CANOPY

FALL 2019

RISING TO THE CHALLENGE

The enduring impact of women on F&ES and on the environmental field.

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Yale SCHOOL OF FORESTRY & ENVIRONMENTAL STUDIES

Keep MODs and Carry On

First-year students at F&ES waste no time getting their hands dirty at MODs, our immersive summer orientation program. As part of Urban MODs, students spend a week familiarizing themselves with the New Haven community, which includes restoration work at Beaver Ponds Park and Cherry Ann Park. Skills and methods related to urban ecosystem analysis, environmental justice, and social ecology are all honed during the week-long program.

JACQUELYN GARRETT

MATTHEW GARRETT

Making a Splash

New Haven's Cherry Ann Park will look a lot cooler when F&ES students arrive for MODs next summer. Work has begun on the construction of a splash pad, made possible by a generous donation from Jackie Fouse '19 M.E.M. (seated at center). Fouse joined F&ES Dean Indy Burke (seated second from left); Colleen Murphy-Dunning (seated far left), director of the Urban Resources Initiative; and community leaders to discuss the future of the park and the importance of rehabilitating the urban natural area.

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Class photo of the Yale School of Forestry's Class of 1969

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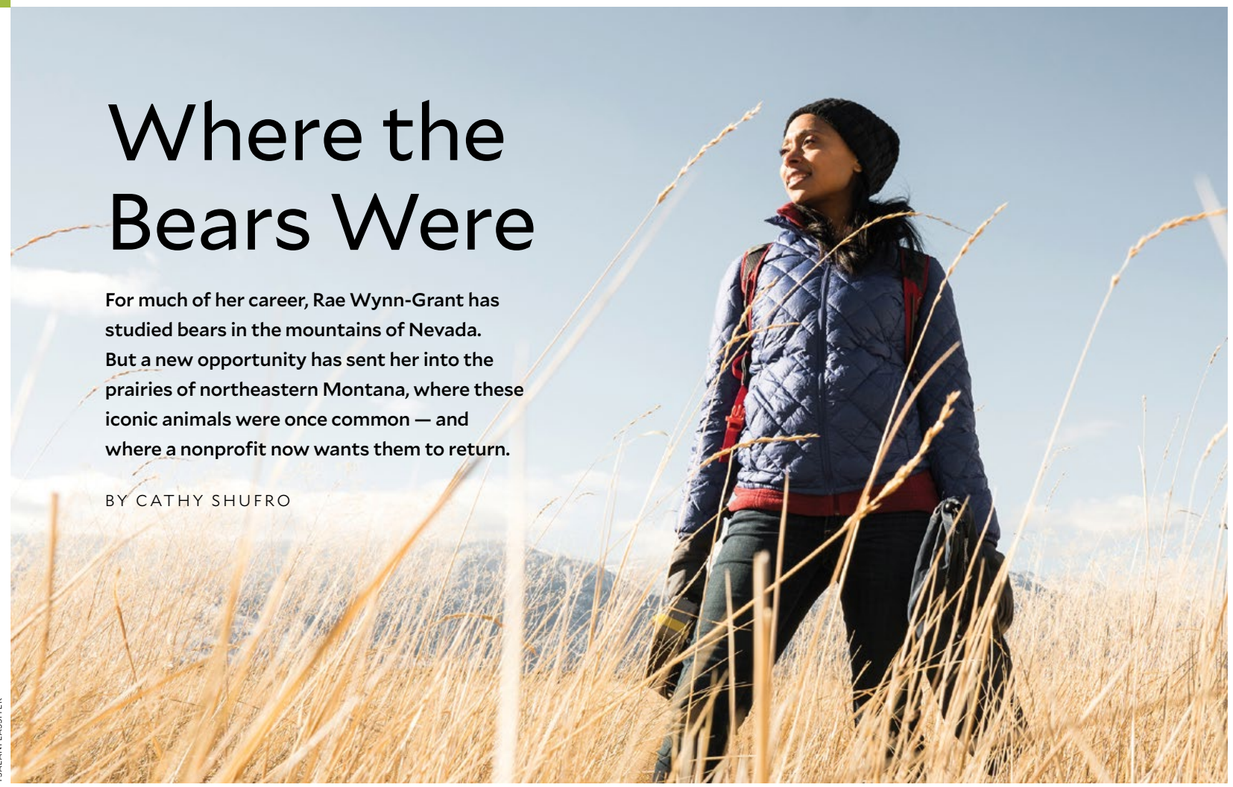

TSALANI LASSITER

Where the Bears Were

For much of her career, Rae Wynn-Grant has studied bears in the mountains of Nevada. But a new opportunity has sent her into the prairies of northeastern Montana, where these iconic animals were once common — and where a nonprofit now wants them to return.

BY CATHY SHUFRO

Rae Wynn-Grant '10 M.E.Sc. had been studying bears in Nevada for seven years when the National Geographic Society sent her to northeastern Montana to work for a group she'd never heard of, the American Prairie Reserve (APR). That meant leaving behind the mountains, where black bears are still common, and moving to the grasslands, where they are not.

"The mountains were in my rearview mirror — and it felt so wrong," she said.

A year later, Wynn-Grant sees things differently: As a student of *Ursus americanus* (the American black bear) and *Ursus arctos horribilis* (the grizzly), she's beginning to feel she belongs here. Because, as it turns out, the bears do, too.

"The prairie is the native home of all of America's large mammal species, bison being the most iconic, but also elk and mountain lions, wolves, and grizzly bears," said Wynn-Grant. "As white settlers came through from east to west, they exterminated wildlife and native peoples in the grasslands and drove them into the mountains."

The APR wants to see those animals roaming the prairie again. Funded by donations, the 18-year-old nonprofit is restoring Montana's northern prairie, buying private land to stitch together vast tracts of fragmented protected lands. It is building the reserve around the Charles M. Russell National Wildlife Refuge, 1.1 million acres near the Saskatchewan border. The organization's consulting biologists estimate that a thriving ecosystem with room for migration will require 3.2 million acres (by comparison, the state of Connecticut comprises 3.5 million acres).

"APR is taking old cattle ranches and restoring them," said Wynn-Grant, whose work with the group is funded by a National Geographic Society fellowship. "They start with grass: They get rid of crappy annual grass that cows graze on and they reseed with native grass species. The grasses just take off. With the native grasses back, the insects come back, and with the insects, the birds."

Even bison are returning. In 2005, after a century without them, the group trucked in 16 plains bison from South Dakota. Today the herd numbers 800. Wynn-Grant sees promise for the return of large carnivores, too. Grizzlies are already spilling out of protected areas such as Glacier National Park, located across the state in mountainous northwestern Montana.

But there are challenges. "The bears are quite literally walking on their four paws toward the prairie in search of high-quality habitat and getting killed along the way," she said. In June she heard that two young grizzlies had been killed 100 miles from the reserve. Conservation groups are already working to minimize human-wildlife conflict on the prairie. For instance, Defenders of Wildlife pays the salaries of range riders who observe where predators and cattle (or people) might mix and then keep them apart.

Wynn-Grant's main task so far has been predicting which habitats will attract bears. Obtaining data to model habitat selection has required negotiations with researchers from conservation groups and state and federal agencies.

Over the coming year, she'll set up camera traps to collect data on bear movements. (Black bears will serve as proxies for grizzlies.) Those sightings, she expects, will help fine-tune her understanding of habitat preferences.

It's not the first time Wynn-Grant has tracked wildlife. Back when she was a student at Yale, she tracked lions in Tanzania for four months on a project run by Laly Lichtenfield '05 Ph.D., co-founder and CEO of African People and Wildlife. It was later, while completing her doctorate at Columbia, that she first started doing hands-on black bear research.

While she remains a visiting scientist at the American Museum of Natural History in New York — and spent three years teaching there as a postdoctoral fellow — she decided to step off the path toward a full-time academic job when she discovered the opportunity with National Geographic.

The fellowship has allowed her more time to develop her skills in science communication and storytelling. Wynn-Grant views this role as something of a public service. It was the nature shows that she'd watched on television as a child that sparked her interest in big mammals. At the time it didn't occur to her that she was learning science. "I was being entertained," she said.

"Being a part of Nat Geo has given me much more of a media presence, which is exciting and fun," she said. Her audiences range from science-loving teenagers in Manhattan to rural Montanans. She values, in particular, speaking to people of color. "Being able to talk about my career and why it's important is raising awareness in a community that hasn't historically been involved in this work."

PETER HOULIHAN

As a large carnivore ecologist, Rae Wynn-Grant gets up close and personal with America's largest predators.

Back when Wynn-Grant was collaring bears in Nevada, she found an unexpected commonality between the animals and humans: a fondness for the rainbow coffee cake donated by Walmart to lure them.

Years of close contact with bears have revealed more meaningful similarities — bears and humans alike seek safe places to raise offspring, each prefers habitats with abundant food, and both like living near water.

"I'm a large omnivore myself," she said. "I really feel passionate about finding coexistence for all of us."

Professional Symbiosis

TERRY DAGRADI

Over the past three decades Marian Chertow has advanced the growing field of industrial ecology across the world — and inspired generations of Yale students to assert themselves as leaders of the field.

BY CARA MCDONOUGH

Industrial symbiosis. Sounds a bit intimidating.

The idea, however, is anything but. Industrial symbiosis, a subfield of industrial ecology, describes what happens when clusters of companies collaborate to improve the use and reuse of materials, water, and energy so that one firm's waste becomes another's source of raw materials. The system is pragmatic, ingenious, and innovative.

The same might be said of Marian Chertow '81 M.P.P.M., '00 Ph.D. As associate professor of industrial environmental management at Yale, Chertow has helped grow the field of industrial ecology, particularly through her research and teaching on industrial symbiosis, helping to establish it as a subfield and profession — especially in the developing world.

She has written seminal papers on how symbiotic systems might achieve energy and resource savings in places like China and India. And she is now working to establish a program in Rwanda, a nation that is eager to recycle and reuse all of its clothing.

"I've always wanted to be part of a useful field, and I've always believed industrial ecology has that as part of its basic mission," Chertow says. "Not only to theorize change but to be part of the solutions in a tangible way."

At Yale, Chertow is also known for providing mentorship that has advanced the careers of generations of students, including well after graduation. She's been described as that rare teacher who is equally interested in theory and real-world application, the leader who always has time to talk shop (or anything else) with industrial ecology up-and-comers.

For these accomplishments, this fall Chertow was inducted into the Connecticut Women's Hall of Fame, an educational outreach organization that celebrates and honors the achievements of women to inspire continued success throughout the state. Over the summer, in Beijing, she also received the International Society for Industrial Ecology's Society Prize, the organization's highest recognition of professional achievement, for her contributions to the field.

"I've always wanted to be part of a useful field, and I've always believed industrial ecology has that as part of its basic mission," Chertow says. "Not only to theorize change but to be part of the solutions in a tangible way."

Before she was a pioneer in the field of industrial ecology, Marian Chertow worked in another emerging field: recycling. After graduating from Barnard, she got a job at a startup recycling company in Connecticut owned by a friend's father. She soon understood that truly improving waste systems required a better understanding of the business side, so she enrolled in Yale's School of Management (SOM).

In 1990 Chertow was hired to teach waste management at Yale. Within a decade Yale would become ground zero for research into the growing field of industrial ecology, which examines the flow of energy and materials through industrial systems and how those systems might be improved to reduce environmental impacts. After earning her Ph.D. from F&ES, she helped create both the *Journal of Industrial Ecology* and the International Society of Industrial Ecology in the early 2000s.

"Marian really understands what's going on on the ground and knows how to make sense of it in a systematic way, building a platform for progress," says Reid Lifset, a research scholar and editor-in-chief of the *Journal of Industrial Ecology*, who met Chertow in 1988.

She practices the same down-to-earth philosophy with her students and teaching. "She cares really deeply about the kind of students we graduate, making sure they get the education they need and can go to the places they need to go," Lifset says.

Weslynne Ashton '08 Ph.D. agrees. Ashton, who is now an associate professor of environmental management and sustainability at Illinois Institute of Technology, was Chertow's first Ph.D. student. She describes her former mentor as not only an "intellectual giant," but someone who always has time to get to know everyone in her sphere.

"She has this fantastic ability to connect with a diverse, wide range of people on a personal as well as professional level," Ashton says. "Relationships are really important to her, and she cultivates them in a way that helps students feel confident."

"She also makes space for her family, and the fact that she was able to do both things was a really great example for me," she says. "And a really great example not only for young women but everyone."

Another one of Chertow's former advisees is Bryan Garcia, who earned a Master of Environmental Management degree from F&ES in 2000, with a focus on industrial ecology. Today he is president and CEO of the Connecticut Green Bank, an innovative organization that aims to bring investment to the clean energy space. She helped Garcia land his first job and continues to offer guidance.

"Marian has just been a lifetime mentor," Garcia says. "Every time I have an important decision in life or my career, she's the first person I call. She always helps me think about opportunities and challenges from different perspectives."

Her work over the years has served as a guidepost for others in the field, says Garcia. "She's been going there for over a decade and is ahead of us all," he says. "Her research is right where society is heading."

For Chertow, the work provides such a rewarding symbiosis of intriguing ideas and personalities that — to hear her talk — it doesn't sound like work at all.

"One of the things I've loved about the industrial ecology program is how varied it is," she says. "You can't really understand it unless you understand the cultural and political factors in other countries. And when you work in depth with students, you get to the root of the issues that we are trying to manage. Not only have I gained valuable friendships, but I've gained a treasure trove of insight."

Taking Action

F&ES was well represented at September's Climate Strike, a global protest demanding action to combat climate change. Demonstrations were held around the world, including in New Haven where members of Yale community marched with other concerned citizens.

NEWS & NOTES

Lewis Cullman, generous philanthropist, dies at 100

Lewis Cullman '41 B.A., an American philanthropist whose generous support helped enrich the F&ES community, died in June.

Cullman and his wife, Dorothy, donated hundreds of millions of dollars to the arts, hospitals, libraries, and educational institutions. One of the largest beneficiaries of their generosity was the New York Botanical Garden, which received $20 million from them over many years, according to *The New York Times*.

This relationship helped establish The Lewis B. Cullman Fellowship, a combined doctoral degree jointly offered by the New York Botanical Garden and F&ES that trains biological scientists to use an interdisciplinary approach to solving problems associated with tropical environments.

"The joint degree program didn't just give me the opportunity to study, it connected me with advisors at both F&ES and the New York Botanical Garden," said Marlyse Duguid '10 M.F. '16 Ph.D. "Building relationships with these amazing botanists made me a better botanist, and I still work closely with them today," said Duguid, a Cullman Fellow from 2011 to 2016, and currently the Thomas G. Siccama Lecturer at F&ES and the director of research at Yale Forests.

Student earns prestigious fellowship

Margaret Tallmadge '20 M.E.M. was named a Switzer Environmental Fellow by the Robert & Patricia Switzer Foundation, a prestigious program that supports future environmental leaders.

Tallmadge, a citizen of the Cherokee Nation, is studying the intersection of energy, business, and the environment, with particular focus on energy and utility policy, finance, and economic development to build wealth and political power in Native American tribes and low-income communities of color. As part of the Fellowship, Tallmadge interned this past summer in Portland, Oregon, at Avangrid Renewables, a national leader in clean energy.

New role for an F&ES 'bridge-builder'

In June, Professor Brad Gentry, an expert in land conservation and conservation finance, was named the Frederick K. Weyerhaeuser Professor in the Practice of Forest Resources Management and Policy at F&ES and the Yale School of Management.

Gentry, who joined F&ES as a senior research scholar in 1995, became a professor in the practice at F&ES in 2012. In 2017, he was appointed senior associate dean of professional practice.

"Brad integrates knowledge of conservation, conservation finance, forest management, and business solutions toward sustainability in his teaching, his service to businesses and conservation organizations, and his leadership at Yale," said F&ES Dean Indy Burke. "He's also a gracious and generous bridge-builder on our campus."

Oliver's career capped with 'festschrift'

A master's degree, a Ph.D., and nearly two decades as a faculty member — it will be hard to imagine F&ES without Chadwick "Chad" Oliver.

The Pinchot Professor of Forestry and Environmental Studies and director of Yale's Global Institute of Sustainable Forestry will retire at the end of the academic year, closing a distinguished career in environmental education and the practice of forestry. In that time, he's authored countless articles, chapters and books; testified before Congress as a recognized expert in his field; and consulted for public and private organizations across the world.

During Reunion Weekend in October, Oliver's career was celebrated with a "festschrift," in which colleagues, former students, and friends presented readings and lectures outlining his life's work.

New dean for student affairs

In July, F&ES welcomed Sean Bogle as the new assistant dean for student affairs.

Bogle comes to Yale from Foothill College, where he served as the dean of student affairs and activities. Before Foothill, he was at Stanford University, where he served first as an assistant dean/residence dean, and then an assistant dean of students/associate director of community standards. Bogle has also held positions in conduct and community standards, as well as residential life.

He replaced Joanne DeBernardo, the longtime assistant dean of student services who retired after 15 years at F&ES.

Easley honored by SAF

Thomas Easley, the assistant dean of community and inclusion at F&ES, was recently honored by the Society of American Foresters (SAF) with the Diversity Leadership Award. The award recognizes SAF members who display the ability, talent, and skill to lead innovative and exemplary diversity and inclusion efforts.

Easley joined F&ES in 2017 after a 13-year stint at the North Carolina State University College of Natural Resources. The first to hold his role, Easley has been tasked with guiding initiatives to increase diversity, equity, and inclusion across the School. That includes building a more representative community of students, faculty, and staff, and developing courses and training that expand skills for communicating effectively across differences.

Blue Sky wins MIT Solve's top prize

MIT Solve, an initiative of the Massachusetts Institute of Technology (MIT), selected 32 "Solver teams" to compete in a pitch competition at the annual United Nations General Assembly week in September. Blue Sky Analytics, founded by Abhilasha Purwar '17 M.E.M., was chosen to present and was one of four teams to take home the $200,000 AI Innovations Prize.

Blue Sky created BreeZo, a mobile app that uses large geospatial datasets to provide historical and real-time air quality data to help users minimize exposure to air pollution. The company is currently focused on air quality data for Purwar's native India, which has 15 of the 20 most polluted cities in the world.

Up, up and away

Madeleine O'Brien '20 M.E.Sc. operates a drone loaded with sensors to measure carbon dioxide concentrations at various heights on the Yale campus this summer as part of a project led by the Yale Center for Earth Observation. O'Brien plans to use some of the data for her thesis research.

RESEARCH UPDATES

Sediment reveals clues about the future of coastal marshes

One of the consequences of sea level rise in many coastal locations will be the inland migration of salt marshland. That is, of course, if these marshes are able to move fast enough to keep up with encroaching waters. To date, however, there has been relatively little data to help predict where marsh will be likely to survive rising seas and the factors that will help determine its odds.

In July, Yale researchers described a novel methodology that tracks the inland movement of marshland by analyzing microscopic fossils in the layers of sediment, a process that has enabled them to identify marsh migration that might not be evident through other methods.

The team, led by Shimon Anisfeld, a senior lecturer and research scientist at F&ES, reported on field experiments at two sites along the Connecticut shoreline. While salt marshes were moving upslope at both sites, they moved at very different rates. While the land slope is a key reason, another potential factor is the effect of large storms, such as Superstorm Sandy. In some cases, the authors speculate, the majority of marsh migration over decades may have occurred during these storm events.

Researchers hope their results and this new methodology will help improve modeling to predict the migration of marshes, a phenomenon that will affect coastal regions across the world, including along most parts of the U.S. Eastern Seaboard.

Yale investments director shifts focus to climate solutions

Dean Takahashi, the longtime senior director of the Yale Investments Office, will spearhead a new multidisciplinary Yale laboratory that will develop and support innovative solutions to the challenge of climate change.

The Yale Carbon Offset Laboratory (COLab) will be based at F&ES but will engage faculty and students from across campus — as well as innovators and scientists from outside the university. In particular, it will work to identify those who are developing technologies that sequester and store carbon and reduce greenhouse gas emissions. It will focus on methods designed to succeed on a large scale, and that can be tested and validated quickly and inexpensively.

The lab will aim to offset more than 1 billion tons of global carbon dioxide emissions over the long term, and it will target more than 10 million tons in emissions offsets by 2030 — or about 50 times Yale's current net emissions. By demonstrating the value of the technologies essential to this endeavor, Takahashi hopes the COLab will also strengthen the global market for carbon offsets, promoting further innovation.

"Yale is a place where we should be coming up with big ideas that have global impact," he added. "We want to find the kinds of projects that could reduce global carbon emissions safely at a large scale, but at a low cost."

Can human-robot collaboration solve recycling challenges?

Last year, China announced that it would reject almost all recyclables imported from other countries due in part to the amount of "impurities" — or non-recyclable materials — in the waste, which slow recovery processes and reduce profitability. Now more countries from south and southeast Asia are considering similar bans, a trend that could create enormous stockpiles of waste and imperil the global recycling industry.

Yale researchers believe robotic technologies might help solve this bottleneck.

An interdisciplinary team of researchers has received $2.5 million from the National Science Foundation to examine whether a collaboration between humans and robots can improve the quality of these recyclables and the profitability of this vital yet struggling sector. At the same time, they will evaluate opportunities to create new human jobs that complement automated systems.

"Waste-sorting is the most important problem that we face in the recycling field because, if we don't do it well, the market prices diminish significantly," said waste expert Marian Chertow, associate professor of industrial environmental management at F&ES and a co-principal investigator for the research project.

Seto honored for contributions to remote-sensing research

Professor Karen Seto this year received the Outstanding Contributions to Remote Sensing Research award from the American Association of Geographers (AAG).

Seto, the Frederick C. Hixon Professor of Geography and Urbanization Science at F&ES, was honored for advancing the understanding of how urbanization contributes to global environmental change and for bringing these insights to the attention of policymakers worldwide.

"Her contributions to the field of remote sensing have been exceptionally influential, especially in the use of Earth observation data and remote sensing techniques, to understand and document urbanization, urban land use and spatial structure," Qihao Weng, professor of geography and director of the Center for Urban and Environmental Change at Indiana State University, wrote in nominating Seto.

"By bridging the social and natural sciences, her research surrounding conceptual frameworks for urban teleconnections — zones of influence beyond the immediate urban surroundings — has brought international attention to the environmental consequences of urbanization."

A Campus for the 21st Century: Online Programs Open Yale Expertise to the World

Two new online certificate programs — on tropical forest landscapes and renewable energy, respectively — have made F&ES expertise available beyond the university's New Haven campus. Working professionals from a range of sectors — and 34 countries — are already taking advantage.

BY DYLAN WALSH '09

Paola Fajardo had recently finished her master's degree in geography at McGill University when she received an email from the Mexican National Forestry Commission, her former employer. She had worked there for four years, leading efforts to conserve and restore endangered ecosystems around the country. Among other things, the email mentioned an online certificate program offered through the Environmental Leadership & Training Initiative (ELTI) at F&ES.

"It sounded like a really innovative program," said Fajardo, who makes a point of staying apprised of professional education opportunities. The ELTI program not only offered a formal certificate, but it covered a wide range of forestry concerns — from the social dimensions of conservation work to project funding strategies — and it provided live interaction with Yale professors and fellow participants. "I knew I wanted to be part of the first cohort."

Now she is.

"Tropical Forest Landscapes: Conservation, Restoration, & Sustainable Use" is one of two experimental online certificate programs launched this academic year at F&ES. The other, "Financing and Deploying Clean Energy," is offered through the Yale Center for Business and the Environment (CBEY) in partnership with the Yale School of Management. Drawing on the center's vast network of professionals and Yale faculty, the program helps participants strengthen their skills in policy, finance, and technology in order to develop innovative approaches to how society produces, distributes, and consumes energy.

Both programs are supported financially and technically by the Poorvu Center for Teaching and Learning, a Yale center that offers training, consultation, and resources to make teaching and learning more public and collaborative. In fact, they emerged from a request for proposal from the Poorvu Center for new projects related to online learning.

After receiving seed money, each center ran a market survey of potential participants: Which subjects would be most useful? What format was preferred? What were reasonable expectations for time and tuition? With answers to these basic questions, ELTI and CBEY designed programs with different structures but fundamentally similar purposes.

First, they have established a new platform through which expertise from across Yale is opened to a global audience. "Financing and Deploying Clean Energy," for instance, takes advantage of 15 faculty members from four different schools across the university and draws course material from environmental science, economics, business, finance, engineering, law, and political science.

> "The selected participants have clearly articulated how this program will not just help them advance their credentials, but also lead to on-the-ground changes in land management."

"Tropical Forest Landscapes" also covers a range of topics related to forest restoration and conservation and has enrolled a predominantly global group: 43 people from 29 countries.

Second, both programs are deeply invested in effecting real and enduring change.

"The goal of this certificate is to accelerate the deployment of clean energy and have immediate impact," said Vero Bourg-Meyer '15 M.E.M., who manages CBEY's program. "Deploying and financing clean energy requires both specific skills and people from many different disciplines, so we've built an educational model to impart these skills and support people who are seeking to accelerate the transition to a clean economy."

The first cohort includes a roughly even division among consultants, policymakers and lobbyists, representatives from energy and utility companies, and banking and finance experts.

"We are a wonderfully diverse Noah's ark of backgrounds and personalities," said Martha Danly, an independent consultant based in the San Francisco Bay Area who is part of the first clean energy class. "The program is helping to clarify where my skills as a technology entrepreneur could have the greatest impact. More than anything, it's giving me the tools to dig deeper into what really matters — a true foundation for lifelong learning."

ELTI is also focused on real-world impact. "The selected participants have clearly articulated how this program will not just help them advance their credentials, but also lead to on-the-ground changes in land management," said Gillian Bloomfield '10 M.F.S., the online training program coordinator at ELTI. "We wanted participants to be able to apply what they learned."

Fajardo has found the same to be true as she works on a plan to balance indigenous community use of mangrove root on the western coast of Mexico with the trees' precarious status. "Not only has the course content been amazing, but so has interaction with the other participants," she said. "They come from all over the world and are working in different institutions — NGOs, government, the U.N., universities — and so it's incredibly helpful to hear what they have to say."

She mentioned one of the first course assignments, in which participants were asked to define "conservation" and "restoration." Though a straightforward task, the results from the group varied tremendously, and this led to a wide-ranging conversation on both what these words can mean and the risk of misunderstanding. "Already," she said, "the certificate has exceeded all my expectations."

RISING TO THE CHALLENGE

In the early years of co-education at F&ES, women like Elizabeth Lyons '81 M.F.S. (holding saw) cleared the path into forestry and environmental education. Lyons has now worked at the National Science Foundation for nearly 25 years, and currently serves as a program director in its Office of International Science and Engineering.

PHOTO COURTESY OF CILLA KELLERT

Since their formal admission in the 1960s, women have played a vital role in the evolution of the Yale School of Forestry & Environmental Studies (F&ES) — and the progress made in the broader environmental movement.

BY HANNAH PERAGINE '18 AND JOSH ANUSEWICZ

Hallie Metzger '75 M.F.S. feels most at home deep in the woods of rural Connecticut, on the 160-acre plot of land her family has owned for decades. She manages the forest there, maintaining test plots for white pine and hybrid chestnut and eradicating invasive species in a critical ecosystem.

This family forest is the reason Metzger decided to attend F&ES in the first place. Armed with a degree from Barnard, she had dreams of being a teacher until the need arose for someone in her family to manage the forest.

So she studied to become a forester — a novel idea at the time, in a field dominated by men. But Metzger — and the first group of women who attended F&ES in the 1960s and 1970s — joined the School at just the right moment.

"We were on the cusp of a radical change," recalls Metzger. "The men who enrolled post-Depression brought forests back from the brink, but they were passing their prime as the field was changing to address the next set of challenges."

On the surface, Metzger's impact on the field of conservation might seem minor; she proudly calls herself "a one-ridge hillbilly." But she played a part in the monumental shift during which the work of conservation and natural resource management expanded into a broader, multifaceted environmentalism. It was an era when the Environmental Protection Agency was born, and the Clean Air Act and Water Pollution Control Act were adopted as law in the United States. There was greater public awareness and appreciation of the natural world and its importance. Conservationists were no longer just the foresters of the earlier environmental movement; they were also politicians, lawyers, educators, business owners, and scientists.

And a growing number of them were women who, like Metzger, were rising to a new challenge.

This year, Yale University is celebrating two major milestones: the 50th anniversary of the matriculation of undergraduate women into Yale College and the 150th anniversary of the first female graduate students at Yale. The university is marking those milestones with a year-long celebration, titled **50WomenAtYale150**, which will include a series of events, exhibits, lectures, and performances held across the Yale campus.

"In the last 150 years, Yale has undergone a transformation from an all-male institution to one that celebrates and supports women's growth and achievements," said Yale President Peter Salovey in a message to the Yale community. "And much of that transformation is owed to the trailblazing women who first took graduate courses, who championed coeducation, and who raised their hands in those early coed classrooms at Yale College."

F&ES was the last of Yale's graduate schools to admit women, in 1966, just years before the watershed Title IX Act that prohibited education programs from discriminating against students on the basis of sex. Much like the environmental movement itself, the School's effort for inclusivity was a slow burn, with just a handful of women matriculating in the late 1960s and early 1970s.

Part of the challenge, Metzger said, was fitting women into a structure that hadn't been built for them. She recalled Professor D.M. Smith's trip to the White Mountains of New Hampshire: "There hadn't been a good setup for women at the camp, so Professor Smith arranged for some of us to bunk with colleagues in the area."

"The existing structure was not going to work," continued Metzger. "We needed to build a new structure, one that met the evolving needs of the School and society."

Decades later, the seeds that prior generations planted have grown. More than 45 percent of living F&ES alumni are women. When the Class of 2020 are handed their diplomas in May, nearly 60 percent of the recipients will be women.

Women from F&ES have made an indelible impact on conservation and environmentalism around the world. They have fought for environmental justice, changed how we manage our forests, invented new ways to recycle our waste, and continue to work to achieve a more sustainable world.

These are just a few of the F&ES women who have led the way.

THE LEGEND

FRANCES BEINECKE ’71 B.A., ’74 M.F.S.

With more than three million members and satellite offices across the globe, the Natural Resources Defense Council (NRDC) is one of the most prominent environmental advocacy groups in the world. Perhaps no one has played a bigger role in its growth over more than four decades than Frances Beinecke. Starting as an intern shortly after the NRDC’s founding — when she was still an F&ES student — she held many positions before working her way up to become president in 2006. During her decades-long tenure, the NRDC had an outsized impact on global law, policy, and research related to climate change, clean air and water, renewable energy, land and wildlife conservation, and environmental justice. Her courageous leadership earned her appointments to the National Commission on the BP Deepwater Horizon Oil Spill and Offshore Drilling in 2010 and the U.S. Secretary of Energy’s advisory board in 2012. As Yale alumna and actress Sigourney Weaver wrote in a 2014 profile in *Vanity Fair*, “Standing up to bullies and never backing down are all second nature to her.”

JOSHUA PAUL/NRDC

THE INNOVATOR

LAURA MCCARTHY ’87 M.F.

Across the western U.S., forest fires have burned with unprecedented frequency and severity in recent years — a phenomenon that is expected to continue in a changing climate. Solutions, therefore, will require unprecedented efforts. Laura McCarthy, the State Forester of New Mexico and former senior policy adviser for fire and fire restoration for The Nature Conservancy (TNC), has helped introduce a revolutionary program called the Rio Grande Water Fund that uses a systems-thinking approach to manage wildfires, forests, water quality, and local jobs. McCarthy created this model program that secures water resources for one million New Mexicans while efficiently managing forest ecosystems in the rural northern New Mexico areas that store the water. This modern approach to natural resource management has been used as an example for new water funds across the United States, in China, and in countries in South America and Africa.

ALAN ECKERT

THE SCHOLAR

DORCETA TAYLOR ’85 M.F.S., ’91 PH.D.

The field of environmental justice as we know it might not have progressed to where it is today without Dorceta Taylor. The first black woman to earn a Ph.D. from F&ES, Taylor wrote the book — more than one, actually — on diversity in the environmental movement, peeling back the layers of the movement’s history to investigate environmental racism, inequality, and social change. Her 2014 study on the state of diversity in nearly 200 U.S. environmental organizations was a watershed moment, sharply bringing into focus a staggering lack of people of color in the field and pushing many prominent organizations to commit to increasing diversity in their workforces. Taylor, who has received numerous accolades for her scholarship and advocacy, remains a prominent voice, serving as director of diversity, equity, and inclusion at the University of Michigan’s School for Environment and Sustainability and teaching courses on environmental justice.

DAVE BRENNER/UNIVERSITY OF MICHIGAN SCHOOL FOR ENVIRONMENT AND SUSTAINABILITY

THE INVENTOR

CHARISSA RUJANAVECH ’13 M.E.M.

Estimates put sales of the iPhone in 2018 at more than 200 million units worldwide, which means just as many old phones potentially being thrown away, each containing valuable rare materials critical to its operation. With a background in sustainable design and manufacturing for apparel companies Nike and Patagonia, Charissa Rujanavech came to Apple with an idea to solve their recycling issue, using her background in ecology to prove that nothing in nature truly goes to waste. She invented Liam, a robot that could quickly disassemble iPhones to recover or properly dispose of the valuable materials inside. Liam eventually morphed into Daisy, a more efficient robot that can take apart several versions of the iPhone at more than 200 units per hour.

COURTESY OF APPLE

Summer Road Trip

After their first year at F&ES, students' internship experiences and research projects take them around the globe, shaping their future careers. Here are a few snapshots of their trips from last summer.


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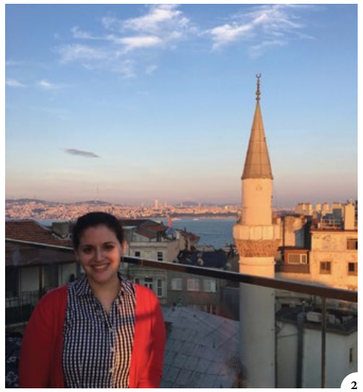
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1 **Abby Chan** worked with Forterra NW in Washington to research funding sources for land management and conservation in the state. 2 **Alix Kashdan** was part of the Climate Change Team of the United Nations Development Programme's Central Asia and Eastern Europe regional hub in Istanbul. 3 Dual-degree student **David Bruce** worked with local architects on an international design competition to propose a center for water research near Cusco, Peru. 4 **Britta Dosch** supported the Climate Change and Reforestation divisions of the UN Environment's Secretariat of the Convention on Biological Diversity in Montréal. 5 **Christina Ospina** worked with Forested Foods, an agroforestry venture in Ethiopia that is working to combat deforestation through sustainable farming of forest-based products. 6 **Aaron Feng** worked as an Environmental Defense Fund Climate Corps Fellow at Credit Suisse in New York City. 7 **Marisa Repka** helped the local government of Honolulu achieve energy benchmarking and low-carbon transportation goals, in partnership with the American Cities Climate Challenge. 8 **Alejandra Hernandez** developed a community engagement and education plan related to water quality and green infrastructure in Mérida, Mexico. 9 **Jesse Laniak** worked with Spectral Energy in Amsterdam, a smart grid developer specializing in renewable-based flexibility in residential and commercial architecture. 10 **Devon Ericksen** learned traditional Hawaiian forest restoration techniques at the Limahuli Garden & Preserve on Kaua'i. 11 **Karam Sheban** conducted research at the first commercial ginseng farm in the United States, located in upstate New York. 12 **Eve Barnett** worked with three National Park Service units in southern Idaho, including Craters of the Moon National Monument & Preserve. 13 **Khin Htet Htet Pyone** worked at the Smithsonian Conservation Biology Institute, using GIS technology to create maps for a proposed national park in rural Myanmar. 14 **Robert Little** was an Environmental Defense Fund Climate Corps Fellow at Pepsi, supporting the corporation's recycling and sustainability efforts.


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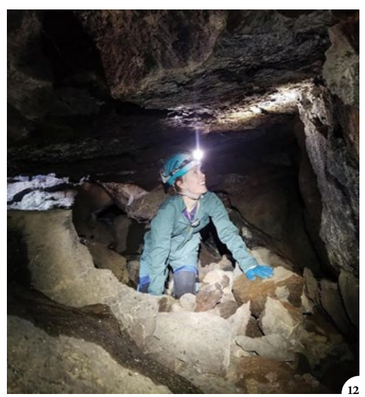
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Ideas for a Better Planet

No single idea is going to solve the complex and tangled environmental challenges facing the planet — it's going to take innovative solutions from experts working in every corner of the world. In a new book, "A Better Planet: 40 Big Ideas for a Sustainable Future," environmental leaders from across a range of disciplines, sectors, and political perspectives share their ideas.

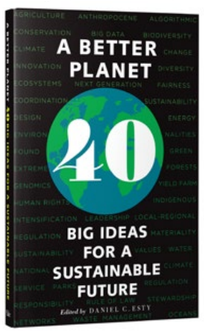
BY INDY BURKE

It is the challenge of the century: Can humans obtain the necessary resources for this and future generations to flourish sustainably without causing irreversible damage to the planet? How do we obtain the requisite food, clean and sufficient water, energy, clean air, and access to green and wild places for our own health? How do we steward the biological diversity of the planet?

These are big questions. Addressing them will require real innovation.

This is why, two years ago, we launched the Yale Environmental Dialogue, an ambitious initiative that aims to change the way society thinks about these challenges — while also offering some concrete ideas for how we can address them. It is also why we have produced a new book, "A Better Planet: 40 Big Ideas for a Sustainable Future," published in October by Yale University Press. The authors are scholars and practitioners working in business, government, and the nonprofit world, as well as a few of our own F&ES students.

Why a book about environmental protection? Why right now? Why dialogue, collaboration, and leadership from experts at a time when there is growing distrust in expertise?



We believe today is exactly the right time for new ideas to guide environmental protection. Now more than ever, we need tractable innovations that rely on science and rigorous analysis, prioritize protection for those both near and far from the threats of irreversible damage, generate opportunities for economic investment and welfare.

It might seem odd to release a book based on this belief in the current political moment, when there is so much suspicion of experts and, indeed, of elite institutions (including our own). Experts are perceived by some to be out of touch, far from the real problems people face every day, and even biased toward one or another political perspective. But this lack of trust is inconsistent in its forms. Public appreciation for what science and technology can bring remains strong when it comes to curing illness, engineering solutions that result in enhanced communication over smartphones and the internet, and delivering new and exciting modes of transportation. To some extent, we experts may have brought some of this distrust on ourselves, through developing tremendous depth in knowledge and tools but perhaps not as much skill in communicating that knowledge or its relevance.

This book addresses the gap between expert innovation and perceived useful knowledge for environmental protection in two ways. First, the essays are the result of scholarly and practical thinking and writing that have been vetted and strengthened by the Yale Environmental Dialogue; authors presented drafts of their essays to diverse audiences who, after spirited discussion, shared feedback that was incorporated into the final versions. Second, our authors were selected for their ability to communicate across levels of expertise, political perspectives, and the range of values people hold regarding environmental protection.

Catalyzing the movement of these innovative ideas into solutions demands leadership. Leaders in business, government, and land management have the opportunity through this book to learn about current and future trends and envision new ways forward that prioritize human and environmental health — many of which can also lead to increased economic growth. It is an exciting time to be reshaping the dialogue about the environment in a way that brings all political viewpoints to the same table, shares common goals for a sustainable future, and catalyzes solutions through innovation.

SURAPOL USANAKUL

THE FOLLOWING EXCERPTS ARE FROM THE BOOK "A BETTER PLANET: 40 BIG IDEAS FOR A SUSTAINABLE FUTURE."

People and the Ocean 3.0:
A New Narrative with Transformative Benefits

"For most of human history, and well into the late twentieth-century, the ocean's immense size, productivity, and resilience made it impossible for people to ever imagine depleting or disrupting it. In many places, fish were so abundant they sometimes leaped into fishing boats. The 1960s mantra 'Dilution is the solution to pollution' reinforced the notion that anything we put into the ocean could not possibly affect such a vast place. We took for granted the beauty and the bounty of the ocean and assumed these were intrinsic features of the ocean that would continue forever. And we acted accordingly... Over the past few decades, the attitude that the ocean represented an endless bounty and bottomless dump was gradually questioned. It is now overwhelmingly obvious that the previous mind-set — along with a broad suite of human actions — has inadvertently caused widespread depletion and disruption. Scientists tell us we have fundamentally altered its very chemistry, biology and physical structure — something once thought impossible...

"Like a phoenix rising from the ashes, however, hope is beginning to emerge and steer us away from this dismal ocean narrative. The challenges are unprecedented, complex, and wicked. The future is unpredictable and likely to harbor hidden challenges. But, the challenges facing the ocean are not insurmountable... Two examples of potentially transformative solutions already under way are fisheries reform and creation of Marine Protected Areas. Each has potential to scale up and form the basis of a new transition to sustainable, equitable, and smart ocean stewardship. They are interconnected to each other and to other big challenges such as climate change and human health. Neither is sufficient alone, but together they provide core elements for a new awakening and a new future."

This is an excerpt of an essay by Jane Lubchenco

Jane Lubchenco, a marine ecologist and University Distinguished Professor at Oregon State University, is the former Administrator of the U.S. National Oceanic and Atmospheric Administration (NOAA).

Helping Kids Stand Up for Their Rights: The Role of Climate Change Litigation

"Global focus on the need for action to address climate change has emerged as a critical sustainability imperative, but long-established environmental strategies seem incapable of delivering change at the scale and pace required. Luckily, the modern environmental movement has proven itself adaptable, evolving over time to accommodate various social, political, and economic contexts. In keeping with this tradition, now is the time for climate change advocacy to take a hard 'rights' turn, emphasizing novel, rights-based strategies that can reinforce traditional environmental approaches. In particular, climate change litigation centered on the rights of young people can focus the climate change debate on those who have the most to lose: future generations…

"Climate change cases with youth plaintiffs have been able to harness the advantage of a compelling ethical narrative. It is hard to deny that all people alive today have a moral obligation to respect the rights of young people and unborn generations to an atmosphere that can support their future existence…

"Framing climate change in terms of the rights it threatens can help sharpen public focus on the problem and, particularly, the intergenerational equities at issue. On the other hand, if we neglect to keep these climate change threats at the forefront of our minds, we will almost certainly fail to rise to the challenge with the required urgency and dedication. Young people standing up in court for their right to a viable future may be our best chance to ensure that we do not fall into this trap and instead fight hard to avoid the worst climate change impacts."

This is an excerpt of an essay by Paul Rink

Paul Rink is a graduate of Yale Law School and the Yale School of Forestry & Environmental Studies.

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Hip-Hop Sustainability: Toward Diversity in Environmental Communication

"Important conversations about environmental issues sometimes take place without all the affected parties at the table… People of color in the United States face elevated risk from environmental harms such as flooding, air pollution, and hazardous waste. But people of color are often underrepresented in conversations about how to solve these problems… To bring more people into the conversation about how we achieve a sustainable future, we need to rethink how we communicate about the environment. We should use more diverse communications modes, styles, and interests to get a more complete set of individuals and groups engaged in conversations about climate change, pollution, food, water toxic exposures, and other important issues.

"One example I am working on illustrates some principles for doing so — what I call 'hip-hop forestry,' which uses the art of hip-hop to communicate about the discipline of forestry. Hip-hop forestry introduces forestry to hip-hop listeners and can also help forestry practitioners make sense of hip-hop…

"Hip-hop forestry builds on the success that hip-hop has already had in starting conversations about important issues. In the 1990s, popular hip-hop artists brought attention to the challenges facing impoverished communities in American cities. Other artists have begun to weave environmental themes into their work. Mos Def, who is from Brooklyn, has a song entitled 'New World Water,' in which he breaks down the challenges some communities face in getting clean water, especially in urban environments… The principles for inclusive communications — tailored, entertaining messages built on understanding of peoples' lives — can help us have conversations that engage all people about the environment."

This is an excerpt of an essay by Thomas Easley

Thomas RaShad Easley is the Assistant Dean of Community and Inclusion at the Yale School of Forestry & Environmental Studies.

FULL SEND PRODUCTIONS/MARKET NEW HAVEN, INC.

Red Lights to Green Lights: Toward an Innovation-oriented Sustainability Strategy

"Environmental law and policy as framed in the 1970s and 1980s focused on 'command and control' regulatory strategies under which the government told businesses what they should *not* do. It was a world of stop signs and *red lights* for polluters. But this framework has proven to be incomplete. It has failed to offer signals as to what society needs businesses *to do*, including what problems to solve, what research and development to undertake, and what investments to make. So years have gone by and many environmental problems persist, including our dependence on polluting fossil fuels and reliance on the same costly and inefficient electrical system that was put in place more than 100 years ago, with electricity flowing across wires on poles. To address these enduring problems, we need to reframe our approach to environmental protection — offering a systematically designed structure of incentives to encourage innovation and problem solving. In short, we need to complement our system of red lights with an expanded set of *green lights*.

"The expanded framework of green lights that I envision would take many forms. Perhaps the greatest spur to innovation and a transformed future would be a commitment to adopt the *polluter pays principle* and to insist on an 'end to *externalities*' — meaning that those who inflict environmental harms on society must pay for them. Implementation of this principle would require that those who cause air or water pollution or chemical exposures and spill harms beyond their own property lines — or who consume natural resources without paying for their full value — be charged for their emissions or other negative impacts. These harm charges would establish a very substantial incentive (or green light) that would signal where efforts to remake products or production processes would find a payoff."

This is an excerpt of an essay by Daniel C. Esty

Daniel Esty, the Hillhouse Professor of Environmental Law and Policy at the Yale School of Forestry & Environmental Studies and Yale Law School, is the editor of the book, "A Better Planet: Forty Big Ideas for a Sustainable Future."

ISTOCKPHOTO.COM/ACLL0

Waste and Materials Management: From Harm Reduction to Value Creation

"The dominant waste management strategy in place across the United States since the late 1980s and early 1990s emphasizes a 'waste management hierarchy' that promotes reuse, recycling, and energy recovery. The hierarchy, which reflects core waste management principles, dictates that people should attempt to conserve as much of the energy and material in objects as possible. The current U.S. system, however, continues to rely on landfilling for disposal and recycling for recovery (which often includes composting), with a much smaller amount of reuse sent to energy-from-waste facilities.

"These old favorites, however, should be seen as fragile environmentally and costly economically, especially in the United States, where the responsibility for waste management falls on cash-strapped local governments. It is not necessarily that we achieve 'zero-landfill' or that we highly curtail municipal recycling. Rather, we should rely less on these strategies and more on approaches to increase the value of waste material, in a recast system that incorporates the findings of recent scientific, economic, and policy analysis and experience drawing on fields such as environmental economics, consumer behavior, operations management, *and industrial ecology* — the study of the flow of materials and energy through systems at different scales…

"Fortunately, we see many examples of entrepreneurial, environmentally minded firms pioneering new material management strategies and business models that create value through reuse, repair, and remanufacture with various elements of the waste stream. Without supportive policies, however, these approaches are likely to remain marginal. In an era when private firms are investing in new technology to upgrade recovery systems and create value from waste, reframing policy to focus on diversion and separation of individual materials into sub-streams can create new jobs and entrepreneurial opportunities, as well as provide life cycle environmental benefits."

This is an excerpt of an essay by Marian Chertow and Matthew Gordon

Marian Chertow is professor of industrial environmental management at the Yale School of Forestry & Environmental Studies, Yale School of Management, and National University of Singapore. Matthew Gordon is a Ph.D. candidate at the Yale School of Forestry & Environmental Studies.

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WELCOME TO PERSPECTIVES

To solve "wicked problems," a group of F&ES students is learning how to think differently in a unique new course.

BY JOSH ANUSEWICZ

The two professors walked to the front of the room on the first day of class and made an odd request: arm wrestle the person next to you.

"The people who get the opponent's hand to touch the table the most times in 30 seconds win — go!"

The class of 120 students, many newly acquainted, obediently engaged in a test of strength until they were informed to stop. The two professors, Julie Zimmerman and Paul Anastas, then positioned themselves, locked hands, and began to arm wrestle — a bit differently. They took turns easily pinning each other's hand to the table for 30 seconds before turning to the class and declaring, "We win!"

This was illustrative of how this course works — how students will think differently. After all, the professors never told the students this was a test of strength; it was a preconception that the students brought to the situation. It was their own intellectual baggage that they brought to problem-solving, restricting their ability to think differently.

This is "Perspectives," not only a course but a shared experience. It's a requirement for all first-year students in the Master of Environmental Management (M.E.M.) program and was developed last year as part of the curriculum that builds common foundational skills. Students are exposed to a wide range of ideas about the challenges and opportunities presented within environmental management through open discussion, fostering a shared understanding of the critical nature of interdisciplinary approaches.

COURTESY OF MARK TITUS

The Bristol Bay region is home to the largest salmon run in the world, critical for jobs, culture, and tourism.

At the center of the course is the concept of systems thinking, a way of understanding the inter-connections that exist in most of our greatest challenges — the climate, biodiversity, water and beyond. Common teaching methods don't rely on systems thinking, but rather the traditional scientific method of reductionism — holding everything constant and changing one variable.

Sometimes, to truly understand a challenge or opportunity, you must look at its entirety, as a system. Then, by understanding all of the parts *and* how they interact, one can determine the best place to intervene.

"If you neglect to consider connections in the system, you often come up with a solution that causes unintended consequences — problems somewhere else that you didn't account for," says Zimmerman, professor of green engineering and senior associate dean of academic affairs at the Yale School of Forestry & Environmental Studies.

"This is a framework for how you approach complex problems — what we call 'wicked problems,'" added Anastas, the Teresa and H. John Heinz III Professor in the Practice of Chemistry for the Environment. "They're complex, they're interconnected, they don't lend themselves to simple solutions. For hundreds of years, we've looked at one aspect of a problem and tried to study it. This is taking a step back and understanding the interrelationships at play here."

Quandaries regarding arm wrestling aren't the "wicked problems" these students will face, of course. What they face are thorny environmental issues that cut across social, political, and economic boundaries, require multiple public and private agencies, and continually evolve with varying levels of conflict.

To that end, "Perspectives" is taught through the lens of a single case study — this year, the proposed Bristol Bay Pebble Mine in Alaska, crowdsourced from the incoming M.E.M. class themselves. For more than a decade, a complex fight has played out over a proposed open-pit copper and gold mine in southwest Alaska. Predictably, proponents of the plan have touted the potential economic benefits of the mine and decreased reliance on foreign natural resources, while those against the proposal fear the environmental and social consequences. The land being tabbed for the proposed mine covers thousands of acres of wetlands, including waters that are home to the world's largest salmon run — critical for local jobs, culture, and tourism.

Efforts to begin building the mine have been stymied, primarily due

to a 2014 ruling by the Environmental Protection Agency (EPA) that blocked the proposal over environmental concerns. After several years of litigation, however, the EPA withdrew the initial ruling this past summer and has begun the process of reviewing the permit again.

In each class, students hear from a new voice. Guest speakers include Verner Wilson III '15 M.E.M., senior oceans campaigner for Friends of the Earth's Oceans & Vessels program and a Bristol Bay native; Dennis McLarren, the former EPA Region 10 Administrator when the permit was denied in 2014; Mike Heatwole, the vice president for public affairs of the Pebble Partnership, the mining company pursuing the permit; and four local women fishermen in Bristol Bay. The class also hosted a screening of a documentary about the conflict, "The Wild," at Criterion Cinemas in New Haven, where the flimmaker, Mark Titus, was on hand to field questions from students and the public.


EMMA FORSBERG

Fishing dominates the Bristol Bay economy, but Pebble Mine proponents foresee greater economic benefits from mining.

Each week after listening to the guest speaker, students break into discussion groups to recalibrate their understanding of the case based on what they've heard, relating to their classmates how their views may have changed after hearing a new perspective. In particular, they are asked to use systems-thinking tools to describe and understand the complexity of the system, which evolves each week with every new perspective brought by the guest speakers. Second-year M.E.M. students are assigned to work with each group and then meet collectively with Zimmerman and Anastas to begin shaping the discussion for the following week.

Though the Pebble Mine case may not hit on a particular area of interest for each student, the professors believe processing new perspectives will be relevant for any "wicked problem" students will face in their careers.

"We want them to think about this important case," Zimmerman said, "but what we really want is for them to think about *how* they are thinking about the case."

"Whether you become a scientist, an activist, an economist — whatever it may be — you need to be able to understand and process other perspectives," added Anastas.

Elizabeth Himschoot '21 M.E.M. had a unique perspective on the Pebble Mine case already. She not only took the course, but is also a native of Dillingham, Alaska — located in the heart of the Bristol Bay region. She's studying land conservation and management with a focus on the rights of indigenous peoples and hopes to return to the Arctic to help protect the ecosystems for the people and wildlife.

Himschoot's perspective may be rooted in personal experience, but she acknowledges the value of taking a step back to understand differing viewpoints.

"My classmates include people who have lobbied against extractive industries and protected wildlife, and there are people who have worked for extractive industries and the energy industry," said Himschoot. "Some of my classmates are from different countries and cultures, which affects their personal perspectives."

"Listening to my classmates and guest speakers provides me with a new understanding of these various perspectives and the ability to accept those views, even if I don't agree with them," she continued.

Perspectives are being shared outside the classroom, as well. Himschoot and Anelise Zimmer '21 M.E.M., who is also from Alaska, hosted a discussion group with their classmates to explain the geography, culture, lifestyle, and industry of Bristol Bay. Himschoot said a number of her classmates participated, with many reaching out after the discussion for additional information.

"It's a way to help our classmates understand Bristol Bay isn't just a name on a page, but that it's a place where humans and nature must coexist," said Himschoot.

It's a system where, unlike arm wrestling, there isn't one goal. The parts must work together to form a genuine win-win solution.

REUNION 2019

Alumni and their families came back to F&ES for Reunion Weekend, October 11–13, which included a field trip to Hammonasset Beach State Park; a "festschrift" honoring the career of distinguished faculty member Chad Oliver; a keynote address from Theresa Pierno, president and CEO of the National Parks Conservation Association; and the traditional Harvest Dinner.

MATTHEW GARRETT

During F&ES Reunion Weekend, in October, Rose Harvey '84 M.E.S. (bottom, second from left) and Jim Lyons '79 M.F. (bottom right), were honored with Distinguished Alumni Rewards. Carmen Guerrero Pérez '10 M.E.M. (top right) received the Prospect Street Award. Theresa Pierno, president and CEO of the National Parks Conservation Association, delivered the keynote address.

MATTHEW GARRETT

AWARD RECIPIENTS

Jim Lyons '79 M.F.

DISTINGUISHED ALUMNI AWARD

Jim Lyons '79 M.F. says he has been fortunate to count a number of visionary leaders, colleagues, and mentors on his winding career path through higher education, conservation, and politics — and he credits them with helping him reach each step along the way. But more so, he credits F&ES with providing him the knowledge and interdisciplinary skills that were fundamental to his successful career.

"My experiences at Yale gave me the confidence to capitalize on the opportunities that presented themselves," said Lyons of his broad career arc.

The list of opportunities is impressive. The U.S. Fish and Wildlife Service — with help from Stephen Kellert '71 Ph.D., one of Lyons' personal heroes — The Society of American Foresters, and the U.S. House of Representatives' Agriculture Committee. He also served as agricultural advisor for then-Congressman Leon Panetta and was appointed Undersecretary for Natural Resources and Environment in the U.S. Department of Agriculture by President Clinton. Lyons returned to government under President Obama, who appointed him deputy assistant secretary in charge of public land management at the Department of the Interior.

Through numerous career changes, he's kept F&ES close, participating in panel discussions and, for nearly 20 years, serving as a lecturer. Retired from national politics, Lyons still shares his expertise on environmental issues in publications like *High Country News* and *The New York Times*, and is actively involved in efforts to protect the Chesapeake Bay.

Rose Harvey '84 M.E.S.

DISTINGUISHED ALUMNA AWARD

Rose Harvey '84 M.E.S. gets things done. When she took on the role of Commissioner of the New York State Office of Parks, Recreation and Historic Preservation, New York parks were in rough shape following 40 years of neglect and deterioration. Appointed by Governor Andrew Cuomo to lead, operate, reimagine, and resuscitate the system, she raised $1.4 billion in public capital to improve and enhance existing parks, while also creating new ones.

The driving force behind her efforts is the belief that access to nature is a fundamental human right.

Harvey has taken it upon herself to deliver that access, especially to communities that need it the most.

"I do believe parks are essential for human happiness, health, social cohesion, and even the economics of a community," she says. "As such, it's important that *everybody* — not just some — have access to parks and nature in their neighborhood."

Harvey credits F&ES for teaching her the skills required to do the work she does, be it instituting educational programming, using GIS to identify cities that are need of parks, or tapping into public finance to create sources of revenue. She expertly weaves these many disparate threads together to achieve very tangible results.

After stepping down as Commissioner, Harvey immediately went back to work running the New City Parks Initiative, a program she dreamt up and incorporated while a McCluskey Fellow at F&ES in 2010. Its mission is to create new or revitalized urban park systems in and for neighborhoods of need.

Carmen Guerrero Pérez '10 M.E.M.

PROSPECT STREET AWARD

Carmen Guerrero Pérez '10 M.E.M. had years of experience in environmental conservation and community engagement in her native Puerto Rico before she ever came to Yale.

So when she arrived at F&ES, she was already quite familiar with complexity, says Susan Clark, Joseph F. Cullman 3rd Adjunct Professor of Wildlife Ecology and Policy Science.

"And she knew that the way to deal with this reality and to really help other people is to get yourself organized so you can deal with that complexity and not be overwhelmed by it," Clark said. "Carmen was someone who could do that because of her considerable real-world experience. She was a 'real-world' person."

Guerrero Pérez, who received the 2019 Prospect Street Award — which recognizes recent graduates who have made significant contributions in their field — is currently the director of the U.S. Environmental Protection Agency's (EPA) Caribbean Environmental Protection Division, which serves as the primary liaison on environmental issues with the governments of the Commonwealth of Puerto Rico and the Territory of the Virgin Islands.

Previously she served as Secretary of the Puerto Rico Department of Natural and Environmental Resources, where she led an expansion of the island's natural protected areas network and the implementation of several executive orders that strengthened Puerto Rico's climate change resiliency and adaptation capacity. She has also led efforts to protect the island's coastal areas and ecosystems.

F&ES Annual Fund

Last year, alumni and friends gave **$361,013** to the F&ES Annual Fund. Your meaningful support helps the School and its students to work towards a more sustainable future. Thank you!

To renew your gift today, visit **yale.edu/giveFES**

Peter Otis, founder of the F&ES Career Development Office (above), and Joanne DeBernardo, former assistant dean of student services (at right, center), were recognized as Distinguished Alumni.

PHOTOS BY MATTHEW GARRETT AND JAVIER DOMINGUEZ

Mark your calendars now for Reunion 2020!
October 9–12, 2020

Class Notes
will appear in *Canopy* each spring.

A DECENT LIVING, A LIVABLE PLANET

Narasimha Rao has spent much of his career showing that poverty in the developing world can be eradicated without making climate change worse. Now he wants those insights to be translated into real policy.

BY KEVIN DENNEHY

ADRIAN CATALIN LAZAR

Growing up in Mumbai, Narasimha Rao understood he was one of the lucky ones. In a crowded city where more than half the population live in slums, Rao enjoyed a stable home and attended a small, private school where he was exposed to global issues at a young age. But seeing poverty all around him each day was unsettling and confusing. Many of the people he knew were desensitized to the problem. For them, the poor were a reminder of what could happen to them in a city where millions of people were chasing few opportunities; others simply could not grasp the scale and complexity of the challenge, let alone how to actually do something about it.

Rao had a different reaction. From an early age he had a desire to understand and reduce inequality. With an interest in engineering, he was drawn to technology and development as a potential solution. "At MIT, while I was getting my master's, I first got interested in advances in information technology as something of an equalizer that might provide developing countries an opportunity to leapfrog," he said recently. "But then I took courses on energy, and I was gripped by the challenge of sustainable development, particularly in emerging economies that needed growth. It raised puzzles, both intellectual and moral, that seemed unaddressed in the discourse."

Rao, who earlier this year joined the Yale School of Forestry & Environmental Studies as assistant professor of energy systems, now studies energy and development in the context of climate change — particularly the social impacts of evolving energy policy on developing countries. Since 2015, he has also led a project, Decent Living Energy, which helps quantify the energy needs — and climate impacts — of eradicating poverty in India, Brazil, and South Africa. In a recent interview, he described his innovative approach to understanding the relationship between energy and poverty, its implications on an increasingly crowded planet, and how society can help improve the lives of billions of people without exacerbating global warming.

The following interview was edited for length and clarity.

Early in your career you were working as a technical consultant in the electricity sector. But you've said a return to India as a visiting faculty member changed your career path. What did you see?

Well, India was going through significant economic reform, liberalizing the electricity and other infrastructure sectors. The first thing I saw was that policy measures prioritized accelerating private investment and maintaining financial viability for service providers, but to the neglect of environmental

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and social protection. This focus neglected extending minimum standards of service to all and failed to balance risk allocation in contractual arrangements. So I started to use the academic platform to encourage reasoned debate and transparency around reform. I had fascinating experiences in the classroom around controversial infrastructure projects where I invited both project sponsors and opposing environmental NGOs, who presented their own versions of reality to baffled graduate students. I saw a role for myself as an interdisciplinary scholar who could competently address both technical and equity aspects of infrastructure development.

As the climate change question gained international attention, the first reaction of many in India was to adopt a head-in-the-sand attitude that this was the developed world's problem — "they created it; we've got to develop and grow." Yes, sure. But in a country with over a billion people that is expected to rapidly raise living standards, the risk of locking in unsustainable development was too great to ignore the problem entirely. This posed interesting contradictions: Individuals on their own were poor, but collectively they could contribute significantly to climate change. The scope for sustainable growth is vast, but knowledge and capital is scarce. How can a country that is developing quickly maintain its rights to develop and grow but also take responsibility for being part of the solution? This was a really interesting moral and intellectual challenge to me that had not been adequately addressed in the academic discourse.

How does the Decent Living Energy project contribute to this discourse?

The project addresses several research gaps. We have been trying to understand the energy required to meet basic needs for decades, since the oil crises of the 1970s. But we didn't have the tools to do a rigorous assessment. Now we do. This knowledge helps in energy planning and also for mitigating climate change. We want to know whether there is a conflict between basic human development and mitigating climate change: Can we reduce energy use to meet the ambitions of the Paris climate agreement without compromising people's basic needs? Most of the global models' scenarios of climate mitigation think of energy demand simply as a function of economic growth and technology as the primary tool for achieving climate mitigation, both in terms of transforming the supply system and end-use equipment. These are idealized trajectories of technology diffusion across the world without consideration, first of all, of whether it was affordable and feasible. But also whether projected energy demands bear any relation to what you actually need for poverty eradication.

I wanted to turn this research on its head a little bit: Let's first look at what poverty eradication *is*, what it entails. What do decent living standards look like? And then what are the implications for resource use, considering low-cost sustainable strategies? Then we compare that with the top-down view that has prevailed in the research community.

What have you found?

In the case studies I've done, it seems that for these countries the expectations for energy growth are sufficient for providing basic living standards, even in a world with only 2 degrees Celsius of warming. But it leaves different levels of headroom for further growth in terms of quality of life, and that raises equity issues as well. Why is it this country is squeezed in terms of energy demand that allows for basic living quality standards whereas other countries have ample room? What does this imply for technology diffusion? We also found significant opportunities in these countries for growing sustainably, with less emissions.

What are some of the baseline components that make a decent living?

A lot of them are commonplace: food, clothing, shelter, water, and sanitation. But even within those factors there are nuances. When you talk about shelter, for instance, we need to consider providing basic comfort — such as maintaining a home at a certain temperature and humidity, which of course has implications for energy use. There are 2 to 3 billion people who may need air conditioning to have basic comfort. That's something, for example, that some people find hard to stomach. They're more concerned about 700 million air conditioners being sold in the next 20 years as being a threat to climate change. But the concentration of people who don't have access to that are in regions that will feel the worst effects of climate change. We also include the means for social affiliation in modern society — cell phones and internet access. This turns out to be relatively benign for climate.

Your research has found that achieving these standards doesn't require a significant rise in carbon emissions. How can government help achieve that?

The two areas that are the most resource intensive — and have the most potential for ballooning in terms of energy use — are buildings and transportation. Smart policies would encourage efficient new buildings, especially in developing countries where a good share of the future building stock largely remains unbuilt. We found, for example, that certain materials that are locally sourced are cheaper and more efficient — they would reduce emissions compared with best practices today for construction, which often uses conventional masonry. Then there is mobility, which is a bit of a no-brainer. People understand that public transit is just better all around. It's more energy efficient, it reduces congestion, it reduces pollution. But it also requires capital investment. For the world's new cities, investing in public transit is important — particularly in bus transit and dedicated lanes for buses. These are a couple of key areas, but there are others.

Balanced diets with coarse grains, for instance, can improve nutrition and reduce emissions. Sustainable consumption with rising income will also be critical. We have shown that minimal levels of air conditioning and basic information and communications technology can have a negligible impact on climate. However, we also know that indiscriminate use of air conditioning and the proliferation of electronic gadgets are significant contributors to growth in energy demand among the affluent.

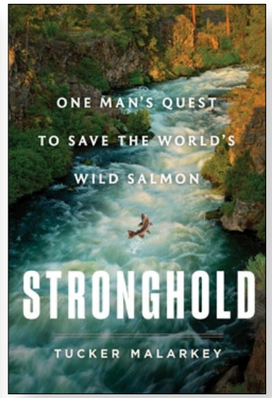
Is this growing knowledge about the complex relationship between energy and poverty having a positive change?

I think it is coming slowly. The number of papers being written and presented in conferences in this field have grown. We have seen interest from policymakers in this research. This can attract funding for projects that pull in resources for developing countries. I'm hoping there will be more spillover from the academic research to the real world, in national energy policy and international climate negotiations. If you ask me where I see the biggest potential for its use, it's that.

A Better Planet: Forty Big Ideas for a Sustainable Future

Edited by Daniel C. Esty
Yale University Press

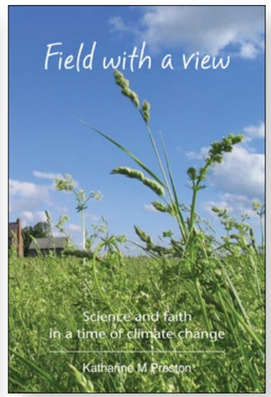
In this new book, produced by the F&ES-based Yale Environmental Dialogue, some of the nation's leading thinkers on environmental issues — including many faculty and alumni of the School — share fresh thinking and forward-looking solutions to some of the greatest challenges facing the U.S. and the world. In 40 essays the book offers a roadmap for moving toward sustainability through actionable, bipartisan approaches based on rigorous analytical research. Authors include Nobel Prize-winning economist William Nordhaus; Jane Lubchenco, former NOAA administrator; Thomas Lovejoy, conservation biologist and "father of biodiversity"; and Susan Biniaz, the former lead climate lawyer for the U.S. State Department who helped negotiate the Paris Agreement.



Stronghold: One Man's Quest to Save the World's Wild Salmon

Tucker Malarkey
Penguin Random House

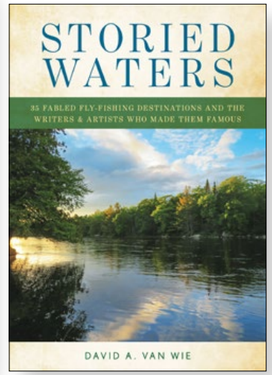
When the salmon runs of the Pacific Northwest began to decline, conservationist and accomplished fly fisherman Guido Rahr '94 M.E.S. was one of the few who understood why. As dams, industry, and climate change degraded the homes of these magnificent fish, Rahr saw that the salmon of the Pacific Rim faced possible near extinction. In this new book, author Tucker Malarkey documents how Rahr has contended with scientists, conservationists, Russian oligarchs, corrupt officials, and unexpected allies in an attempt to secure a stronghold for the endangered salmon, an extraordinary keystone species whose demise would reverberate across the planet.



Field with a View: Science and Faith in a Time of Climate Change

Katharine M. Preston
Wild Goose Publications

In her new book, Katharine M. Preston '74 M.F.S. urges readers to think more deeply about the human condition and our choices during a time of climate crisis. Moved by the landscapes that surround her home in Essex, New York, located on the shoreline of Lake Champlain, Preston draws on both her ecological and theological training, writing "for scientists leery of faith, people of faith who know and love the miracles of science, and anybody who shares a vision of the planet as sacred community."



Storied Waters: 35 Fabled Fly-Fishing Destinations and the Writers & Artists Who Made Them Famous

David A. Van Wie
Globe Pequot/Stackpole Books

"Storied Waters" chronicles writer and photographer David A. Van Wie's odyssey from Maine to Wisconsin and back to explore and fly fish America's most legendary waterways and celebrate the writers and artists who made them famous. In a 5,000-mile journey covering more than 50 locations in eight states, Van Wie, who studied at F&ES, follows and fishes in the footsteps of giants from Thoreau to Hemingway, Aldo Leopold to Winslow Homer, and many more. "Storied Waters" provides a virtual roadmap through 200 years of fly-fishing literature and a literal roadmap — complete with fishing tips — to the sport's most hallowed waters.

PEDAL POWER

A group of Yale professors are using bicycles to measure heat stress in New Haven

BY JOSH ANUSEWICZ

Yichen Yang '20 M.E.Sc. (right page) is one of several F&ES students who has equipped their bicycle with a temperature sensor (above) this semester.

New Haven serves as a perfect living laboratory each summer for Urban MODs, a weeklong part of the F&ES orientation program that teaches incoming students field skills related to urban ecosystems while familiarizing themselves with the local community. Students study local plant life, participate in greenspace restoration, and use GPS and GIS tools to gather and analyze data on streets across the city.

This summer, the GPS and GIS data collection was expanded to include new information on urban heat islands (UHI) — with help from the students' preferred mode of transportation.

A research team led by F&ES professors Xuhui Lee and Justin Farrell designed the study, in which sensors were mounted to the bicycles students used to travel between field sites during the three weeks of MODs. The sensors — specially designed to shield direct sunlight in order to accurately log air temperature to within 0.1 degree and relative humidity to within two percent — relayed the data via a smartphone app, which allowed users to see hyperlocal current temperatures across New Haven.

The study aims to identify the city's urban heat islands, which are seen as a major contributor to urban warming. Identifying these problem areas could allow for mitigation through green architecture or more greenspace, and Lee hopes that the lessons learned from MODs could lead to adapting the technology for other cities across the country.

Estimates show F&ES students, collectively, biked more than 5,000 miles during the three-week orientation program, potentially securing a considerable amount of data. Lee said F&ES student volunteers will continue logging data throughout the academic year, using sensors mounted to their personal bicycles.

"This is an exciting project, where students get to expand their knowledge of data collection and analysis and learn how to use cutting-edge software programs," added Lee.

This study was made possible by the Leitner Awards for Uncommon Environmental Collaborations — funded by James Leitner '75 B.A. — that promote collaborations for environmental teaching and research across the Yale campus. Roman Kuc from the Yale School of Engineering & Applied Science and Zhong Shao of the Yale Department of Computer Science also contributed to this project. The project proposals were required to advance at least one of six objective outlines in the F&ES strategic plan: climate change, urban systems and the environment, environmental communications, environmental data science, environmental justice and environmental health, and interdisciplinary team teaching.

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A twilight view of Bass Tower from Kroon Hall during 2019 reunion