

BREAKTHROUGHS

A Magazine for Alumni and Friends
of the College of Natural Resources,
University of California, Berkeley

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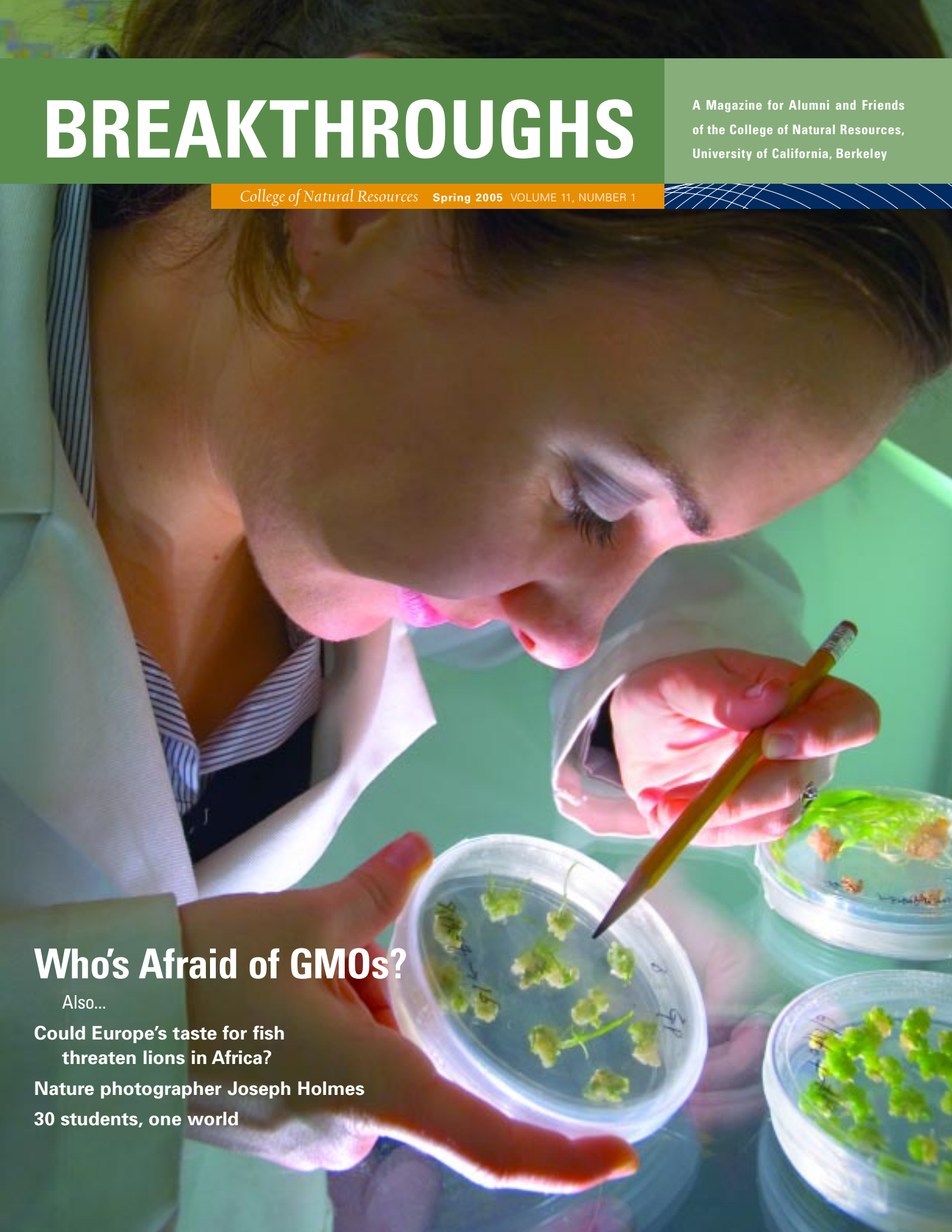
Who's Afraid of GMOs?

Also...

Could Europe's taste for fish
threaten lions in Africa?

Nature photographer Joseph Holmes

30 students, one world





Lindsay Ludden

“THIS ISSUE OF *BREAKTHROUGHS* COVERS A LOT OF GROUND, AND YOU MAY NOTICE SOME CHANGES IN OUR APPROACH TO THE MAGAZINE.”

On the cover:

Graduate student Michelle Perl inspects sorghum tissue that will be used to introduce a gene to improve the nutritional quality of the crop. Read this issue's cover story, “Who's Afraid of GMOs?” beginning on page 8.

Photograph by Genevieve Shiffar

Message from the Dean

In January, my family had the opportunity to visit our son Jason at his Peace Corps assignment in the village of Missira, Guinea. We came home with

vivid images of life in West Africa, many of which highlight the connections and impact that UC Berkeley continues to have in the developing world.

I discovered one such connection in the tiny hut of a Peace Corps volunteer, where I found a dog-eared copy of *Agroecology*, Professor Miguel Altieri's seminal work on achieving sustainable agriculture through respect for indigenous knowledge, protection of the environment, and promotion of social equity. Later, while staying in Dakar, Senegal, I came across an international symposium on African locust problems, and several posters that referred to the biocontrol work pioneered in our Division of Insect Biology. This issue's cover story (page 8) explores the promise and perils of genetic engineering—a technology that many scientists regard as yet another approach to solving agricultural challenges in the developing world.

UC Berkeley and Jason's alma mater, the University of Wisconsin-Madison, each send far more Peace Corps volunteers to West Africa than any other U.S. universities. The young volunteers' work teaching agricultural

techniques is simple, yet astounding. In Jason's region, agriculture is practiced without tractors or even animal power, and crops are subject to drought, insect invasions, and disease. As Jason puts it, “The job is easy, but the living is hard.” (This issue of *Breakthroughs* looks at another group of young people who've found a way to engage in global problems—see “30 Students, One World” on page 16.)

Toward the end of my family's African travels, we headed south and witnessed an astounding abundance of wildlife: lions and leopards, giraffes and zebras, elephants, foxes, and much, much more. But in West Africa we had witnessed something very different. We saw firsthand the decimation of West African animal life, which is the subject of an important recent study by Justin Brashares, professor of ecosystem science. On page 20, read about the links that Brashares and his collaborators have found between over-fishing, the need of local populations to find alternative protein sources, and a disastrous decline of land-based West African wildlife.

This issue of *Breakthroughs* covers a lot of ground, and you may notice some changes in our approach to the magazine. I hope you'll let me know what you think of these changes, or simply share your own ideas and experiences, by writing a letter to the editor. Enjoy the issue. 🇺🇸

Dean Paul Ludden

A handwritten signature in blue ink that reads "Paul W. Ludden".

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We want to hear from you!

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Foresters Take Logging Skills to Cutting Edge

Briefs

When Gina Lopez told her pals that she had joined the school's logging team, they were aghast.

"Gina, I can't believe you'd do that," one of her housemates said. "It's logging!"

But here she was at the California Conclave intercollegiate logging competition, gripping a double-bladed ax with both hands, rearing back and letting it fly at a bull's-eye painted on a round slab of Douglas fir.

A few dozen competitors from California's only university logging teams—Berkeley, Humboldt State, and Cal Poly San Luis Obispo—had spent a chilly night on this rugged 3,200-acre ranch north of Santa Cruz. Mostly forestry students, they emerged from their yurts in the morning to vie against one another in about a dozen events, including woodchopping, ax-throwing, and heaving a 10-foot log called a caber.

Big, friendly dogs were sniffing around, Johnny Cash tunes were wafting out of a boombox, chain saws were being unloaded from mud-splattered pickups, and burgers—both beef and tofu—were sizzling on an open grill.

"It's a new era in forestry," said Lopez, who, unlike Paul Bunyan, is short, female, Latina, and vegetarian. Taking in the scene, the sophomore from Gardena was looking forward to a full day Saturday of obstacle-course-running and race-like-a-bear-is-after-you tree-climbing.

Such diversions have been part of the logger's leisure hours since men who ate meals the size of small ecosystems felled trees for the first ancient subdivisions. But today's up-and-coming foresters can find it disheartening to hone the same skills on campuses where ax-flinging and competitive chain saw events are seen as so not right.

"Even saying I'm a forestry major, I get attacked," said Mike O'Brien, an avid logging competitor and president of Berkeley's forestry club. "But you have to take the time with people and be patient with them."

O'Brien and his seven teammates have persevered. Cal's logging squad went dormant in the early 1990s



Sophiak Peou

and was revived only in the last few years. It raises funds selling Christmas

trees, and members also peddle specially designed T-shirts at Berkeley's annual football showdown with archrival Stanford, whose symbol is a goofy-looking, bug-eyed redwood.

Last year's T-shirt pictured Stanford's beloved tree as a stump, with the ominous caption: "Not every tree deserves a hug."

At the ranch, competitors would pause after grueling spurts of sawing to scrutinize tree rings, cambium layers, and massive knots. After a while, they'd gather up the energy to heave a caber, stride across open pits on teeter-totter logs while hauling a 35-pound steel cable, or dash up an inclined pole with a chain saw, rev it up, slice off a chunk of wood, and run back down.

When they weren't straining, grunting, or cheering for anyone at the business end of an ax, they were engaging in the more cerebral events—leaf identification and compass skills.

"What people miss is that we're not talking about guys whose goal in life is to go out and clear-cut a forest," said Roger Phelps, a spokesman for Stihl Inc., the world's biggest manufacturer of chain saws. "These are intelligent individuals studying sustainable forestry, wildlife ecology, and resource management."

—Steve Chawkins

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The California Alumni Foresters (CAF) are widely recognized as the most dedicated alumni group on the Berkeley campus. Alumni and friends have established two funds to continue this legacy. The Foresters' Teaching Fund supports equipment, teaching, field trips, and Forestry Summer Camp, and the CAF Professional Forester Scholarship Fund helps students forge career paths as professional foresters. To support either of these funds, call Joni Rippee at (510) 642-0095.

Sophiak Peou



Seniors Andrew Nelson (above) and Mike O'Brien (top) let their axes fly on Sproul Plaza.

Modesto-based Cooperative Extension farm advisor Gregory Billikopf (right) and CamelBak executive Woody Skal (center) confer with an almond field worker about the need for drinking water throughout the day.

Helping Field Workers Keep Their Cool

Long, taxing days of manual labor are a fact of life for many agricultural field workers, and it is no secret that much of that work is done under searing summer skies. But high temperatures and solar rays are not just uncomfortable—during strenuous work, they can be hazardous or even deadly.

California state law requires that drinking water be made available to workers throughout the day, and most agricultural employers supply the water in conveniently located coolers. But according to Howard Rosenberg, a Cooperative Extension specialist in agricultural and resource economics, that's often not enough. Through field studies and interviews, Rosenberg has found that workers tend to drink only when they are very thirsty, and the amount they consume does not meet their bodies' needs.

"Heat stress problems in agricultural workplaces have both knowledge and structural roots," Rosenberg says. "Even though 'Drink enough water' is a common admonition at training sessions, most workers, supervisors, and managers don't really understand how the body generates and copes with excess heat, what the connection is between under-hydration and heat illness, or why relying on thirst as the cue to drink is risky." In addition, Rosenberg says, there are real costs to a worker who indulges in a trip to the water cooler, including the physical effort of getting there

Hot Ammunition Poses Health and Environmental Threats

One of the world's newest wartime pollutants is depleted uranium, or DU—a dense, slightly radioactive metal that has been shown to cause cancer in lab rats. The U.S. military has used DU ammunition to rip through enemy tanks and heavy armor in every major conflict since the 1991 Gulf War.

But Dan Fahey, a Ph.D. candidate in the Department of Environmental Science, Policy, and Management, has dedicated himself to bringing the hazardous side effects of DU to light. A Navy veteran and former board member of the National Gulf War Resource Center, Fahey says the impact of the ammunition against armor creates toxic particles that may affect the health of soldiers and civilians long after a conflict ends.

For years, Fahey has worked to promote greater research on the health effects of DU, as well as testing and monitoring of veterans exposed to DU. He has appeared on BBC radio, CNN, NPR, and the Voice of America, and in publications ranging from the *Financial Times* to *Rolling Stone*. His work succeeded in prompting the military to train all servicemen and women in the use of DU ammunition and its dangers. And he has worked with Congressman Bob Filner, D-Calif., to launch an investigation of the policies used to test and monitor veterans exposed to DU munitions in Iraq.

At Berkeley, Fahey is building on his DU work to examine the environmental causes and consequences of armed conflict. Working with Professor Nancy Peluso, Fahey plans to study environmental issues in war-torn areas of Africa.

—Sara Bernard



Howard Rosenberg

and back, the possible perception of "slacking," and foregone earnings for workers whose pay is based on their output.

Rosenberg has explored whether field workers would wear and benefit from hydration packs like those used by many athletes and U.S. soldiers. Whether that particular idea will fly has yet to be seen, but in the meantime, Rosenberg continues to promote the principle of reducing the "price" of hydration by keeping coolers closer to workers as they move, and encouraging farm operators to provide more education about heat stress and the body's hydration needs.

—Cyril Manning



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Correction

The Fall-Winter 2004 issue's cover story, "CNR on the Front Line," by Susan Piper, failed to acknowledge two important sources. The article's historical presentation was largely based on *A Sustaining Comradeship: A Brief History of University of California Cooperative Extension* (1988), and *Science and Service: A History of the Land-Grant University and Agriculture in California* (1995), both by Ann Foley Scheuring.

Breakthroughs regrets the error.



Kim Meyer '04 (center) and students from Oakland high schools work together to pull invasive species that compete with *Salicornia virginica* (pickleweed), an important native species.

Stand and Deliver

The opportunity to get out of the classroom and into the field is a hallmark of undergraduate education at CNR. But participants of ESPM 190—who are charged with teaching Oakland high school students about the environment—learn about far more than science.

The class is a key component of the College's Environmental Leadership Outreach Program, which is designed to address the severe underrepresentation of urban, underserved youth of color in the environmental sciences. In the class, energetic undergraduates spend the first half of the semester being coached as environmental educators and developing field-based curricula of their choosing. In the second half of the semester, the Berkeley students deliver lessons to the Oakland teens, tackling restoration projects and dissecting topics including biodiversity, water issues, and air pollution.

Which is not to say that it's easy. "We all have this whole idealistic view of how great teaching is, with those images of *Stand and Deliver* in our heads," says sophomore Simone Cifuentes, who took the course last spring. "Then you get there and it's not like that. It can be enchanting and disenchanting, all at the same time."

According to Mark Spencer, the academic coordinator of the program, the experience is not just valuable to the teens, but also to Cal students who have a unique opportunity "to learn real things about life from the Oakland kids." And by the end of the experience, says Spencer, "The high schoolers begin to see that the UC campus is a place where they, too, belong."

—Sara Bernard

Surprising Spiders

Two recent studies published in the *Proceedings of the National Academy of Sciences* by CNR insect biologists provide new insights into the behavior and evolution of spiders.

One study, by Assistant Professor Eileen Hebets, found that it isn't just vertebrates who use learning, memory, and social experience to choose a mate. Spiders do, too.

Hebets found that a sexually immature female wolf spider that has been courted by a mature male is substantially more likely, later in life, to choose a mate similar to the one she first encountered (not entirely unlike marrying the man who reminds you of a high school crush).

Scientists have rarely had much regard for what happens in spiders' lives before sexual maturity, at least when it came to positing arthropod sexual selection theories. Females have generally been assumed to possess a genetic preference for a certain phenotype in their mates, but Hebets' findings suggest that social experience and memory may be more important.

In a separate study, Professor Rosemary Gillespie reported that the similarities between the webs of different spider species in Hawaii provide fresh evidence that behavioral tendencies can evolve rather predictably, even in widely separated geographic places.

She found that separate species of *Tetragnatha* spiders, located on different islands and sharing no common ancestry, constructed webs of nearly identical shape, structure, and function. Gillespie and her colleagues concluded that the spiders' ability to construct nearly identical webs must have evolved independently, driven by matching environmental conditions.

The idea that traits can evolve independently isn't new, but this process never before had been applied to behaviors as complex as spinning a web.

—Sarah Bernard and Cyril Manning



Tetragnatha filiciphila



Triple Threat to California Forests

This winter, experts from the Integrated Hardwood Range Management Program released two groundbreaking white papers that explain the three biggest threats to California's oak woodlands: fire, development, and agriculture.

White papers, which typically argue a specific position or solution to a problem, are an excellent tool for Extension specialists and advisors in their mission to deliver science-based solutions to issues facing the people of California.

According to Doug McCreary, a natural resources specialist and primary author of the white paper on fire, Californians are finally realizing that living with fire is as normal as living with earthquakes. "Science tells us that fire is a natural part of the oak woodland ecology," McCreary says. "We have to develop strategies that allow for ecologically productive fires, while minimizing the catastrophic impacts of fire on people and property."

The second white paper deals with an equally sensitive and controversial issue: land use among the oaks, whose range covers nearly two-thirds of the state. According to the paper's chief architect, Greg Giusti, a forest and wildland ecology advisor, "land-use topics in oak woodlands are every bit as heated as the spotted owl debates of the 1990s." The white paper argues that the two main processes influencing oak woodlands today are land clearing (for subdivisions and intensive agriculture) and the continued parcelization of large, continuous woodland ownerships for development. Coastal counties from Mendocino to Santa Barbara and the Sierra foothill communities from Placer to Mariposa have all been wrestling with oak issues revolving around housing development and an ever-expanding wine-grape industry.

"We're witnessing the first steps taken by the state to address the issues of oak woodland conversion by certain types of land use," says Giusti. "We still have a long way to go."

Both white papers are available online at <http://danr.ucop.edu/ihrmp/>.

—Cyril Manning

Bar Code Revolution Ahead?

Meant for mechanical eyes only, the ubiquitous bar code divulges little information to today's casual shopper. But Dara O'Rourke, a labor expert in the College's Department of Environmental Science, Policy, and Management, says that with a few tweaks, it could help foment a consumer revolution. As he explained in a World Bank Group policy paper in the spring, shoppers choosing, say, turkeys could one day scan bar codes with their cell phone cameras to find out where the birds were from, and even see pictures of the farms. The transformed bar code would call attention to environmentally friendly products and raise the consciousness of shoppers everywhere.

The idea isn't entirely fanciful. Software already exists that allows camera phones to read bar codes. And some companies have begun sharing encoded product-tracking information with curious consumers. This year, Heritage Foods started providing a tracking number with every piece of meat it sells. When keyed into the company's website, the number provides the animal's medical and feed history. The site also features a turkey Web cam, so you can examine the animals' living conditions for yourself. As Patrick Martins, cofounder of Heritage Foods, puts it, you can "see Tom naturally mating with Henrietta."

The disclosure of so much production-process detail has risks: what if a turkey keels over on camera? Many companies are reluctant to throw open their doors while their competitors remain invisible. Still, a sizable number of consumers actually want to know how their sausage (or turkey) is made. These folks are less worried about losing their appetites than they are about buying something seriously unhealthy.

O'Rourke, whose 1997 report on Nike factory conditions in Vietnam helped spur consumer boycotts, says he hopes the government will construct a vast product-tracking database available to scanner-wielding consumers. If he gets his wish, the bar code may become the most interesting thing on the box.

—Nathanael Johnson

This article originally appeared in The New York Times Magazine.

Genevieve Shiffar



Undergrads Give Cal High Marks

Everybody knows that UC Berkeley is a top-ranked research university. (The *London Times* recently ranked Cal number two in the world.) And everybody also knows that for Berkeley undergraduates, that means a miserably impersonal education with large lecture classes conducted by teaching assistants, since professors are locked in their labs—right? Well, no ... at least not according to the actual students.

In fact, in a massive annual survey conducted last fall, 84.3 percent of Cal students declared themselves "somewhat" to "very" satisfied with their overall academic experience at Berkeley. On question after question about the details of their education, the positive responses outweighed the negative.

Of the 9,595 undergraduates who responded to a 2004 undergraduate survey, 53.5 percent had taken classes in the past year with a professor who knew the respondent's name. Only 16.2 percent of respondents had never been called on by name; 30.2 percent had rarely had that experience. Nor were those professors invisible outside of class: more than half of respondents—54.6 percent—said they had met with faculty members in person, either occasionally, often, or very often in the past year.

The reality is even brighter at CNR, where students enjoy a small college home, low student-to-teacher ratios, and faculty advisers who are always available.

—Bonnie Azab Powell



Chris Wilmers

Chris Wilmers tracks wolves by radio in the Lamar Valley, Yellowstone National Park.

Postdoc Takes Tracking, Analysis to the Next Level

Chris Wilmers, who received his Ph.D in environmental science at CNR last year, received a highly competitive National Science Foundation Postdoctoral Research Fellowship in Biological Informatics for 2005.

Bioinformatics is the science of developing and using computer databases and algorithms to accelerate and enhance biological research.

Wilmers, whose graduate research focused on the dining habits of gray wolves in Yellowstone National Park, will use his NSF fellowship to better understand how the movements of animals within a given habitat affect the food chain, using global positioning system, or GPS, tagging to track the precise habits of individual animals.

Because physical landscapes have a significant impact on habitat, Wilmers expects the biological insights gained through his fellowship to be of great interest both to theoretical ecologists and to conservationists seeking to maintain and restore ecosystems.

For more information on Wilmers' work, including news clips and streaming video, visit <http://nature.berkeley.edu/~cwilmers>. —Cyril Manning

While government fellowships are an important source of graduate funding, private fellowships—awarded to students who show outstanding promise of academic contribution—are crucial to attracting the best and brightest graduate and post-graduate students to CNR. To learn how you can fund graduate education and research through a private fellowship, call Kathryn Moriarty at (510) 643-6641.

Briefs

Gary Bañuelos, soil scientist with the USDA Agricultural Research Service, inspects the leaves of a transgenic Indian mustard plant used to remove selenium from contaminated soil.

Transgenic Plants Root Out Ag Pollution

Contamination of soil and drainage water by toxic heavy metals is one of the most serious problems in agriculture. This was strikingly illustrated in the 1980s in the San Joaquin Valley, when extraordinary levels of selenium led to death and embryonic defects in migratory birds and other wildlife. The selenium, a naturally occurring element that leaches into the subsurface drainage water in certain geological areas, was the result of years of agricultural drainage in the valley.

Because of extraordinary cleanup costs, real-world solutions to such contamination have been elusive. This spring, however, researchers at the College's Department of Plant and Microbial Biology, the U.S. Department of Agriculture (USDA), and Colorado State University proved the concept that plants genetically engineered to tolerate and remove heavy metals can get the job done. "The principle is to extract pollutants through the plant roots, harvest the shoots, and carry them away from the site for safe disposal," says Professor Norman Terry, coauthor of the study. "These plants could clean up huge acreages of soil, easily and inexpensively."

In their study, the researchers modified Indian mustard plants to produce greater quantities of certain enzymes that regulate how much selenium (in the form of selenate) gets taken up by the roots. Earlier studies had proven the technique in laboratory and greenhouse experiments, but this study, published in the journal *Environmental Science and Technology*, showed it to be successful under actual field conditions. Their results showed a 430 percent increase in the amount of selenium accumulated in the transgenic mustard shoots as compared to wild-type plants.

Because genetically engineered strains of a given plant can cross-pollinate with wild types of the same species—and may pose risks to other populations within an ecosystem—the fieldwork was subject to stringent precautions. Researchers exhaustively documented the function of each genetic alteration, the different characteristics of the transgenic and wild type mustard plants, and all potential interactions between the host plants and other species within the ecosystem. Wildlife was fenced out of the test plots, and the harvest of the plants was timed to preclude any possibility of cross-pollination. In addition, the study was closely monitored and videotaped by USDA inspectors.

"The regulatory hurdles can make this type of research difficult to pursue, but they represent legitimate concerns that we need to address," Terry says. "In the end, the clear benefit is developing new technologies that clean up the environment."

Read more about genetic engineering in agriculture in "Who's Afraid of GMOs?" on page 8.



Stella Zambranski, USDA ARS



Farm Fresh for Everyone

Farm Fresh Choice, a unique program that improves access to fresh produce in lower-income areas of Oakland and Berkeley, was recently recognized by Chancellor Robert Birgeneau as a model partnership between the University and the local community.

The program works to make fresh produce available through weekly mini produce stands at childcare centers. CNR's Center for Weight and Health and Department of Agricultural and Resource Economics help Farm Fresh Choice with information and advice on health, marketing, and economic topics, in addition to tracking the program's impact on small farmers and participants' consumer behavior.



Improving on Paradise

This year, one of the College's most spectacular natural research and teaching resources, the Richard B. Gump South Pacific Research Station on the island of Moorea, received a \$2 million infusion from the Gordon and Betty Moore Foundation. The grant will fund expanded research facilities, housing for investigators, and infrastructure improvements, including fiber optic networking.

In 2004, the National Science Foundation selected Moorea for its prestigious Long Term Ecological Research (LTER) program. The upgrades made possible by the grant are essential to support LTER and to accommodate the related growth of coral reef research.

New Faculty

Two new faculty members have joined the College this spring. Assistant Professor **Elizabeth Boyer** brings her expertise in watershed hydrology to the Department of Environmental Science, Policy, and Management from Syracuse, New York, where she held dual appointments at the State University of New York and Syracuse University. Cell biologist **Arash Komeili** joins the Department of Plant and Microbial Biology as assistant professor. He was most recently a Beckman Senior Fellow at the California Institute of Technology.

Breakthroughs posed a few questions to Boyer and Komeili in order to get to know CNR's newest faces.

Elizabeth Boyer

What do you find most exciting about hydrology?

Hydrology is a central science of the natural world. The role of water is a key to understanding many processes that interest me, including water quality, acid precipitation, forest and agricultural productivity, and the regulation of climate.

What water issue do you think will be the most important to society in the coming years?

One issue related to my work is scarcity, in terms of both water quantity and quality. Many parts of the world already lack clean water, many landscapes are being degraded, and many surface and ground waters are being polluted. Water scarcity will be an even greater problem in coming years as demand for water increases with population and economic growth.

What are your plans now that you're at CNR?

My courses in watershed hydrology and forest hydrology will emphasize how water moves through landscapes and interacts with ecology. My research will focus on watersheds and will contribute to understanding how hydrological and biogeochemical cycles interact to shape ecosystems and water quality, both on a local and a regional scale.



Arash Komeili

Cell biology encompasses a lot of science. Where's your focus?

I study magnetosomes, which are intracellular organelles that certain bacteria use for orientation and navigation along the earth's magnetic field.

Why is that important?

Understanding how these bacteria produce magnetosomes has the potential to benefit a variety of scientific disciplines. One of the most exciting areas that might benefit from this work is the use of magnetite crystals to investigate the history of life on earth. When magnetotactic bacteria die, they leave behind their magnetosome chains as fossils. These have been found in 2-billion-year-old sediments as well as in a Martian meteorite. Studying how modern day organisms form magnetite may help us understand the ancient environments that would have formed them.

What attracted you to Berkeley?

Berkeley is an incredible research and teaching institution, and to have an opportunity to be a part of such an environment is really phenomenal. Also, I feel a strong connection to the Bay Area from my graduate school experience at UCSF, and couldn't wait to move back.



Who's Afraid *of* GMOs?

Researchers manipulate the genetic makeup of plants by introducing genes into plant cells, selecting and multiplying those cells, and then cuing the cells to reform a plant, each cell of which now has the new gene. Graduate student Michelle Perl inspects sorghum tissue that will be used to introduce a gene to improve the nutritional quality of the crop.



Genevieve Shiffar

The promise and perils of genetically engineered crops

By Justin Gerdes

In fall 2002, the Sacramento-based biotechnology company Ventria Biosciences approached the California Rice Commission (CRC) with a novel idea. Ventria sought to ramp up production of rice genetically engineered to produce human proteins as an anti-diarrheal medication, a crop that had previously been grown only in test plots. The request marked one of the first attempts by a company in the United States to use an engineered food crop to produce drugs on a commercial scale—and ushered in the era of “pharma” crops.

Rice is big business in California. It's a \$500 million industry, and the state accounts for 20 percent of rice produced in the U.S.—with 40 percent of that total sent to one market: Japan. Alarmed that genes from pharma rice could cross-pollinate with conventional Japanese strains of rice, Japan balked. The Japanese Rice Retailers Association sent a letter to the CRC stating that, “if the [pharma] rice is actually commercialized in the U.S., we shall strongly request the Japanese government to take necessary measures not to import any California rice to Japan.” Joining the Japanese in seeking to block the commercialization of Ventria's pharma rice was a dis-



Inga Science

parate collection of environmental and consumer groups, including the Sierra Club and the Center for Food Safety.

At the same time, biotech supporters came to Ventria's defense. The Biotechnology Industry Organization, an influential trade association, argued that the potential public health benefits of pharma crops trump any attendant risks, and that the federal government's regulatory scheme protects the public.

In March 2004, the CRC advisory board, made up of rice growers and sellers, voted to allow Ventria to grow its pharma rice, but only under certain conditions. For example, the rice had to be sown outside the Sacramento Valley, California's rice-growing region, and fields needed buffer zones. Even with CRC approval, Ventria needed the go-ahead from the California Department of Food and Agriculture (CDFA) and the U.S. Department of Agriculture (USDA); in April, the CDFA rejected the CRC's agreement

and the USDA rejected Ventria's application to plant 120 acres of experimental rice. Frustrated with its inability to gain regulatory approval for the pharma rice and concerned about unpopular public sentiment in California, Ventria announced plans in November to move its operations to Missouri.

Ventria's quest to gain approval for its pharma rice captures much of the intractability of the debate over genetically engineered organisms (or GMOs, for genetically modified organisms—a technical misnomer but commonly used). GMOs engineered to produce pharmaceuticals, kill insects, or resist herbicides hold enormous promise for the future of society. But they also pose a raft of questions: Will consumers in the United States embrace the technology, and will foreign markets accept them? Can growers keep genetically modified (GM) crops from contaminating natural strains? Can con-

All photos: Genevieve Shiffar



Researchers and students from the College of Natural Resources care for genetically engineered plants that are transferred to the greenhouse. Undergraduate David Bae plants wheat seed that is genetically engineered to cause fewer allergic reactions. CNR greenhouse facilities are subject to stringent federal safeguards to prevent escape of genetically engineered organisms.



In some cases, plants are engineered directly to resist disease. But the grape plants above are not genetically engineered; instead the disease-causing bacterium *Xylella fastidiosa* has been modified to help researchers understand how the bacteria colonize and ultimately kill the plants. Here, graduate student Tracy Powell inspects a grape leaf before it is infected with *Xylella*.



Graduate student Maggi Woodhouse inspects a corn cob for the pattern of colored kernels caused by *hopping genes*—the phenomenon that is responsible for the color patterns on Indian corn. Basic studies such as these help researchers to understand the evolutionary development of corn as a crop.



The ultimate goal of much genetic engineering research is to improve the performance or quality of agricultural crop plants. Postgraduate researcher Rajvinder Kaur (left) and undergraduate Erica Moehle inspect sorghum plants that have been engineered to improve the nutrition that animals or people would derive from eating the grain.



Genevieve Shiffar

By looking at a transgenic line of *Arabidopsis* (which contains a foreign gene that is used as a marker), postdoctoral researcher Tzung-Fu Hsieh is able to examine how genes for certain traits (such as seed size) transfer from one generation to the next. Basic studies such as these help researchers understand seed development and crop yield.

sumers be sure the GM crops are safe to eat? Have the purported benefits of GM crops—increased yields, reduced pesticide use, pollution abatement through no-till farming—been realized, and do they justify the potential environmental and public health risks?

In the early 1970s, a team of researchers—Paul Berg, Herbert Boyer, and Stanley Cohen—discovered techniques that made possible the direct manipulation of genes. Traditional breeding of species has long involved the laborious crossing of related varieties to finesse favorable outcomes: a more vividly pink rose, a hardier stalk of corn. Now, for the first time, scientists could isolate genes responsible for desirable traits in one organism—say, a toxin in the bacterium *Bacillus thuringiensis* (Bt) that kills cotton bollworms (see “The Promise of GM Crops in Developing Nations,” page 11), and transfer that gene to other organisms—for example, cotton or corn plants. The trio’s work brought forth the era of biotechnology and led to one of the industry’s greatest commercial successes: the advent of genetically modified crops. And their brainchild is booming.

In January 2005, just 11 years after the Flavr Savr tomato was introduced as the first GM crop, the International Service for Acquisition of Agri-biotech

Applications reported that worldwide plantings of genetically engineered crops rose 20 percent in the previous year, part of an eight-year trend. These crops covered 200 million acres, an area the size of California and Texas combined. Genetically engineered crops are now grown in 17 countries, on nearly 20 percent of the world’s 3.7 billion acres devoted to food crop cultivation. In China, which trails only the U.S. in biotech research funding, half of the country’s farm fields could be growing genetically modified crops in a decade. And, though only a handful of GM crops (corn, cotton, soybeans, and canola) account for the vast majority of acreage planted, several dozen new biotech crops, including raspberries, lettuce, and peanuts, are in development.

Despite this remarkable growth, persistent concerns over the technology’s economic, social, environmental, and public-health impacts cast a continued shadow of controversy over GMOs. And perhaps no place is more emblematic of that clash, or more appropriate as a setting to reflect on the competing claims, than the University of California, Berkeley.

Peggy Lemaux’s office in Koshland Hall is a corn shrine; husks—on posters, embroidery, magnets—adorn all her walls. Having trained with Stan Cohen in the 1980s, Lemaux is now a cereal specialist and one of the

Genevieve Shiffar



Peggy Lemaux

GENETICALLY ENGINEERED CROPS ARE NOW GROWN IN 17 COUNTRIES, ON NEARLY 20 PERCENT OF THE WORLD'S 3.7 BILLION ACRES DEVOTED TO FOOD CROP CULTIVATION.

three Cooperative Extension specialists in the UC system who work on biotechnology (of the other two, one works in animal biotech, not agriculture). Charged with educating the public and farmers on the gamut of farming practices—traditional and organic as well as GM—Lemaux makes frequent public appearances and runs UCBiotech.org, a one-stop clearinghouse for biotech information and educational resources.

Though Lemaux eschews debates over genetic engineering and affirms her responsibility, through Cooperative Extension, to “find what the middle ground is,” she says that anti-GM crop groups attempt to paint her and UC Berkeley as firmly “in the pocket of industry.” The source of much of that lingering suspicion over the university’s supposed coziness with the biotech industry

stems from the 1998 collaborative agreement struck with the biotech giant Novartis (now named Syngenta). Pursuant to the deal, Novartis provided the Department of Plant and Microbial Biology (PMB) \$25 million over five years. In exchange, Novartis gained access to Berkeley research done by those receiving money and patent rights to discoveries made during the deal, although in the end, none were taken. (See “The Novartis Experiment,” *Breakthroughs*, Fall/Winter 2004.)

Although a July 2004 report on the Novartis deal by the Institute for Food and Agricultural Standards at Michigan State University concluded that “the greatest hopes of its supporters and the greatest fears of its detractors have not come to pass,” it also found that the agreement’s funding of an entire academic department

THE PROMISE OF GM CROPS IN DEVELOPING NATIONS

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The potential risks of GM crops may be debated for years to come, but many researchers are convinced that biotechnology in agriculture holds the potential to benefit the world’s neediest populations. One such researcher is

David Zilberman, professor of agricultural and resource economics, who in 2003 found that cotton crops in India that were genetically engineered to resist insects produced higher yields and required significantly less pesticide compared with nonbio-engineered crops.

The study showed particular promise for small-scale, low-income farmers in developing nations, according to Zilberman and lead author Matin Qaim (who conducted the research as a postdoctoral fellow at CNR). “Many critics have questioned whether genetically modified crops would be economically and environmentally beneficial to farmers

in developing countries,” Zilberman said. “Our research indicates that transgenic crops should be a viable option.”

The researchers studied 157 farm sites in India, each with three adjacent plots. One plot was planted with cotton bioengineered with a gene from the insecticidal bacterium *Bacillus thuringiensis* (Bt), which is resistant to bollworm pests that plague crops in India. The second plot was planted with the same hybrid of cotton but without the Bt gene, and the third with a cotton hybrid traditionally grown in the local area.

The researchers found that average yields for Bt cotton were a remarkable 80 percent greater than their non-Bt counterparts, and 87 percent greater than the local cotton hybrids. “With populations in developing countries growing exponentially, and available farmland stagnating, there is an urgent need to find ways to increase crop yields,” said Qaim.

While transgenic crops had previously been shown to reduce the use of certain pesticides, they had not substantially increased yields in countries such as the United States and China.

Why the difference in India? The answer seems to be that the region suffers from a significantly higher volume of crop-destroying pests, and that there has not been a widespread adoption of chemical pesticides in India to control crop damage. Transgenic crops would likely have greater potential to increase yields in such regions, said the authors.

Critics maintain that in addition to potential health and environmental risks, GM crops threaten to make developing-world farmers dependent on the biotech companies that hold intellectual property rights to the GM seeds. To that end, Zilberman is now deeply involved in the creation of the Public-Sector Intellectual Property Resource for Agriculture (PIPRA), a consortium of universities and foundations that would facilitate access to intellectual property rights of genetically engineered crops for humanitarian purposes.

“The bottom line,” maintains Zilberman, “is that biotechnology has the potential to positively impact the lives of small, poor farmers in developing nations. It would be a shame if anti-GMO fears kept important technology away from those who stand to benefit the most from it.”—Sarah Yang

Who's Afraid of GMOs?

was “outside the mainstream for research contracts with industry,” and shouldn’t be repeated.

As Lemaux sees it, the Novartis deal offered a way to supplement declining state and federal funds, with very few strings

Genevieve Shiffar



David Quist

attached. “The Syngenta relationship was the most benign corporate-academic relationship in which I have been involved. They didn’t interfere with our research agendas at all. We just proposed what we wanted to do and then did it.” To Lemaux, being labeled an “industry lackey” is expected, because it’s an easy way for opponents to dismiss her arguments. “If they don’t say that, then people might believe what I have to say. If I said, ‘Well, actually, I know that the data say that these particular crops are not allergenic, don’t cause disease, and people don’t die from them, then what could they say? They need me to look suspect.”

After a company tests a new GM food product for acute toxicity, Lemaux says,

those results should be reviewed by government agencies, as occurs in the pharmaceutical industry. She also feels that new GM food products should be treated just like any other product introduced to the U.S. market. “People say, ‘Oh my goodness, they’re not tested! It’s voluntary.’ But who stands to lose more than the company if they screw up? We don’t know this [long-term health effects] about any food that we eat. How would you test over 10 or 20 years? Who would you test? Should we do this on all the food [GM or not] brought into the U.S.?”

And on GM crops’ environmental benefits, Lemaux is a believer. “In my opinion, looking at the data—and there are people who disagree with this and who claim they have data to refute this—the vast majority of the data is on the side of the GM crops now on the market having spared the environment and improved farmers’ lives, either through less use of pesticides or through increased low- or no-till farming.”

In a spare, sunny office in Hilgard Hall, David Quist is remarkably relaxed for a Ph.D. candidate about to deliver his dissertation. Thrust into the international media spotlight in 2001 when a paper on GM corn contamination of native strains in Mexico, coauthored with UC Berkeley ecologist Ignacio Chapela, was published and then renounced by *Nature*, Quist has recently been an object of media attention again because of an ongoing dispute over Chapela’s application for tenure.

GMOs ENGINEERED TO PRODUCE PHARMACEUTICALS, KILL INSECTS, OR RESIST HERBICIDES HOLD ENORMOUS PROMISE FOR THE FUTURE OF SOCIETY. BUT THEY ALSO POSE A RAFT OF QUESTIONS.

Though Quist rejects labels like anti-biotechnology or luddite, he is championed by anti-GMO activists, and has become an advocate for a ban on GM crops, at least until a precautionary approach can assess the risks of what is, to him, an unproven technology. An early and outspoken opponent of the Berkeley-Novartis deal (he co-founded Students for Responsible Research in response to the agreement), Quist espouses what he says is a more nuanced position on GM crops than his critics, one that “transcends rigid agricultural boundaries and takes into account ecological and social risk.”

Quist and Lemaux agree that, because genes and pollen can transfer relatively easily between crop strains, contamination of the food supply and the environment is an issue that must be addressed. They also agree that you have to ask, “So, what is the impact?” But to Quist, it’s this follow-up that has not been addressed. “A lot of the concern about GM technology is that we’ve allowed this global release of GMOs without having our hands really around these questions about what the potential risks are. A lot of people think it may be premature—irresponsible even—to release the technology without having some baseline level of scientific assurance about what level of risk we are undertaking.” He continues, “The bottom line is that there are too many unknowns out there—is it going to harm Monarch butterflies? Is it going to decrease the genetic diversity that we care

about? Are predator–prey insects in the field, which are beneficial to agriculture, going to be affected as well?

“A lot of proponents of the technology will say—with human health or the environment—‘There’s no evidence to suggest that this is harmful.’ Well, there’s no tracking, so you don’t know if someone is getting sick because they’ve been eating GM cornflakes. Absence of evidence is not evidence that there’s no harm or risk.”

Part of the problem, Quist maintains, is that the tools used to assess the impact of GM crops are limited. “Genetic engineering has been wonderful in terms of telling us how genes express in certain systems, looking at mechanisms. But for filling those gaps—when you put it out into the environment—how does it behave? For all these kinds of questions, an ecological and multidisciplinary approach can identify answers where the reductionist, mechanistic [strict agricultural science] approaches really can’t.”

Quist cautions, too, that beyond questions of scientific uncertainty and ecological risk, there are cultural concerns with GM crops. “I think about Mexican farmers. The GMO issue is not just a scientific issue. Unfortunately, a lot of people want to say, ‘If you use the best science available, we’ll know how to go ahead with this.’ Well, no. These are societal choices, not just scientific choices.” He contends that the farmers he met while performing studies on GM contamination of native corn populations

Did you know?

A recent CNR study found that transgenic crops can clean up pollution.

See “Transgenic Plants Root Out Ag Pollution” on page 6.





Inga Science

in Mexico should be afforded the opportunity to choose whether or not their ecological heritage—maize—should be threatened by genetically engineered crops.

Amid the breakneck growth in GM crop plantings over the past decade, a sizable block of the planet is still suspicious of, if not hostile to, GM crops. Ninety-nine percent of GM crop acreage is found in just six countries: the United States, Argentina, China, Canada, South Africa, and Brazil. GM crops have yet to make significant gains in developing countries. And in Asia and Europe, consumers have not embraced GM crops; despite lifting a six-year moratorium on new GM crop imports in May of last year, for example, opposition to GM foods still runs as high as 70 percent in the European Union.

For Peggy Lemaux, GM crops can be an important part of our agricultural future, in spite of the uncertainty over long-term public health and environmental concerns, because of the technology's promise to relieve hunger and lighten the significant environmental impacts of current agricultural practices. "If there are more and more people, we have to use more land to grow the food we need for those people. And if we can do it in a more environmentally friendly way, then that's what I want to do. That's what I consider moving towards sustainability. I believe that, as many feel about organic farming, the responsible use of GM crops can lead to sustainable practices. But I don't feel either approach has all the answers. I don't think we should be forced to choose one or the other. I would hope we could use any technology we can to spare the environment and to improve people's nutrition," she says.

David Quist remains hopeful that research into and oversight of GM crops' ecological and food-safety risks will match the enthusiasm of the technology's most vocal supporters and detractors. "There's a basis for questioning this technology that doesn't just stop at, 'Does the science say it is safe or not?'" he says. "I wouldn't resign myself to saying, 'This is unstoppable, so don't get in the way.' If it's not the right way we should be going with agriculture, we should rethink it. When you look at the technology, it's just moving so much faster than our ability to develop biosafety strategies that we may need to take a more precautionary approach."



“It’s important that people debate the enormous potential contributions and perceived dangers to global society posed by this technology,” says Dean Paul Ludden. “It’s one of the great questions of our era. It’s only fitting that Berkeley, as one the world’s leading research institutions, and CNR, as the college that unites science and society, should be at the center of the debate. We would have failed in our mission if it were otherwise.” 🚩

—Justin Gerdes is a Berkeley-based freelance writer whose work has appeared in Terrain, The Commonwealth, MotherJones.com, and The Environmental News Network.

What do you think? Send letters to the editor: breakthroughs@nature.berkeley.edu. (Letters are subject to editing for length, format, and clarity. Please include a phone number for verification.)

GMOs ON THE BALLOT

In March 2004, voters in Mendocino County approved the first county-wide ban in the United States on raising genetically engineered crops and animals (GMOs) despite significant industry spending to defeat the measure. By year’s end, Marin and Trinity Counties joined Mendocino in enacting their own anti-GMO measures, while three counties—two with agricultural interests—defeated similar measures. In all, more than a dozen of California’s 58 counties either voted on or have proposed such measures. Meanwhile, a pro-GMO resolution was passed in Fresno by that county’s board of supervisors.

Gains by the anti-GMO movement are largely symbolic so far, as the counties where anti-GMO measures have passed are not in the Central Valley, where most of California’s genetically engineered crops are grown. But the county-by-county anti-GMO trend could pave the way for a statewide ballot measure. “We have an opportunity here in California to act in a preventative way, because we don’t have that many GE crops yet,” says Renata Brillinger, director of Californians for GE-Free Agriculture, a group that has advised California counties exploring anti-GMO measures. “It’s a chance for California farmers and citizens to make a decision.”

But others believe the state’s anti-GMO organizers are on the fringe of public opinion. “You’ve got a very strong organic community in California, but it’s not necessarily the majority of voters,” says Greg Graff, a postdoctoral research fellow in agricultural and resource economics. “Should they have the right to ban a particular mode of production within the state?”—Justin Gerdes





“OUR GOAL WAS TO
MAKE A SMALLER
HOME WITHIN THIS
LARGE CAMPUS.”

Living GLOBALLY: 30 Students, One World

For freshmen (l-r) Angelica Kalika, Rachel Lem, and Jennifer Millman, along with about 30 other students, Cal's environmentally themed dorm provides community, close faculty contact, and memories that will last a lifetime.

By Catherine Price

Suk-Ann Yee, a junior majoring in Environmental Science, is an excellent shot. On the wall of her room hangs a poster of a grizzly bear with the outline of a heart-shaped target traced in pink on its chest. It's been punctured by large, rough-edged holes.

“Those are from a shotgun,” Yee giggles, pointing out several additional, less deadly hits.

Yee is the residential program adviser for the Global Environment Theme Program (GETH), a dorm that's both a home and a living classroom for 30 undergraduates. Luckily for the students under her watch, Yee's sharp-shooting skills are getting rusty. The poster is a souvenir from her summer job working for the U.S. Fish and Wildlife Service in Alaska, where she learned to shoot—just in case she had to defend herself from angry animals. The job included banding geese, studying frog deformities to measure water quality, and living in a



field camp with no running water. Now Yee is back at school, where the challenges of living in a tent have been replaced with the responsibility of mentoring underclassmen.

A co-ed dormitory located in the Foothill residence complex just north of campus, GETH was created for students interested in exploring social, economic, and scientific issues of the environment in their daily lives. As in most dorms, students live two or three to a room, share a common living area, and often eat together in the dining hall. But the students here are also a specialized bunch. In 17-year-old Lia Marshall's room, for instance, Bjork and *Fight Club* posters share wall space with a crowd of Sierra Club photographs, and a recycling bin sits prominently next to her desk. After a summer break spent doing environmental work in Costa Rica, she says she's happy to live where "the environment is a unifying theme." In fact, Marshall says GETH "was one of my motivations for coming to Cal." Now she's contemplating a double major in Conservation and Resource Studies and Public Health, and hopes for a career



© Seth Alburnado

“PEOPLE ARE MAKING

says. “Our goal was to make a smaller home within this large campus.” He coordinated logistics with Troy Gilbert at the campus residential services office and a core group of involved CNR faculty (John Battles, Peter Berck, George Chang, Kate O’Neill, and Stephen Welter). The theme house opened in 2003 with 20 residents. That number rose to just over 30 this year, and the GETH advisory board plans to increase the capacity to 44 students next year.

To help make this growing community more cohesive, Suk-Ann Yee recently organized a camping retreat for residents. “I forced everyone to spend the night sleeping in tents,” she says. It seems such efforts are successful—GETH students who decide to move off campus often do so with friends they’ve met through the program. As Yee puts it, “People are making a community on-campus and off.”

Another prime benefit for GETH students is the opportunity to meet and interact with professors outside of the classroom. For instance, every week GETH students gather just down the stairs from their rooms to hear faculty and other guests talk about issues like environmental economics and atmospheric chemistry. Afterwards, teachers and students have dinner together. “It’s nice,” Yee says. “The professors like to know what’s going on in students’ lives.”

For students, the rewards of making such connections are tangible—from getting letters of recommendation to receiving academic advice and occasionally even job leads. Most importantly, residents have an excellent opportunity to build student-mentor relationships. “Allen has been there to listen when I’m upset,” says Yee. “And John has encouraged me to apply for scholarships. I probably wouldn’t have done it without him. I probably would have given up.”



Resident assistant Suk-Ann Yee has been watching out for GETH underclassmen since the program’s inception last year.

that combines environmental work with international relations.

Down the hall, freshman Marcus Gabriel says that “the coolest thing is to find people who have the same passions and interests that I do. It’s great to find people who are even more into recycling than I am.”

GETH is the brainchild of Allen Goldstein, associate professor of biogeochemistry. Goldstein came up with the theme house idea while pondering ways to provide CNR students with an extraordinary undergraduate experience. “We wanted to break down the barriers that often exist between faculty and freshmen,” Goldstein

A COMMUNITY ON-CAMPUS AND OFF.”

Despite all of this, it may be the field trips that do the most to make GETH so extraordinary. On recent excursions, the students visited Point Reyes National Seashore to study fault lines, endangered grasses, and Tule elk restoration; toured the fledgling University of California campus at Merced to survey environmental compliance; and visited the Central Valley to see salmon spawn. John Battles, an associate professor of forest ecology, has even taken students kayaking off of Monterey Bay, in the Elkhorn Slough National Estuarine Research Reserve, to study pesticide runoff.

“Elkhorn Slough is a stunning place with an incredible availability of marine wildlife,” says Battles, who coordinated all of the trip’s logistics, including recruiting experienced guides to make sure that no one went overboard. Students and teachers spent four hours paddling down the slough, where they were approached by curious seals, otters, and pelicans. And of course, there was the kayaking. “By the end of the day we were doing races,” Battles says.

Providing such close, personal experiences with the environment was part of the original vision for the theme house. “We wanted to do something really notable, fun, and different,” Battles says. “As a teacher it’s great because you can point to what you’re studying instead of just showing slides. And it helps keep a balance by doing things that are both fun and informative.”

Out of six residential theme houses at Berkeley, GETH is the only one sponsored by an academic unit. “I think it’s a real testament to CNR’s commitment to undergraduate education and faculty-student interaction,” says Troy Gilbert. “It’s a great example of the kind of things we can do at Berkeley. Despite the fact that

it’s a great research university, many faculty members are truly committed to the quality of the undergraduate experience.” 🚩

—Catherine Price is a freelance journalist and founding editor of Salt Magazine (www.saltmag.net).

Residents of GETH have many opportunities to get their hands wet in the field, from witnessing salmon spawn (above) to accessing study sites by kayak (right).



The Global Environment Theme House receives support from the Berkeley Fund for Natural Resources. In addition, the faculty involved with GETH have used all the discretionary funding they are awarded for teaching freshman and sophomore seminars to maintain GETH activities. To support GETH and other undergraduate programs through the Berkeley Fund for Natural Resources, call Matt Fratus at (510) 643-1041.



All photos: Justin Brashares

UNDER PRESSURE

Overfishing puts a strain on land-based wildlife in Ghana

By Sarah Yang

What does demand in Europe for African seafood have to do with the fate of a wild leopard on the plains of Ghana? According to research published last fall in the journal *Science*, there is a link between the two that is both clear and distressing.

The West African nation of Ghana once had a thriving fishing industry. But, according to the study, dwindling fish stocks due to trawling by foreign fishing fleets have caused an increase in the “bush meat” trade—the illegal hunting of wild game—filling the protein and economic gap in the Ghanaian food chain. Researchers say that declining marine resources for Ghanaians have led to the extinction of almost half the species studied in some wildlife reserves. It is the first study to provide empirical evidence of an association long suspected by many conservation groups.

“This study provides the strongest link yet between a local fish supply with immediate, dramatic effects on bush meat hunting and terrestrial wildlife,” said lead author Justin Brashares, assistant professor of ecosystem sciences. “If people aren’t able to get their protein from fish, they’ll turn elsewhere for food and economic survival. Unfortunately, the impact on wild game resources is not sustainable, and species are literally disappearing from the reserves.”

Conservation groups, fisheries researchers, and African leaders have blamed subsidized foreign fleets for helping to accelerate the downturn in the fish supply. The study notes that the European Union (EU) maintains the largest foreign presence off the coast of West Africa, with EU fish catches increasing twenty-fold from 1950 to 2001, and financial subsidies jumping from \$6 million in 1981 to more than \$350 million in 2001.

“Other studies have shown that EU subsidies artificially increase the profitability for EU ships to fish in African waters,” said Brashares, who began this work as a postdoctoral researcher at the University of Cambridge. “If it weren’t for this financial support, these studies suggest, it wouldn’t be worthwhile for EU fleets to head to West Africa.”

Brashares collaborated with researchers in Africa and from the University of British Columbia in Canada, the Ghana Wildlife Division, and the Wildlife Conservation Society in New York.

He compiled census data recorded by park rangers from 1970 to 1998 for 41 species of larger mammals at six savanna nature reserves in Ghana. These animals included buffalo, antelope, jackals, lions, elephants, monkeys, and baboons. The information was compared with the supply of fish in the region during the same time period, as determined by data from the United Nations Food and Agriculture Organization (FAO).



WITHOUT INTERVENTIONS, THE LAPSE OF RESOURCES COULD RESULT IN WIDESPREAD HUMAN POVERTY AND FOOD INSECURITY.



The researchers found a stunning 76 percent drop in the abundance of the 41 species studied. Some of the smaller reserves saw local extinctions—defined as no recorded sightings for two years—of nearly half of those species.

At the same time, the supply of fish in Ghana ranged from 230,000 to 480,000 tons in a year, and varied by as much as 24 percent between consecutive years.

The researchers found that years with a lower-than-average supply of fish had higher-than-average declines in land-based wildlife abundance. This relationship was seen regardless of other potentially confounding factors, such as weather, political cycles, and oil prices.

They also found that low fish counts were linked to higher hunter counts by park rangers. The higher numbers of hunters seen in the reserves were, not surprisingly, closely related to the increased rate of wildlife decline.

To check the impact on the marketplace, the researchers started surveying sales and price information for bush meat at 12 local markets throughout Ghana in 1999. Over the next four years, they found that the monthly supply of fish in the markets was negatively linked to both the price of fish and the volume of bush meat sold there.

Conservative estimates put the regional bush meat trade at 400,000 tons per year. Brashares noted that the figure is almost certainly an underestimate, since many animals are butchered or smoked by the time they get to market, making them difficult to identify.

Experts say some of Ghana's problems date back to 1982, when the United Nations Convention on the Law of the Sea established economic exclusion zones that entitled countries to exclusive use of all marine resources 200 miles off their shorelines. This meant that Ghanaian fishing boats, which had traditionally fished all along the coast of West Africa, would have to pay other countries for access

to foreign fishing grounds, something the economically struggling country could not afford.

At the same time, Ghana's enforcement of its own exclusion zone is weak, making it difficult to assess the level of illegal fishing by foreign fleets. Many conservation experts say that the fish licensing agreements Ghana and many other African countries have with the European Union and other industrialized nations are tailored to benefit the non-African fleets.

"These agreements are extremely unfair," said Daniel Pauly, professor and director of the Fisheries Centre at the University of British Columbia and one of the world's leading experts on global fisheries. Pauly was not connected to this study.

Pauly and other researchers tell of industrialized nations holding economic and other aid packages to Africa for ransom during negotiations for fishing license agreements. "If you have a very powerful economy negotiating with a weak one, then it's very difficult for weak ones to say no," he said.

As a result, said Pauly, the terms of the agreements are unusually generous to the foreign fleets, typically giving a certain number of boats access to the fishing grounds for a specified period of time, with no limits on the catch. "It's as if someone gave you three shopping carts for a day at a supermarket and told you that you wouldn't need to go through the cashier," he said. "Of course, people wouldn't go to the potatoes; they'd go to the meat department."

It's an issue that one outspoken West African leader, John Atta-Mills, the former vice president of Ghana who recently failed in his bid for the presidency, has brought up in the past. He pointed out in a February 2004 article in *National Resources Forum* that Ghana's fishing sector currently employs about 20 percent of the country's total labor force, but it's rapidly declining.

"Unemployment for fishers has significant social and economic impacts since Ghanaian fishers are generally poorly educated and landless, with few

other options for income generation," wrote Atta-Mills. "Many unemployed fishers have migrated to the cities looking for work that is simply unavailable and have been unable to improve their economic conditions."

Part of the decline could be attributed to overfishing to feed a growing population—a three-fold increase from 6 million in 1957 to nearly 18 million in 1996—as well as habitat degradation. But Atta-Mills specifically cited the intense harvesting of fish by the EU fleet and called for policy reform to minimize the impact of foreign fleets on West African marine resources.

The authors of the paper say that reforming EU policy will not completely resolve the problems of diminishing natural resources in Ghana and other West African nations, but it is a solution that can be enacted quickly.

"Other solutions, such as developing a sustainable regional livestock and agriculture resource, are essential but could take decades to implement," said Brashares. "I don't think we have that time."

The authors said without interventions, the collapse of both aquatic and terrestrial resources would likely result in widespread human poverty and food insecurity in the region.

"At a time when regional protein shortages are evidently impacting not only local people but also driving a region-wide collapse of biodiversity, it seems questionable that foreign governments should be using their taxpayers' money to subsidize the mining of developing countries' fish stocks," said Balmford. "Given the EU's expressed concerns about the bush meat trade, phasing out subsidies to their own fleets offers at least a short-term route to limit the trade while simultaneously enhancing local fishers' livelihoods." 🚩

—Sarah Yang covers science for UC Berkeley's Office of Media Relations.



Joseph Holmes, B.S., Conservation of Natural Resources, '73, has been photographing wild landscapes, mainly in color, for 36 years. A native of Berkeley, Holmes has spent his career "schlepping all over creation" with a 34-pound view camera outfit. He mastered several traditional, chemical printmaking processes, but today says that "mature color photography without computers is simply impossible. The old problems that kept color from working right have been solved!"



Scott Braley

My Story:
Nature photographer **Joseph Holmes**

Interview by Cyril Manning



A friend of mine in high school showed me a copy of *Gentle Wilderness: The Sierra Nevada*. I had never noticed that photographs could be more than just pictures of stuff, but this book proved that they can be works of art. And it happened to be about a thing that had become sacred to me without my having realized it: the Sierra Nevada.

I knew when I saw that book at 16 that photography suited my own particular abilities. I knew that photography could be important and contribute to something that I needed to do, which was to help us figure out how to preserve the planet against our own onslaught.

I sometimes teach photography because I enjoy it and because it took me a long time to figure out how it works. For instance, almost everyone who makes black and white images with film underexposes their negatives substantially. And it takes them years to figure it out, but you can explain it to them in five minutes and save them a lot of time and a lot of wasted pictures. Color management is the part of digital imaging that's the most confusing and complicated. It took me longer to learn it well than it took me to get my undergraduate degree, but I can explain it to somebody a whole lot quicker than that.

The first thing that makes my work unique is the way I see compositions. The more clarity there is in someone's vision and craft as an artist, the more recognizable their work tends to be. For instance, Van Gogh's paintings are really superb, and they all look like he made them. Composition is the most important thing that all of my favorite photographers do. It's the most fundamental. The craft of the rendering is also vital, and takes the most time. The choice of subject matter is big too.

I like to think that there really is just one environmental issue. I call it "excessive human presence"—meaning the sum of all that we have done to change the planet and have already committed to doing in the future. If you think of that as the one problem, then you can stop saying, "It's greed—No, it's the Americans consuming too much coal and oil—No, it's the Bangladeshis being too numerous ..." or whichever of the many angles you prefer to take on it. People can just argue endlessly and pointlessly about the details when really it is just one big problem, with one root—our own success as a species. I call it our ascension toward infinite knowledge—and it's a double-edged sword. We give ourselves power with our technology, but we fail to restrain ourselves in a commensurate way. Many of the processes by which we live are inherently unsustainable at any level.

One day in 1982 I walked into the National Archives in Washington, D.C., because I happened to come out of the wrong Metro station. Let's just say I wouldn't have walked two blocks out of my way to go there, because what are you going to see but a bunch of old documents, right?

But then if you stop and read them it's another matter—because it turns out they're really good. The preamble to the Constitution says, "We the People of the United States, in Order to form a more perfect Union, establish Justice, insure domestic Tranquility, provide for the common defence, promote the general Welfare, and secure the Blessings of Liberty to ourselves and our Posterity, do ordain and establish this Constitution for the United States of America."

How can you secure the blessings of liberty for yourself and your posterity if you use them all up now? It's nonsense. It's unconstitutional for us to destroy our natural resources by failing to live sustainably. I believe that in that preamble's simple wisdom lies the best hope for the future.

When I was 16 I thought, how could I possibly have a career as wonderful as John Lennon's? How could I say things that were important and hope to have a tremendous impact on a huge number of people? I couldn't choose music—I knew I'd do better as a photographer. But it was the same kind of undertaking. To do something that was mine, that I could really believe in, that people would love and that I would love, and that needed to be done.

My undergraduate studies filled in a lot of space that I needed to have filled in. I was pretty certain I would spend my life making photographs, but I wanted to become properly educated before I did that. I think a standard education ought to be a lot more like what I got from the Conservation of Natural Resources major. Everyone should have to take at least an introductory class on the environment and humanity's relationships with it. Even if they're going to business school. *Especially* if they're going to business school.

John Szarkowski wrote a forward to one of Ansel Adams' books, and he quoted Fred Astaire in the movie *Funny Face*, playing a fashion photographer. Audrey Hepburn's character asked him, "Why do you photograph beautiful women?" and he said, "Madam, you'd be amazed at how small the demand is for pictures of trees."

Well, I've made my living largely by selling pictures of trees. But I consider myself equal parts photographer and omnologist. I coined the term omnologist many years ago: one who studies everything. I think Cal ought to have an actual department of omnology. For me, CNR was just that. 🚩

Photos: previous page, Alpenglow, Point Sublime, Grand Canyon, Arizona 1991. This page, top left, Lily pads, Reelfoot Lake, Tennessee 1979; The Blemange, Arizona 2002; Autumn leaves, Acadia National Park, Maine 1985. An online gallery of Holmes' images can be found at www.josephholmes.com.

Class Notes

Sharing your news is now easier than ever! Just use the mailer enclosed in this issue, visit <http://nature.berkeley.edu/notes>, or email your update to breakthroughs@nature.berkeley.edu.

'35

Emanuel Jacobson, B.S., Agriculture, graduated from UCLA (but we think his fond recollection of his time spent at Berkeley certainly merits a class note—*Ed*). He writes: "I arrived in Berkeley for the fall semester in 1931. My first three years in California were equally divided between Berkeley and Davis. In 1934, the department of Subtropical Horticulture was moved to UCLA, where I was one of the first six students to earn a B.S. in agriculture." A retired citrus and avocado grower, he lives in Tel Aviv, Israel.

'41

Grant A. Mitchell, B.S., Forestry, attended the 1939 summer camp. Ten days after graduation he enlisted in the U.S. Army Air Corps and became a senior weather forecaster, and eventually became a master sergeant in charge of the McClellans Field weather station. "Due to a change in events I never went into forestry, although at 87 years of age, I'm still active!"

'53

Julius Menn, B.S., Biology, M.S., Entomology, '54, and Ph.D., Entomology/Toxicology, '58, is currently an international consultant for USDA/FAS, consulting in Vietnam, establishing a pesticide monitoring system in Hanoi. On December 2 colleagues and friends from UC Berkeley, industry, and the USDA honored Julius at Berkeley, where he gave an address reflecting on a career in crop protection chemistry. "A most memorable event."

'58

Jack E. Throop, B.S., Forestry, stays busy consulting for his ex-employer Lockheed Martin and other aerospace companies in the Houston area. "My work is enabled by the University's success in teaching me English composition," he says. "Since most aerospace engineers do not like to write, there is a wealth of consulting work for anyone willing and able to write a coherent sentence." His family life consists mainly of recreation, "enjoying our five grandchildren, and traveling."

'67

Michael G. Volz, B.S., Plant Nutrition, and Ph.D., Soil Science, '72, works for the California Department of Health Services in Richmond as chief of the Office of Laboratory Resource Preparedness and Response, Emergency Operations Center, and as project officer in the All-Hazards Risk Assessment Laboratory.

'68

Ed Holsten, B.S., Forestry, completed a three-year stint in the Peace Corps in Chile after graduation, followed by graduate school at University of Washington, where he wrote a dissertation on Costa Rica. After completing his Ph.D. in 1977, Ed relocated to Alaska. In March, he retired from the Forest Service after 30 years and plans to remain in Alaska fulltime.

'69

Max Copenhagen, B.S., Forestry, continues to work on fuel hazard reduction in the San Bernardino National Forest. "We are almost done with our land management plan revision," he says. "Here is a photo of one of our more aggressive prescribed burns up near Big Bear last year. Biswell would be proud." On a personal note, he reports, "Our three-year-old granddaughter Alaina is wonderful, and we have a new puppy. Glad to hear from you if you have time to send a note: maxcope@verizon.net."



'72

Patricia Hedge, B.S., Conservation of Natural Resources, worked in environmental conservation with several national organizations and was a regional director for the Wilderness Society. Now, she serves as a Peace Corps volunteer in Jamaica in the environmental sector. She sees it as "a great way to give back and an opportunity to prove that this phase of life can also offer great adventures."

'73

Janet Franco, B.S., Genetics, lived in Israel for seven months after graduation and attended the Medical College of Georgia, where she was certified in nuclear medicine technology. She worked in Albuquerque, New Mexico, as a nuclear medicine technologist, then moved to Fort Collins, Colorado, to earn an M.S. in Radiological Physics from Colorado State University. After working as medical physicist in Houston, she moved to Portland to work for the state of Oregon. She joined Oregon Health and Science University (her current employer) in research lab radiation safety, but returned to hospital setting as Clinical Radiation Safety Officer in 1999.

John Hannum, B.S., Forestry, owns his own insurance brokerage in Lafayette, Calif. He has been in business for 29 years and has eight employees.

Harold M. Hoogasian, B.S., Genetics, and his wife Nikki purchased a working coffee farm in 2004, located in Holualoa (Kona), Hawaii. Growing and marketing estate-grown, 100 percent Kona coffee under the trade name "Kona Perfect," Harold now feels like he is living up to his degree from the College of Agricultural Sciences. "In fact," he says, "after classes in coffee husbandry from the University of Hawaii Ag Extension, I know now that coffee is cultivated in soil, not dirt!"

'74

Donald E. Campton, B.S., Genetics, is the regional geneticist for the U.S. Fish and Wildlife Service, Pacific Region. He is stationed in Longview, Wash., and deals with both policy and science issues. "I was part of the first graduating class of CNR in 1974, after the merger of the College of Agriculture and the School of Forestry. Genetics was a small program then. No one imagined that we would be sequencing DNA in our lifetimes. Genetics has become a major issue in fish and wildlife management and conservation biology."

Richard Merritt, Ph.D., Entomology, is currently chair of the Department of Entomology at Michigan State University, East Lansing. He was honored with the MSU Distinguished Professor award in 2004 and has received the MSU College of Natural Science Distinguished Faculty award.

'76

Laura (Jacobs) Barton, B.S., Food, Nutrition and Dietetics, spent several years in the dietetics field, and then became a West Coast sales manager for a French cheese company. For the past 17 years she has been working in domestic and international marketing for the state of Oregon, promoting the state's agricultural products. Her career allows traveling to Mexico, South America, Southeast Asia, Europe, Japan, and Korea, although her current focus is in-state and domestic.

Carol Freedman, B.S., Conservation of Natural Resources, earned an M.A. in Environmental Planning from UCLA in 1978 and went on to do consulting in the design of geographic information systems. She did a "career about-face" in 1994 and now owns and operates her own interior design consulting business.

John Gross, B.S., Conservation of Natural Resources, operates a small business that offers guided river trips fishing for salmon, steelhead, trout, and bass on many rivers throughout western Oregon.



Dennis L. Merritt, Ph.D., Entomology, is finishing his book on Jung and ecopsychology, entitled *The Dairy Farmer's Guide to the Universe: Jung, Hermes, Ecopsychology and Post 9-11*. The book is due out this year.

Nick Sundt, B.S., Conservation and Resource Studies, and M.A., Energy Resources Group, '80, lives in Washington, D.C. During most of the 1980s he worked at the Congressional Office of Technology Assessment and spent summers as a Forest Service smokejumper in the Pacific Northwest. After editing two climate change periodicals during the 1990s, Nick joined the U.S. Global Change Research Program in 2000 and today is responsible for the program's websites and other communications.

'77

Daina Dravnieks Apple, B.S., Political Economy of Natural Resources, and M.A., Geography, '80, currently serves as staff assistant to the U.S. Forest Service deputy chief for programs, legislation, and communication in Washington, DC. In 2002 she was elected a fellow of the Society of American Foresters (SAF), and this year she was appointed to the SAF Forest Science and Technology Board.

Gina Frierman-Hunt, B.S., Conservation of Natural Resources, was appointed to the City of Sierra Madre Planning Commission this summer. Sierra Madre is a small city of about 10,000 people adjacent to Pasadena.

Kathryn McLain, B.S., Conservation of Natural Resources, and her husband had their doctorates conferred last November by Hartford Seminary, and are both in their 18th year as Congregational UCC ministers in the Boston area. "My CNR studies have provided a strong foundation for twining theological questions with pragmatic realities, and for pairing outreach efforts with environmental concerns as a contemporary harmony of science and religion," she says.

David Newman, B.S., Forestry, and his wife Barbara have two children, Katie, 8, and Jenny, 7. "Last summer we did a cross-country trip visiting the western national parks and the previous summer we did a similar trip around the UK." David is a professor of forest resource economics and policy at the University of Georgia. "Forestry education continues to be challenging," he says. "It is difficult to find students who have a burning desire to study forest economics."

'78

Michael Bade, B.S., Conservation and Resource Studies, worked briefly in air quality planning and then went to architecture school at UC Berkeley. After graduation with an M. Arch., he practiced in the U.S. for five years and then moved to Tokyo, where he practiced for 12 years. "I first had the opportunity to design and develop projects with environmental sustainability considerations as formal design criteria in Tokyo," he says. Upon returning to the U.S. in 2000, he joined the UC Office of the President as assistant director of design and construction services, with responsibilities for oversight of new building designs system-wide. Michael was the lead staff member in the development of the University's new Green Building and Clean Energy Policy while at UCOP. He recently became director of capital programs at UC San Francisco, which is in the midst of developing a new research campus at Mission Bay in San Francisco. "UCSF is a very exciting place to be!"

Vishnu-priya Sneller, Ph.D., Parasitology/Medical Entomology, has been with the Centers for Disease Control and Prevention for nine years, and produced the adult immunization schedule that has been adopted by the Department of Health and Human Services. Vishnu-priya also spends time involved with refugee health and complex emergencies, "which is closer to my heart than analyzing databases. I wish I could have continued as a parasitologist or vector-borne disease epidemiologist. I still hold dear my time at Berkeley and miss being with Dr. Reginald H. Dadd (deceased) and Dr. Clarence Weinman, who were my co-thesis directors and mentors par excellence."

Michael Wellborn, B.S., Conservation of Natural Resources, reports runs the Advance Planning section for the County of Orange. In 2004, as president of the Board of Directors of the California Watershed Network, he helped oppose a state Department of Industrial Relations labor interpretation that made community volunteers subject to prevailing wage requirements. "The impacts of this determination undermined restoration, trail maintenance, and community clean-up efforts and brought up serious labor questions.... We engaged with the governor's office and Berkeley Assemblywoman Loni Hancock, who bravely submitted a bill to save community volunteerism. The bill was signed by the governor in August, to the relief of volunteers throughout California."

'79

Vincent Berg, M.S., Range Management, worked for two years at Lawrence Berkeley Laboratory, then for 18 years at PG&E, in jobs that included business planning, forecasting, marketing, and information technology. For the past five years, he has been doing capacity and performance planning for the data network at Charles Schwab.

Cynthia Macedo Feibert, B.S., Biology of Natural Resources, works part time at the Ohio State University Experiment Station. She and her husband met in graduate school at UC Santa Cruz, performed research in tropical ecology in Brazil (where he is from), and now have three daughters.

Margaret Rands, M.S., Conservation of Natural Resources; M.P.P., Goldman School of Public Policy, '81, took advantage of an offer to retire early from her position as manager of the Santa Clara County California Integrated Waste Management Division last July. She subsequently moved to Texas to spend more time with her family, including three grandchildren. "I'm looking for a home to buy, enjoying explorations of the East Texas area, taking opportunities to travel, and considering what I want to do next," she says.

'80

Elicia (Newkirk) Benstein, B.S., Nutrition, Food Science and Dietetics, married in 2000 and now has three stepchildren. Her husband, Harvey, is conductor of the Contra Costa Chamber Orchestra and the Walnut Creek Concert Band (where they met; she plays the flute). Elicia works at Jelly Belly, where she creates new candy products and jelly belly flavors.

Teri Ewell Broadhurst, B.S., Nutrition, Food Science and Dietetics, and M.P.H., Nutrition, writes, "Life is good. Health and wellness of body, mind, and spirit is the key! If you want to find me, piperteri@yahoo.com is the best way."

Meg Gawler, B.S., Conservation of Natural Resources, has been an independent nature conservation and human development consultant for six years. She lives and works in France, near Geneva, Switzerland. Her work focuses mostly on evaluations of conservation projects and programs. "I am doing some exciting work evaluating UNICEF's work in Central and Eastern Europe and the former Soviet Republics," she reports. In 2004, various missions took Meg to Mali, Thailand, Spain, Belarus, Georgia, FYRO Macedonia, Albania, and Tanzania. "My family now boasts four delightful granddaughters, and fun includes training a young and lively Lusitano horse."

'81

Heidi (Stettler) Hagler, B.S., Nutrition, Food Science and Dietetics, received an M.S. in Nutrition from the University of London and has been married and lived in Belmont, Calif., for 16 years. She has a 13-year-old son and a nine-year-old daughter. "I've worked for the same company for 15 years. I've been on the same masters swim team for 10 years. But the new form of recreation I took up only two years ago qualifies as news: full-contact kung fu! And yes, I really am too old, but it is so much fun!"

Dale Morris, B.S., Forestry, is a regional natural resources officer at the Bureau of Indian Affairs, Pacific Regional Office, in Sacramento.

'82

Janet M. Pang, B.S., Nutrition and Food Science, has been in food product development since graduation, and has primarily worked with natural and organic foods. She is currently working for California Natural Products in Lathrop, Calif. She was a guest speaker in Professor Benito De Lumen's Nutritional Science 106 class in 2003 and 2004. She is happily married to Stanley Liu. "We both attended and graduated from Oakland High School in 1978, but we didn't meet until a friend introduced us in 1999."

'83

Steven M. Carr, Ph.D., Genetics, is currently professor of biology at the Memorial University of Newfoundland, and was recently cross-appointed to the Faculty of Medicine as professor of genetics. His research (see www.mun.ca/biology/scarr/Research.html) focuses on population genomics of vertebrate species, with special interest in endangered marine species (seals, cod, and wolfish) and the founding human population of Newfoundland—the oldest colony in North America. Steve teaches courses in genetics, evolution, and biotechnology, and was named one of MUN's best teachers by the 2004 McLean's annual review of Canadian universities. He married Justyna Ciszewska in December 2002. They have enjoyed travel to Russia, Poland, and California. They live in the historic downtown area of St. John's, North America's oldest city.

Vijaya Nagarajan, B.S., Political Economy of Natural Resources, is finishing up a book on women's ritual art and ecology, *Drawing Down Desires: Women, Ritual and Ecology in India*. She married in 1991 and now is a mother of twin four-year-old girls. She finished her Ph.D. in 1998 at Berkeley in South Asian Studies, emphasizing anthropology, Tamil literature, and art history. She was at Harvard on the Women's Studies in Religion fellowship from 2001-2002, recently attained tenure in the Department of Religious Studies at University of San Francisco, and teaches in USF's Environmental Studies program. Vijaya "I have a lot to be grateful for," she says. "I am also looking for a couple of old friends from those days whom I lost touch with."

David Stanley (Samuelso), Ph.D., Entomology, has made a career transition after 16 years at the University of Nebraska. He is now the research leader and supervisory research entomologist at the Biological Control of Insects Research Laboratory, USDA/ARS, in Columbia, Missouri.

'84

Donald A. Friend, B.S., Conservation of Natural Resources, received a Fulbright Scholarship for sabbatical leave to the Institut für Geographie at Friedrich-Alexander Universität, Erlangen, Germany during the 2004-2005 school year. There, he is finishing a text on mountain peoples and environments, to be published by University of California Press. Upon returning to the U.S. he will serve as chair of the geography department at Minnesota State University.

David T. Leung, B.S., Political Economy of Natural Resources, moved to Shanghai, China, with his family in 1997. They now live in Beijing. He reports: "It is wonderful being able to experience firsthand the explosive growth of the Chinese economy and see how millions of lives are being changed (mostly for the better, but a few are being left behind)." David now works for a company that manufactures and markets biopharmaceutical products and herbal medicine. "I only regret that I dozed off when my professors explained how DNA works."

Evan Read, B.S., Genetics, has been working as a scientific illustrator at the Population Council for over 10 years. He moved to New York City in 1991 to earn an M.F.A. in painting, and now has a painting studio. His work uses strong color with pattern and simple shapes to treat a range of subjects, from science to pop culture. He is married and has a five-year-old daughter.

'85

Michael Green, B.S., Conservation and Resource Studies, has been the director of the nonprofit Center for Environmental Health for the past eight years. Focused on the intersection of public health and the environment, the center works to prevent pollution that can make people sick, and advocates for alternatives to toxic chemicals. Michael is proud of the center's many major victories. Last summer, they helped prompt the largest product recall in U.S. history: 150 million pieces of children's jewelry were pulled from gumball machines nationwide to protect children from potential lead poisoning. "I would love to hear from CNR grads who are interested in human health and the environment," he says. His email is mgreen@cehca.org.



Ken Raust, M.For., Forestry, moved to Colorado 19 years ago. "While my profession turned out to be something completely different than natural resources, I still enjoy the outdoors. I have a place in Silverthorne, Colorado, and spend a lot of time outdoors skiing, hiking, and playing golf. Oddly enough, my forestry education prepared me well for the business world. Both involve thinking and planning for longterm growth!"

Michael Simsik, B.S., Forestry, completed a doctorate in education at the University of Massachusetts-Amherst in May 2003. He is now program leader for the Urban Food System at the Cornell Cooperative Extension office in New York City.

'86

Eric Minzenberg, B.S., Forestry, served in the Peace Corps in Ecuador from 1995 to 1997, and completed his M.A. in Latin American studies at San Diego State University in 2000. He is currently at the University of Florida, writing a Ph.D. dissertation dealing with peasants and hunting in the Brazilian Amazon.

'87

Rica Kuno Matsumura, B.S., Genetics, established a TV game company in Japan last year and is looking forward to hearing from friends who are working in the industry. Her email is rica@kc4.so-net.ne.jp.

'88

Jeri Berc, Ph.D., Soil Science, will be joining the policy staff at the EPA Office of Water in Washington, D.C. She has been working on international environmental and sustainable development issues and representing the USDA in various U.N. treaty meetings, including climate change, biodiversity, and desertification.



Rob Lilieholm, Ph.D., Wildland Resource Science, has become increasingly involved in a new bioregional planning program at Utah State University, where he keeps busy forecasting future landscape-level urbanization patterns and their impact on wildlands. Rob and his wife are both currently on sabbatical from USU. He reports that, "Somewhere along the way, we've acquired two dependents (Jennifer is 12 and Tommy is 8)."

Sandra Rosenblum, B.S., Conservation and Resource Studies, returned to Berkeley to earn her M.P.H. degree after a five-year stint as a certified nurse midwife. She is currently working as the maternal, child, and adolescent health director for Marin County. "Because I take my job so seriously, last June my husband Peter and I welcomed our own first child, Nathaniel Kurt," she says.

'89

James L. J. Houpis, Ph.D., Wildland Resource Science, is dean of the College of Natural Sciences at California State University, Chico. In the past year under his leadership, the college established a new environmental literacy program, expanded its ecological and environmental research, added a new degree option in applied ecology, and are in the process of establishing the Center for Ecology and Environmental Sciences.

Chris Nelson, B.S., Conservation and Resource Studies, was married in 1999 and is the father of two young boys, Kyle and Liam. Chris has been working on remediation of the Presidio of San Francisco for more than five years.

Andrew M. Streiber, B.S., Political Economy of Natural Resources, left the Los Angeles music industry in 1998, after almost 10 years. In 1999, he started working on prerequisites for veterinary school, and he is now in his third year at the Kansas State University College of Veterinary Medicine. He will graduate as a Doctor of Veterinary Medicine in May 2006. "I hope to return to Southern California as an intern in surgery and critical care for a year and then go into small animal private practice in general medicine," he says.

'90

Lea (Hutchinson) Murry, B.S., Nutrition and Food Science; M.P.H., Public Health Nutrition, '92, is the president and founder of Certified Trainers, Inc., a small company in Oakland. She and her staff provide educational and first aid/CPR training to staff and administrators of nonmedical residential care facilities. Lea is married to Benjamin Murray, has two children (Camren, 8, and Travis, 3). They plan to move to Miami, Fla., this summer to establish her company there.

'91

Robyn Myers, M.S., Landscape and Systems Ecology, works on the NRCS Watershed Planning Services Staff in Davis, Calif. In her off time at home in American Canyon (Napa County), Robyn and her husband Brad (a park ranger with the East Bay Regional Park District) are breeder-caretakers for Korina, a black lab/golden retriever mix whose puppies are raised to become canine companions for people with disabilities. Information and photos are available at <http://ice.ucdavis.edu/~robbyn/Korina>. Information on service dogs is available at www.cci.org.

Joshua Polston, B.S., Political Economy of Natural Resources, and M.A., Urban Planning, '98, recently began working for MuniFinancial as a senior project manager, assisting cities and counties with financial planning and programming. He had his second child, Bayla, in October.



'93

Jon Chorover, Ph.D., Soil Science, moved from a faculty position at Penn State to the University of Arizona in 2001. "I could not pass up the opportunity to get back out West," he says. Now an associate professor of environmental chemistry specializing in soil and water systems, Jon says he is enjoying the beautiful Sonoran Desert.

Simon Kingston, B.S., Forest Management, married Lisa Conner in 1995 and worked for Weyerhaeuser Company in Washington state from 1995 to 1999. Since 2000 he has worked for Colorado State University as a National Park Service Cooperator and as a desktop application developer for the National Park Service's NPSpecies database, which documents the occurrence of organisms in the National Parks. See <http://science.nature.nps.gov/im/apps/npspp> for more information.

Laurel Treviño Murphy, M.S., Wildland Resource Sciences, is building an eco-house with photovoltaic and rainwater collection systems, appropriate architecture, super efficient appliances, and a greenhouse for native plants and bonsai. She is becoming a land steward of 10 acres in the Texas Hill Country with a vegetation of oak savanna and cedar elms. She is thinning excess "cedar" (*Juniperus ashei*), re-introducing native grasses and wildflowers, and cultivating native trees and shrubs including oaks, yaupon holly, deciduous holly, Texas persimmon, and many more. Her husband, Carlos Torres-Verdín, received his Ph.D. at Berkeley and is a professor at the University of Texas at Austin. They are confident in their long-term plan for the eco-house, and have received prizes for their water-wise native plant landscape.

Evan R. Sorem, B.S., Political Economy of Natural Resources, is married and is expecting a second child this spring. "We are very excited about adding to our family," he writes. "The most excited person is this child's big brother, Andrew. He can't wait."



Jennifer K. Vallina, B.S., Political Economy of Natural Resources, recently purchased a house in Silver Spring, Md. Her baby is due July 4.

'94

Rebecca Drummond, B.S., Conservation and Resource Studies, was an English teacher in Ecuador for three years, and then returned to southern New Mexico to teach adult basic education and ESL in border communities. She recently received an M.A. in Geography and Regional Development at the University of Arizona and has spent the past four years working with Mexican-American families with diabetes, as well as health workers. She developed a family-based diabetes curriculum that received a Health Education Multi-Media Yearly Award from the Arizona Public Health Association. She is currently a program evaluator for a CDC initiative that focuses on asthma, diabetes, and obesity in rural communities along the Arizona-Mexico border.

Holly (Elizabeth) Glenn Carter, B.S., Bioresource Sciences, graduated from the Royal Veterinary College in London in 2000 and is currently working on a certificate in exotic and zoo animal medicine. She works as a small animal vet and is married to an Englishman named Daniel Carter. Their first child was born in April 2004.



Amit Batabyal, Ph.D., Agricultural and Resource Economics, is the Arthur J. Gosnell Professor of Economics at the Rochester Institute of Technology in Rochester, New York. Academic research and upper division undergraduate teaching are his two primary duties.

'95

Dan Oppenheimer, Ph.D., Entomology, works at at Biomarin Pharmaceuticals, where he was recently promoted to program leader, PKU director, and program manager.

'97

Kerry Eastman (Stendell), B.S., Conservation and Resource Studies, was married in 2002 to Eric Stendell (Bioresource Sciences '96). They are expecting their first child this spring.



'98

Andrew Hoppin, M.S., Wildland Resource Science, aims to transform domestic politics by empowering grassroots organizations and campaigns through technology tools. "See www.civicspacelabs.org and www.trellon.com for organizations I'm currently working with."

Elissa Meites, B.S., Bioresource Sciences, earned an M.P.H. in Public Health Policy and Management in 2004. She will finish her M.D. at Stanford in 2005 and is looking forward to beginning her residency in family medicine.

'00

Kate Phillips-Barrasso, B.S., Conservation and Resource Studies, is completing an M.A. in International Development Studies, focusing on natural resources and development. She married Giulio Barrasso, who she met while teaching English in Italy, in May of last year.



'02

Amy M. Ling, B.S., Conservation and Resource Studies, is in her second year at Harvard Law School, working to develop and promote an environmental law curriculum. She is an article editor on the *Harvard Environmental Law Review* and the speakers/education chairperson of the Harvard Environmental Law Society. Amy spent last summer working in the Environmental Protection Division of the Massachusetts attorney general's office, working on national regulations. "I'm also a tour guide for the admissions office," she says. "So anyone from CNR who would like to talk about Harvard or law school generally, feel free to contact me." Her email is aling@law.harvard.edu.

Monica L. Morrill, B.S., Environmental Economics and Policy, has been living in Europe since graduation. She received an M.A. in International Relations through the University of Paris, XI, worked with an investigative journalist on a bestselling book on counterterrorism, and currently works in the European Parliament. Monica recently started a Ph.D. program at the University of Cambridge in Economic Geography, investigating the economic and political impacts of parallel importation and arbitrage within the European Union. "I miss the University Library and the Morrison Room at Berkeley, and I miss sitting on the grass in front of Gianinni," she says. "The people and the place made my academic experience a source of encouragement to contribute to environmental, economic, and political solutions."

Jonathan Shu, B.S., Environmental Economics Policy, is expecting a baby in September.

Scott Turner, Ph.D., Nutritional Sciences, has had two children since graduating. Lola is 2 years old and Dutch is 4 months.

Matt Wacker, M.S., Environmental Science, works for a nonprofit organization that owns or manages nearly 50,000 acres of habitat for threatened and endangered species throughout California. He is responsible for biological monitoring and surveying, noxious weed control, livestock grazing, prescribed burning, grassland and riparian restoration, and public education and outreach within four preserves (two in Solano County and two in Butte County). He works on a variety of special projects throughout California involving the management of vernal pools, grasslands, and oak woodlands. He recently moved to Orangevale, CA with his wife Marcy and son Jackson, and is converting a portion of their property to a small nursery devoted to California native grasses.

'03

Rachel Grande, B.S., Nutritional Sciences and Toxicology, is currently in her second year at UCSF School of Pharmacy and plans to specialize in pharmaceutical sciences.

'04

Audrey Krompholz, B.S., Environmental Science, is an environmental consultant at Professional Service Industries, Inc. She has become an EPA-accredited California site surveillance technician and has started project manager training. "Seventy-five percent of my company's recent hires are new Cal graduates," she reports. "It makes the office workplace lively and fun!"

2004 Hilgard Society

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DONOR SPOTLIGHT: Russell and Corinne Rustici

Siblings Russell and Corinne Rustici were both born and raised in San Francisco, and both attended UC Berkeley—Russ at the College of Engineering, where he graduated in 1948, and Corinne in the food, nutrition, and dietetics program at the College of Agriculture (forebear of the College of Natural Resources), graduating in 1946.

After attending Cal, Russ was a highway engineer and then ran the family produce business and invested in real estate. He eventually purchased a cattle ranch in Lake County, Calif., and today says ranching is what has made him the happiest in life. Corinne became a registered dietician after graduating. She worked for several health and human service organizations throughout the Bay Area and had her own private practice for many years.

Although their lives have taken very different paths, supporting the programs of the College of Natural Resources has had great personal meaning for both Russ

and Corinne. Over the past three years, Corinne's estate has committed over \$4.2 million to the department of Nutritional Sciences and Toxicology, funding an endowment dedicated to advancing human nutrition through applied research, teaching, and outreach.

In December, Russ gave \$1 million to the College to create the Russell Rustici Chair in Rangeland Management. This endowed chair will support a faculty member of the highest caliber in focusing on the productive use of rangelands to help promote the sustainability of the domestic livestock industry.

Russ explains the motivation for his and Corinne's generosity in simple terms: "We've always been great believers in education. It's deeply satisfying to know we are accomplishing something good."

—Kathryn Moriarty Baldwin

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- Sign up for @Cal, the online community where you can reconnect with old classmates, network with other alumni, and keep up with College news and events. To register, visit <http://naturealum.berkeley.edu>.
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Volunteer

- Do you have some great ideas about how to create a vibrant CNR alumni community? Become a founding member of the new CNR Alumni Association by joining its steering committee. Call Matt Fratus at (510) 643-1041 or email fratus@nature.berkeley.edu.
- Spend just a few hours recruiting prospective undergraduates for the College of Natural Resources. Represent CNR—and your profession—by speaking at your high school alma mater or to college-bound teenagers in your community. To share your experiences with students who might be interested in any of our nine majors, contact Monica Lin at linm@nature.berkeley.edu or (510) 643-4647.
- Offer a summer or school-year internship at your organization to a bright CNR undergraduate. You can post an announcement to 1,000 student subscribers by sending email to cnr_newsline@berkeley.edu. Or, to add a listing to an extensive internship and job database just for Cal students, contact career counselor Susan Kishi at kishi@berkeley.edu.

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Even as state and federal funding for higher education declines, CNR remains committed to providing access to unparalleled learning experiences for all of its undergraduates and graduate students.

- To learn more about supporting our distinguished faculty, our research programs, or our graduate and undergraduate students, call Kathryn Moriarty Baldwin at (510) 643-6641.
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