

2013 ANNUAL REPORT

CELEBRATING A DECADE OF SOLUTIONS





“Environmental and sustainability problems in the 21st century are challenging and complex. Solving them requires the integration of many different kinds of knowledge and know-how. At Stanford, faculty from all seven schools work together on solutions-oriented research, thanks in large part to the encouragement and facilitation provided by the Stanford Woods Institute. That’s powerful.”

—*Pamela A. Matson, Chester Naramore Dean of the School of Earth Sciences,
Richard and Rhoda Goldman Professor in Environmental Studies and Woods Senior Fellow*



Message from the Directors

The Stanford Woods Institute for the Environment was created to harness the ingenuity, passion and pioneering spirit of Stanford University in pursuit of breakthrough solutions to the world's most critical environmental and sustainability challenges. Woods pursues this mission through interdisciplinary research by Stanford's exceptional faculty and scholars, convening global experts, developing leaders and linking knowledge to action.

As we reflect on 2013, we're also celebrating Woods' first decade of progress toward a world in which societies meet people's needs for water, food, health, energy and other vital services while protecting and nurturing the earth.

Nearly a decade ago Woods' fledgling Environmental Venture Projects (EVPs) program provided a seed grant to researchers seeking to explore

methods for recovering energy from the nitrogen in wastewater. Today, Woods-affiliated researchers and their partners are testing that technology, and it will be central to the new Codiga Resource Recovery Center breaking ground on campus in 2014.

Another of our early EVP projects funded research on solar-powered drip irrigation systems in a region of sub-Saharan Africa where drought and hunger are endemic. In 2013, shortly after *National Geographic* recognized the Benin solar project as one of its "most hopeful energy stories," Stanford researchers published new findings showing the technology has great potential to reduce hunger, raise incomes and improve development prospects in a part of the world that greatly needs those advancements.

These two solutions represent a fraction of the work Stanford's world-class scholars and our partners in the public and private sectors are doing to advance innovative solutions to some of the most urgent threats to global sustainability.

We are energized by the progress they've made and the promise their work holds for a more sustainable world in decades to come.

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

Debbie Drake Dunne

Executive Director (2013)

Food Security

The question of how to feed the world's hungry without depleting the planet's natural resources is central to global sustainability. The Stanford Woods Institute is working to meet that food security challenge by supporting interdisciplinary research that factors national security, gender, education, infectious disease, water and nutrient management, energy and climate change into the hunger equation.

The Center on Food Security and the Environment (FSE)—a joint effort of Woods and the Freeman Spogli Institute for International Studies—is the fulcrum for food security research at Stanford. FSE blends natural and social sciences to provide insightful research that links health, development, the environment and national security in unique ways.

“Food security lies in closing the gaps between ‘what could be’ and ‘what is,’” said William Wrigley Senior Fellow and FSE Director Rosamond “Roz” Naylor (Environmental Earth System Science). “And ‘what could be’—the potential of agricultural systems to feed the world with adequate nutrition without harming the environment—will become increasingly constrained during the 21st century by global climate change and natural resource scarcity as the human population expands to eight, nine or even 10 billion. But these are not abstract issues. They are issues about people—their struggles and successes. Hunger is an intensely human experience.”

A forthcoming book edited by Naylor, *The Evolving Sphere of Food Security* (Oxford University Press),



FSE is convening researchers from around the world to advance the science around Chinese aquaculture from a food security perspective.

dives into these issues, presenting an integrated story of how global food security affects human lives, resource use and policy. Completed in 2013, the book includes contributions from interdisciplinary researchers at Woods and beyond.

Other FSE research produced last year explored a broad range of issues ranging from climate impacts on crop yields to environmental consequences of aquaculture. “These are not simple questions; they don’t have intuitive, simple impacts on the environment,” said Senior Fellow and FSE Associate Director David Lobell (Environmental Earth System Science). “We really try to understand emerging trends in food security, which are not well understood.”

The Ecological Society of America recognized Stanford’s impact in this arena by awarding its 2013 Sustainability Science Award to Senior Fellow Pamela Matson, the Chester Naramore Dean of the School of Earth Sciences. Matson was honored for her work with a team of researchers, including FSE affiliates, to document 15 years of agricultural development in the Yaqui Valley, Mexico, one of the most intensive agricultural regions of the world, and its transition to more sustainable management.

The influential work of FSE researchers also received major media attention, such as when *National Geographic* named an FSE project among its “Five Most Hopeful Energy Stories of 2012,”

and prestigious honors, such as when Lobell was awarded a MacArthur “genius” grant.

2013 Highlights

- *Proceedings of the National Academy of Sciences* published a study co-authored by Roz Naylor (Environmental Earth System Science) and FSE Fellow Jennifer Burney showing that localized irrigation systems have the potential to reduce hunger, raise incomes and improve development prospects in Africa.
- *Environmental Research Letters* published a study led by Senior Fellow David Lobell (Environmental Earth System Science) showing that agricultural climate adaptation measures can generate significant mitigation effects, making them a highly worthwhile investment.
- *Nature* published a study co-authored by Senior Fellow Peter Vitousek (Biology) revealing for the first time extensive information on the magnitude, scope and impacts of a major contributor to pollution in China: human-caused nitrogen emissions.
- *Nature Climate Change* published research led by Lobell showing that the impact of water stress on crops may be greater than that of heat stress.
- May marked the end of FSE’s three-year-long Global Food Policy and Food Security Symposium series at Stanford, featuring lectures by the world’s leading food and agricultural development policy experts, including former Secretary-General of the United Nations Kofi Annan and Woods senior fellows. From the series, FSE published a volume of edited papers and a free online high school unit on global food policy and food security in the 21st century. In the fall of 2013 FSE secured \$250,000 in funding from a private donor for a new *Food and Nutrition Policy Symposium Series*.
- *Aquaculture* published a study co-authored by Naylor showing, among other findings, that per capita fish consumption in China is 20 to 35 percent higher than official statistics. Naylor also secured funding to hold a major symposium on fisheries and food security in China.
- Lobell was honored with a MacArthur Foundation “genius” grant for his research on the impact of climate change on crop production and food security. Lobell was also named to *Foreign Policy* magazine’s list of “Top 100 Global Thinkers of 2013.”
- California Gov. Jerry Brown attended a talk by Naylor at the American Geophysical Union Fall Meeting that connected climate change with potential global unrest. Afterward, in an address to the audience, Brown referred to Naylor’s research, saying it would have “big political consequences.”

Researchers working with Woods published numerous other research papers, chapters and publications exploring food security problems and solutions in 2013; browse an expanded selection of published research at: woods.stanford.edu/foodsecurity2013.

Senior Fellow David Lobell (second from right), was honored with a MacArthur Foundation “genius” grant for his research on the impact of climate change on crop production and food security.



Photo: Mike Lusmore/DuckRabbit

In Africa, Stanford researchers are studying the benefits of solar-powered irrigation, which increases harvests and household income while saving time women and girls would otherwise spend fetching water.



Photo: Jennifer Burney

Ecosystem Services & Conservation

The planet's diverse ecosystems provide a broad range of natural benefits and services with value that extends far beyond the traditional marketplace. The Stanford Woods Institute is working to quantify that "natural capital" through its work with the Natural Capital Project, a joint venture with The Nature Conservancy, the University of Minnesota and the World Wildlife Fund. The collaborative already has yielded major returns on knowledge, networks and practical software-based tools that help natural resource managers around the world maximize the societal value of their land, freshwater and oceans while forecasting returns to society on investment in nature.

"We know that people's lives and livelihoods depend on nature. Understanding where and when nature matters most will improve decisions. That's the crux of our mission," said Mary Ruckelshaus, managing director of the Natural Capital

Project and Woods consulting professor. "Instead of viewing this work solely from the perspective of how people hurt nature, we're also looking at the way nature benefits humans. It's a feedback loop. Nature provides benefits, but human activities can affect those benefits we receive."

The Natural Capital Project is developing and improving novel scientific methods and open-source software models to quantify and value those benefits, in partnership with conservationists, land managers and leaders around the globe. The Project's signature tool is the Integrated Valuation of Environmental Services and Tradeoffs (InVEST) family of software that enables decision-makers to quantify nature's values, assess the trade-offs associated with alternative marine and land use choices, and integrate conservation and human development into land use, coastal marine and investment decisions.

The Project's staff, along with its conservation partners, is using InVEST in demonstration sites around the world. One of the marks of its success has been its worldwide dissemination. During 2013, the Project conducted InVEST trainings on natural capital valuation for more than 1,000 people in disparate locations from California and Vermont to Chili and Nicaragua to Bhutan and Nepal.

In June of 2013 the Project rolled out its newest open-source software tool that will guide cost-effective investments in nature for clean and reliable water supplies. The Resource Investment Optimization System (RIOS) was developed with partners in Latin America, where countries such as Colombia, Mexico and Brazil are experimenting with new conservation financing and water security mechanisms known as water funds. These funds are intended to improve the reliability of clean water supplies by managing watersheds, the green infrastructure that supplies, regulates and cleans water.

Using the RIOS approach in Colombia, one local water fund could improve the return on investment by up to 600 percent over previous approaches to watershed investment.

RIOS has been field tested throughout Latin America and could prove useful anywhere in the world. Project leaders already have fielded numerous inquiries from both the federal government and local nonprofit organizations about how they can use RIOS in the United States to protect more watershed lands.

Stanford researchers discovered that birds can provide natural pest control, increasing coffee growers' income by up to \$310 per hectare annually.



The Natural Capital Project's senior scientists, led by Mary Ruckelshaus and Gretchen Daily (center), are pioneering new ways to quantify nature's benefits to society.





These Galveston County, Texas, wetlands are a valuable natural asset for reducing damages from coastal storms, according to new research from the Natural Capital Project.

“This is a revolutionary way to think about infrastructure investments,” Ruckelshaus said. “RIOS provides a scientifically sound and easy way to guide investments in nature in a way that is good for people and the environment.”

2013 Highlights

- Natural Capital Project staff published a groundbreaking study highlighting the role of natural habitats such as dunes, coral reefs, sea grasses and mangroves in protecting millions of U.S. residents and billions of dollars in property from coastal storms. The study, published in the journal *Nature Climate Change*, offers the first comprehensive map of the entire U.S. coastline that shows where and how much protection communities get from natural habitats. The study attracted tremendous media interest, and Obama Administration officials followed up for more information about the study in connection with their climate adaptation planning.
- The Natural Capital Project completed a three-year engagement working on marine spatial

planning with West Coast Aquatic on Vancouver Island, the first partner with whom it began to develop the suite of marine ecosystem service models for InVEST. Local partners have been trained to use the approach and software, and now lead spatial planning efforts using co-developed tools to help link information about natural capital to decisions with better outcomes for people and planet.

- Daniel Karp, a 2012 participant in Woods’ Rising Environmental Leaders Program, was lead author of a paper that found coffee growers in Costa Rica can bolster bird biodiversity by leaving patches of their plantations as untouched rain forest. His work suggests that the birds are returning the favor by eating an aggressive coffee bean pest, the borer beetle, thereby improving coffee bean yields by hundreds of dollars per hectare. The study, co-authored by Senior Fellows Gretchen Daily (Biology), Paul Ehrlich (Biology) and Elizabeth Hadley (Biology), is the first to put a monetary value on the pest-control benefits rain forests can provide to agriculture, which the researchers hope can inform both farmers and conservationists.

Researchers working with the Stanford Woods Institute published numerous studies and papers about ecosystem services and conservation during 2013. Browse the full list here: woods.stanford.edu/conservation2013.

Oceans

Humans depend on the ocean to help stabilize the climate, provide food and support livelihoods. Yet human activities can place great stress on marine systems, with unintended consequences ranging from ocean acidification to sea level rise to fisheries collapse. The Stanford Woods Institute works to meet these and other challenges facing ocean health through a partnership in the Center for Ocean Solutions, a unique collaboration among Woods, Stanford's Hopkins Marine Station, the Monterey Bay Aquarium and the Monterey Bay Aquarium Research Institute. Drawing on the interdisciplinary expertise of scientists, engineers and lawyers, the Center applies the best available science and policy expertise to ocean governance, ecosystem resilience and climate change impacts. The Center also prepares leaders to take on these challenges.

Over the last three years, the Center has emerged as a science-to-policy leader, generating high-impact articles, reports and policy briefs that have catalyzed new use-inspired research programs for government and policy discussions in the halls of Congress. Washington State Sen. Kevin Ranker pointed out a key example of the Center's work to address ocean acidification during a 2013 symposium celebrating the Center's five-year anniversary.

"Because of the work of Oceans Solutions and others, we were able to get real-time data," Ranker said, referencing a comprehensive ocean acidification report the Center's researchers tailored to his state's circumstances. "We were able to show



Photo: Rob Dunbar

Stanford ocean researchers Rob Dunbar, Stephen Monismith and Meg Caldwell took Stanford students (shown here) to Palau to study how increasing acidification is affecting coral reefs and the local fishing industry.

very specific job connections and linkages between economic drivers and the environment." That, Ranker said, resulted in millions of dollars of state funding for an ocean acidification research center and an ocean resource management and conservation trust fund.

The Center has generated a number of other key policy resources dealing with ocean acidification, including a 2013 article in the *Harvard Environmental Law Review*: "10 Ways States Can Combat Ocean Acidification (and Why They Should)." Produced by Center Executive Director Meg Caldwell (Law), a senior lecturer with Woods, and Ryan Kelly, an early career fellow, the article was the first of its

kind to outline practical steps that states can take to address the issue.

In addition, the federal Ocean Research and Resources Advisory Panel's Ocean Acidification Task Force adopted a novel Center for Ocean Solutions analysis of how local, state and federal agencies and policymakers can proactively address ocean acidification and increase coastal ecosystem resiliency.

Through such efforts, the Center is providing important local context to public discussion of ocean challenges, as well as identifying readily available policy levers to address local conditions.

“We’re willing to reframe and shake up the established dialogue,” said Caldwell. “We want decision-makers to say, ‘This is a group that brings the best science to their innovative thinking. Let’s go to them.’”

2013 Highlights

- The Center was called on to deliver the Coastal Issues chapter of the Southwest Regional Report for the 2013 National Climate Assessment. Through this chapter and complementary external engagement, the Center is showing how state and local decision-makers can effectively apply scientific knowledge to guide preparation and coastal adaptation.
- A Center for Ocean Solutions team developed a sophisticated process to identify marine species by inspecting genetic material shed in water. Woods awarded the team—co-led by Stanford Civil and Environmental Engineering Professor Ali Boehm and Woods Senior Fellow Larry Crowder (Biology)—Environmental Venture Project funding to expand its “eDNA” research and verify whether the tool can be widely applied to marine life monitoring.
- The Center is a collaborator on the four-year, multi-institutional \$3 million Ocean Tipping Points project that seeks to embed the science of tipping points in ocean management, with funding from the Gordon and Betty Moore Foundation. The Center is synthesizing growing

scientific understanding of tipping points in marine systems and working with practitioners to develop useful approaches for integrating that information into ecosystem management.

- Woods-affiliated researchers adapted technology developed by the Monterey Bay Aquarium Research Institute to launch a robotic sensor that detects microbes, harmful algae and toxins in near-real time in Puget Sound. The technology, called the “Environmental Sample Processor,” could help resource managers, businesses and communities quickly assess whether beaches are safe to use and shellfish is safe to harvest.
- At the annual American Association for the Advancement of Science meeting, Senior Fellow, by courtesy, Barbara Block (Biology) discussed her Wired Ocean Initiative work to enable live feeds of ocean animal movements relayed by a series of floating WiFi hotspots. Block is at the

forefront of a movement to connect scientific work with global networks of research and technology that hold the promise of better understanding the changing biosphere.

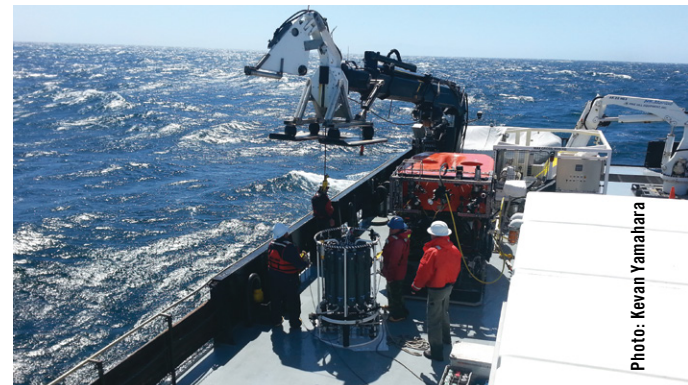
- Stanford scientists discovered that some purple sea urchins living along the coast of California and Oregon have the surprising ability to rapidly evolve in acidic ocean water—a capacity that may come in handy as climate change increases ocean acidity. The study revealed previously unknown adaptive variations that could help some marine species survive in future acidified seas.

Researchers working with the Stanford Woods Institute published numerous studies and papers about ocean issues during 2013. Browse the full list: woods.stanford.edu/oceans2013. Download the Center’s full annual report at: woods.stanford.edu/center-ocean-solutions-annualreport2013.

Stanford scientists have discovered that some purple sea urchins on the California coast are more adaptable to ocean acidification.



Researchers from the Center for Ocean Solutions are collecting water to test with a new eDNA tool, which can identify marine species in the water sample.



Sustainable Development

The Stanford Woods Institute is demonstrating how local communities can develop and pursue sustainable development plans that protect the environment while addressing related social and economic issues, including economic growth, education, health, social equity and infrastructure.

This model is being developed in Costa Rica, where Woods works directly with low- and middle-income communities to improve their economic outlook while protecting the environment. Working through the Osa and Golfito Initiative—known by its Spanish acronym, INOGO—Woods has partnered with local stakeholders to develop a strategy for sustainable human development and environmental stewardship in the Osa and Golfito region.

Long a prime ecotourism destination, the Osa and Golfito region is poised for significant changes brought by the proposed construction of a major international airport and hydroelectric dam. Rising demand for palm oil—and its potential to drive

conversion of rain forest to single-crop plantations—is another area of concern in the region.

Working hand-in-hand with Costa Ricans in local communities, the public and private sector and nongovernmental organizations, INOGO teams have generated useful decision-making information, products and processes that will guide and support local stakeholders who must deal with these and other changes as the region develops.

“We’re working to integrate human well-being into natural well-being, creating a living, interactive process for sustainable development,” said Senior Fellow Rodolfo Dirzo (Biology), who leads the project with Senior Fellow William Durham (Anthropology). The INOGO model of sustainable development will serve as a template for other areas of high biological and cultural diversity, Durham added.

The benefits of having anthropologists and biologists working with an entire community to map

a sustainable vision of the future are apparent in INOGO’s collaborative process. Locally trained staff surveyed hundreds of area residents to identify the region’s economic and ecological needs, priorities, assets and challenges. “We went in and listened and listened and listened some more. You always have more to learn from locals than they have to learn from you,” Durham said.

These interviews led to key local partnerships and served as a basis for INOGO’s diagnostic regional analysis completed in 2013. In addition, the team has produced Alternative Futures Scenarios and case studies informed by local perspectives. These resources have enabled local actors to articulate their sustainable vision for the region’s future development. In June 2013, INOGO hosted a summit in San José, Costa Rica, to finalize that vision and discuss action needed to move forward. A distinguished group of local and national leaders, including the vice president of Costa Rica, attended.

The initiative’s next phase already is under way. INOGO recently launched a key component of this next phase: the Caminos de Liderazgo, or Pathways to Leadership program, a collaboration with the Costa Rica/USA Foundation, Costa Rica’s National Parks Service, Nature Air (a Costa Rican airline) and a number of national tour operators. Drawing on previous experiences in the area—and models developed by Woods—the program will focus on the development of the rural community’s tourism trade. INOGO will continue to guide this effort with a focus on supporting conservation and sustainable development in the region.

The INOGO team, led by Rodolfo Dirzo and William Durham (at right), worked closely with partners in Costa Rica to create a diagnostic regional analysis.



INOGO is working with local leaders and entrepreneurs from the Osa and Golfito region to build community identity and develop a vision for sustainable economic development.





INOGO researchers are modeling the impacts of a new international airport, hydroelectric dam and conversion of rain forests to palm oil plantations near Costa Rica's Terraba-Sierpe National Wetlands.

Other pilot demonstrations in the works include model sustainable palm plantations, ecotourism training and evaluation of the proposed hydropower dam's impact on downstream mangrove estuaries.

The initiative also is providing tools, information and forums to help local leaders implement their vision. Included are a monitoring program to help the community track key economic, social and environmental changes, and an annual forum to bring together local change leaders.

2013 Highlights

- Woods and INOGO hosted an Uncommon Dialogue to explore the potential for ecological design and operation of two planned hydroelectric dams in the Osa and Golfito region. Participants explored how to balance national energy demands and movement toward a regional energy market with the best possible social and environmental outcomes for all involved.
- INOGO researchers completed an in-depth analysis of land use and land cover in the region using RapidEye satellite images. This analysis, called INOGO Mapas, provides visual insights into the region's changing landscapes and fosters understanding of how different forested areas might connect and form biological corridors. INOGO Mapas is the highest resolution land cover classification ever prepared of the Osa and Golfito region. The map and associated spatial data is available to research scientists, nongovernmental organizations and any other interested parties, and will be updated in the years to come.
- Senior Fellow Rodolfo Dirzo (Biology) and consulting researcher Lucia Morales presented results from INOGO's terrestrial ecosystem analyses at the annual congress of the Association for Tropical Biology and Conservation, held in San José, Costa Rica.
- INOGO leveraged its growing network to help facilitate a sister parks agreement between Costa Rica's National System of Conservation Areas, the St. Croix National Scenic Riverway and 12 other U.S. National Park System units in the upper Midwest. The sister park agreement was envisioned as a way to spotlight the migration of neotropical birds that travel from Canada, along the Midwestern Parks, to Costa Rica.

Researchers working with the Stanford Woods Institute published numerous research papers, chapters and other publications exploring sustainable development in 2013. Browse an expanded selection at: woods.stanford.edu/susdevelopment2013.

Climate

In a year that marked a record high for levels of climate change-fueling greenhouse gases, the Stanford Woods Institute helped shape global discussion of how society prepares for the future.

Climate change is a crosscutting issue that informs and drives interdisciplinary research across Woods' seven focal areas. Stanford researchers in this area span the fields of biology, earth sciences, engineering, economics, education, public health, communications, law and politics. Through Woods, they are joining forces to develop new analyses, convene experts and advance dialogue with key stakeholders to assess the risks climate change poses for human health, global food and water supplies, stable ecosystems and economies.

Concurrently, Woods researchers are leading efforts to discern how global decision-makers can prepare, adapt and mitigate for climate change and its potential to drive or magnify the effects of rising sea levels as well as catastrophic storms, droughts, crop failures, wildfires, and outbreaks of disease and pests.

"What is the likelihood that extremes in these areas will be created or magnified by climate change? That's something we can address scientifically, and decision-makers can act on," said Senior Fellow Noah Diffenbaugh (Environmental Earth System Science), who testified about global warming for a congressional forum organized by the Safe Climate Caucus in September 2013. "We're much more likely to get a solution from that perspective."



Photo: Rob Dunbar

Stanford researchers go to the earth's farthest reaches, including Antarctica, to study the changing climate and its effects on ecosystems.

Demonstrations of Stanford's impact came in the form of prestigious honors such as a MacArthur "genius" grant awarded to Senior Fellow David Lobell (Environmental Earth System Science), presentations to influential lawmakers and policymakers, and widespread coverage from major media outlets such as *The New York Times*, Associated Press, *USA Today*, NPR and NBC News.

The best illustration of Stanford's influence on the evolving climate dialogue was the university's central role in compiling a major United Nations Intergovernmental Panel on Climate Change (IPCC) report. Senior Fellow Chris Field (Biology, Environmental Earth System Science) co-chaired

the report's Stanford-based IPCC working group, while Diffenbaugh and Lobell were lead authors, and Senior Fellow Terry Root (Biology, by courtesy) was a review editor on the report. "There is no institution as richly represented as Stanford," Field said of the group he directs. Another recent IPCC report, focused on climate change mitigation, included three Stanford professors as writers and editors. For both reports, Stanford provided functional support, including library research privileges for authors from developing countries.

"I have colleagues that can't be on the IPCC because of the time it takes," Root said. "But Woods is saying 'go do it.'"

The report by Field's group takes a new look at a variety of issues such as climate change impacts on the ocean, food security and livelihoods. Its overarching focus embodies a shift toward examining increased likelihoods of extreme weather and how to manage the risk. "Even though we face some serious challenges, we have some attractive opportunities for building a better world in the future," Field said.

2013 Highlights

- Woods hosted "Managing the Risks of Extreme Climate Events and Disasters," an Uncommon Dialogue led by Chris Field. The event convened researchers from Stanford and other universities, policy experts, public officials and agency staff to review the state of scientific knowledge on climate change, climate extremes and disasters. Panel discussions focused on investments in preparation for, as well as response and recovery from, climate disasters. Participants also discussed the roles of the public and private sectors, universities and the media in preparing for extreme climate events.
- Senior Fellows Diffenbaugh and Field published research showing that the planet is undergoing one of the largest climate changes in the past 65 million years. Field and Diffenbaugh found that this change is occurring at a rate 10 times faster than at any point in that period. Without intervention, this pace could lead to a 5- to 6-degree Celsius spike in annual

temperatures by the end of the century. Associated impacts are likely to include more frequent occurrences of severe thunderstorms, according to a separate study led by Diffenbaugh and published by the *Proceedings of the National Academy of Science*. Such extreme storms are one of the primary causes of catastrophic losses in the United States.

- Woods held a press briefing in Washington, D.C., to release findings from a survey by Senior Fellow, by courtesy, Jon Krosnick (Communication, Political Science) which indicated that an overwhelming majority of Americans want to prepare in order to minimize the damage likely to be caused by global warming-induced sea level rise and storms. The survey, commissioned by Woods and the Center for Ocean Solutions, received global media attention.

Stanford climate research is leading to recommendations for adapting to and preparing for more intense storms, droughts and other extremes fueled by global warming.



- *Nature Climate Change* published research by Senior Fellow Lobell showing that corn is more vulnerable to extreme heat and drought than previously thought—a finding that has major implications for helping corn farmers optimize their output.
- The journal *Nature* named Field one of its "Five to Watch" in 2014. The journal's editors cited Field's work as co-chair of an Intergovernmental Panel on Climate Change report on the impacts of climate change.

Stanford Woods Institute researchers published numerous research papers, chapters and other publications exploring climate change in 2013; browse an expanded selection of published research at: woods.stanford.edu/climate2013.

Through cutting-edge research ranging from complex computer modeling to probing public opinion surveys, natural and social scientists such as (from left) Senior Fellows Chris Field, David Lobell, Terry Root and Noah Diffenbaugh are bypassing partisan stalemates to reframe the discussion about climate change.



STEPHEN SCHNEIDER: A Guiding Force



Photo: Linda Cicero

Three years after his death in 2010, Stephen Schneider, a renowned climate scientist, Stanford biology professor and Woods senior fellow, continues to exert an outsized influence.

Schneider served as an honest, credible adviser to decision-makers and stakeholders in industry, government and the nonprofit sector on possible climate-related events and policy responses. He played a key role in the creation of the Intergovernmental Panel on Climate Change (IPCC) and was an author of the IPCC's first four assessment reports. He founded the interdisciplinary journal *Climatic Change* and served as its editor in chief until his death. Through his research, media communication and public outreach, he worked tirelessly to improve understanding of science, environment and climate impact risks.

In 2013 the second annual Stephen Schneider Award for Climate Science Communication went to Nicholas Stern, an eminent economist and outspoken proponent of moving to a low-carbon economy. (James Hansen, then-head of the NASA Goddard Institute for Space Studies, won the award in 2012.) The year also

marked the first annual Stephen H. Schneider Memorial Lecture, given by former Vice President Al Gore. Schneider was one of four “generations” of IPCC authors honored when the IPCC shared the 2007 Nobel Peace Prize with the former vice president for their collective climate work. Before giving the lecture in April, Gore spoke at a private ceremony dedicating a stone bench in Schneider's honor.

“He was a force of nature,” Gore said. “There are very few people in history as successful as Steve was in helping to protect that only home we have ever known.”

On Earth Day 2014 Stanford announced that University archivists had made the Stephen H. Schneider Collection available to the public. The archive documents Schneider's work beginning in 1965, including a scientific paper published in 1971 in which he and S.I. Rasool predicted the world was cooling. “Then they got more data and realized they had it wrong—that the earth was warming—and Steve published a paper saying why they were wrong,” recalled his widow, Senior Fellow Terry Root (Biology, by courtesy).

“He was basically the grandfather of climate change science,” said Root, noting that Schneider didn't slow down, even when he was diagnosed with lymphoma. “When he was told he didn't have much time left, he actually sped up.”

Schneider's materials will continue to guide climate researchers into the future. More information about the archive is available at stanford.io/1hOnA9b.

Former Vice President Al Gore speaks at a ceremony dedicating a stone bench in the Papua New Guinea Sculpture Garden on the Stanford campus in honor of the late Stephen H. Schneider.



Photo: Linda Cicero

Freshwater

Freshwater is the planet's most crucial resource. Yet many regions face shortages, demand for it is growing and climate change is threatening existing supplies.

Interdisciplinary teams of Stanford researchers are working around the world to ensure abundant freshwater for drinking, growing food, maintaining healthy ecosystems and generating safe, renewable energy. In conjunction with Woods programs like Water in the West, the Global Freshwater Initiative and Environmental Venture Projects, these scholars are pioneering new technologies, leading cross-sector dialogues and creating international partnerships to address rising threats to water supplies both close to home and across the globe.

That work is taking place on campus with the groundbreaking of an innovative resource recovery center that will turn wastewater into an asset. It encompasses the drought and chronic water shortages affecting California's Central Valley, seven million acres of the world's most productive agricultural land. And it extends around the world with research teams working to increase water security in places like Jordan, one of the 10 countries most in need of freshwater.

"As the pace of global water crises has quickened, Woods has brought together some of the best water experts in the world to identify and develop innovative long-term solutions," said Woods Professor of the Practice Leon Szeptycki, the executive director of Water in the West. "Woods experts work not only across disciplines, but also in active partnership with public and



Stanford Woods Institute researchers are studying the intersections of water and energy.

private officials to ensure that our solutions are workable and implemented."

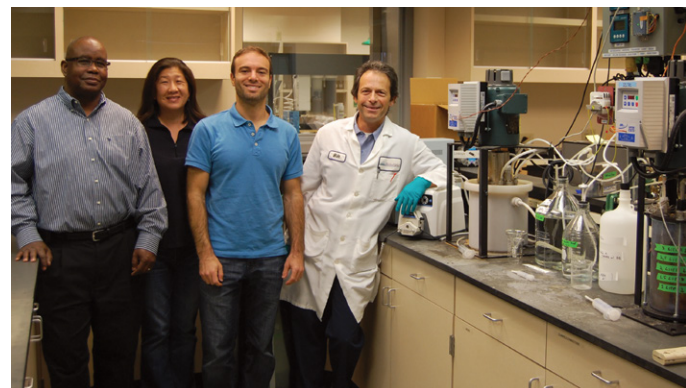
One team of experts is exploring how to reform water usage rules and improve freshwater system performance in Jordan. After a decade of drought and resulting crop failures, Jordan's water supplies are near the breaking point, due in part to demand from a growing influx of refugees—more than 600,000—from war-torn Syria.

In 2013 the Global Freshwater Initiative, a Woods program led by Senior Fellow Steven Gorelick (Environmental Earth System Science) was awarded three years of funding by the National Science Foundation to launch the Jordan Water Project, an international, interdisciplinary research

effort aimed at developing new approaches for enhancing the sustainability of freshwater

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Stanford postdoctoral scholar Yaniv Scherson (center right) is working with partners at the Delta Diablo Sanitation District in Antioch, Calif., to test a process for recovering renewable energy from nitrogen in wastewater.



Freshwater

Continued from page 15

resources in Jordan and, ultimately, arid regions throughout the world.

The challenges are enormous. The amount of renewable water in Jordan is equal to just over one percent of that available in the U.S. In addition, the region is expected to experience temperature increases of about 2.5 degrees Celsius by mid-century as well as longer dry periods.

“Our international team of hydrologists and social scientists is working collaboratively to explore ways to reduce the vulnerability of stressed freshwater systems,” Gorelick said. “The centerpiece of our effort is a simulation model of Jordan’s water system that can be used as a tool to quantitatively evaluate innovations such as optimized allocation, risk management, subsidies, water markets and trans-boundary institutions.”

As Californians know well, water stress isn’t just a developing world issue. Water in the West—a partnership with the Bill Lane Center for the American West—is addressing issues of supply in the nation’s most populous state. The demands for this critical resource extend far beyond California’s rural communities and urban centers to an agricultural sector that supplies food globally and helps fuel the eighth largest economy in the world. Much of the nation’s fresh fruits, nuts and vegetables are grown on irrigated farmland in the Central Valley. As 2014 shapes up to be one of California’s worst drought years on record, researchers estimate that this key growing region will receive only two-thirds of its normal water deliveries from state and federal water projects.



Photo: Benjamin E. Wood

The Global Freshwater Initiative is exploring how to reform institutional water usage rules and improve systems for providing freshwater in Jordan.

Farmers are expected to replace much of that supply by pumping groundwater, California’s largest source of water during drought years. Groundwater provides about 30 percent of the supply during normal years and 40 percent or more in dry years. But that supply won’t last forever if current pumping practices continue, a topic Water in the West is exploring in ongoing dialogues, workshops and policy reports.

A 2013 Uncommon Dialogue on groundwater and land-use planning brought together 30 groundwater managers, land use managers, water lawyers, consultants and academics to develop practical solutions to the impacts of land use on groundwater supply and quality. This conversation and

earlier dialogues provided the foundation for a series of papers on groundwater due to come out in 2014, including a report offering suggestions for improving the linkage between groundwater and land use planning.

“Every land use decision affects groundwater resources,” said Tim Parker, president of Parker Groundwater, one of the dialogue participants.

Voices like Parker’s and others engaged in these conversations are informing the work Water in the West is doing to advise policymakers about best practices for groundwater management in the western United States.

2013 Highlights

- Water in the West released a survey of academic literature published between 1990 and 2013 highlighting interconnections between water and energy. The report, “Water and Energy Nexus: A Literature Review,” points out where water and wastewater managers are missing substantial opportunities to save energy and money. It also identifies significant gaps in knowledge about the amount of water used to extract energy resources such as natural gas, oil and coal, and to generate electricity.
- The third workshop in the Comparative Groundwater Law and Policy Program series focused on groundwater ecosystem services with a tour of important groundwater sites and a visit to the Cosumnes River Preserve and the Sacramento-San Joaquin River Delta. The 28 attendees came from the U.S. and Australia.
- Perry L. McCarty Co-Director Barton “Buzz” Thompson (Law) and his co-authors provided recommendations for improving the health of California’s Delta in “Stress Relief: Prescriptions for a Healthier Delta Ecosystem,” published by the Public Policy Institute of California. The report recommends comprehensive, science-based management of multiple sources of stress on ailing ecosystems in the Delta.
- Stanford researchers with the Global Freshwater Institute, including Senior Fellows Steven Gorelick and Scott Fendorf (Environmental

Earth System Science), discovered a previously unrecognized source of arsenic in water: sinking ground around deep wells drilled in the Mekong Delta region of southern Vietnam.

- A groundbreaking analysis co-authored by the Global Freshwater Initiative won the 2012 American Geophysical Union’s Water Resources Research Editor’s Choice Award. The paper, published in the October 2012 issue of the journal *Water Resources Research*, was the first to systematically analyze and classify water crises around the world.
- A partnership between Stanford University and the Delta Diablo Sanitation District in Antioch, Calif., began testing at pilot scale (1/100th of full scale) a process developed by Stanford postdoctoral scholar Yaniv Scherson to recover renewable energy from wastewater. The process converts wastewater nitrogen into

nitrous oxide gas, then uses the gas to increase the power output of engines at wastewater treatment facilities.

- Rosemary Knight (Geophysics), a Woods senior fellow by courtesy, tackled the growing problem of saltwater intrusion into local aquifers by developing partnerships with water managers along the Central California coast and demonstrating the use of new types of sensors to manage recharging of aquifers.
- In December, Thompson concluded his trial of a longstanding water dispute between Montana and Wyoming as special master for the United States Supreme Court.

Researchers working with the Stanford Woods Institute published numerous studies and papers about freshwater during 2013. Browse here: woods.stanford.edu/freshwater2013.

Postdoctoral researcher Laura Erban, lead author of a study on arsenic in Vietnamese groundwater, samples a well in the Mekong Delta region.



Stanford’s Water in the West program is convening experts and advancing strategies to address groundwater overdraft in key agricultural areas.



Public Health

The Stanford Woods Institute seeks innovative ways to solve environment-related health challenges faced by households in some of the world's poorest countries. Through Woods initiatives such as the Water, Health and Development program (WHD), Stanford researchers are pioneering research, tools and strategies to improve hygiene and sanitation, reduce exposure to toxins, and increase access to clean water and nutritious food in the developing world.

In 2013, as international public health organizations prepared to transition from the U.N. Millennium Development Goals to new objectives for 2015–2050, Stanford researchers informed the global policy discussion in powerful ways.

Through exhaustive studies, WHD researchers supervised by Higgins-Magid Senior Fellow Jenna Davis (Civil and Environmental Engineering) revealed water policy flaws in much of sub-Saharan Africa. One discovery earned the

study's lead author, Emmett Interdisciplinary Program in Environment and Resources graduate student Valentina Zuin, an invitation from Mozambique to translate the findings into a national agenda for universal water access. The Stanford research also helped persuade decision-makers to include water tariff reforms in a \$178 million World Bank-funded project.

"I am very thankful to the Stanford Woods Institute ... for the high-quality work they produced, which is pioneering in Mozambique," Manuel Alvarinho, president of Mozambique's Water Regulatory Council, wrote in an email.

Senior Fellow Stephen Luby (Medicine), an epidemiologist who joined Woods from the Centers for Disease Control (CDC), launched field work in Bangladesh to better understand pollution from brick kilns in Bangladesh. Particulate matter from the kilns contributes to thousands of premature deaths every year. Luby worked with

Woods-affiliated Professor of Civil and Environmental Engineering Lynn Hildemann and Dennis Grahn, a senior research scientist in Stanford's biology department, to develop a cleaner, more complete combustion system for the kilns.

"That's work I never would have been able to do with the CDC," Luby said. "This is a really exciting environment to be in. There are no limits."

WHD researchers also developed new tools and technologies, including an easy-to-use water disinfection device that requires no electricity and a portable, affordable dry household toilet, as part of an economically sustainable effort to recover resources such as compost from human waste.

These and other innovative research and technological advances made during 2013 hold the promise of clean drinking water, healthy air and hygienic household sanitation for billions of people.

Senior Fellow Stephen Luby meets with brick kiln operators and research partners in Gazipur, Bangladesh.



Residents of Cap Haitien, Haiti, receive portable, affordable dry household toilets developed by WHD program researchers.



2013 Highlights

- *Ecology Letters* published a study co-authored by Senior Fellow James Holland Jones (Anthropology) that poked holes in a widely accepted theory connecting biodiversity abundance with a reduced disease risk for humans. Jones and his fellow investigators found that the links between biodiversity and disease prevalence are variable and dependent on the disease system, local ecology and probably human social context. Therefore, they stated, more



Photo: United Nations

WHD program researchers are working in developing nations like Bangladesh to design and deploy water chlorination systems that work with hand pumps.

effective control of diseases transmitted from animals to humans may require more detailed understanding of how pathogens are transmitted. The findings have significant implications for the study of animal pathogens, which cause more than three quarters of new, emerging or re-emerging human diseases.

- A drinking water chlorination system developed by WHD researchers won the 2013 American Society of Civil Engineers Sustainable Development Award in recognition of a project that “solves a pressing need in a developing country.”
- A panel of judges representing NASA, Silicon Valley companies and Bay Area universities, among other institutions, named a Stanford-based initiative to deploy portable, affordable dry household toilets in the developing world as the “Best Overall Solution” in a Showcase of Solutions for Planetary Sustainability. The showcase, part of the Sustainable Silicon Valley Water, Energy and Smart Technology Summit, highlighted game-changing ideas “that can scale to have a positive impact for sustainability at a planetary level.”
- The *Journal of Water, Sanitation and Hygiene for Development* published a study by WHD researchers showing that the water tariff structure used in much of sub-Saharan Africa and beyond penalizes the poor by pricing water higher for people who use it most, such as those supplying neighbors without in-home connections.
- The Gates Foundation awarded a \$100,000 grant to Woods-affiliated Assistant Professor of Bioengineering Manu Prakash to test an electromagnetic patch that noninvasively detects live parasitic worms in infected patients. The patch, which Prakash developed with Judy Sakanari, a research pathologist at the University of California at San Francisco School of Medicine, will cost less than \$10 and will be easier to use in rural settings.
- Senior Fellows Jenna Davis, Roz Naylor (Environmental Earth System Science), Woods Research Associate Amy Pickering and Assistant Professor of Medicine Eran Bendavid continued work on a multi-year project to measure how water supply access, food security and disease affect poverty over time in rural Kenya. The project’s goals include identifying local interventions and policy responses.

Researchers working with the Stanford Woods Institute published numerous research papers, chapters and other publications exploring public health problems and solutions in 2013; browse an expanded selection of published research at: woods.stanford.edu/publichealth2013.

Developing Leaders

“I’m here for my children and their children,” said Mark Ellis, a participant in the 2013 First Nations’ Futures Institute, a Stanford program that prepares young indigenous leaders to tackle social, economic, environmental and cultural challenges in their communities. “I’m here to make a difference.”

His drive to create a more sustainable future could apply to participants in any of the Stanford Woods Institute’s unique leadership programs.

Woods leadership programs serve Stanford students and early career scholars, as well as researchers from across North America and leaders working to advance sustainability in the public and private sectors. A diverse portfolio of programs shares a focus on developing skills, knowledge and networks to move ideas into action and support informed decision making. This unique strategic approach helps current and emerging leaders build leadership and communications skills while taking advantage of professional development opportunities, such as introductions to key contacts in government, nongovernmental organizations (NGOs), think tanks and business.

“Our students and postdoctoral scholars are exploring ways to magnify the impact of their research, develop partnerships and strengthen their networks,” said Sherrie Taguchi, director of programs. “They’re discovering career opportunities both within and beyond academia to make a transformative impact.”



Photo: Nathan Mitchell

Rising Environmental Leaders Program participants meet with senior legislative staffers in Sen. Dianne Feinstein’s office during the 2013 D.C. Boot Camp.

In 2013 Woods significantly advanced a cornerstone program for graduate students and postdoctoral scholars by expanding its Rising Environmental Leaders Program (RELP) to offer year-round workshops and community-building events, as well as enhanced offerings for postdoctoral scholars.

These changes extend and capitalize on the impact of RELP’s signature “D.C. Boot Camp.” The spring event has grown to encompass nearly 50 speakers in the course of a week, affording RELP participants the opportunity to engage with top lawmakers and senior members of the Obama

administration, as well as agency and NGO staff who can provide on-the-ground perspectives into how Washington works and the role science can play in shaping policy. Meetings with World Bank officials provided a new international perspective in 2013, when Stanford alumni participated in a panel offering RELP participants valuable networking opportunities and career advice.

“It was a thousand times the best Stanford program I’ve participated in,” said Subhan Ali, a 2013 RELP participant and doctoral student, who had high praise for speakers like former U.S. Secretary of Energy Stephen Chu. “I especially

resonated with his discussion of our responsibility as the next generation of leaders for the environment, the key role universities and academics play in policy and the transformative way we can each shape the future through our careers, whether as a scholar, a policymaker or an executive.”

Woods programs are fostering new opportunities for leaders from beyond Stanford as well. In 2013, the First Nations’ Futures Institute expanded its partnership with indigenous community organizations, including the First Alaskans Institute and the Sealaska Corporation. These connections broadened the program’s reach to all Alaska Natives, as well as Native Hawaiians and Māori.

The Leopold Leadership Program, which provides outstanding academic researchers with tools for integrating science into policy, has trained 195 fellows who are working on critical issues around the world. The program expanded its focus in 2013 to emphasize ways for researchers to amplify their impact through collaboration. That fresh approach is built around trainings that help fellows establish core skills and then accomplish paradigm-shifting objectives.

“Drive-by science” is no longer sufficient, said Pam Sturner, the program’s executive director. “The traditional model for leadership in academia is top-down. People who are working on solutions that go beyond the Academy have to work across disciplines, and develop relationships that build trust to move things along over time.”

2013 Leadership Programs

- First Nations’ Futures Institute
- Fisheries Leadership and Sustainability Forum
- Leopold Leadership Program
- Mel Lane Student Program
- Rising Environmental Leaders Program

2013 Education Programs

- Mentoring Undergraduates in Interdisciplinary Research (MUIR) Program
- Stanford Interdisciplinary Graduate Fellowship (SIGF) Program
- YES! (Young Environmental Scholars) Seminar Series

Young indigenous leaders and experienced practitioners exchange ideas in the First Nations’ Futures Institute.



“I feel like I have a map now in my head of the different avenues you can take to effect change”

—Angelina Sanderson Bellamy

Postdoctoral scholar studying sustainable agriculture, 2013 RELP participant

Leopold Leadership Program Fellow Mark Carr (right) is working to create a network of marine reserves along the California coast. His efforts are emblematic of the work Leopold fellows are doing to integrate science into environmental policy.



Advancing Environmental Decisions

Pioneering research is essential to breakthrough solutions. But solutions don't propagate themselves. Woods moves ideas into action by connecting Stanford scholars' work with those who make and implement decisions that affect the environment. Along the way, collaborations with private and public institutions ensure that this research is relevant and accessible.

Casting a wide net, Woods organizes forums, workshops and briefings to convene diverse academic, public and private sector experts who can collectively identify challenges along with the research needed to solve them. These dynamic exchanges frame issues in neutral forums focused on finding workable solutions to sustainability problems while bringing new perspectives to Stanford's environmental researchers.

Woods demonstrated this collaborative approach in 2013 while advancing strategies to manage risks associated with climate change. In a year leading up the release of a major United Nations

Intergovernmental Panel on Climate Change (IPCC) report on the subject, Woods gauged the needs of policymakers and decision-makers, surveyed public opinion and facilitated cross-sector dialogues between Stanford's experts and those working to make communities more resilient to the effects of global warming.

As part of that effort, Woods Executive Director Debbie Drake Dunne met with state and federal decision-makers to understand their climate adaptation research needs. In response to their feedback, Woods joined with the Center for Ocean Solutions and Senior Fellow, by courtesy, Jon Krosnick (Communication, Political Science) to develop a series of surveys measuring public attitudes toward potential risks from climate change, as well as methods for addressing and communicating about those risks. Surveys were administered nationally, and oversampling was done in California and New York.

To release the results, Woods organized its

first national policy briefing at the National Press Club in Washington, D.C., where Krosnick unveiled his findings and an expert panel discussed the results.

Demand for the information was intense. The event attracted an overflow audience of media and policy experts, including representatives from the White House Council on Environmental Quality, numerous congressional offices, state and federal agencies, nongovernmental organizations and other universities. Stories ran in more than 50 national and international news outlets, and a number of legislative offices and government agencies requested follow-up briefings.

Soon afterward, the cross-sector conversation about climate change risks and adaptation deepened with an Uncommon Dialogue organized by Woods and Senior Fellow Chris Field (Biology, Environmental Earth System Science). Field is the co-chair of an Intergovernmental Panel on Climate Change working group responsible for five major reports on the issue. He led academic leaders, decision-makers and policymakers in conversations aimed at aggregating the most current information and sharing best practices for encouraging climate adaptation, communicating risks to the public and formulating strategies for moving forward.

"It's not just about passing along knowledge. Through these dialogues and exchanges, we're integrating decision-makers into the process of finding solutions," Dunne said. "By joining forces, we can more strategically link science to

Senior Fellow Noah Diffenbaugh provides expert testimony about extreme weather and climate change on Capitol Hill.



Senior Fellow Rob Dunbar testifies before the United Nations Convention on Law of the Sea.





Senior Fellow, by courtesy, Jon Krosnick presents Stanford climate change survey findings at the National Press Club in Washington, D.C.

action and expedite change. That synergy will be increasingly important if society is going to meet the challenges of climate change.”

2013 Highlights

- Senior Lecturer and Center for Ocean Solutions Executive Director Meg Caldwell (Law) testified before a California State Assembly Select Committee about the impacts of sea level rise in the state, sharing recent survey results from Woods and the Center for Ocean Solutions about public preferences for policies that would address the associated risks.
- Senior Fellow, by courtesy, Rosemary Knight (Geophysics) testified before the same committee, describing the impact of sea level rise on coastal agriculture and outlining the potential use of geophysical technology to monitor salt-water intrusion of coastal aquifers.
- Senior Fellow Noah Diffenbaugh (Environmental Earth System Science) testified before the congressional Safe Climate Caucus, providing scientific perspective on the risks of global warming-related extreme weather as part of a larger panel that included citizens affected by climate and extreme weather.
- Senior Fellow Rob Dunbar (Environmental Earth System Science) discussed the consequences of ocean acidification as a participant on a panel assembled at the United Nations Convention on Law of the Sea. “You can be a climate change skeptic, but you cannot deny that ocean acidification is occurring,” he said later.
- Woods and the Osa and Golfito Initiative hosted an Uncommon Dialogue to explore the potential for ecological design and operation of dams. Dam design and operation experts met with representatives from Costa Rica’s government-run electricity provider to discuss challenges and opportunities for two planned dams in that country.
- The National Academy of Sciences appointed Senior Fellow Chris Field (Biology, Environmental Earth System Science) and Woods-affiliated Geophysics Professor Mark Zoback to a federal advisory group tasked with designing programs focused on human health, environmental protection and oil system safety for the Gulf of Mexico and the U.S. Outer Continental Shelf.
- Woods’ Energy and Environment Affiliates Program (EEAP) brought companies, foundations and universities together to discuss Stanford research on promising technologies for clean energy and renewable materials.

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 to develop knowledge to solve ocean challenges

Meg Caldwell, Executive Director
Larry Crowder, Science Director
centerforoceansolutions.org

ENERGY AND ENVIRONMENT AFFILIATES PROGRAM



A partnership between member industrial firms and Stanford that features symposia, workshops, customized plans for engaging the Stanford community, networking opportunities, and a best practices and ideas forum with other companies, foundations and universities

Steve Eglash, Executive Director
eeap.stanford.edu

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
Walter Falcon, Deputy Director
David Lobell, Associate Director
foodsecurity.stanford.edu

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
globalfreshwater.stanford.edu

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

Mary Ruckelshaus, Managing Director
naturalcapitalproject.org

OSA & GOLFITO INITIATIVE



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

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.stanford.edu

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
waterinthewest.stanford.edu

ENVIRONMENTAL VENTURE PROJECTS

Finding practical solutions to major environmental and sustainability challenges often requires innovative approaches to science, technology, resource management and public policy. To catalyze transformative research around the world, the Stanford Woods Institute for the Environment has awarded millions of dollars in seed grants through its flagship Environmental Venture Projects (EVPs) program. These grants support interdisciplinary research teams from all seven of Stanford's schools and 34 of its departments.

The EVP program seeks to support research that:

- Produces high-risk, transformative projects that have the potential to develop solutions to major environmental challenges
- Represents new, interdisciplinary collaborations among faculty who have not previously worked together
- Is directly relevant to the environment and/or challenges within seven focal areas: climate, ecosystem services and conservation, food security, freshwater, oceans, public health and sustainable development
- Addresses crosscutting issues, such as environmental ethics, incentive systems, risk perception, and analysis and valuation of natural systems

Since the annual EVP program began in 2004, it has awarded \$9.5 million in seed grants to more than 50 projects. Those initial grants have led to approximately \$40 million in follow-on funding from other sources. Of that funding, approximately half has gone to Stanford faculty for additional research, while the other half has been used to launch new research centers spawned from EVP projects and Uncommon Dialogues.

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woods.stanford.edu/research/environmental-venture-projects

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**The Stanford Woods Institute
 for the Environment**

2013 Annual Report
Celebrating a Decade of Solutions

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**The Stanford Woods Institute
 for the Environment**

Jerry Yang & Akiko Yamazaki
 Environment & Energy Building

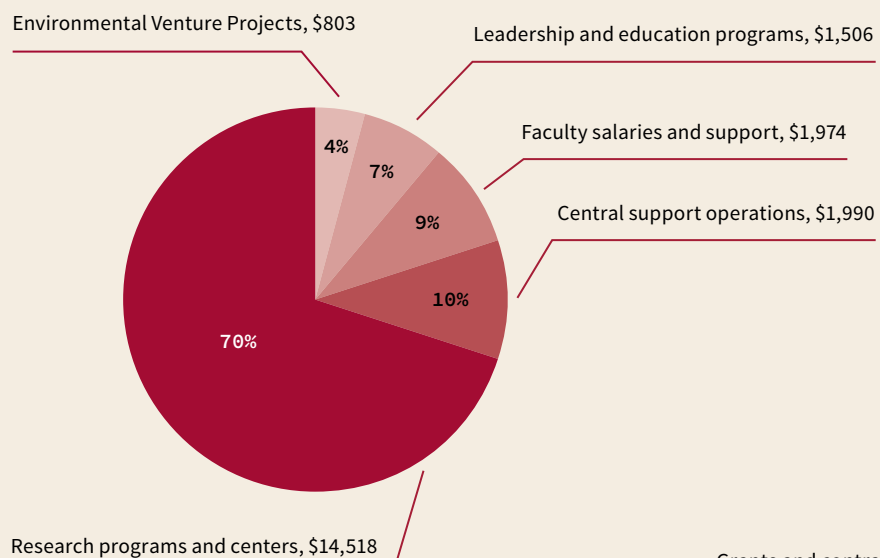
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Expenses & Revenue

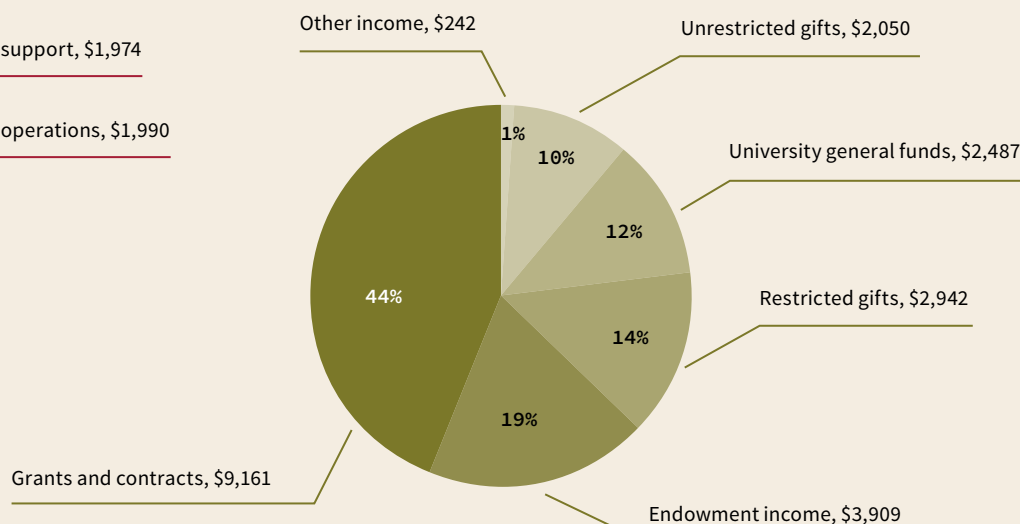
FISCAL YEAR 2012–2013 (Actual)

Sources of revenue that supported the Stanford Woods Institute for the Environment in fiscal year 2012–2013 amounted to \$20.8 million, of which 12 percent originated from university general funds, 19 percent from endowment income, 24 percent from gifts and 44 percent from sponsored research projects. Expenses during fiscal year 2012–2013 amounted to \$20.8 million. Woods' largest expenditures included Environmental Venture Projects and other research programs and centers totaling \$15.3 million, or 74 percent of the institute's annual budget.

TOTAL EXPENSES (in thousands): \$20,791



TOTAL REVENUE (in thousands): \$20,791





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