an environment on a par with the health of local species and ecosystems.

In Kenya, for example, his lab is working with researchers, landowners, and pastoralists to devise ways of sharing and using land that enhance the productivity and prosperity of both human and animal populations.

Elephants at Mpala Research Centre in Laikipia, Kenya are a common sight for researchers in the Kartzinel Lab. Here, a young female stands protectively over a calf who is just learning to sample the grass that can make up a large proportion of its adult relatives' diets. The Kartzinel Lab collects dung samples from animals at Mpala, including elephants, and uses molecular tools to analyze what types of plants different species eat and how food networks fluctuate over time. Photo: Patrick Freeman

"In many places, some of the biggest challenges for promoting wildlife conservation and advancing human livelihoods involve making sure everyone has enough to eat," he says. "That includes the people, their livestock, and the wildlife that exist alongside of them."

As Kartzinel explains, most of Kenya's charismatic wildlife exist outside of the public National Parks—and traditional pastoralists, farmers, and ranchers are growing crops and raising livestock in these same areas.

"Our work can help people make decisions about where to take their livestock by giving them a better awareness of their impacts on vegetation and the needs of wildlife," he says. "This way, we can contribute to the mission of local and international conservation organizations that are working on the ground to find more equitable and sustainable solutions to human-livestock-wildlife coexistence."

TECHNOLOGY AND TEAMWORK

Rapid advances in DNA-sequencing technology have enabled the lab to generate new findings and make enormous headway on such real-world applications; however, limitations still exist. For instance, as Kartzinel explains, it still takes a few months before an analysis of field samples can tell the group anything about how species are behaving in the real world.

"There's a gap between the pace of research and the pace of conservation decision-making, and I really want to close that gap," he says. "I think some of the most exciting advances will come in the next five or 10 years. That's when we'll be able to inject useful information into the decisions that people face in real time."

Kartzinel credits much of his lab's innovation and intellectual capacity to a diverse group of students and postdocs.

The semi-arid savannas of Kenya are highly dependent on seasonal monsoons to bring much-needed water to the wildlife and people that call them home; however, under changing climate conditions, these monsoons are becoming increasingly erratic, leading to longer, and more severe drought conditions. Entire rivers, like the Ewaso Nyiro pictured, can stop flowing seasonally until they are recharged from highland rainfall when drought conditions break. Photo: Patrick Freeman

"Our team includes people who are molecular biologists first and foremost, and we have field and experimental ecologists who are still learning how to use pipettes," he says. "Creating the conditions for this type of cross-pollination to succeed is hard work, but there is a payoff where groups of people commit to applying their unique strengths to shared interests; there is creativity in collaboration."

Indeed, the Kartzinel Lab has no shortage of talent. Just this year, two undergraduate mentees are on their way to Fulbright experiences.

Kartzinel is clear about the enormity of the questions his lab is trying to answer, and the necessity of using different perspectives to generate evidence that can then be put into practice.

"We are making conservation decisions at big scales and sometimes in ways that are very consequential for people and for endangered species. And we're making a lot of those decisions based on assumptions about the web of life that we've never really tested," he says. "Ecologists are smart people and very observant, and we're probably getting a lot of things right. But the stakes are high, and our science has to become more precise and more predictive."

The Kartzinel lab's method of using molecular biology to inform conservation decisions is at once novel and crucial. But Kartzinel thinks there's more to the task than necessity. For him, these questions are fascinating—simply for their own sake.

"I can offer you lots of reasons why it's important that go beyond my own childish desire to have fun and learn about the world," he laughs, "but I don't think that should be a requirement. This type of research can be really important—but if it's just interesting, you know, that's alright too." ■

THE ECOLOGY OF EMPIRE

HISTORIAN TRACES CHINA'S ENVIRONMENTAL TRANSFORMATION

Five thousand years ago, China was a very different place: a landscape of forests, grasslands and wetlands that was home to a diverse body of wildlife. It is now home to so many people that it is difficult to imagine the rhinos, elephants and alligators that once lived there.

"If you look at China now, it's one of the most environmentally transformed regions on Earth," says IBES fellow and Assistant Professor of History Brian Lander. "There are almost no wild animals in the population centers of China. There aren't even squirrels. There are a few birds, like pigeons and sparrows. But if you compare it to here, it just feels so dominated by humans."

Lander's research emerged from his realization that very few historians were studying how this transformation happened, and why the human impact was so dramatic in China. One answer, according to the archival records he has examined, lies in the 2,000-plus year history of China's imperial governments.

"I had no interest in political history when I began my research, but I gradually realized that almost all the documents in ancient China are being produced by the state," he says. "That led me to recognize that the state was, in fact, one of the main things that was transforming the environment."

BUILDING AN EMPIRE

As Lander explains, pre-industrial political systems were fueled by the resources of the land; thus, their primary goal was to replace "unproductive" natural ecosystems with farmland. And as they grew, their ability to transform the environment did too. By the time China's first empire, Qin, was formed in 221 B.C., it had the power to launch massive infrastructure projects that were designed to create more farmland, to grow more grain, and, ultimately, to generate more tax revenue.

And Qin and the empires that followed were generally successful. Lander's research has shown that, compared to other ancient states, China's early empires were highly centralized and efficient.

"They had these whole systems in place to extract resources from their huge domains," he says. "So they could do things like build new roads, build irrigation systems, colonize new regions, and send in settlers to cut down forests and turn them into farmland."

In the 3rd century B.C. China's first empire, Qin, built the first "great wall of China," which probably blocked the seasonal migration of animals across the steppe. Depicted here are the remnants of Qin's wall in Guyuan, western China. Photo: Brian Lander

They also had control over millions of imperial subjects, the dominant workforce for large-scale projects in the pre-fossil fuel era. Perhaps most importantly, the Qin empire established the centralized state as the model for political organization in China, which it remains to this day.

As Lander explains, the sources that weave this story were written by government officials, and so they tell us very little about everyday people.

Although there is little documentation of it, there must have been some level of resistance, perhaps on the part of farmers who were tired of paying taxes to the state, or laborers who objected to the scale or purpose of government projects.

"It's easy to tell stories that feed into certain narratives, and I'm trying not to do that," says Lander. "We don't have common people's stories from early China; we have all these sources that come from the top. So it makes it very easy to tell a top-down story, and it makes it almost impossible to tell a bottom-up kind of story."

"I'm very clear that I'm not saying that the state is all-powerful," he says, "just that Chinese states endured for millennia and played a role in transforming the environment."

ECOLOGICAL EFFECTS

While political power is one focus of Lander's research, he is also interested in how people gradually transformed natural ecosystems into agricultural ones.

"Even 2,000 years ago, there were 60 million people in North China, which means that there were already huge areas of the lowlands whose natural ecosystems had been entirely destroyed," he says.

So what do we know about the ecosystems that have been lost?

The high mountains are the only places in North China where natural forests still exist. Views like this one, of Mt. Taibai, can help historians imagine the forests that once covered the lowlands. Photo: Brian Lander

To answer this question, Lander has been working with Postdoctoral Research Associate in Computational Molecular Biology Katherine Brunson, focusing on animal bones excavated from archaeological sites in the area.

"When you do that, you realize that there would have been a huge number of wild animals," he says, "and groups of species that you don't find together at any place that exists now."

Although the lowlands of North China had already been converted to farmland 2,000 years ago, species like deer, leopards, bears, and others survived in mountainous areas.

But a few hundred years ago, crops like maize and sweet potatoes arrived from the New World and allowed people to farm the lower-quality land in the highlands. As more humans moved to higher ground and cleared the forests, the wildlife that had survived in those areas slowly dwindled. Eventually, species like tigers and rhinoceros were entirely eliminated from China, and the only large animals that survived were those that lived in high mountains, like pandas.

As Lander explains, this is just the big picture. The challenge for environmental historians is to understand the details of this process.

"Each animal has its own history," he says. "Part of what I'm interested in doing is thinking about each one separately, rather than just making blanket statements about how people wiped out all the animals."

PUTTING IT IN PERSPECTIVE

Lander's goal is to understand environmental change, rather than to assign blame.

"It is easy to describe the human colonization of natural environments as destruction or degradation, and I don't disagree with this," he says. "But human systems are ecological systems too. I want to know, how did agricultural systems become the dominant ecosystems in these regions over the last 10,000 years?"

Part of his aim is to lengthen our understanding of human impacts on the environment beyond recent centuries.

This 2000 year-old bronze vessel was excavated in Shaanxi, China, 3500 km north of the current range of Sumatran rhinoceros. Artifacts like this can be useful for reconstructing the historical distribution of animals. Photo: Brian Lander

A recent U.N. study made headlines for showing that a certain percentage of the Earth's species have been lost. But studies like these tend to use modern biology as a baseline, which means that their scope is limited to the last few hundred years.

"But if you look at China, you can see that huge areas had already lost their larger mammals 2,000 years ago," says Lander. "What that means is that these figures of species loss are actually too low. This is true also in places like the Nile Valley or Mesopotamia. The old centers of human civilization were all transformed, especially in their river valleys."

Through his research, Lander also wants to open new questions surrounding politics and the environment, and the overarching dynamics of human societies.

For example, many environmentalists consider capitalism unsustainable, but fail to explain how an alternative system could avoid the drive for economic growth that has characterized all political systems in human history.

"If political systems are fundamentally based on increasing economic production so they can have more resources, that's not actually sustainable," he says.

"If we want to think about what a sustainable human future would look like, we need to think about how political systems work." ■

graduate student spotlight

In many ways, nearby Narragansett Bay is just what you would expect: a large expanse of blue, teeming with wildlife and phytoplankton. But thanks to its urban environs, its waters also contain a hefty dose of environmental pollutants like nitrogen.

Where, exactly, does this nitrogen come from? That's what IBES graduate affiliate **Emily Joyce** wants to know. A mentee of biogeochemist Meredith Hastings, famed for her expertise in isolating nitrogen isotopes and identifying their sources, Joyce is devoting her time at Brown to understanding how much of the nitrogen in Narragansett Bay is deposited by precipitation, and how much is deposited by other city sources.

"Using precipitation samples that were collected year-round in Providence in 2017, we can now better estimate the amount of nitrogen deposited into Narragansett Bay through precipitation," she says, explaining that this work only considers a process known as "wet" deposition. "We found that total nitrogen wet-deposited from the atmosphere has increased today by at least a factor of around 2.5 times since 1990."

Now, she and her fellow lab members are working to quantify the amount of "dry" nitrogen deposition on Narragansett Bay, which occurs via gases and particles. This calculation is vital for understanding the biogeochemistry of the bay, but had previously only ever been estimated.

Joyce believes that quantifying total urban nitrogen deposition is vital to ensure a healthy bay today, and in the future.

"Understanding the sources of excess nitrogen is key for effective nitrogen pollution management; however, our understanding of the contribution of nitrogen from atmospheric deposition is limited by a significant lack of observations conducted, especially for dry deposition." says Joyce. "Our preliminary results for wet deposition suggest that total nitrogen deposition has increased considerably over the past 30 years, which may have important implications for future environmental policy."

Earth, Itself 2019: BLUE SKY

1. Photographer Kathie Florsheim presents a selection of her work chronicling the effects of climate change on vulnerable Roy Carpenter's Beach. Photo: Mariana DeBare / Photograph © Kathie Florsheim. All rights reserved.

2. Panelists Jesse Bellemare, Peter Heywood, Lucia Monge, and Toni Lyn Morelli discuss nimble species at the John Carter Brown Library. Photo: Mariana DeBare

3. IBES fellow Stephen Porder explains Brown's new sustainability plan, which pledges net-zero emissions by 2040. Photo: Mariana DeBare

4. Undergraduate, graduate, and early career flash talk presenters take questions from the audience after their speedy, TED-style environmental talks. Photo: Mariana DeBare

5. IBES graduate affiliate Ethan Kyzivat offers his thoughts on collective action in the face of a global climate crisis on the Blue Sky "Park Bench." Photo: Mariana DeBare

6. Conference convener Lenore Manderson, IBES faculty, and guests discuss art and science perspectives on imagined futures and science imaginaries as responses to global warming. Photo: Mariana DeBare

Blue Sky

concludes the *Earth, Itself* series.

Thank you to conference convener Lenore Manderson and all of our event supporters for an illuminating five years of art/science collaborations.


5


6

graduate student spotlight

Recent Ph.D. recipient **Keith Spangler** wants to know: whose health is most at risk from climate change?

"I link weather and climate data with sociodemographic information to assess whether, and to what extent, climate and climate change disproportionately affect the most socially vulnerable communities," he says. "I also use health data to explore how warm-season heat mortality has changed over time, and to identify possible drivers of these changes."

An enrollee of Brown's Open Graduate Education Program, Spangler earned a Sc.M. in epidemiology while working toward his Ph.D. in earth, environmental, and planetary sciences. As he explains, equitable and just management of public health disparities is an essential component of adaptation to climate change and its related hazards.

"The natural environment affects our health in an unfathomable amount of ways, and many of these pathways are being affected in the context of global environmental change," he says. "What really got me interested in climate-health research more broadly is its potential to have real-world impact and improve population health and well-being, particularly for those at greatest risk."

Spangler explains how he has found professional fulfilment through his dissertation research.

"I hope that my research encourages continued collaborations and conversations between geoscientists and epidemiologists," he says. "Interdisciplinary work is challenging on many levels, but it is extremely rewarding both in terms of personal growth and for advancing science."

UNEARTHING PERU'S COLONIAL PAST

Archaeologist digs up new perspectives on indigenous history

Populations and their surrounding environments are often inextricably intertwined. But what happens under colonial rule, when powerful empires try to override this complex relationship?

Archaeologist and Assistant Professor of Anthropology **Parker VanValkenburgh** is examining this question through the lens of the Spanish colonial *reducción* movement of the 1570s—a large-scale attempt to "modernize" over two million indigenous Peruvians by resettling them into planned towns. Although many written records of this movement remain, they often omit key details about the founding of the towns or the effects of the resettlement effort on inhabitants' daily lives.

"The historical documents tend to offer high-level generalizations about the movement that don't reflect the complexities of this massive social engineering project," he says. "I am trying to use archaeology as a way to tell a more complicated story, or investigate the more complicated elements of this process."

The ruins of the Iglesia Matriz (principal Church) of the Villa of Zaña, Peru, largely destroyed by an El Niño-linked flood in 1720. Photo: Parker VanValkenburgh

To this end, VanValkenburgh and his colleagues have unearthed centuries-old settlements from the parched soil of Peru's coastal desert—both those that were home to indigenous groups prior to the Spanish invasion, and those that house the towns, or *reducciones*, constructed under colonial rule.

At the outset, some of his findings appear unsurprising. Within a few decades of the initial resettlement effort, Native people did appear to abandon the *reducciones*;

but this subversion of colonial dictates appears to have been a move made out of necessity, rather than rebellion.

"The environment ended up being a really big part of the story, because the aridity of the Peruvian coast makes water access absolutely essential to life," he says. "Agricultural communities need irrigation water in order to be able to farm, and people need water in order to be able to live."

According to VanValkenburgh, colonial decimation of the indigenous population had likely made it impossible for Native people to maintain their existing canals and water infrastructure.

"When, all of a sudden, you have this massive collapse in population, all these new dynamics arise," he explains.

VanValkenburgh's findings suggest that Native communities simply moved upriver, to be closer to easy water access—an environmentally prescribed necessity that undermined Spanish administrators' attempts at permanent resettlement.

But rather than reverting to more traditional encampments after the move, these communities instead appeared to rebuild new settlements that were designed precisely to Spanish colonial specifications.

"Native people settle in towns that are almost excessively observant in their conformity to colonial norms," he says. "And they end up being able to renegotiate the terms of their own subjugation."

And although, in this case, Native communities were able to get their needs met at the hands of their colonizers, the story doesn't end there. In fact, as VanValkenburgh explains, being socially marginalized in an unforgiving environment is a challenge that indigenous people have been living with since colonial times.

"The longer-term story here is that many of these same indigenous communities continue to live in these really marginal environments along the Peruvian coast," he says, recounting multiple storms in the 20th century that threatened or wiped out coastal Native towns. "People who are socially marginal are also environmentally marginal. The longer-term aspect of my research is: how does that happen? How is the environment, in a sense, 'harnessed' in a way that marginalizes people?"

VanValkenburgh is continuing this work in a second project, which looks at a similar record of Native resettlement—but this time, on the Eastern slopes of the Andes, where the environment is extremely wet.

"I'm interested in the way in which this same story played out in a very different way, in a very different environment," he says. "The idea here is to keep the conditions the same, but to radically modify the environment as a variable and to see: do you see the same process where people are abandoning these towns and refounding them?"

In VanValkenburgh's view, archaeologists have a unique opportunity to discover and contemplate marginalized versions of history that offer lessons not only for humanity's present, but for our future as well. As he explains, people have always generated creative solutions to pressing issues—both in ways that we might expect and in ways that ultimately turned existing reality on its head.

"When you open up your mind to the entire expanse of human history—in all of its glory and all of its doom—I think it expands your imaginary toolkit for dealing with the big problems that we might face in the future," he concludes. "Thinking about the deep past, and examining the fact that there have been so many times in history when a small series of decisions radically changed the course of human societies is, I think, deeply inspiring." ■

Abandoned terraces and associated archaeological sites at around 3600m elevation in the Chachapoyas region of Peru. Photo: Parker VanValkenburgh

WISDOM IN ARCTIC WATERS

PIONEERING GEOSCIENTIST TO UNEARTH SECRETS BURIED IN SEDIMENT

Five thousand miles northwest of College Hill, a series of Alaskan lakes have attracted the attention of expert geochemist **Yongsong Huang**. The sediments found deep in these waters are the oldest in the region and may contain clues to the planet's—and humanity's—past and future.

Alaska and other high-latitude regions are of special interest to today's climate scientists. There, sea ice in the warmest months has decreased by two-thirds over the last 40 years, and temperatures are rising more than twice as fast as temperatures across the rest of the planet. But the methods scientists use to reproduce Earth's past climate are not always applicable in the Arctic environment.

One of these methods involves analyzing organic compounds called *alkenones*. Originally discovered in the 1970s, alkenones are ubiquitous in the ocean and are commonly used to reconstruct the temperature of the long geologic past. However, until recently, their utility was limited at high latitudes, where alkenones are either absent or too low in concentration for accurate measurements.

Moreover, in places like the Bering Strait, the terrain has existed as both land and ocean in accordance with sea-level fluctuations during Earth's glacial-interglacial cycles, and so sediment is discontinuous.

As Huang explains, during the last glacial maximum, approximately 21,000 years ago, sea level was around 130 meters lower and Asia and North America were connected by a land bridge that was up to 1,000 kilometers wide.

Following a coring expedition in summer 2019, the team expects to obtain a climate and environmental record spanning >150,000 years. Photo: Scott Amy

The team camps on frozen Imuruk Lake, with an ice thickness of ~1.5 m. The aircraft is equipped with a ski that can land right beside the team's coring site. Photo: Scott Amy

"Traditionally, people have used ocean sediment to study the past—but the ocean was not ocean in glacial times," he says. "This was a relatively important gap: a lack of good proxies or sedimentary archives with which you can measure the past temperature, in regions where climate change is having the greatest impact."

But in 2003, he and his team discovered a bizarre, new form of alkenone plentiful in certain Arctic freshwater lakes. These strange molecules differ significantly from the alkenones found in oceans and salty lakes, but genetic testing proves that they are produced by the same order of algae. And just like their more conventional counterparts, the structure of these "new" freshwater alkenones varies in accordance with temperature: as waters get warmer, the number of double bonds decreases. This makes them excellent *geo-thermometers*, natural tools for reconstructing temperature changes at high latitudes.

Previous field expeditions enabled Huang and his team to unearth sediments containing the freshwater alkenones from some younger lakes on the North Slope of Alaska. Now, with new funding from IBES and the National Geographic Society, they are once again traveling north—this time to Alaska's Seward Peninsula—to exhume sediments from the region's most ancient waters.

"These lakes are unique," he says. "They provide us with past temperatures in the region when traditional ocean paleotemperature proxies don't work."

SURPRISES IN SEDIMENT

During one of the team's previous excursions, Huang and his colleagues discovered something unexpected in the depths of Lake E5, a body of water whose sedimentary archive dates to the last glacial period—32,000 to 20,000 years ago.

"Initially, we were just in Alaska to study temperature changes using this new class of thermometers we developed," says Huang. "But when we looked at the glacial lake sediments from Lake E5, we found a lot of potential markers suggesting that humans might have been there for more than 30,000 years."

An aerial view of the landscape surrounding Imuruk Lake. The mountain ridges are made of basalt rocks. Photo: Scott Amy

If confirmed, this will be a startling finding. Most existing archaeological and anthropological research suggests that modern humans colonized North America around 14,000 years ago, and were not previously present on the continent other than for possible occasional seasonal adventures.

"We found that the lake sediments contain a lot of fire markers, like charcoal and polycyclic aromatic hydrocarbons, which are produced by burning wood," says Huang. "However, frequent fires during the last glacial period don't make sense because these places belong to the Arctic tundra ecosystem, which is known to rarely burn now."

"Based on the current ecological theory, when it's colder, they will be even less likely to burn," he explains. "You don't have enough lightning to ignite fires, and a lower temperature will lower the lightning possibility as well."

The team also found biomarkers specific to human fecal material in the lake sediments.

And although there is no concrete anthropological evidence supporting human presence in Alaska during this earlier time, the idea is not completely without support. Indeed, genetic analysis suggests that the ancestors of modern Native Americans could have been present on the land bridge between Asia and North America for at least 10,000 years before making it to what is now mainland North America.

Could Huang's biomarkers be the missing proof of this theory?

Taken together, the team's discoveries suggest major revisions to either the current ecological theory, or the current anthropological theory.

"Right now I have this evidence for fire in a really cold time. And it could be human," says Huang. "It could also be natural, if the ecological theory is wrong."

The team hopes that its next field expedition to Alaska will help clarify the relevance of the biomarkers it discovered two summers ago. The new target lake contains a sedimentary archive that could be up to 200,000 years old—much older than the source of the team's previous discovery. Such an archive would include earlier glacial times, when scientists know there were no humans on the North American continent.

"Now I need to go to another time when it's also cold, but when there were definitively no humans," he explains. "If I also see a lot of fire at that time, then it means that the ecological theory is wrong, which is a very important contribution. If I don't see any fire at older times, I've demonstrated that the fire we found during the most recent glacial period was due to humans."

THE PAST INFORMS THE FUTURE

Huang believes that this work is crucial for looking back, as well as for looking forward.

"From a pure science point of view, discovering a new geo-thermometer is very exciting," he says. "It's beginning to make a way for us to understand the climate in a region where, previously, there were no other ways to get temperature."

Furthermore, understanding historical shifts in climate can help scientists make sense of long-standing mysteries, such as the sudden disappearance of Vikings in the 14th century. Huang's research recently offered a climate-based explanation for this vanishing act: a temperature drop of five or six degrees over only about 10 years. Under such conditions, the Vikings, who farmed domestic animals rather than hunting seals, likely lost their steady food supply and could no longer survive.

Huang poses with the transporting aircraft in summer 2018 during a previous—and unsuccessful—coring attempt at Imuruk Lake. Photo: Yongsong Huang

But Huang's work has implications for studying the future of human populations too, as well as the future of all other ecosystems on Earth.

As he explains, unless scientists can train their models with thousands of highly accurate climate data points that cover many different places on Earth over many different timescales, simulations of future climate will continue to have significant uncertainties.

"In predicting the future," he says, "one of the best things to do is to learn from the past."

Over the last two decades, Huang says that he has learned a lot about the past—much of which he never bargained for.

"I would say that this particular project has really taught me a lot about how science advances," he says. "It started from one question and then evolved by itself."

"It's almost that I am dragged by it," he laughs, "rather than dragging it myself." ■

STAY, OR LEAVE?

Population scientist explores hurricanes' impacts on migration

In the United States, waterfront locales have long been seen as desirable places to live. And, thanks to years of investments in adaptation to coastal storms, they have remained relatively safe as well.

But in a world of warming temperatures, rising seas, and coastal storms that are forecasted to become more intense and destructive, many of these areas—including major population hubs like New York City, Miami, and New Orleans—are beginning to feel the effects.

Now, demographer and Associate Professor of Population Studies (Research) and Environment and Society **Elizabeth Fussell** is investigating a deceptively simple question: in the United States, do hurricanes encourage people to move away from coastal counties, or not?

Her answer so far? Sometimes, yes... and sometimes, no.

"What we find is that the pre-disaster population trend—in other words, whether a county was growing, declining, or staying relatively stable before a hurricane event—is far more predictive of what will happen after a hurricane than the hurricane itself," she says. "There are drivers of population change and migration that are far more powerful than hurricanes."

Hurricanes, however, do tend to make a place more diverse.

For instance, while teaching at Tulane University, Fussell found that Hurricane Katrina brought an entirely new population to New Orleans: Latino immigrants, most of whom had been living elsewhere in the U.S. and performing many different jobs, arrived in the city after the storm to do construction work.

"Before Hurricane Katrina, the Latino population of the New Orleans metropolitan area had been about three percent, and afterward it had almost doubled. They have maintained that share of the population over the 14 years since Katrina," she says. "That's an interesting dynamic that is really underappreciated by people who study disasters. We typically think about how disasters might displace people, but we don't consider how they may actually draw people to the place that was affected."

If a place maintains or grows its population after a disaster, it is often because current policies and practices generally encourage people to stay where they are. For instance, homeowners' insurance policies generally cover rebuilding a stricken home on the same plot of land, not recouping the home's value and rebuilding somewhere safer.

Moreover, government-run home buyout programs don't specify where displaced homeowners should resettle. And, as Fussell explains, people often live by the water simply because they want to—so they may take the buyout, and then move to a similarly vulnerable place.

"If we are trying to move people out of harm's way, we need to understand the limitations of current recovery and adaptation approaches, which encourage people to remain in place," she says. "We need to tweak those approaches to move people into safer places. This is challenging because residents have invested in their homes and built relationships in their communities. Homes and communities are not easily replaced."

Hurricanes reshape communities in complex and often unforeseen ways. Photo: Gabe Raggio/Pixabay

Disaster recovery policies also have a homeowner bias that allows some people to stay in their homes while others are priced out of housing markets.

As Fussell explains, white residents across America are much more likely than other racial groups to own homes, rather than rent. This inequity plays out in a variety of ways, but its impact is felt especially strongly after disasters. In New Orleans after Hurricane Katrina, homeowners were much more likely to return and rebuild their homes, while renters were unable to afford inflated rents in a slowly recovering rental market. This partially accounts for black residents' lower rate of return to New Orleans after Hurricane Katrina, together with historical patterns of segregation into lower-lying, and therefore more flood-prone, neighborhoods.

"What social scientists can do is show how inequitable the current situation is," says Fussell. "We can show that those people who are the most vulnerable to displacement or other social impacts of climate change and disasters do not have the safety net that they need to recover quickly and completely."

In Fussell's view, policymakers need two things in order to fix these issues: disaster recovery policies that meet the housing needs of both homeowners and renters, and climate adaptation research that shows where the existing policies will likely fall short.

"The impacts of climate change on human well-being occurs unequally across members of our society, and it tends to reinforce existing inequalities. We already have policy mechanisms to redress many of these issues," she concludes. "It's not like we have to reinvent the wheel to solve these problems. What we need to do is fine-tune the wheel so that we can incrementally address issues that don't only have to do with climate change, but have to do with everyday social inequalities." ■

alumna spotlight

In the mid-1970s, **Cynthia Roberts** '81 wasn't entirely sure what she would do after college; but when her application for admission to Brown University begged the question, she wrote down "environmental law."

And she was right. After spending a post-college year promoting the Clean Air Act in Washington, D.C., she landed in law school—ultimately channeling her undergraduate and graduate experiences into high-powered roles such as assistant attorney general tasked with environmental protection in Colorado and executive director of Riverbend Environmental Education Center in Pennsylvania.

When asked about her time at Brown, Roberts immediately references Professor Emeritus of Environmental Studies Harold Ward, a chemistry professor who founded the University's Center for Environmental Studies in 1978. Ward himself had earned a law degree from Harvard in 1975, specifically to equip him to better engage environmental issues.

As she recalls, Ward's insistence on students' involvement in the local community led to Roberts' own early forays into civic engagement during college: lobbying for the passage of a bottle deposit bill in Rhode Island and writing a senior capstone report on the oft-ignored relationship between groundwater contamination and urban zoning.

"My education made it very clear that that an individual can make a difference. I think that was an important lesson," she says. "And, that part of our responsibility as educated people is to get involved with issues that impact our communities."

Roberts, who now lives in New York with her family, has continued this legacy of engaged scholarship by serving on a variety of community environmental councils and boards, including IBES's own Advisory Council. Some of her most recent activities include working with the Friends of Scarsdale Parks to revitalize an abandoned park, participating in the citizen science program through the New York Botanical Garden, and teaching local second-graders about birds for the Audubon Society.

She and her husband, William, also feel passionately about supporting paid summer research internships for Brown undergraduates who are working on climate change and other environmental issues.

"Whatever their financial circumstances, these students can get some job experience, they can be inspired by the organization that they're working with, and they can see what works and what doesn't work," she explains. "They can also see what additional expertise they may want to pursue after Brown, whether it's academic training, an additional skill set, or a totally different field that they hadn't even thought of."

Roberts is optimistic about the enthusiasm for environmental science displayed by the youth that she speaks with. Whether they have their sights set on Brown or not, even high school students appear to be making vital connections between their own passions and the precarious state of the world at large.

"It is really uplifting to learn that they're very interested in environmental issues," she says. "They may be interested in filmmaking or writing or public health, but they're all interested in contributing to create that sustainable, just future for our planet that IBES promotes."

And with a steadily increasing number of incoming Brunonians declaring an interest in environmental studies and science, Roberts believes that the Institute's commitment to human dignity, interdisciplinary breadth, and disciplinary depth is both well-placed and well-suited to the task ahead.

As she sees it, environmental education at the Institute produces alumni who are highly knowledgeable, intellectually adaptable, and deeply motivated to make a difference.

"You have a broad enough worldview when you graduate that you can enter almost any field or profession or community and have an impact," concludes Roberts.

"That's the strength of Brown," she says.

INTRODUCING: MYLES LENNON

Myles Lennon, a former Brown undergraduate, returns to campus this fall—this time, as an IBES fellow and Dean's Assistant Professor of Environment and Society and Anthropology. Lennon has long been interested in moving beyond entrenched policy perspectives to allow for more creativity and nuance when facing environmental challenges. As he explains, eight years spent working on energy efficiency and energy equity policy and advocacy in New York reinforced to him that business-as-usual is often insufficient.

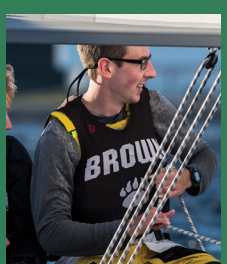
"Too often I found that my colleagues and I were aware of the limitations of the strategies that we doggedly pursued toward an equitable clean energy economy," he says. "Yet, we pursued those strategies anyway because the institutional spaces that we traveled in did not afford us the latitude to bring to bear more critical, creative, and thoughtful forms of practice."

In search of a more flexible and fruitful lens through which to view contemporary environmental challenges, Lennon turned to the field of anthropology. Today, his research explores the sustainability strategies that emerge when the advice of clean energy technocrats meets the radical populism of grassroots activists—and how these strategies ultimately transform the raced and classed politics of differently situated social groups.

Lennon looks forward to continuing this work at Brown and as part of the Institute community.

"I'm thrilled to be joining IBES, as it offers a multidisciplinary community of environmental scholars and practitioners who recognize that we need to respond to environmental challenges through multiple avenues and at different scales simultaneously," he says. "I believe that IBES will expose me to a range of important research that I have limited engagement with as an anthropologist, further diversifying the lens through which I apprehend the climate and energy problems that animate my work."

student spotlight



Tropical rainforests are vital to global biodiversity and the carbon cycle, but researchers know relatively little about how nutrients and energy move through the forests. A team of IBES scholars has come up with a way to improve scientific knowledge in the heart of the Atlantic Rainforest in Bahia, Brazil by studying legumes, plants that make nutrients—literally—out of thin air.

As part of a project designed and led by Ph.D. candidate Lindsay McCulloch and overseen by biogeochemist Stephen Porder, undergraduates **Sawyer Balint '20** and Kelsey Fenn had the opportunity to travel to Bahia and participate, hands-on, in fieldwork.

"Eleven different legume species had been grown in a greenhouse under varying water and soil nutrient availability for about four months," says Balint, who was the most junior member of the team. "We were interested in how changes in environmental factors impacted rates of the nutrient-making process, symbiotic nitrogen fixation."

The wider project aims to enhance researchers' understanding of how environmental conditions under climate change impact the legumes' ability to function.

As Balint explains, although analyzing symbiotic nitrogen fixation rates for more than 800 individual plants was tedious work, it was immensely rewarding. Ultimately, he says, this sort of work is an essential step toward clarifying the role of tropical nutrient-makers like legumes in the global carbon cycle.

"By better understanding how legumes respond to water and nutrient limitation," says Balint, "we can make better-informed predictions of how nutrient cycling will be impacted by our changing world."

IBES IS 'A NATURAL FIT'

Apple Exec Kate Adams discusses Brown's distinctiveness, and the Institute's perfect niche

Attorney **Kate Adams** '86 has an impressive resume. Among other roles, she has been law clerk for Supreme Court Justice Sandra Day O'Connor, trial attorney for the Environment and Natural Resources Division of the U.S. Department of Justice, partner at Sidley Austin LLP in New York, and senior vice president and general counsel of Honeywell, Inc.

Now general counsel and senior vice president of legal and global security at Apple, Adams feels on top of her game.

"It's a dream job," she says. "At Apple, we really believe that the products and the services that we provide are enriching billions of lives on this planet, and we strive to do that in a way that leaves the world a better place."

Adams' drive to make the world a better place is an ambition with long and deep roots. As a child in Brooklyn, New York, she was surrounded by environmental activists. Indeed, it was there in 1970 that her parents, John H. and Patricia Adams, established the now-international environmental advocacy group, the Natural Resources Defense Council (NRDC).

"It was sort of a family affair," recalls Adams. "We spent time in the offices of the people working at NRDC and socialized with them, but also with the broader community of people who were working on environmental causes."

As a young adult, Adams recalls her undergraduate years being bookended by a rigorous and regimented high school experience at an elite boarding school, and highly structured, traditional law training at the University of Chicago.

But despite its equivalent academic rigor and prestige, her time at Brown felt entirely different.

"It was a deep counterpoint to those other experiences—the Open Curriculum, the experience of being your own guide, in many ways, to your educational development," she says.

Adams draws parallels between the Brown paradigm of exploration and risk-taking in a fertile yet forgiving environment and the real-world murkiness she has had to navigate in the decades since she marched through the Van Wickle Gates.

"At Brown, you were given a high degree of freedom at quite a young age to chart your intellectual course, and to explore things that might feel scary," says Adams. "I think that has lived on throughout my career, and in being able to navigate a lot of open-endedness and grayness in terms of what choices to make."

To many alumni, the true distinctiveness of a Brown education lies in this openness, and in the consequent sharing of knowledge across fields. Adams is no exception.

"It was the perfect college for me," she says. "I got a phenomenal education and I didn't need distribution requirements to achieve that. I think I took classes in pretty much every discipline by the end of the four years."

To Adams, the founding of an environmental institute on College Hill—especially one with a major emphasis on collaboration—has felt inevitable since her undergraduate days.

"IBES has this specifically interdisciplinary focus on environment and society, which I think is a perfect fit with the Brown mission," she says. "Brown is in a position to make a unique contribution by marrying those two concepts. That's a perspective that doesn't exist strongly elsewhere."

Indeed, Adams has been an enthusiastic patron of IBES since its doors opened in 2014. She and her husband, Duke Wiser, have supported a variety of research endeavors at the Institute, from expanding ecological understanding of reforestation in Brazil's Atlantic rainforest to tracing the effect of climate change on preterm birth. She is hopeful that these and other projects will inform action on the most pressing challenges of living in a warming world.

"When you're looking at Earth-threatening problems, the hope is that IBES will make meaningful contributions to solving, ameliorating, or mitigating the damage to humans and their environment from climate change and other forms of environmental degradation—and to take a position as a voice as we tackle these problems globally," she says. "You can already see that coming through in some of the research emerging from the Institute."

To Adams, IBES's strength lies not only in its capacity for innovative and impactful research, but also in its potential to craft a clear path for undergraduates seeking an education that will adequately prepare them to navigate the complex and disparate silos of knowledge inherent to today's environmental challenges.

"IBES draws on the entire University network to be able to pull all the strands together from a lot of different departments," she explains. "In an area like this where much of the best research is going to be interdisciplinary, the student doesn't know how to pull on those strands themselves, individually. It's just too heavy a lift."

"To have this Institute that the students can take advantage of, whose mission is to make sure that the various parts of this vast organism are coordinated and pull together in a smart way," she says, "it's just a huge educational opportunity." ■

DID YOU KNOW? Brown has pledged to reduce campus greenhouse gas emissions by 75 percent by 2025, and to net zero by 2040.

Thanks to committees of faculty, staff, and students from across the University, chaired by IBES fellows Stephen Porder and Leah VanWey, Brown has established a clear path to achieving this aggressive target. Brown recently signed two power purchase agreements: one with a new, 240-acre solar farm in Rhode Island, and one with a new wind farm in Texas. Together, these facilities will produce as much electricity as Brown consumes, cutting net emissions by 50 percent relative to 2017 levels. By 2025, the University will switch from natural gas to recycled bio-oil in its central heating facility, reducing emissions by another 25 percent. In addition, Brown will begin retrofitting campus buildings and infrastructure so that heat can be delivered by renewably generated, electricity-driven heat pumps rather than on-site combustion, enabling the University to meet its target of net-zero emissions by 2040. This effort, the largest infrastructure project ever undertaken by the University, will become a central part of how Brown teaches about sustainability and the intergenerational work of finding solutions.

SHIFTING ICE AND WAYS OF LIFE

Novel Institute team invites local perspectives on ice melt

IBES researchers view Uummannaq Island from above as they depart after 10 days of fieldwork. During their time there, nearly all the snow melted and numerous cracks in the sea ice appeared, particularly on the west side of the island. Photo: Sarah Cooley

Scientists know that sea ice in the Arctic Ocean has been shrinking dramatically over the past few decades; but the behavior of *shorefast ice*, the ice that forms within Arctic fjords, has been less well understood.

Now, Postdoctoral Research Associate in Environment and Society **Johnny Ryan** and colleagues are combining cutting-edge remote sensing techniques with innovative social science techniques to understand not only the changing behavior of fjord ice, but how these changes affect those who rely on it for daily life.

Their research centers on a place called Uummannaq, a small town in northwest Greenland. Fjord ice there, and in other regions of the Arctic, has been largely ignored by scientists due to technological limitations.

The town of Uummannaq as viewed from above. Photo: Sarah Cooley

"When scientists study sea ice, they tend to rely on coarse satellite imagery—like 25x25 km^2," he says. "But that imagery cannot identify the presence, or absence, of ice within a fjord that is only 5 km wide."

Sophisticated new satellites, such as Planet Labs' CubeSat constellation, which can resolve features as small as 10 meters in diameter, are starting to overcome these constraints. Ryan's mentor, IBES fellow **Laurence C. Smith**, runs a lab group that specializes in using such high-resolution imagery to investigate changes in Arctic surface water. But, as Ryan explains, even the sharpest images are limited in their ability to explain what is happening on the ground.

"Right now, we're still only looking at a 2D surface and not able to get much information about the fjord ice thickness or the processes that are causing it to break up," he says. "We're raising all these new questions, which can't necessarily be addressed with just satellite imagery."

But by working with locals in the community, Ryan's social science colleagues, IBES Director **Amanda Lynch** and Honorary Professors of Environment and Society **Brigt Dale** and **Siri Veland**, will introduce another potent source of information about changes in Arctic shorefast ice.

"Our plan is to go to Uummannaq with our scientific knowledge from satellite imagery, and try to understand how well it agrees with local knowledge," says Ryan. "In this way, they can help direct our future research—but then we can also tailor our scientific research so that is useful to people who live in Uummannaq."

The Smith Lab is known for its expertise in capturing real-time images of Arctic ice with drones; but on this field expedition, Ryan and his team hope to get even more out of such technology by sharing it.

"We want to give something back to the community, and we thought a good way of doing this would be to work with the local children. Some of them already have drones, but getting them familiar with photography and filmmaking and those sort of skills would be really cool," he says. "They live in such an amazing environment. If they were documenting some of the environmental change happening on their doorstep, it would be a pretty powerful way of communicating how climate change is affecting these communities."

Ryan and the team are hopeful that their unique IBES-derived blend of natural and social science research, together with insights from residents of Uummannaq, will provide a novel, robust, and innovative perspective on changes in Arctic sea ice.

"By using this knowledge from all these different sources—from people in interviews, from satellites, and from drones—hopefully we can understand more about the system," he says. "And if we understand more about the system, we can start to make predictions about how it will respond as the climate warms."

Their work represents a new paradigm in climate science.

"There's a huge pool of knowledge that is contained in people's minds," he says. "If you put the effort in to go and collect this information and work with local communities in a way that is mutually beneficial, I think there is a lot of opportunity to actually understand some of these environmental systems in ways that we've never been able to before." ■

INTRODUCING: LAURENCE C. SMITH

Thanks to its outsized effect on high latitudes, climate change is already causing substantial alterations in the Arctic physical environment. To understand more about the evolution of water and ice in the far north, Earth scientist **Laurence C. Smith** is charting a new course—combining field expeditions with satellite and airborne remote sensing technology to study changing river flows, melting ice sheets and glaciers, and thawing permafrost.

"Global climate change is a serious threat for people and the environment, and the Arctic is experiencing it at roughly double the global average rate," says Smith, now John Atwater and Diana Nelson University Professor of Environmental Studies and professor of earth, environmental and planetary sciences at Brown. "By leveraging cutting-edge satellite technologies and remote field work, I hope to understand and predict some of these globally important changes that are happening now."

Smith is engaged in research across the Arctic, from Alaska and northern Canada to Siberia, Greenland, and Iceland. His lab focuses on understanding little-understood physical processes in obscure geographic locations—all in an effort to answer pressing questions that will impact scientists' ability to forecast the disparate effects of climate change.

"For example, melting of the Greenland ice sheet is already contributing significantly to global sea-level rise and will continue to in the years ahead, yet the climate models that are used to predict future sea-level rise caused by Greenland have not been verified or tested on the ice sheet surface," he explains. "One of the novel things we have done is to actually go onto the ice sheet surface, in the melt zone, to test the accuracy of these global climate models."

Smith is thrilled to be bringing his groundbreaking research and expertise to Brown, and to the Institute.

"IBES is a growing center of excellence cutting across the social and physical sciences, something I feel society needs badly right now," he says. "Brown undergraduate and graduate students are superb and I am excited about the many opportunities to interact with them through small class settings and research. My new IBES colleagues are brilliant and dedicated scholars, and I look forward to learning much from them."

student spotlight

To avoid catastrophic environmental change and to uphold the dignity of those most vulnerable to its effects, wealthy nations must take immediate and dramatic steps to curb greenhouse gas emissions. To this end, senior **Emma Bouton** is leading the Rhode Island chapter of Sunrise, a youth-led movement dedicated to ending climate change.

By mobilizing large groups of students, engaging with staffers, and drawing media attention to the issue, Bouton and her team successfully encouraged Congressman David Cicilline (D-RI) to become an original co-sponsor of the U.S. House's Green New Deal Resolution.

Bouton's interest in the outdoors began in childhood, on her family's farm in rural New Hampshire. Since arriving at Brown, her passion for the natural world has become more centered on social justice.

"My ultimate goal," she explains, "is to stop climate change by fundamentally changing the unjust systems that produced the problem in the first place, creating a more livable and equitable world."

INTRODUCING: RACHEL WETTS

Climate change is widely considered one of the most alarming and urgent concerns of our time, but the United States has been slow to take meaningful action to address it. Environmental sociologist **Rachel Wetts** wants to understand why.

"The scientific community tells us that climate change will bring devastating effects both to human societies and the natural world, and yet we have barely begun to make the kind of changes that are needed to avoid the most dangerous consequences," says Wetts, now Acacia Assistant Professor of Environment and Society and Sociology. "That's not only a huge problem, but it's also something of a puzzle: Why do we seem to be rushing headlong into a disaster?"

As Wetts explains, American inaction on climate change appears to have roots in both culture and politics: cultural values such as individualism clash with the problem's intrinsically communal nature, while powerful political and financial interests have spread misinformation and leveraged their resources to block action on the issue.

"I'm interested in understanding how these different social forces have worked to block the actions we need to take to address climate change—and what we might change going forward to overcome these challenges," she says.

At IBES, Wetts is looking forward to collaborating with colleagues who share her commitment to rigorous inquiry and practical policy relevance.

"I see great value in being part of a community of scholars who are focused on environmental processes, but who bring their own distinctive disciplinary traditions, methods, and expertise to the table," she says. "This means we get to learn things from each other we otherwise wouldn't be exposed to, and we also have to learn to communicate the broader implications of our work to people who approach problems from very different perspectives."

DID YOU KNOW? IBES now offers a competitive summer internship for undergraduates in partnership with the Leadership Alliance.

The Leadership Alliance is a Brown University-based consortium that strives to develop underrepresented students into outstanding leaders and role models in academia, business, and the public sector. Highly motivated upperclassmen from across the country can apply for the nine-week, full-time paid internship which includes a competitive stipend, housing, and travel. Participants gain hands-on research experience and mentoring with an IBES faculty advisor from one of a variety of disciplines, including earth, environmental and planetary sciences; ecology and evolutionary biology; history; sociology; epidemiology; and anthropology. The opportunity is run at IBES by Institute fellows Samiah Moustafa and Elizabeth Fussell, who have an important goal for the program.

"Through our collaboration with the Leadership Alliance," says Moustafa, "we aim to increase the number of underrepresented minorities receiving doctoral degrees in the natural, environmental, and social sciences, at the national and institutional level."

INTRODUCING: DANIEL ENRIQUE IBARRA

Climate scientist and geochemist **Daniel Enrique Ibarra** knows just how vital water is to both natural and social ecosystems. But how is this limited natural resource evolving over time?

Ibarra, who is currently a visiting assistant professor at IBES, uses present and past data to better understand how water availability might change in a warming world.

"Unlike predictions of future temperature, predictions of changes in the water cycle—like precipitation and river runoff—are quite uncertain," he says. "My work uses past changes in the water cycle to ask: how much wetter or drier was a region under warmer or colder conditions? How sensitive is a region's water balance to temperature changes? What is the role of vegetation and changes in water delivery on terrestrial water availability?"

Finding answers to these complex questions requires Ibarra to make use of both modern datasets and ancient, paleoclimate records, often with the help of LiDAR and other remote sensing tools.

Ibarra's research has already revealed how dramatically water resources have changed globally over the past thousands to millions of years. His fieldwork has brought him to such disparate places as Asia, the Philippines, and North America.

He is looking forward to bringing his work to IBES and cultivating new relationships with fellow experts in biogeochemistry, climate science, and land use change.

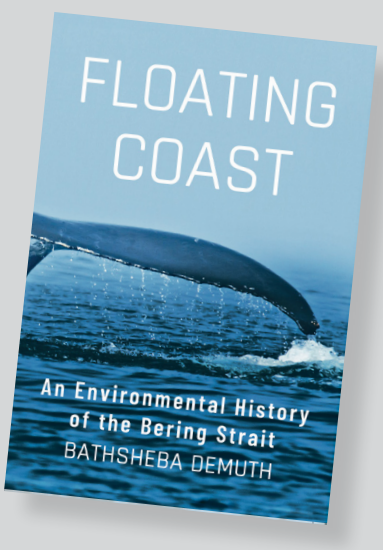
"Being a part of IBES will give me the collaborations and resources to pursue these projects at a much larger scale," he says.

Ibarra will join the Institute in 2021 as a rostered fellow.

IBES fellows' books out this year include:

FLOATING COAST:
AN ENVIRONMENTAL HISTORY
OF THE BERING STRAIT
Bathsheba Demuth
August 2019, W. W. Norton & Company

The first-ever comprehensive history of Beringia, the Arctic land and waters stretching from Russia to Canada, *Floating Coast* breaks away from familiar narratives to provide a fresh and fascinating perspective on an overlooked landscape. The unforgiving territory along the Bering Strait had long been home to humans–the Inupiat and Yupik in Alaska, and the Yupik and Chukchi in Russia–before Americans and Europeans arrived with revolutionary ideas for progress. Rapidly, these frigid lands and waters became the site of an ongoing experiment: How, under conditions of extreme scarcity, would the great modern ideologies of capitalism and communism control and manage the resources they craved?



LEADERSHIP

Director: Amanda Lynch, Earth, Environmental and Planetary Sciences
Deputy Director: Dov Sax, Ecology and Evolutionary Biology
Director of Undergraduate Studies: Dawn King, Environment and Society

INSTITUTE FELLOWS

Bathsheba Demuth, History
Scott Frickel, Sociology
Meredith Hastings, Earth, Environmental and Planetary Sciences
Tyler Kartzinel, Ecology and Evolutionary Biology
James Kellner, Ecology and Evolutionary Biology
Brian Lander, History
Myles Lennon, Anthropology
Stephen Porder, Ecology and Evolutionary Biology
J. Timmons Roberts, Sociology
Laurence C. Smith, Earth, Environmental and Planetary Sciences
Leah VanWey, Sociology
Rachel Wetts, Sociology
Gregory Wellenius, Epidemiology

TEACHING FELLOWS

Dawn King, Environment and Society
Samiah Moustafa, Environment and Society
H. Curtis Spalding, Environment and Society
Kurt Teichert, Environment and Society

ELECTED FELLOWS

Anna Aizer, Economics
Joseph Braun, Epidemiology
Andrew Foster, Economics
Baylor Fox-Kemper, Earth, Environmental and Planetary Sciences
Timothy Herbert, Earth, Environmental and Planetary Sciences
Yongsong Huang, Earth, Environmental and Planetary Sciences
Robert Hurt, Engineering
Nancy J. Jacobs, History
Agnes Kane, Pathology
Karl Kelsey, Epidemiology
Jung-Eun Lee, Earth, Environmental and Planetary Sciences
John Logan, Sociology
John Bradley Marston, Physics
John Mustard, Earth, Environmental and Planetary Sciences
James Russell, Earth, Environmental and Planetary Sciences
Neil Safier, History
Eric Suuberg, Engineering
Peter Van Dommelen, Joukowsky Institute for Archaeology and the Ancient World
Parker VanValkenburgh, Anthropology

VISITING FELLOWS

Robert Brulle, Environment and Society
Katherine Brunson, Archaeology and the Ancient World
Brigt Dale, Environment and Society
Elizabeth Fussell, Population Studies
Michael Goldstein, Environment and Society
Daniel Ibarra, Earth, Environmental and Planetary Sciences
Lenore Manderson, Environmental Studies
Siri Veland, Environmental Studies

AFFILIATE FELLOWS

Steven Clemens, Earth, Environmental and Planetary Sciences
Jeff Colgan, Political Science
Justine Hastings, Economics
Richard Locke, Provost, Political Science
G. Tayhas R. Palmore, Engineering
Elizabeth Rush, English
David Savitz, Epidemiology
Andrew Scherer, Anthropology
Katherine Smith, Ecology and Evolutionary Biology
Daniel Spade, Pathology

IBES ADVISORY COUNCIL

Kenneth Rivlin, Chair
Wendy Abrams
Catherine Merten Allchin
Ricardo Bayon
Elizabeth Belfer
Kate Brandt
Therese Carter
David Cogut
David Crane
David A. Crown
Barbara Entwisle
Nathalie Farman-Farma
Kathryn S. Fuller
James B. Garvin
Robert Goodman
Warren B. Kanders
Sophie Purdom
Taylor Ricketts
Cynthia Roberts
J. Marshall Shepherd
Bina Venkataraman
Peter S. Voss

Content by: Vanessa Janek
Designed by: Office of University Communications

Front cover: The village of Qaarsut as viewed from above, en route to the Arctic town of Uummannaq. Photo: Sarah Cooley

BROWN
Institute at Brown for
Environment & Society

The Institute at Brown for
Environment & Society
Brown University
Box 1951
Providence, RI 02912

"All too often, historical writing fails to acknowledge that it is not simply humans who shape history. The past shows no comfortable separation between what happens to beings and places and what happens to people. What is the nature of history when nature is part of what makes history?"

Bathsheba Demuth
Assistant Professor of History

Brown students change the world.
IBES helps them save the planet.

Make a gift at:
brown.edu/go/giving/IBES