# 2016–2017 ANNUAL REPORT



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# Message from the Director

Since its founding in 2004, the Stanford Woods Institute for the Environment has catalyzed interdisciplinary, solutions-oriented scholarship. Through appointments of outstanding scholars, funding for innovative research, hosting ambitious programs and centers, targeted training in environmental leadership, and generating myriad cross-sector conversations, the institute has played a key role in Stanford's emergence as a global powerhouse for environmental issues.

When I joined the institute in September of 2016, it was a well-established success story. Inspired leadership from the founding directors, Jeff Koseff and Buzz Thompson, deep commitment from a wise and forwardlooking advisory council, led by Ward Woods, and enthusiastic engagement from faculty, reseachers and students across the university ensured a rich suite of activities and a high level of professionalism. My dominant emotions during my first year were awe at the sweep of the institute's ambition and admiration for all that has been accomplished—plus humility about the magnitude of the urgent challenges and the great opportunities entailed in moving the world toward a sustainable future.



In the last year, we have seen dramatic events in politics and in the environment. The historic Paris Climate Agreement went into effect on November 4, four days before the 2016 U.S. presidential election. Many local, national, and international efforts to address climate change and other environmental issues are thriving, with, for example, rapid increases in the deployment of renewable energy and in the fraction of the world's oceans designated as marine protected areas. At the same time, a global rise in populism is shifting attention away from environmental issues and, in some cases, away from evidence-based approaches to solving problems. This despite recent catastrophic losses from extreme events ranging from deadly flooding in South Asia to three massive hurricanes and intense wildfires in the U.S., which provide shocking reminders of the importance of our relationship with nature.

Where does all this leave the institute? For me, the answer is clear. We need to be bold about not only understanding, but also solving, environmental problems. We need to build on the skills and perspectives of scholars across the university. And we need to be ambitious about novel partnerships, with governments, companies, NGOs, and civil society, to deliver solutions at scale.

We have much to do, but we start from a solid foundation. This annual report summarizes a wide range of important accomplishments. All of us who are part of the Stanford Woods Institute for the Environment see these as contributions to a draft blueprint for a sustainable future.

### Sincerely,

### **Chris Field**

Perry L. McCarty Director, Stanford Woods Institute for the Environment Stanford University

# CLIMATE

changing climate has cascading affects that ripple through ecosystems, water sources, and communities. From economics to conservation, melting ice to rising seas, the threats and impacts from rising global temperatures cross all policy and research boundaries. Climate change factors into the work of each center and program

at the Stanford Woods Institute, and is inextricably linked to many of the challenges our community is working to solve. The institute brings together researchers across Stanford's seven schools to advance knowledge, tools, and practical information that will help communities around the globe adapt to changing and uncertain conditions in the future.

### Highlights

### **Climate Change and Extreme Events**

Does climate change influence the severity and probability of extreme events, and if so, by how much? This is a pressing question for leaders, cities and agencies planning for future disasters. A study led by Kimmelman Family Senior Fellow Noah Diffenbaugh (School of Earth, Energy and Enviornmental Sciences) provides an attribution framework for understanding the influence of global warming on different types of extreme climate events. The results suggest climate change has increased the severity and probability of hottest monthly and daily temperatures.

### **Managed Retreat**

The rise in frequency and severity of extreme weather events puts certain regions at greater risk of coastal flooding, heavy rain, erosion and other dangers. Though controversial, relocating from vulnerable areas is one solution on the table for communities. After analyzing cases of "managed retreat" from around the world, Stanford researchers are providing a first-of-its-kind foundation for policymakers trying to decide whether and how to implement the strategy.



### **Informing Decisions**

The institute organized a policy forum in Washington, D.C., to inform decision makers on pressing subjects such as freshwater availability, clean energy, and carbon mitigation. The effort, which produced discussion papers authored by expert panelists, was led by former deputy secretary of the Department of the Interior David J. Hayes and included prominent figures from government, industry and academia.

#### **After Paris**

Woods fellows and affiliates reacted to the decision by the President to withdraw the United States from the Paris Agreement with both concern and renewed determination. Stanford President Marc Tessier-Lavigne and Provost Persis Drell issued a statement on the university's commitment to progress on climate change following the decision. Stanford leaders and scholars contributed further perspectives on repercussions of a U.S. withdraw and what it means for the country and the world going forward.

#### Stop Talking About Climate Change?

Climate change has become a polarizing topic in the United States. Rob Jackson, Michelle and Kevin Douglas Provostial Professor in the School of Earth, Energy & Environmental Sciences (Stanford Earth), proposed shifting the dialogue from the charged term to the shared benefits of addressing the problem, including job creation, health and safety.

#### **Carbon Removal and Mitigation**

Betting the world's future on massive-scale deployment of carbon removal technologies is risky explained Stanford Earth scholars Katharine Mach, Senior Research Scientist, and Chris Field, Melvin and Joan Lane Professor for Interdisciplinary Environmental Studies, in a perspective in the journal Science. Some plans involve land use at a huge scale that could impact ecosystems and food security. The researchers recommend a balanced approach which includes ways to reduce emissions, such as investing in renewable energy. Research from Senior Fellow Rob Jackson underscored the importance of mitigation, showing that actual declines in stagnant CO2 emissions won't materialize without advances in carbon capture and storage technology and sustained growth in renewables. Jackson also highlighted that a major opportunity for avoiding climate change's worst impacts lies in reducing methane emissions, particularly from food production.

# ECOSYSTEMS & CONSERVATION

healthy planet is key to the health of those who inhabit it. Stanford researchers are taking stock of nature's full value as well as the effects of human activities on ecosystems and the environment. Partnerships such as the Natural Capital Project engage decision-makers

in developing and using innovative software to find and secure natural areas that produce benefits vital to sustaining human life. Through these and other collaborations, Woods-affiliated researchers are opening new pathways to improve the well-being of people and nature.

### Highlights

### **Blue Planet Prize**

For her work on practical actions and policies to secure ecosystems and human wellbeing, Natural Capital Project co-founder and Bing Professor of Environmental Science Gretchen Daily was honored with the 2017 Blue Planet Prize, a \$450,000 award widely considered the Nobel Prize for environmental science. The Natural Capital Project has had a number of successes, including informing decisions on land use in China, transportation in Latin America, and sourcing of products across the globe with enhanced understanding of environmental impacts. Daily joins the ranks of Stanford's other Blue Planet Prize recipients, including Harold Mooney, Paul S. and Billie Achilles Professor of Environmental Biology, Emeritus, and Paul Ehrlich, Bing Professor of Population Studies. Ehrlich was a mentor to Daily during her time at Stanford as an undergraduate, graduate student and postdoctoral scholar.

### **Ecosystems of California**

Ecosystems of California, a comprehensive reference guide for California's diverse ecological landscape edited by Senior Fellow Harold Mooney and Erika Zavaleta, professor at the University of California at Santa Cruz, received the Gold Medal for Contribution to Publishing in the 86th Annual California Book Awards as well as the PROSE Award for Excellence in Physical Sciences & Mathematics. In addition, Woods staff worked with Mooney and his co-authors to produce a policy-focused supplement to the book entitled, Ecosystems of California: Threats and Responses.

"The way people think about nature and the science that can inform our decisions are changing. This is a moment of revolution."

-Stanford Professor Gretchen Daily

### **ECOSYSTEMS & CONSERVATION**

### **China: Areas of High Ecological Importance**

Using software from the Natural Capital Project, researchers, including Senior Fellow Gretchen Daily, helped Chinese leaders identify ecologically valuable areas that the country plans to protect as part of an ecological initiative. This effort highlights the need to value ecosystem services, as doing so can result in better decision-making from leaders in the more than 80 countries where the software is in use.

### **Underground Conservation Easements**

Rob Jackson, Michelle and Kevin Douglas Provostial Professor in the School of Earth, Energy & Environmental Sciences (Stanford Earth), along with two environmental law experts proposed creating underground easements to allow private landowners a way to restrict hydraulic fracturing and mining without relying on governments to create new regulations. The 'mineral estate conservation easement' would work much like conservation easements on the land's surface, prohibiting development while offering a potential tax break for landowners.

### **Deforestation in Africa**

As multinational corporations expand agricultural operations in Africa to produce in-demand commodity crops such as soy and oil palm, a study by Stanford Earth researchers highlights the devastating impacts such land use change has on valuable tropical forests. The authors—PhD student Elsa Ordway, Greg Asner, professor at Stanford Earth by courtesy, and Eric Lambin, George and Setsuko Ishiyama Provostial Professor—recommend implementing policies that would alleviate poverty in local regions and incentivize forest conservation.

### **Predicting Environmental Impacts**

Researchers with the Natural Capital Project developed a new way for companies to better understand how the production of their products affects the environment. By using data to hone in on regional landscape differences and characteristics, the Land Use Change Improved Life Cycle Assessment, or LUCI-LCA, is designed to provide a more accurate method of the predicted impacts of new designs and sourcing than traditional life-cycle assessments that take a broader, less-detailed approach.

# FOOD SECURIT

ood security exists when people have enough physical and economic access to food to meet their dietary needs for an active and health life. Stanford researchers are working to increase food security—without degrading the environment—even as climate change ratchets up the challenges to food production around the globe. The Center for Food Security and the Environment, a program of the Freeman Spogli Institute for International Studies and the Stanford Woods Institute for the

Environment, continue to expand a multidisciplinary research portfolio focused on water resources, tropical oil crops, data science for food security, nutrition and health, aquaculture, climate and agriculture, crop and livestock systems and rural education. This research generates vital knowledge in designing new solutions to global hunger and environmental degradation, while informing policies needed to feed the world's growing population.

### Highlights

### Forecasting the Future of Oil Crops

How can we make the oil crop industry sustainable? What are the related land management and availability issues? Derek Byerlee of Georgetown University; Walter Falcon, the Farnsworth Professor of International Agricultural Policy (Emeritus); and Rosamond Naylor, the William Wrigley Professor in the School of Earth, Energy & Environmental Sciences; discuss these and other pressing questions in their book, "The Tropical Oil Crop Revolution: Food, Feed, Fuel and Forests." They predict a decrease in oil crop demand to ease pressure on native ecosystems, thus giving hope for a more sustainable sector. They note the necessity and likelihood for convergence among societies, consumers, businesses and governments in order to enact these changes.

### **Predicting Poverty**

Preventing poverty requires locating its victims. Marshall Burke, an assistant professor in the School of Earth, Energy & Environmental Sciences; and David Lobell, the William Wrigley Senior Fellow at the Stanford



Woods Institute; proposed pioneered the use of satellite imagery to predict village-level wealth. Because brighter areas at night are generally more developed, the researchers combined high-resolution daytime and nighttime satellite imagery. Then they used the comparative data to identify features correlated with economic development. Their algorithm learned to pick out signs of urban areas, such as roads and buildings. This algorithm proved to be surprisingly accurate, and outperformed existing approaches in predicting poverty distribution. The researchers hope the improved poverty maps help aid organizations and policymakers make more informed development decisions.

### **Reforming China's Fisheries**

China accounts for one-fifth of global fish catch volume. How can the best available science be implemented in the country's fisheries management to protect coastal and ocean ecosystems? Ling Cao, a social science research associate at the Center on Food Security and the Environment; and Woods Senior Fellow Rosamond Naylor; coauthored an analysis that examined the opportunity for marine fisheries reform in China in relation to its most recent five-year conservation plan. They highlight that while China has attempted to reverse the decline for past fish stocks, these efforts are futile without country-wide institutional reform. The researchers recommend new institutions for science-based fisheries management, secure fishing access, educational programs for fisheries managers and increased public access to scientific data.

#### **Explaining Food Security Policy**

The Center on Food Security and the Environment hosted engaging conversations as part of its Food and Nutrition Policy Symposium Series. Expert lecturers included David Little, a professor of aquatic resources and development at the University of Sterling; Ronald Hardy, director of the Aquaculture Research Institute at the University of Idaho; and Pamela Ronald, a professor of plant pathology at the University of California, Davis. The series is supported by Zach Nelson and Elizabeth Horn in honor of Phillip Falcon.

# FRESHWATER

he need for freshwater is growing along with a rising global population. Threats to that critical resource are rising too, as climate change amplifies the risks of catastrophic droughts and floods to dangerous extremes. Stanford researchers are addressing these and other freshwater threats in some of the most water-challenged regions of the world. Programs like the Global Freshwater Initiative and Water in the West provide critical data and analysis about sustainable freshwater resources while developing strategies to ensure the long-term viability of water supplies from both a scientific and governance perspective. Through these and other Woods-supported initiatives, Stanford researchers are working to improve water security for people in the American West and around the world.

### Highlights

### Water Transfers Scorecard

How do states in the Colorado River Basin rank when it comes to using environmental water transfers, a legal tool that enables water rights holders to voluntarily transfer their water to rivers, streams and wetlands to benefit the environment? A study led by Water in the West Executive Director Leon Szeptycki found that Colorado was the most successful while Arizona was the furthest behind in supporting this valuable option for conservation.

### **Cleaning Wastewater**

The William and Cloy Codiga Resource Recovery Center, a project years in the making and a first-of-its-kind approach to wastewater recycling, became fully operational in 2017. The research and ideas for the center, which switches from an energy-intensive aerobic system to an anaerobic system for treating wastewater, received seed grant funding from two environmental venture project grants as well as other sources. The project has the potential to cut up to 50 percent of the energy usage in wastewater treatment. So far there have been more than 150 tours of the facility and nine graduate students trained as operators. The system is currently removing greater than 95 percent of organic contamination in the

### FRESHWATER

raw wastewater and a street lamp on site is burning continuously using the renewable energy biogas produced from the wastewater. The center is in the design phases of a project with the California Energy Commission and Silicon Valley Clean Water to scale up its flagship SAF-MBR technology in Redwood City. That new system will supplant the center as the largest such system in the world.

### Water Infrastructure

Aging infrastructure is a persistent problem throughout the nation and the risks it presents will only worsen as the climate changes. During the wettest winter on record in California, the spillway of Oroville Dam was breached causing 180,000 evacuation notices. Kimmelman Family Fellow Noah Diffenbaugh showed that extreme weather in California is expected to increase with climate change. A study coauthored by Diffenbaugh and other Stanford researchers showed the traditional 100-year flooding estimates for bridges fail to account for the full risk of bridge collapse as climate extremes become more prevalent. Financing for beneficial infrastructure projects is also a challenge. To help address this issue, a team of researchers led by Newsha Ajami, Director of Urban Water Policy at Water in the West, created a "Living Map" of innovative ways to finance water projects in the United States that will help regions finance upgrades.

#### **Saltwater Intrusion**

Removing too much groundwater from underground aquifers risks changing the fluid pressure and drawing

in seawater, corrupting water supplies. To help local groundwater managers identify regions most impacted by saltwater intrusion, researchers led by Rosemary Knight, George L. Harrington Professor in the School of Earth, Energy & Environmental Sciences, used geophysical imaging techniques to map where saltwater is getting into groundwater aquifers in Monterey Bay.

#### Standing Rock and the Law

The construction of the Dakota Access Pipeline has drawn extended protests and public challenges. Stanford experts in law and earth science explained the legal and environmental issues surrounding the pipeline, which is set to run beneath the Missouri River, the main water source for the Standing Rock Sioux Reservation in North Dakota. Native American water rights is a highly debated subject among legal scholars. Barton "Buzz" Thompson, Founding Perry L. McCarty Director of the Woods Institute, discussed another case involving the Agua Caliente tribe in Palm Springs and how it could help clarify tribal rights to groundwater.

#### War and Water Use

Researchers with the Global Freshwater Initiative used satellite data to show how the Syrian civil war and subsequent refugee migration caused sudden changes in the area's land use and freshwater resources. The conflict caused agricultural irrigation and reservoir storage to decrease by nearly 50 percent compared to prewar conditions. This combined with drought recovery led an increase in the Yarmouk River flow to downstream Jordan.

# OCEANS

he Stanford Woods Institute works to bring Stanford's singular strengths to bear on solving ocean challenges ranging from ocean acidification to ensuring coastal communities are prepared for weather extremes fueled by climate change. Through the Center for Ocean Solutions, Stanford researchers are bridging cutting-edge science and policy to build the data and cross-sector dialog required for critical resource management decisions. Recently appointed COS co-directors Fiorenza Micheli and Jim Leape are leveraging the expertise of Stanford's seven schools to address the urgent challenge of sustaining ocean health in the face of a rapidly changing climate and, in particular, to harness innovations of the "data revolution" to help the world meet those challenges.

### Highlights

### **Examining Oil Sands Risks to Ocean**

As the U.S. overhauls energy and environmental regulations, a troubling question hangs over an emerging source of unconventional oil the president has indicated he wants to expand. Bitumen—a tar-like fuel extracted from oil sands in Canada and elsewhere—is often stored in coastal areas and transported by ship. So, what are its potential effects on valuable ocean environments? The short answer, according to a study coauthored by Stephanie Green, a Banting postdoctoral fellow in the Center for Ocean Solutions: we have no idea. Green and her colleagues recommend collecting more information about the possible environmental effects of bitumen before making regulatory decisions.

### Simulating Ocean of the Future

Although a dire threat to coral and other marine systems that provide food and employment for hundreds of millions of people, ocean acidification is not a wellknown phenomenon. Jeremy Bailenson, the Thomas More Storke Professor of Communiction, is trying to change that through the magic of virtual reality. His lab released "The Stanford Ocean Acidification Experience," a free science education tool that can take you to the bottom of the sea, then fast-forward to the end of the

# Dive Deeper

### OCEANS

century, when many coral reefs are predicted to corrode in waters made acidic by the absorption of carbon dioxide from the atmosphere.

### Finding Hope Below the Waves

Despite climate change's wide-reaching impacts on ocean ecosystems, some kelp forest populations have remained stable or increased, according to a global survey coauthored by Fiorenza Micheli, the David and Lucile Packard Professor of Marine Science. While the impacts of climate change still generally harm kelp, these effects vary by region and species, the researchers find. However, areas with better local management were often found to have increasing kelp populations. This indicates that management in other sectors can play a greater role in kelp species survival by easing damage from impacts such as fishing, pollution and coastal development. Micheli, a Woods senior fellow, stresses the importance of unvaried research funding to continue monitoring the populations, which provide billions of



Solutions are available in their 2016 Annual Report, available at: http://centerforoceansolutions.org/ annual-report-2016

dollars worth of natural services.

### **Exposing Benefits of Marine Protected Areas**

Expanded marine protected areas (MPAs) are successful in limiting fishing, thus increasing reef shark populations, which support ecosystem health, according to a study coauthored by Barbara Block, the Charles and Elizabeth Prothro Professor in Marine Sciences; and Woods Senior Fellows Fiorenza Micheli and Giulio De Leo. The researchers find little evidence of fishing in a Pacific Ocean MPA, but a high density of fishing vessels just outside the MPA borders. This suggests even remote locations would be primed for fishing if protection disappears.

# PUBLIC HEALTH

he Stanford Woods Institute brings worldclass experts in medicine, environmental health and other disciplines together to solve complex challenges in resource-scarce areas. Through the institute's Water, Health and Development program and other projects, Stanford researchers are working to sustain the health and well being of people around the world.

### Highlights

### Winning with Water

Marking a milestone planetary health research collaboration, Stanford epidemiologist Stephen Luby is part of an international consortium that received a £10 million grant to potentially improve the lives of more than a billion people. The five-year project aims to transform water infrastructure, water management and sanitation practices in urban slums around the world. The project will deliver the first-ever public health and environmental data on the outcomes of an alternative water management approach. Luby, a member of the core team that developed the grant proposal, was tapped to be the human health evaluation leader on the project.

Explaining Antibacterial Soap Ban

When the U.S. Food and Drug Administration (FDA)

effectively banned a personal hygiene product used by millions of Americans, some public confusion was bound to ensue. In its decision to give manufacturers a year to remove certain chemicals from their antibacterial soaps, the FDA cited a study led by Stephen Luby showing no significant difference in results from plain soap and antibacterial soap. A Woods-produced Q&A with Luby about the FDA decision was viewed more than 17,000 times from users of Reddit, "the front page of the internet."

### **Reducing Climate Change Health Impact**

What connects heat exposure illness in California with drought in Syria? In these and many other global health challenges, the root cause is climate change. A report co-authored by researchers including Senior Associate Dean of Global Health and Woods Senior Fellow Michele Barry, recommended the U.S. initiate a formal, decadelong emergency response to climate change, managed

### PUBLIC HEALTH

by the State Department, and frame climate change as a global health security issue. Barry and her colleagues point to the need for a more resilient health system with better planning, technology, and understanding of how organizations work and how people function during crisis.

### **Revealing Ebola Mystery**

A year after the Ebola epidemic in West Africa, researchers including Woods Senior Fellows Michele Barry and James Holland Jones identified individuals in a hot spot for the epidemic who had antibodies to the virus but said they had had no symptoms during the time of active transmission. The research confirms previous suspicions that Ebola does not uniformly cause severe disease, and that people may be infected without showing signs of illness. The study, which suggests the epidemic was more widespread than previously believed, received widespread media attention.

### **Finding Room to Improve Emissions Mitigation**

Research led by Amy Pickering, an engineering research associate at Woods' Program on Water, Health and Development, found a carbon offset program involving distribution of water filters in Kenya had inaccuracies in self-reported data and reflected a missed opportunity for improving community health. Such schemes, in which governments, industry and individuals offset their emissions by purchasing credits representing carbon dioxide removed or reduced from the atmosphere, could be financially sustainable tools for scaling up water treatment and improving health in low-income settings, according to Pickering and her coauthors. They recommend third-party monitoring to ensure effectiveness.

# SUSTAINABLE DEVELOPMENT

hrough Woods' Osa and Golfito Initiative (known by its Spanish acronym INOGO), Stanford researchers and students are working with residents, government, the private sector and NGOs in a biodiversity hotspot of Costa Rica. The initiative is developing a strategy that empowers people to improve their economic outlook while stewarding the environment.

### Highlights

### **Ecotourism as Economic Engine**

Through its Caminos de Liderazgo (Pathways to Leadership) program co-funded by the CRUSA Foundation of Costa Rica, INOGO aided in the creation of an ecotourism destination that promotes sustainable development in rural Costa Rica. Caminos de Osa, a tour route modeled on the Inca Trail, features local artisans and cultural experiences. A South China Morning Post story profiled the initiative, and described it as "enriching the visitor experience and contributing to the economic well-being" of the area.

### Sharing the INOGO Story

Colombia's National Department of Planning invited INOGO Associate Director Emily Arnold Mest to share lessons learned from the initiative's work in Costa Rica. Mest spoke on a panel of local university and government representatives at the presentation of a master plan for a region of Colombia poised for development of ecotourism, agroindustry, and improved well being of local populations.

### Honoring Sustainability Hero

The annual Stanford Bright Award, co-sponsored by Woods and the Stanford Law School, went to Tom Lalampaa for his influential leadership of community-led conservancy groups that sustain local wildlife and resources. Lalampaa is the chief programs officer of the Northern Rangelands Trust in Kenya. The \$100,000 prize recognizes significant contributions to global sustainability. "Tom has demonstrated the opportunity to promote economic development, sow peace among neighboring tribes and conserve Africa's tremendous wildlife, all at the same time," said nomination



committee chair Barton H. "Buzz" Thompson Jr., the Robert E. Paradise Professor in Natural Resources Law and Woods senior fellow.

### **Explaining Sustainability**

Stanford has become an acknowledged leader in sustainability through its efforts to "walk the talk" in the way it operates the university as well as the way it educates and conducts research. In a Q&A, Stanford Earth Dean and Woods Senior Fellow Pamela Matson discussed the university's approach to sustainability both on campus and in educating future leaders. She said these efforts are critical as we try to meet the needs of today's 7-plus billion people without damaging the life support systems—water, air, land, oceans and more—needed to sustain future generations, expected to reach 11 billion by the end of the century.

### Finding More Energy-Efficient Concrete on Mars

If humans reach Mars, or even establish settlements on the moon, they will need thousands of tons of concrete. That's because of lethal radiation and micrometeorites that would quickly punch holes into ordinary structures. Working with NASA engineers, Michael Lepech, an associate professor of civil and environmental engineering and Woods senior fellow, used animal protein to make a promising form of concrete. Unlike conventional concrete, the material does not require large amounts of heat and energy to produce.

# **RESEARCH CENTERS & PROGRAMS**

DISEASE ECOLOGY, HEALTH AND THE ENVIRONMENT

![](_page_16_Picture_2.jpeg)

A joint initiative launched in 2015 with Stanford's Center for Innovation in Global Health, drawing on experts in public health, ecology, engineering, computer science, medicine and the social sciences to discover ecological solutions to humanity's health challenges and to develop the next generation of planetary health innovators.

Giulio De Leo, Faculty Director Susanne Sokolow, Executive Director https://woods.stanford.edu/ecohealthsolutions

## NATURAL CAPITAL PROJECT

![](_page_16_Picture_6.jpeg)

A joint venture with The Nature Conservancy, the World Wildlife Fund and the University of Minnesota Institute on the Environment that uses open-source software and other tools to enable decision-makers to quantify nature's values, assess trade-offs associated with alternative land and water use choices, and integrate conservation and human development into land and water use and investment decisions.

Gretchen Daily, Co-Director Mary Ruckelshaus, Managing Director naturalcapitalproject.org

### CENTER ON FOOD SECURITY AND THE ENVIRONMENT

![](_page_16_Picture_10.jpeg)

A joint effort with the Freeman Spogli Institute for International Studies that addresses the challenges of feeding the world's growing population without depleting the planet's natural resources.

Rosamond Naylor, Director David Lobell, Deputy Director fse.fsi.stanford.edu

### STANFORD ENVIRONMENT ASSESSMENT FACILITY

![](_page_16_Picture_14.jpeg)

An interdisciplinary research effort investigating how to make the process of scientific assessment more effective, supporting interactions between scientists, researchers, and decision-makers to tackle pressing environmental challenges and opportunities.

Katharine Mach, Director Chris Field, Advisory Committee Chair woods.stanford.edu/SEAF

#### **GLOBAL FRESHWATER INITIATIVE**

![](_page_17_Picture_1.jpeg)

An interdisciplinary research effort that studies the long-term viability of freshwater supplies for people and the environment, factoring in threats from climate change, shifts in land use, increasing population and decaying infrastructure. The program focuses on developing and water-scarce regions throughout the world.

Steven Gorelick, Faculty Director globalfreshwater.stanford.edu

### WATER IN THE WEST

![](_page_17_Picture_5.jpeg)

A joint program with Stanford's Bill Lane Center for the American West that develops and promotes solutions to key water management questions in the West, including better groundwater management, more sustainable urban water use, better use of markets and other mechanisms to help western states cope with water scarcity.

Leon Szeptycki, Executive Director waterinthewest.stanford.edu

### **CENTER FOR OCEAN SOLUTIONS**

![](_page_17_Picture_9.jpeg)

A center launched in 2008 to catalyze the innovations needed to sustain ocean health. By bridging science and policy, COS prepares leaders to meet coastal and ocean challenges.

Larry Crowder, Science Director centerforoceansolutions.org

### WATER, HEALTH & DEVELOPMENT

![](_page_17_Picture_13.jpeg)

A program aimed at identifying ways to improve and increase the sustainability of water supply and sanitation service delivery, while also enhancing capacity for sustainable water and wastewater management in developing countries.

Jenna Davis, Faculty Director water.stanford.edu

### **OSA & GOLFITO INITIATIVE (INOGO)**

![](_page_17_Picture_17.jpeg)

An initiative to support sustainable human development and environmental stewardship in Costa Rica's Osa and Golfito region through work with local communities, government, the private sector and nongovernmental organizations.

Rodolfo Dirzo, Faculty Director William Durham, Faculty Director Emily Arnold Mest, Associate Director inogo.stanford.edu

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# PRESS CLUB

# **ADVANCING DECISIONS**

B y engaging with decision-makers, leaders, and community stakeholders, Woods is magnifying the impact of Stanford's pioneering environmental research in the United States and around the globe. From in-depth conversations with policy leaders to public forums with panels of experts discussing pressing environmental

challenges and solutions, Woods is informing critical resource management decisions with the latest scientific and policy research. Through information exchange with government officials, business leaders, public servants and other groups, Stanford research factors in cross-sector expertise while linking knowledge to action.

### Highlights

### Future of California Water

In a forum in Sacramento, researchers from Water in the West and the School of Earth, Energy and Environmental Sciences (Stanford Earth) discussed their work on groundwater measurements and ways data can be improved. Mark Cowin, Director of the California Department of Water Resources, served as keynote speaker for the event, which drew an audience of mostly policy professionals and stakeholders. Work presented included remote mapping of groundwater formations using satellite data by Rosemary Knight, George L. Harrington Professor at Stanford Earth, a characterization of deep groundwater storage by Rob Jackson, Michelle and Kevin Douglas Provostial Professor at Stanford Earth, and a survey of groundwater managers to improve data relevance by Tara Moran, Sustainable Groundwater Program Lead at Water in the West.

### Leadership on Climate

In a forum in Washington, D.C., led by former deputy secretary of the Department of the Interior David J. Hayes, prominent experts from the public, private and academic sectors provided guidance to the next administration on reducing greenhouse gas emissions and accelerating the pivot to a clean energy economy. Part of a multi-event series, the forum launched 14

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discussion papers written by panelists and attendees on topics ranging from climate-related public health risks to carbon sequestration.

### **Climate Conversation**

Laurence Tubiana is France's lead climate negotiator and was a key architect of the Paris Agreement of 2015. She visited Stanford for a conversation with Perry L. McCarty Director Chris Field to discuss her role in the Paris Agreement and the goals of the international community for the COP22 meeting in Marrakech. Katharine Mach, Senior Research Scientist in the School of Earth, Energy & Environmental Sciences, who worked on the Intergovernmental Panel on Climate Change (IPCC) assessment that underpinned the Paris talks, discussed the opportunities and obstacles for the Agreement and the goals for COP22.

### **Groundwater Sustainability**

Thousands of local agencies and stakeholders are working to form agencies responsible for managing high- and medium-priority groundwater basins as part of the state's Sustainable Groundwater Management Act (SGMA). Researchers led by Esther Conrad, postdoctoral researcher at Water in the West, created a report highlighting the political and logistical challenges of the governance process and strategies that local agencies are using to navigate them. In addition, given the political and physical complexities surrounding groundwater basins, a report led by Tara Moran provides a framework for developing groundwater models, a key step for implementing SGMA.

### **Energy and the Environment**

Together with the Precourt Institute for Energy, Woods convened a series of three panel sessions in Washington, D.C., to highlight pressing environmental and energy challenges and risks that the Trump Administration will need to confront. The sessions focused on clean energy, climate adaptation, and food, water and energy security. Stanford scholars and other experts identified and discussed how innovation in technology, data collection and analysis, and policy formulation can help address these challenges.

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# CATALYZING RESEARCH

oods fosters cross-discipline collaboration and sponsors solutions-focused research around the world. At the heart of this effort is the Environmental Venture Projects (EVP) seed grant program and the Realizing

Environmental Innovation Program (REIP). EVP helps innovative, often high-risk projects get off the ground, while REIP supports later-stage interdisciplinary research projects that have shown initial promise in identifying solutions.

### Highlights

### Simulating the Ocean of the Future

Although a dire threat to coral and other marine systems that provide food and employment for hundreds of millions of people, ocean acidification is not a wellknown phenomenon. The Stanford Ocean Acidification Experience may change that. The free science education tool can take you to the bottom of the sea, then fast-forward to the end of the century, when many coral reefs are predicted to corrode in waters made acidic by the absorption of carbon dioxide from the atmosphere. Senior Fellow Jeremy Bailenson, the Thomas More Storke Professor of Communication and Woods senior fellow, developed the software with funding from the Gordon and Betty Moore Foundation and the Woods Environmental Venture Projects program.

### Honoring a Genius

Woods-affiliated assistant professor of bioengineering Manu Prakash was named a 2016 fellow of the John D. and Catherine T. MacArthur Foundation. The \$625,000 fellowship, popularly known as a "genius grant," recognizes Prakash for research "driven by curiosity about the diversity of life forms on our planet and how they work, empathy for problems in resource-poor settings, and a deep interest in democratizing the experience and joy of science globally." Prakash is working on a Woods-funded project to develop a device that can test mosquito saliva for pathogens and vector species, and could lead to early warning systems for health epidemics

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### Understanding What Global Warming Means for Mosquito-Borne Diseases

As temperatures rise with climate change, mosquito season extends past the summer months in many parts of the world. How does this lengthened season influence the risk of being infected with mosquito-born diseases such as dengue, chikungunya and Zika? Stanford researchers, including Woods-affiliated assistant professor of biology Erin Mordecai, modeled how rising temperatures might influence mosquito behavior and disease risk around the world. The research has its origins at least partially in a Woods-funded project aimed at improving mosquito surveillance data to inform decisions on where to spend limited resources for mosquito control.

### **Understanding Why Bridges Collapse**

The U.S. is considering massive updates to infrastructure, including crumbling bridges. One obstacle: the current means of assessing bridges may underestimate their vulnerability, according to a study that came out of a Woods-sponsored project to analyze the impact of climate change on infrastructure vulnerability. Case in point is the collapse of a bridge along California's iconic Big Sur coast, which isolated communities and cost local businesses millions of dollars. Standard risk assessments made it hard to identify the bridge's vulnerability.

### Providing a Rare Glimpse of Marine Ecosystems

An emerging technique—analyzing DNA in skin, scales and feces animals leave behind—has shown promise for revealing hidden ecosystems on land and in fresh water. Deep ocean environments had largely proven too complex for the approach until Woods-affiliated researchers used it to detect ocean animals more than 7,200 feet down. Their study, which had its origins in a Woods-funded project, also marks the first time the approach has been used in the waters of Monterey Bay. Because the bay has been the focus of relatively intensive ongoing research, there are unique opportunities for eDNA analysis of ecological change over time.

# **EDUCATING LEADERS**

oods leadership and education programs are preparing students, researchers, professionals and decision-makers to forge new pathways to sustainability. A diverse portfolio of programs focuses on developing skills, knowledge and networks to move ideas into action and support informed decision-making. Our programmatic

offerings range from an intensive series of workshops and panels introducing emerging researchers to the inner workings of the nation's capital, to a community-based leadership program preparing local entrepreneurs to steward and benefit from biodiversity in Costa Rica's Osa and Golfito region.

### Highlights

### **Developing Environmental Leaders**

Woods selected 20 scholars for its Rising Environmental Leaders Program (RELP), an annual initiative to help Stanford graduate students and postdoctoral fellows develop leadership and communications skills to maximize the impact of their research. In 2017, the RELP scholars attended several workshops in preparation for the annual D.C. Boot Camp, an intensive networking week in the nation's capital that shows fellows how to link science to policy. This year, the RELP cohort piloted a mini-boot-camp in Sacramento to learn about California's role as an environmental solutions leader and participating in subnational policy-making.

### Linking Undergraduates to Opportunities

Woods launched the Forum for Undergraduate Environmental Leadership (FUEL), which allows Stanford students to investigate environmental careers, gain exposure to advancements in the field and discover how their interests can be translated into opportunities. In addition to a series of on-campus conversations with environmental leaders, participants visit Sacramento to meet with policymakers and professionals in the field to learn about setting environmental priorities, land management and policy implementation. These meetings put them in contact with officials from the governor

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office, the California Department of Fish and Wildlife and CalEPA, among others.

### **Holding Out Hope for Science**

John Holdren, former President Obama's senior advisor on science and technology, came to Stanford to discuss the recent and future role of science in an atmosphere of government austerity. He gave the fifth annual Stephen H. Schneider Memorial Lecture, named for the famed climate scientist and Woods senior fellow who died in 2010. Holdren warned of a looming "catastrophe for climate science" due to federal funding cuts, but urged academics and concerned citizens to move forward with climate change research, scientific discovery and environmental justice issues.

### **Funding Remarkable Student Projects**

The Mel Lane Student Grants Program offers funding to support Stanford student-managed environmental projects that align with Woods focal areas. These projects make a measurable impact on sustainability issues through direct activities or applied research. Funded 2017 projects include a carbon pricing pilot program for the Stanford campus, an initiative to improve food security for victims of Super Typhoon Haiyan in the Philippines and a photojournalism project that documents cultural environmentalism of Native American youth.

### Honoring a Young Environmental Leader

Stanford senior Meghan Shea, a past fellow in the Woods Mentoring Undergraduates in Interdisciplinary Research (MUIR) program and FUEL program, was named a Rhodes Scholars. As part of MUIR, a program that provides summer stipends for undergraduate researchers to support interdisciplinary environmental research by Stanford faculty, Shea analyzed how seagrass communities off Palau help buffer nearby corals against ocean acidification. The Rhodes Scholarship offers students two or three years of expense-free study at England's University of Oxford. Shea will pursue a master's degree in nature, society and environmental governance.

# FINANCIALS

### Fiscal Year 2015-2016 (Actual)

Sources of revenue which support the Stanford Woods Institute for the Environment in fiscal year 2015–2016 amounted to \$20.8 million, of which 11 percent originated from university general funds, 19 percent from endowment income, 17 percent from gifts, and 52 percent from grants and contracts. Expenses during the fiscal year 2015–2016 amounted to \$20.8 million. Woods largest expenditure includes Environmental Venture Projects and other research programs and centers, totaling \$16.5 million, or 79 percent of the institute's annual budget.

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Total Sources of Revenue \$20,754

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### Annual Report Credits

### **Editorial Staff**

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