

2014–2015 ANNUAL REPORT



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Message from the Directors



Dear Friends,

In reflecting upon the past year it is gratifying to see real progress on numerous fronts for those of us working to advance global sustainability.

As we prepared this report, countries around the globe were finalizing their commitments to a binding climate agreement that many of us hope will emerge from the Paris climate talks in December. More locally, the drought in California, while devastating, has prompted historic actions by state leaders that will ultimately lead to new and more effective management of our state water resources and, in particular, our vital and very vulnerable

groundwater. State, national, and international leaders are now focusing on these issues with a renewed sense of urgency and commitment, as is the public. This growing momentum for harmonizing the needs of people and the planet is encouraging as we work to catalyze interdisciplinary, solutions-oriented research and connect it with decision-makers. In this regard the Stanford Woods Institute has been actively pursuing solutions to these, and many other challenges, and Stanford research and expertise have informed the progress that has occurred in numerous ways.

The Woods Institute was created to focus the expertise of all seven schools at Stanford on solving the world's most pressing environmental challenges. The problems we seek to address have multiple facets, and so do the solutions. By working across disciplines, we have transformed the way we do research, and in so doing are helping to produce compelling and lasting solutions.

Those transformations are taking the form of cleaner water in Bangladesh, where researchers with our Water, Health and Development Program are pioneering inexpensive devices to purify water at the point of collection. They take the form of subscription sanitation services in places like Haiti that keep waste out of drinking water while providing the co-benefits of jobs and fertilizer. In West Africa, Woods-funded teams are studying how reintroducing freshwater prawns to river ecosystems can fight a pervasive and deadly parasitic disease,

while creating new sources of revenue and protein sources in the process. In China, Stanford food security experts are partnering with Chinese scientists and local stakeholders to develop a sustainable aquaculture industry that adds to global fish supplies without depleting ocean ecosystems. In the Middle East and here in the West, Woods-supported researchers are working to increase water security by tracing the links between climate change and drought conditions and by developing, testing and deploying new technologies, systems and policies for water reuse, recycling and management.

In addition to providing the seed funding and catalysis for this and so much more groundbreaking research, Woods is also facilitating the cross-sector connections needed to advance its uptake, and is working to prepare the next generation of environmental leaders to carry it forward. Our Rising Environmental Leaders Program attracts fellows with a common focus on sustainability from all seven schools on campus. These graduate students and postdoctoral scholars are working to stem deforestation, make clean energy economical, ensure sustainable groundwater supplies, reduce exposure to unsafe chemicals in household products, improve sanitation in developing countries, and deepen knowledge of the connections between people and nature on many other fronts.

We invite you to read more about these and the many other exciting advances our remarkably diverse community of researchers, students and staff has pursued over the past academic year.* They do so with the critical and invaluable guidance and support of our funders, partners and Stanford's leadership. We deeply appreciate your interest, commitment and engagement with us.

Sincerely,

Jeff Koseff and Buzz Thompson

Jeffrey R. Koseff

Perry L. McCarty Director and Senior Fellow
William Alden Campbell and Martha Campbell
Professor of Civil and Environmental Engineering

Barton H. "Buzz" Thompson, Jr.

Perry L. McCarty Director and Senior Fellow
Robert E. Paradise Professor in Natural
Resources Law

* This Annual Report encompasses 2014 and the first half of 2015 as we move to align our coverage with the academic, rather than calendar, year.



CLIMATE

The drivers and effects of climate change are interconnected, crossing physical, ecological, economic, political and ethical boundaries.

Advancing solutions and deeper understanding of climate variability requires similar connectivity, as well as collaboration among scholars across Woods' centers and programs. We support interdisciplinary research assessing the impact of climate disruption on people and planet, focusing

solutions and mitigation efforts water supplies, agricultural production, biodiversity, ecosystem health, built infrastructure and economies at the local, regional and national levels. Stanford researchers are working across disciplines and sectors to assess climate risks, reduce vulnerabilities and mitigate and adapt to the effects of global warming. See a selection of highlights from our community's cross-cutting climate research below.

Highlights

Climate and the California drought

A study led by Woods Senior Fellow Noah Diffenbaugh (Earth system science) found that the extreme atmospheric conditions associated with California's crippling drought are far more likely to occur under today's global warming conditions than in the climate that existed before humans emitted large amounts of greenhouse gases. The Diffenbaugh Lab followed up with a related study linking climate change, warmer temperatures and

drought conditions. Both papers were widely reported on by the media and led to Diffenbaugh's invitation to Sacramento to brief state officials and agency staff.

Weather extremes

A 2015 study co-authored by Stanford and Princeton University researchers found that trends in atmospheric circulation patterns can partially explain Earth's increasingly severe weather. While scientists had previously surmised that the link existed, robust empirical evidence was lacking.

“Thoughtful approaches to adaptation and mitigation: they can be a drag on the economy, or they can be the next big thing.”

—Stanford climate scientist Chris Field

CLIMATE

United Nations report

Woods Senior Fellow Chris Field, the Melvin and Joan Lane Professor for Interdisciplinary Environmental Studies, spent five years leading a large team of international scientists as they prepared a major United Nations report on climate change impacts, observed vulnerabilities and opportunities for adaptation. The team ultimately produced a 2,000-page report as part of a massive, three-part U.N. Intergovernmental Panel on Climate Change Fifth Assessment Report, which details a consensus view on the current state and fate of the world’s climate.

Washington, D.C., dialogue

Stanford experts led a robust dialogue at the National Press Club in Washington, D.C., during a Woods-organized panel discussion on climate change impacts and how to reduce them.

Agricultural impacts

A study by William Wrigley Senior Fellow David Lobell (Earth system science) found U.S. corn yields are growing more sensitive to heat and drought. Farmers are faced with difficult tradeoffs in adapting to a changing climate in which unfavorable weather will become more common, the study found.

Clean energy roadmap

A study authored by Woods Senior Fellow Mark Z. Jacobsen (civil and environmental engineering) found that it is technically and economically feasible to convert California’s all-purpose energy infrastructure to one powered by clean, renewable energy by 2050.

Honors for Schneider

In October 2014, renowned Stanford climate scientist and Woods Senior Fellow Stephen H. Schneider was posthumously inducted into the California Hall of Fame by Governor Jerry Brown. Well-known for his emphasis on science communication, Schneider had consulted with federal agencies and/or White House staff in every U.S. presidential administration since the Nixon era.



ECOSYSTEMS & CONSERVATION

Stanford researchers are continually expanding our knowledge of the links between human well-being and healthy ecosystems. Woods advances these efforts by supporting interdisciplinary researchers as well as centers and programs like the Natural Capital Project (NatCap). This joint venture of the Stanford Woods Institute, The Nature Conservancy, the World Wildlife Fund and the University of Minnesota Institute on the Environment develops new science and open-source software tools for quantifying nature's values and assessing trade-offs associated with alternative land and water use choices. These tools help integrate conservation and human development

into land and water use and investment decisions. NatCap's model engages leaders in key government agencies and corporations in the United States and abroad to ensure that information produced is immediately relevant for decisions. The project provides these decision-makers with cutting-edge research, a network of support, and practical approaches and tools to create solutions that benefit people and nature. Read on for highlights from the work researchers with NatCap and other Woods centers and programs are doing to help businesses, governments and other institutions make informed decisions about nature's contributions to a thriving economy and healthy society.

Highlights

Milestone publication

In June 2015, researchers affiliated with NatCap published a collection of papers on "nature as capital." The Special Feature of the Proceedings of the National Academy of Sciences explored the state of the science—and the gaps that need to be filled—in order

to incorporate natural capital and the ecosystem services it provides into decision-making. Woods worked with Natcap to assemble a panel of experts to discuss the feature's findings at a forum in Washington, D.C.

Natural capital summit

In May 2015, NatCap and its partners in Sweden convened a landmark event—the Stockholm Summit on

“The well-being of natural ecosystems—including the animals—actually represents the well-being of humans as well.”

—Stanford Biology Professor Rodolfo Dirzo

ECOSYSTEMS & CONSERVATION

Natural Capital—to help accelerate efforts to integrate nature’s values into decision-making. Leaders came from around the world to learn about innovative “use cases,” and to develop a shared action plan.

Coastal zone management

NatCap scientists developed new open source software that can calculate how coral, mangrove and seagrass habitats reduce risk to coastal and marine ecosystems. These tools were used to design the first integrated coastal zone management plan for the Caribbean country of Belize, and could help with similar efforts in other coastal regions.

Planning tools

NatCap developed a new free, open-source software tool to help governments site infrastructure projects so that they minimize adverse impacts on ecosystem services and maximize benefits to people. The tool brings the Project’s total number of ecosystem models and tools to 20.

Biodiversity insights

An April 2014 study co-authored by Stanford-based researchers including Woods senior fellows Gretchen Daily, Bing Professor of Environmental Science; and Elizabeth Hadly, Paul S. and Billie Achilles Professor in Environmental Biology, found that farmland and forest remnants can be more valuable for biodiversity than previously assumed, challenging a long-accepted theory used to estimate extinction rates, predict ecological risk and make conservation policy.

Disease risks

By temporarily removing large mammals from an ecosystem, Stanford scientists including Woods Senior Fellow Rodolfo Dirzo, Bing Professor in Environmental Science, and postdoctoral researcher Dan Salkeld discovered that populations of disease-carrying rodents grew unchecked, increasing the risk of transmitting deadly pathogens to humans.



FOOD SECURITY

By 2050, the world's population is estimated to reach 9 billion people. Can we produce enough food to sustain them without irreversibly depleting our lands and waters? Stanford researchers are addressing this and other critical issues of hunger, poverty and environmental degradation by generating vital knowledge and policy-relevant solutions through the Center on Food Security and the Environment (FSE). A joint initiative of Woods and Stanford's Freeman Spogli Institute for International Studies, FSE works to connect the dots between water and nutrient management, energy and climate change, national security,

gender, education and infectious disease. Its interdisciplinary team of scholars addresses hunger at the global, regional and local scales through a research portfolio focused on seven key areas: food and nutrition security, aquaculture, biofuels, climate and agriculture, agricultural innovations and crop and livestock systems. FSE also pursues a robust teaching program and direct science and policy advising by Stanford earth scientists, economists, public health and nutrition specialists, biologists, law and political science experts. Read on for highlights from FSE's 2014–15 work.

Highlights

Sustainable palm oil?

Palm oil is one of the world's fastest growing and most valuable agricultural commodities, but is a leading cause of tropical deforestation. In 2014, an interdisciplinary team of Stanford researchers led by FSE Director and Woods Senior Fellow Rosamund "Roz" Naylor

(Earth systems science), launched a three-year study of methods for creating more sustainable palm oil supply that promote economic growth and environmental sustainability in Indonesia and West Africa.

Chinese aquaculture

As part of Naylor's ongoing research on Chinese aquaculture and fisheries, she convened and chaired a three-day conference in Beijing covering the future

FOOD SECURITY

of Chinese fish production and trade, and the industry's potential to meet Chinese and global food security needs. Naylor, the William Wrigley Professor in the School of Earth, Energy and Environmental Sciences, and Stanford postdoctoral scholar Ling Cao followed up with a new paper on the potential of Chinese aquaculture to tip the balance in world fish supplies.

Milestone publications

FSE scholars published two major books in 2014: "Frontiers in Food Policy: Perspectives in sub-Saharan Africa" (edited by Woods Senior Fellow Emeritus Walter Falcon, the Helen Farnsworth Professor of International Agricultural Policy, emeritus, and Roz Naylor) and "The Evolving Sphere of Food Security" (edited by Naylor). The former is a compilation of papers by participants in the multi-year Global Food Policy and Food Security Symposium Series. The latter is a collaborative effort of 19 Stanford faculty authors to examine the many faces and facets of global food security from a wide range of academic perspectives including law, medicine, political science, international relations, earth sciences and biology.

Higher yields, less nitrogen

With colleagues from China Agricultural University, Woods Senior Fellow Peter Vitousek, the Clifford G. Morrison Professor in Population and Resource Studies, found that farming practices in China can be redesigned to simultaneously improve yields and reduce environmental damage by implementing a system of "integrated soil-crop system management". The approach allows farmers to use less nitrogen fertilizer and still grow yields high enough to meet China's rising food security needs.

Crops and climate risks

A 2014 research paper on climate and global crop yield declines by William Wrigley Senior Fellow David Lobell (Earth system science), was one of 25 articles selected by the editors of the scientific journal *Environmental Research Letters* to be featured in the journal's "Highlights of 2014" collection. Lobell's recent findings in this area include papers on rising temperatures and falling crop yields; vulnerability of U.S. corn yields to hot, dry weather; and farmers and climate change adaptation. He also co-authored a paper on more powerful and accurate methods for predicting future wheat yields, which included suggestions for avoiding some of the predicted losses.

Warmer temps, more harvests

A study co-authored by FSE Deputy Director Lobell found that the area of U.S. farmland capable of a two-crop annual harvest grew dramatically as a result of warmer temperatures and later fall freezes. However, gains may be negated by future losses in crop yields expected to come with climate change.

Lambin honored

Woods Senior Fellow Eric Lambin, the George and Setuko Ishiyama Provostial Professor, won the Volvo Environment Prize, an award founded in 1988 that has become one of the world's most prestigious environmental prizes. It is awarded annually to people who have made outstanding scientific discoveries within the areas of environment and sustainable development. Lambin (Earth systems science) was recognized for his work analyzing satellite images of Earth and linking them to socioeconomic data.



FRESHWATER

Finding answers to the world's pressing water supply and access challenges requires cross-ing disciplines and exploring a wide range of approaches. Stanford researchers are working together on sustainable solutions ranging from a low-cost water pump chlorinator to a high-tech, multi-million-dollar wastewater resource recovery center. They also are looking at water supply issues from a law and public policy standpoint, providing guidance to decision-makers through knowledge-based tools such as an interactive website illustrating California's major groundwater challenges and potential solutions. To advance

these and other innovative freshwater solutions, Woods supports the Global Freshwater Initiative, which develops strategies to promote the long-term viability of freshwater supplies; the Water, Health & Development Program, which identifies ways to improve and increase the sustainability of water supply and sanitation service delivery; and the Water in the West Program, which addresses multiple dimensions of realistic, integrated solutions to the American West's water challenges. Read on for examples of work Woods-affiliated researchers are doing to ensure adequate supply and access to safe water for billions of people.

Highlights

Funding water projects in times of financial uncertainty

Researchers with Stanford's Water in the West Program set out a blueprint—including a small per-usage fee—for overhauling the way California funds water infrastructure and innovation projects and for overcoming fiscal restrictions.

Pricing water to encourage conservation

Working with the Water in the West Program, Woods-affiliated economics professor Frank Wolak developed a model of customer-level demand that can be used to design tiered water rate schedules that meet conservation and utility revenue objectives.

California drought

Water in the West convened an expert panel



FRESHWATER

discussion on causes, policy implications and possible responses to California's historic drought.

Groundwater management

Water in the West researchers produced a comprehensive online report about California's diminishing supply of groundwater, and began work on a website that will allow water managers, policy-makers and other stakeholders to compare Western states' groundwater laws and policies.

Policy innovations

A Stanford-led report, presented at a widely attended campus forum with California Gov. Jerry Brown, pointed the way to technological innovation in the water sector. The report recommends revising pricing policies, regulatory frameworks and financing.

Water security

Researchers with the Global Freshwater Initiative began fieldwork for the Jordan Water Project, an international, interdisciplinary effort aimed at developing new approaches for enhancing the sustainability of freshwater resources in Jordan and other arid regions.

Urban supply

A study of urban water supply vulnerability co-authored by Woods Senior Fellow Steven Gorelick (Environmental Earth System Science), was recognized as the "Best Paper of 2014" by the scientific journal *Environmental Research Letters*.



Our vast marine environments span nearly three quarters of the earth, and play an essential role in regulating climate and weather systems as well as providing food, employment and transportation for people globally. In turn, society must play a key role in managing and mitigating its impact on the ocean. Through the Center for Ocean Solutions (COS), Woods has partnered with Stanford’s Hopkins Marine Station, the Monterey Bay Aquarium and the Monterey Bay Aquarium Research Institute (MBARI) to study and develop solutions to address ocean threats

and prepare leaders to take on those challenges. COS leverages the research and policy expertise of Stanford and its partners to gather key data and develop new insights into the human-ocean interface ranging from ocean acidification to overfishing to sea level rise. Drawing on the interdisciplinary expertise of scientists, engineers and lawyers, the center harnesses the best available science to advance science-based solutions. Read on for highlights of the work COS researchers are doing to support informed ocean decisions, healthy marine ecosystems and vibrant coastal communities.

Highlights

Human-marine interactions

COS and Woods hosted two workshops on human-marine interactions, featuring a “dream team” of interdisciplinary speakers discussing how the environment affects human wellbeing as well as what drives people toward environmentally and socially sustainable behavior.

Environmental DNA

The center’s Environmental DNA (eDNA) project was awarded \$830,000 out of a larger \$7 million federal grant to develop and test innovative genetic sampling techniques that could revolutionize marine wildlife monitoring. The process allows scientists to collect small water samples filled with bits of DNA and identify which organisms are present in that environment based on each species’ unique genetic fingerprint—without ever having to see or capture the organisms themselves.

OCEANS

Coastal hypoxia research

A COS working group focused on ocean hypoxia published a 2014 article that helped the Southern California Coastal Water Research Project Commission identify and develop a pathway to solutions for addressing declining oxygen content along the California coast.

Natural capital and climate adaptation

Building on successful engagements with coastal planners from Sonoma, Marin, Monterey and Santa Cruz counties, the center's collaborative coastal adaptation efforts with the Natural Capital Project expanded to integrate regional lessons into state-wide efforts in partnership with the California Coastal Commission and State Coastal Conservancy.

Small-scale fisheries

The center's small-scale fisheries team published two peer-reviewed papers describing a number of strategies for developing more sustainable fisheries communities using adaptive, flexible management and social-ecological systems thinking.

Ocean acidification and science policy

COS published a white paper summarizing the legal and policy levers for addressing ocean acidification in California's Marine Protected Areas for the Resources Legacy Fund, a major funder of natural resources conservation. The charity will use this white paper to inform its funding priorities over the next five to ten years.

Leadership development

In 2014, the Monterey Area Institutions' Network for Education (a collaboration between COS and seven Monterey Bay area academic campuses focused on training future ocean leaders) saw an increase in the number of leadership development activities offered to our graduate audience, including four seminars, five workshops and two all-campus networking events involving over 250 participants and 20 guest speakers. The collaboration was also awarded its first-ever grant in 2014: A \$25,000 WhaleTail grant to support the upcoming 2015 Summer Ocean Policy Course from the California Coastal Commission.

Ocean tipping points

The center's interdisciplinary, cross-institutional Ocean Tipping Points project team published five peer-reviewed articles, presented at 38 global conferences and extensively engaged managers, researchers and community groups in its two case study regions of Haida Gwaii, British Columbia and Hawai'i, U.S.

Oceans' industrial revolution

In a new paper published in the journal *Science*, Senior Fellow and Harold A. Miller Professor in Marine Sciences Steve Palumbi (Humanities and Sciences) and colleagues from several universities write that the same patterns of human activity that led to the collapse of hundreds of species on land are now occurring in the sea, just a century or so later.



PUBLIC HEALTH

The environment factors into public health on multiple fronts. To address them, Woods brings Stanford's world-class medical scholars together with experts on environmental health and other disciplines to solve complex challenges in areas where resources are scarce. Scholars with our Water, Health and Development program are working with partners in Asia, Africa and the Caribbean to deliver affordable water supply and sanitation services in a way that enhances human health through safer, more sustainable water and wastewater management. In Haiti, an initiative run by Stanford graduate

students is reducing water contamination from human waste while creating jobs and compost. In Bangladesh, a team led by Woods researchers is developing low-cost chlorination devices that treat water at the point of collection for thousands living in urban slums. In Senegal, researchers funded by Woods' Environmental Venture Projects program are pioneering natural—and effective—approaches to curb the spread of schistosomiasis, a deadly neglected tropical disease. Read on to learn more about these projects and other work Stanford researchers are doing to sustain the health and well-being of people around the world.

Highlights

Prawns vs. parasites

A Stanford-led team's work in Senegal, West Africa, was recognized as the best health project in the Data for Development Challenge Senegal, in which international teams use anonymous mobile phone data to analyze issues ranging from agriculture to urban

planning. The researchers are studying whether freshwater prawns that prey on parasite-infected snails can control the spread of schistosomiasis, while providing a source of marketable protein-rich food. Researchers used mobile data to calibrate the effect of people's movement on schistosomiasis transmission.

“The goal is to isolate feces from people. Then we neutralize that waste so it’s not a hazard anymore, but actually a valuable product.”

—Stanford Ph.D. candidate Kory Russel, co-founder of re.source

PUBLIC HEALTH

Sanitation solutions

In many of the world’s overcrowded urban slums, residents must choose between open defecation, crowded public toilets or expensive private pit latrines that can’t be emptied safely. Waste in these areas frequently contaminates local water supplies. A Stanford team is developing a solution: a subscription service for portable, affordable dry household toilets, which has been field tested in Haiti and will soon be deployed in Bangladesh.

Cleaner drinking water

During World Water Week in Stockholm, Woods’ Water, Health and Development Program won a cash prize and international recognition for its efforts to develop an affordable, sustainable solution to increase access to freshwater. The project involves the design of a community-scale, fully automated chlorine dosing device that can be installed on shared water points in low-income urban settings.

Paper microscopes

Stanford Woods Institute-affiliated Professor Manu Prakash (bioengineering) invented a print-and-fold optical microscope that can be assembled from a flat sheet of paper. While it costs less than a dollar in parts, it can

magnify objects over 2,000 times and is small enough to fit in a pocket. Prakash’s dream is that this ultra-low-cost microscope will someday be distributed widely to detect dangerous blood-borne diseases like malaria, African sleeping sickness, schistosomiasis and chagas.

Safer beaches

The stomach flu, which often comes with diarrhea, vomiting and fever, is one of several ailments that can affect people infected by water polluted with fecal bacteria from sewage. A new analysis by researchers at Stanford, UCLA and the nonprofit environmental group Heal the Bay shows that relatively easy-to-use predictive modeling systems offer a “vast improvement” over current monitoring methods.

Perilous pathogens

A newly recognized human pathogen with unknown health consequences has been found to occur over a large part of the San Francisco Bay Area. A 2014 study details how Stanford researchers found the bacterium, *Borrelia miyamotoi*, as well as *Borrelia burgdorferi*, the bacterium that causes Lyme disease, in ticks they sampled throughout the area.



SUSTAINABLE DEVELOPMENT

Costa Rica's coastal Osa and Golfito counties in the southern Pacific have long been an ecotourism destination, renowned for their beauty and biological diversity. But the region is poised for significant changes, including the proposed construction of a major international airport and hydroelectric dam. Rising demand for palm oil—with its potential to drive conversion from other agricultural land uses to lucrative single-crop plantations—is another area of potential concern. Through Woods' Osa and Golfito Initiative, Stanford

researchers and students are working hand in hand with local residents, government, the private sector and NGOs to address these concerns by pioneering a living process for sustainable development that is led by Costa Ricans. INOGO, an acronym formed by the Initiative's name in Spanish, is developing a strategy for the region that integrates economic well-being, environmental health and social equity. Read on for highlights of work INOGO is doing to empower people to improve their economic outlook while stewarding the environment.

Highlights

Presidential visit

Launched with a visit from Costa Rica's president, Luis Guillermo Solís, the Pathways to Leadership (Camino de Osa) program helps train local ecotourism entrepreneurs and helps them network with the tourism industry. Co-organized by INOGO, the program has received support and interest from a range of government officials and national organizations.

Regional overview

INOGO researchers produced an overview of the Osa and Golfito region's biological characteristics, conservation priorities and threats and literature on regional environmental services. The report suggests possible actions for achieving sustainability of terrestrial ecosystems.

Oil palm research

INOGO launched its Experimental Sustainable Palm Laboratory to evaluate innovations in crop diversification



SUSTAINABLE DEVELOPMENT

and increased sustainability as well as pathogen—and pest-resistance in oil palm plantations.

Integrated farm

INOGO started an integrated farm project to teach school groups and tourists about the benefits of intercropping, local production for local consumption and a farm's potential to provide for a family's food needs while supporting biodiversity.

*“We have discovered
that green is the true
color of gold, and that
we must preserve it.”*

—Pedro Garro, local leader, Caminos
de Osa initiative

Research Centers & Programs

The Stanford Woods Institute for the Environment incubates and supports strategic research centers and programs designed to tackle major sustainability challenges facing the planet. Through these interdisciplinary initiatives, Woods brings together top scholars from Stanford and other academic institutions and connects them with prominent leaders from government, nongovernmental organizations and business to develop practical solutions to real-world problems.

CENTER FOR OCEAN SOLUTIONS



A collaboration among Stanford University (through the Stanford Woods Institute and the Hopkins Marine Station), the Monterey Bay Aquarium and the Monterey Bay Aquarium Research Institute, advancing knowledge and solutions to ocean challenges.

Larry Crowder, Science Director

CENTER ON FOOD SECURITY AND THE ENVIRONMENT



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.

Roz Naylor, Director

David Lobell, Deputy Director

GLOBAL FRESHWATER INITIATIVE



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

NATURAL CAPITAL PROJECT



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 (Stanford)

Mary Ruckelshaus, Managing Director

OSA & GOLFITO INITIATIVE (INOGO)



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

WATER, HEALTH & DEVELOPMENT



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 IN THE WEST



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



ADVANCING DECISIONS

Woods magnifies the impact of Stanford's breakthrough environmental research by reaching beyond campus to inform and advance environmental decision-making. Through forums, workshops and briefings we convene diverse public and private sectors experts—from Stanford and beyond campus—who can collectively identify challenges along with the research and solutions needed to address them.

These interactions add new dimensions, in-field perspectives and currency to Stanford research. In turn, Woods staff and our affiliated scholars translate and disseminate new findings for those who make and implement decisions affecting the environment. Read on for highlights from our recent work to engage business leaders, policymakers, public servants and others in the process of developing, scaling up and implementing solutions.

Highlights

The business of sustainability

The Stanford Woods Institute hosted its inaugural Business of Sustainability Summit in May 2014, engaging a diverse cohort of 54 CEOs, chief sustainability officers and business unit heads from 47 companies, along with Woods faculty representing all seven Stanford schools. This convening stimulated dialogue, built valuable connections and allowed business leaders and Woods faculty who are trailblazers and pioneers in sustainability to share innovative ideas and strategy.

Reducing climate risks

A Stanford Woods Institute-organized panel of experts led a robust dialogue on mitigating as well as preparing for the risks posed by climate change at the National Press Club in Washington, D.C. Recent research on extreme weather, food security, drought and new technologies was explored at the September event, which drew a cross-sector audience of nearly 100 policy- and decision-makers from federal agencies, environmental non-profits, development banks and other research institutions.

ADVANCING DECISIONS

Dealing with drought

California Gov. Jerry Brown joined a wide range of water experts at Stanford for discussion of policy prescriptions and new research on improving water management. Panelists at the October talks, including Woods Co-Director and Senior Fellow Buzz Thompson (Law), outlined ways to achieve realistic water pricing, infrastructure financing, consistent regulation, technological innovation and improved conservation.

Advising a megacity

Newsha Ajami, Director of Urban Water Policy with Stanford's program on Water in the West, was invited by Brazilian officials to help them grapple with their worst drought in history and a resulting water crisis in the megacity of São Paulo. Ajami met with representatives of Brazil's government, federal and state water agencies, Brazilian universities, the U.S. embassy and other organizations.

Informing food security policy

William Wrigley Professor Rosamond Naylor (Earth System Science), director of the Center on Food Security and the Environment (FSE), briefed UN and other international policy experts on key elements from her recently published book, *The Evolving Sphere of Food Security*. In December Naylor and FSE faculty affiliate Stephen Stedman met with representatives of the World Food Program, the Food and Agriculture Organization and the International Fund for Agricultural Development—organizations that often work together on issues of agriculture, food assistance and rural development.

Briefing drought responders

Upon receiving Woods research briefs, California officials invited Senior Fellow Noah Diffenbaugh (Earth system science) to brief stakeholders including Natural Resources Secretary John Laird, as well as staff scientists and the Governor's Interagency Drought Task Force, on his lab's recent studies of the linkages between climate change and California's persistent drought.

Nature and decision-making

Conservation and natural resource experts gathered at Resources for the Future in Washington, D.C. to discuss and field questions about the latest research on factoring ecosystem services into decision-making. Woods organized the June 2015 event to showcase a series of 13 papers produced by researchers associated with the Natural Capital Project for a landmark special section of the *Proceedings of the National Academies of Science* on "Nature as Capital."

Expanding worldviews

More than a dozen Stanford Woods Institute faculty were involved in teaching an online and on-campus course curated for decision-makers to learn new strategies, tools and technologies for integrating science into their work. The course, "Environmental Risk and Resilience," was offered by Worldview Stanford in partnership with the Stanford Woods Institute and the School of Earth, Energy and Environmental Sciences.



CATALYZING RESEARCH

We stand at the tipping point of sustainability on several fronts. Threats posed by a changing climate, burgeoning human population, dwindling water supplies and rising seas—to name a few—loom large. To tackle these challenges, Woods 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, which helps innovative, often high-risk projects get off the ground. Since the EVP program began in 2004, Woods has awarded

more than \$9 million in grants to 60 research teams working in more than 20 countries. These projects have garnered more than \$40.5 million in follow-on funding and have involved faculty from all of Stanford's seven schools. The newly launched Realizing Environmental Innovation Program (REIP) will support later-stage interdisciplinary research projects that have shown initial promise in identifying solutions. The program will award funding and offer external advising. Read on for highlights of the progress that Woods-funded interdisciplinary research made in 2014 and 2015.

Highlights

Combating disease ecologically

EVP-seeded research on using aquaculture to fight schistosomiasis, a pervasive tropical disease, garnered attention and more than \$3 million in follow-on funding from organizations such as the Bill and Melinda Gates Foundation and the National Science Foundation. Project leads at Stanford plan to extend the

model they've created to address other public health challenges by establishing a Center for Disease Ecology; they've already received initial funding from Stanford's Center for Innovation in Global Health.

Agriculture and plague

A study that grew out of Environmental Venture Projects-funded research showed the connection between cropland expansion and plague in



CATALYZING RESEARCH

East Africa, expanding our understanding of zoonotic diseases and possible ways to prevent them.

Recovering wastewater

Stanford faculty who have received funding from Woods' Environmental Venture Projects program to study ways of extracting resources from wastewater successfully spearheaded an effort to build a water reclamation research facility at Stanford.

Nanofilters

Researchers funded by Woods' Environmental Venture Projects program published a study showing that affordable, easy-to-build nanowire filters can purify water effectively and efficiently.

Environmental DNA

In a paper published in the journal *Science*, researchers supported by a Woods Environmental Venture Project grant funded by the Seaver Institute proposed employing emerging sampling techniques for environmental DNA that could make assessing marine biodiversity, controlling invasive species and saving endangered ones significantly easier.

Challenging conservation theory

A team of researchers who received early support from Woods' Environmental Venture Projects program published an analysis that challenges the widely accepted conservation theory that protecting threatened species with unique functional roles is synonymous with protecting ecosystems. Their paper sets out a path to more effective resource management.



EDUCATING LEADERS

Woods 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. Read on for highlights from these and other programs to learn more about our work to prepare the next generation of global environmental leaders.

Highlights

Navigating the capital

Twenty graduate students and postdoctoral scholars learned how to fund academic work, build networks, inform policymakers and communicate science research through Woods' Rising Environmental Leadership Program (RELP). Now in its fifth year, the program offered campus workshops, networking socials and an intensive D.C. Boot Camp introducing participants to more than 40 inside-the-beltway professionals, including Stanford alumni and top White House Science Adviser John Holdren.

Student initiatives

Through the Mel Lane Student Grants Program, Woods funded Stanford student projects that hold the promise of bringing sustainable clean power to developing countries and using 3D printers to construct affordable drinking water purifiers, among other bold objectives.

Water and peace

Just as conflict over water can fuel revolt, sound water management and regional cooperation on water issues can create stability. That was the message of Jordan's minister of water and irrigation during a standing-room-only Woods Environmental Forum in May 2014.



EDUCATING LEADERS

Leveraging ecotourism

Costa Rican entrepreneurs are learning about leadership and the value of biodiversity in Caminos de Liderazgo (Pathways to Leadership), a new INOGO program launched in 2014. The program works with about 30 regional leaders to promote the development of rural community tourism, which provides both economic development opportunities and serves as a vehicle for environmental stewardship in sensitive biological corridors.

Faculty leadership

In 2015 Higgins-Magid Senior Fellow Jenna Davis (Engineering) and Anna Michalak, a researcher in the Carnegie Institution for Science's Department of Global

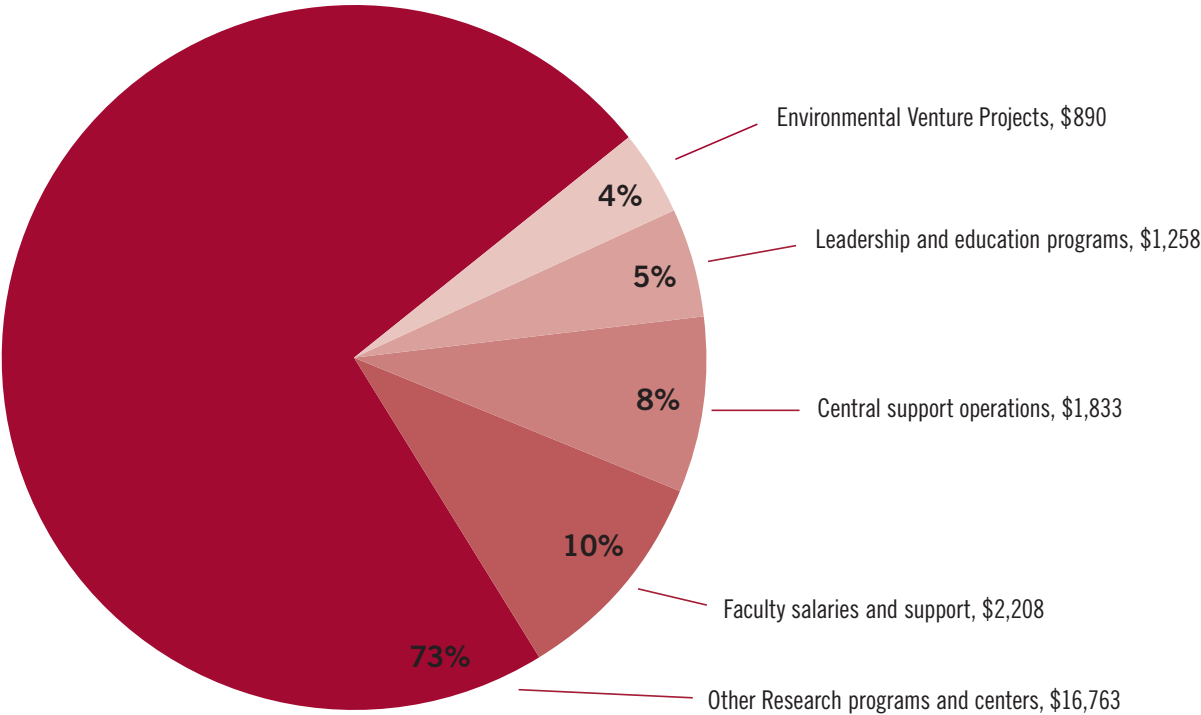
Ecology, were selected along with 18 other researchers around the country to join the ranks of the prestigious Leopold Leadership Program. This fellowship program, which is based at Stanford, provides outstanding environmental researchers with skills and approaches for communicating and working with partners in NGOs, business, government and communities to integrate science into decision-making.



Fiscal Year 2013-2014 (Actual)

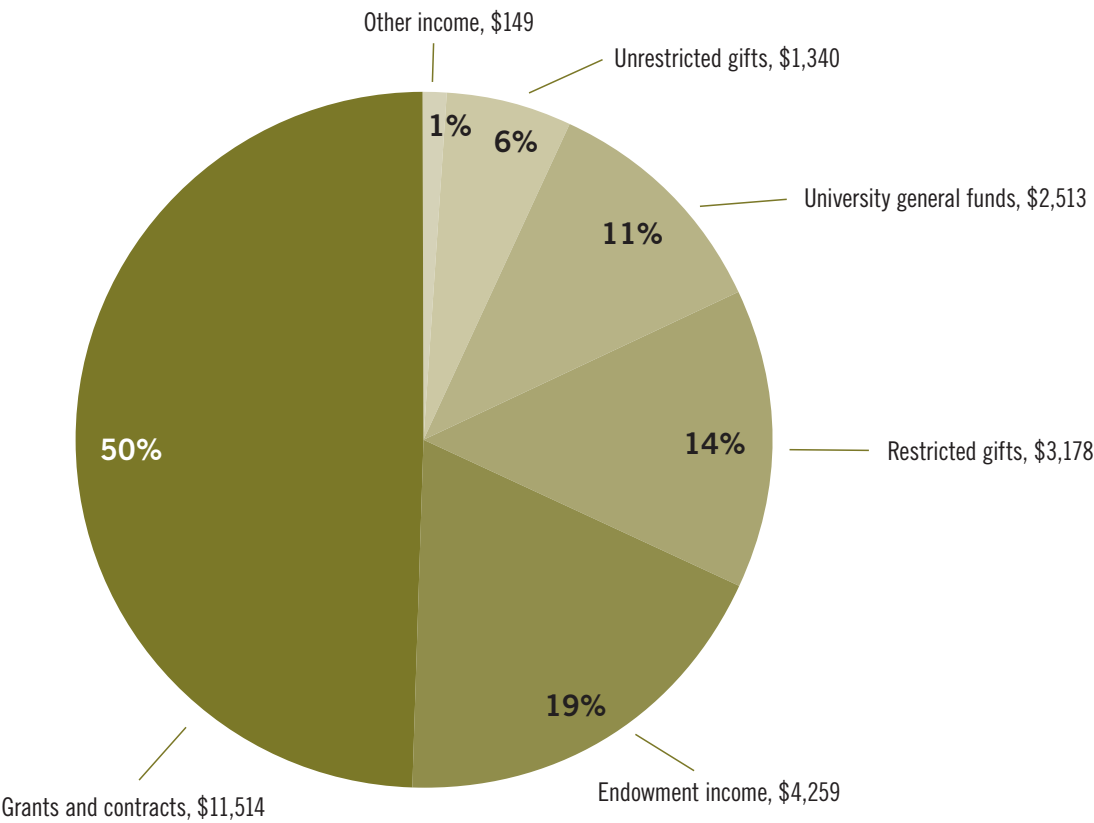
Sources of revenue which support the Stanford Woods Institute for the Environment in fiscal year 2013 – 2014 amounted to \$23.0 million, of which 11 percent originated from university general funds, 19 percent from endowment income, 20 percent from gifts, and 50 percent from grants and contracts. Expenses during the fiscal year 2013 – 2014 amounted to \$23.0 million. Woods largest expenditure includes Environmental Venture Projects and other research programs and centers, totaling \$17.7 million, or 77 percent of the institute’s annual budget.

Expenses (in thousands)



Total Expenses \$22,953

Sources of Revenue
(in thousands)



Total Sources of Revenue \$22,953



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