Jasper Ridge Biological Preserve

Annual Report 2006–07

STANFORD

School of Humanities and Sciences

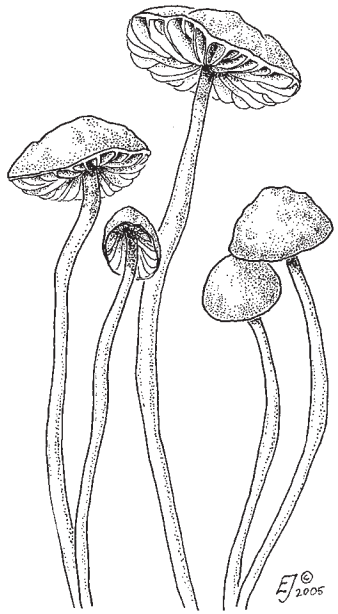
The mission of Jasper Ridge Biological Preserve is to contribute to the understanding of the Earth's natural systems through research, education, and protection of the preserve's resources.

Contents

From the Faculty Director

Chris Field

The awarding of the 2007 Nobel Peace Prize to the Intergovernmental Panel on Climate Change (IPCC) and to Al Gore strongly affirms that science really can make a difference. For many years, the scientific community has been uncovering stronger and stronger evidence that human actions are changing the climate and that we are headed for what former Vice President Gore calls a "planetary emergency."



Despite an international treaty and years of negotiation, the world has not made much progress on climate change. In 2006, global emissions of carbon dioxide were 35% higher than in 1990. But the situation is beginning to change dramatically. Many cities and states, including California, have enacted strong climate legislation. A wide range of private companies has made sustainability a core feature of their business strategy. And green is the new catchphrase for everything from consumer products to executive training programs. I think the Nobel Committee got it exactly right in recognizing that this dramatic, hopefully world-altering, change would not be possible without the combination of impeccably strong science and passionate public leadership. The IPCC is providing the first and Al Gore is providing the second.

High-quality research, like that conducted at Jasper Ridge, is the foundation for the success of the IPCC. Jasper Ridge is, at its core, about scientific discovery. The three focal points of the preserve's mission—

Chris Field and members of the Field Studies in Earth Systems class setting up an eddy covariance system for measuring carbon exchange and water loss by the grassland.

research, education, and conservation—all support discovery either directly or indirectly. Of course, the mission of Jasper Ridge also goes beyond nurturing new discovery, especially in the direction of educating both students and the public about why scientific discovery is important and how it can be used, and in the direction of insuring that the opportunity for new discovery is sustained into the future. Work from Jasper Ridge, and from hundreds of other field stations and thousands of laboratories, is the foundation on which the reports of the IPCC are built.

Nobel Prizes in the sciences typically reward a single discovery, something like elucidating the structure of DNA. But this year's Nobel Prize for Peace differs from this model in two important ways. First, by citing the work of the IPCC rather than an individual, it recognizes that understanding the challenge of climate change has required the work of many individuals and that assembling their individual discoveries into a comprehensive assessment is an enormously important scientific task. Second, by citing Gore, the Nobel Committee recognizes that progress on the climate problem requires public attention and action beyond that motivated simply by the scientific breakthroughs.

The scientists who work at Jasper Ridge generally pursue their investigations for two main reasons. The first is that they find the scientific problems deeply fascinating and the process of discovery richly rewarding. But second, they are motivated by a strong conviction that their discoveries can make the world a better place. Typically, a scientist gets lots of feedback on the first criterion and very little on the second. I view this year's Nobel Peace Prize as a big thank you to the community of scientists working on the climate problem, confirming that all of the hard work really does make a difference. I consider it a privilege to add my personal thanks.

Jasper Ridge continues to serve as a foundation for new discoveries. Two major initiatives now underway hold promise for increasing the attractiveness of the preserve as a site for basic research. One of the most important of these is a facilities master planning effort, led by Philippe. The master planning effort is a road map to the future. It takes a broad overview of future challenges and opportunities, and it addresses those in the context of the preserve's strong commitment to small footprint, sustainable solutions. Another effort, now nearing completion, is intended to enable research by synthesizing available information. This state of the preserve assessment, assembled under Nona's leadership, will give researchers an efficient overview of past research, facilitating studies that track changes over time, that depend on large databases, and that need to be interpreted in a site-specific context.

The Jasper Ridge mission extends beyond research. The Jasper Ridge advisory committee, the staff, and I are looking at a series of initiatives for upgrading the ability of the preserve to be even more effective in its education and conservation activities. Under Cindy, the education program continues to energize new groups of students. We are looking at a range of options for further broadening opportunities for students at all levels to be involved with Jasper Ridge.

Part of the reason Jasper Ridge is a great place to work is that it combines rich ecosystems with a terrific location. Another part of the reason is that researchers can build on a legacy of historical information. A third factor making Jasper Ridge a great place to work is that the people who support it make things go smoothly and efficiently. This year, we bid farewell to Leonard Robinson, who has contributed so much to the success of Jasper Ridge, over so many years. Thanks, Leonard, for everything. To docents, staff, and researchers, thanks for a great year!

Management and Operations

Philippe S. Cohen

In April 2007, Jasper Ridge Biological Preserve participated in Stanford's Community Day. For the first time, this participation involved bringing visitors to the preserve. The university arranged for the Marguerite shuttle service to bring people to learn about 21 projects at the preserve; in all about 500 visitors came. The entire event proved to be a powerful reminder of just how excited the public can become about the program activities at the preserve and of how much researchers, docents, and staff enjoy interacting with that public. It is our intention to continue our involvement with this event, which occurs every other year. Not only is it a useful means for exposing the public to the important research and educational activities that take place at the preserve, but it also gives us a chance to refine our skills at sharing our enthusiasm for our work and communicating why it is so meaningful.

Many Community Day visitors were amazed to learn of Stanford's remarkable and unabated commitment to the preserve and the lands it comprises. The university's commitment to both the protection of the preserve's natural heritage and to its research and educational productivity was made particularly visible by the efforts in the last year to develop a facilities master plan as called for by the strategic plan. This effort has special meaning for me because it bears directly on a question that has been of great interest to me throughout my twenty-plus years of biological field station management: why are some field stations more successful and consistently productive than others? Over those years, I've visited dozens of biological field stations and interacted with numerous colleagues. It has been striking just how similar the circumstances are that conspire to undermine long-term productivity at field stations. Initially, there is a downturn in the local/regional economy of the field station's sponsoring institution; this usually leads to funding cuts, or funding that doesn't keep pace with inflationary pressures, or the transfer of responsibilities to the field station that previously were covered by the sponsoring institution. Most often, these changes target the infrastructure budget and, if severe enough, staffing levels. Finally, it is the loss of infrastructure support that most commonly rings the death knell for long-term productivity. The fiscal pressure of maintaining facilities, utilities, equipment, databases, roads, and trails becomes so onerous that it compromises the functional integrity of the field station and productivity goes down. Once that happens, the sponsoring institution begins to question the real value of the field station, creating a vicious cycle that is difficult to break once it has begun. For many involved in field station management, this scenario is counter-intuitive because we most often think that the real determinants of research and educational productivity are factors such as land size, habitat diversity, travel time to campus, and other logistical challenges. But in fact, both the National Science Foundation and the University of California have found that quality of academic facilities is the most consistent predictor of long-term educational and research productivity.

Looking northeast at the photovoltaic panels on the roof of the Leslie Shao-Ming Sun Field Station. These panels convert sunlight into electricity, providing most of the energy consumed by the building and helping minimize the building's environmental footprint.

Over the years, as I became more attuned to the importance that infrastruc-

1. Philippe Cohen providing a tour of the sustainability features of the Sun Field Station to a class from Woodside High School.

2. Docent Bob Dodge showing Community Day visitors some of the tools, artifacts, and natural resources utilized by early human inhabitants of the Jasper Ridge area prior to the arrival of the Spanish in the 1700s.

3. Professor David Freyberg atop Searsville dam, speaking to Community Day visitors about the influence of watershed processes on the reservoir and the management challenges they present.

ture plays in the success of biological field stations, I also started to appreciate how sustainable infrastructure and practices need to be a core element of a field station if it is to successfully weather the vagaries of budgetary swings. As a field station manager, sustainable practices not only means "green practices," but strategies that minimize demands on field station fiscal resources while also providing essential support services for the core missions of research, education, and conservation of natural resources. Therefore I was delighted that the strategic plan made sustainability one of the core goals of the preserve: "The infrastructure at JRBP can also support the preserve's mission through demonstrating a commitment to sustainability and resource protection." The past year has focused on developing a facilities master plan that puts into operation the goals outlined in the strategic plan, helping ensure the long-term research and educational productivity of the preserve, and further integrating research, education, and management while also minimizing the ecological footprint of human activity. This effort will also further reinforce the preserve's commitment to sustainability and resource protection with buildings, roads, trails, monitoring, data resources, and other infrastructure that is high in quality but low in environmental impact. Working with Nona Chiariello (JRBP research coordinator) and representatives from the office of the Dean of Humanities and Sciences at Stanford (Karen Nagy, executive dean and Don Intersimone, facilities manager), it is my hope that a plan can be completed and implementation begin in the coming year.

The master plan will span the full suite of operations and facilities needed to support implementation of the strategic plan. The topics addressed by the master plan include: minimizing our ecological footprint without compromising the future success of program activities; determining which structures and how many are needed to ensure that the preserve can meet the functional requirements for fulfilling its mission; upgrading telecommunications and developing a wireless backbone that can support remote sensor networks that enhance research and educational opportunities; maintaining the road, trail, and fencing infrastructure of the preserve; and identifying further strategies to enhance fire management. We are even looking at ways to extend shuttle service from campus in order to reduce student and researcher dependence upon vehicles for accessing the preserve. At the same time, Nona has been coordinating researchers on a state

Hikers cross Searsville dam while "Walking the Farm" with professor David Kennedy. This 23.5-mile perimeter hike of Stanford lands was sponsored by The Bill Lane Center for the Study of the North American West, which Kennedy codirects.[1]

4. *Dittrichia graveolens*, a recent invasive species to the preserve, produces numerous seeds that are easily dispersed by wind.

5. Cary Tronson and Brooke Fabricant covering an outbreak of *Dittrichia graveolens* with landscape tarp to prevent seed spread. The site is on property immediately adjacent to Jasper Ridge; we were able to control this outbreak thanks to the cooperation of the landowner.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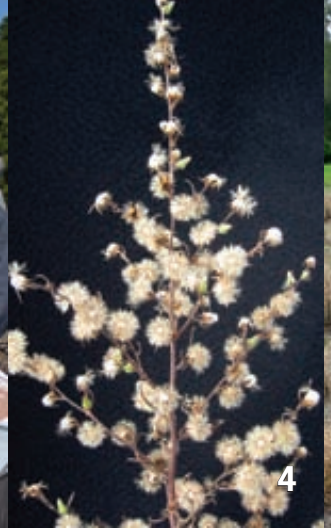
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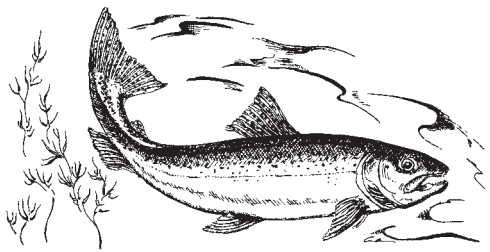
of the preserve assessment that will establish important baselines and identify trends in the preserve's natural and cultural resources. This information will help inform future research as well as current and future management challenges.

In addition to this master planning effort, there has been increased focus on developing a more detailed set of goals and criteria for the future of Searsville Lake. I have been working with professor David Freyberg and the Jasper Ridge advisory committee to substantially update and articulate the preferred options for the reservoir and to integrate those options with the needs and priorities of the university.

Finally, I want to describe an event this past year that hints at how management and outreach by the preserve will be shaped in the future. Recently, an invasive plant, *Dittrichia graveolens* (stinkweed), has invaded in discrete parts of the preserve. We have actively tried to control this species. However, we recently noticed that in a nearby property there was a large outbreak of the plant that was threatening substantial seed dispersal onto the preserve. I contacted the landowner and received permission to cover the area of concern with landscape cloth in order to prevent seed dispersal since the plant had already gone to seed. This marked the first instance of which I am aware that the preserve actively engaged neighbors in a cooperative land management activity in order to protect the long-term integrity of Jasper Ridge habitats. This type of outreach may be at the core of successfully managing preserve lands in the future—outreach that forges alliances with neighbors and organizations by finding common ground and shared values.

The preserve continues to work on the future of Searsville Lake, which is rapidly silting in. This will be a major challenge for the preserve in the coming years. Taken from the old Searsville lab, this early-winter view looks east toward the chaparral-covered slopes across the reservoir.



Leonard Robinson

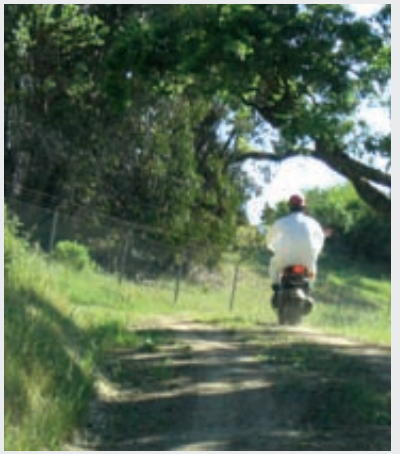
Four Decades at Jasper Ridge

Resident caretaker Leonard Robinson's dedication to Jasper Ridge spans four decades. He has contributed to every aspect of the preserve, from maintaining roads and water lines to inventing clever fixes for all manner of sticky operational challenges. He has helped graduate students in the field, kept directors from making foolish mistakes, scavenged materials when we desperately needed them, and graced the community with a generosity of spirit that will not be forgotten.

For most of us familiar with Leonard's unwavering devotion and commitment to Jasper Ridge, we have come to realize that he has been one of our most reliable safety nets. When something went wrong—flooding, trail erosion, a leaking roof, a vehicle stuck someplace, a student needing soil moved—whatever the problem, Leonard could always be counted on to either solve it or provide that one extra bit of assistance that kept the situation from creeping toward disaster. Many of us can recount instances too numerous to list in which he kept us from making mistakes or devised a way to get things done that saved us all time, money, injury, and embarrassment.

Jasper Ridge would not be what it is today without Leonard's contributions. Collectively, we say thank you for all you have done for us. We will miss you!

LEONARD'S
BRIDGE



Bill Love Anderegg, a senior in Human Biology, during an early-morning bird census for his honor's thesis research.

Research and Monitoring

Nona Chiariello

New directions in environmental research became increasingly evident at Jasper Ridge this year. Several studies applied technologies that have not been used previously in the preserve, providing new kinds of baseline information and the potential for groundbreaking research. Other studies repeated observations from decades ago, revealing changes in important resources. Long-term studies not only extended the time frame of their analyses but also branched out into companion experiments. Research on species of concern moved towards applying the results of basic research to experimental strategies for improved conservation. These new efforts broaden our ability to detect, understand, and respond to environmental change.

The year provided strong reminders of the value of long-term monitoring. The 2006–07 growing season was our driest in 17 years, with less than half the precipitation of the two preceding years. In addition we had an unusually hard freeze in early January. Both the cold snap and the drought made possible some unexpected and significant findings.

Monitoring studies also detected some new species. The herbarium volunteers discovered a single individual of a very invasive species, slender false brome (*Brachypodium sylvaticum*), as well as one young sapling of tanoak (*Lithocarpus densiflorus*), a native species thought to have disappeared during the logging era. In photos from the camera trap study by professor Rodolfo Dirzo's lab, master's student Eric Abelson identified an Audubon cottontail (*Sylvilagus audubonii*). It looks very similar to the brush rabbit (*S. bachmani*), the only *Sylvilagus* species recorded in previous surveys.

In total, 47 scientists, 49 students, and more than 50 volunteers and technical staff participated in 68 studies this year (appendix 1). One master's and three doctoral students completed their degrees (profiled on pages 20–21). In 2006 and 2007, 31 dissertations and papers were published or accepted for publication (appendix 2). Also, ten chapters were submitted for our state of the preserve assessment.

The following discussion provides a glimpse of our activities this year. More information is available on the Jasper Ridge website.[2]

New Environmental Surveys

In August, research began on an application of aircraft-based, high-resolution mapping technology. The Carnegie Airborne Observatory,[3] directed by Greg Asner, conducted small-footprint light detection and ranging (LiDAR) simultaneously with hyperspectral imaging by NASA's Advanced Visible Infrared Imaging Spectrometer (AVIRIS).

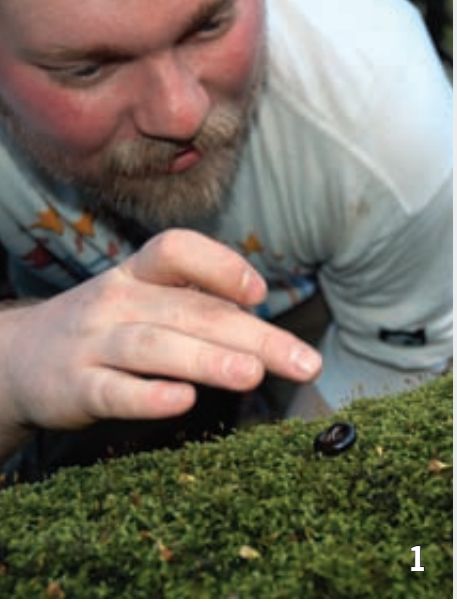
Rapid progress in this combined technology is reshaping the way earth scientists think about environmental monitoring. Conventional LiDAR improved environmental mapping by providing high resolution information on two elevation layers—the ground and the top of the plant canopy (see example on page 15). Now, there are ways to see what's between these surfaces. Advanced LiDAR reveals structural information about the plant canopy, while spectral imaging reveals biochemical signatures relating to functional aspects of vegetation. Together they can be used to produce high resolution maps of foliar chemistry, phenology, and invasives.

The combination of LiDAR and AVIRIS is a prototype for NEON,[4] the National Ecological Observatory Network, which is going to develop an airborne observatory using these technologies. NEON is one of several national programs in the earth sciences for meeting the data needs of increasingly sophisticated and fine-scaled models of global climate and the biosphere. The Jasper Ridge study also contributes to prototyping data retrieval and processing. This work is funded by a grant from the National Science Foundation to Michael Gertz of UC Davis for cyber-infrastructure that supports NEON. Susan Ustin, a coinvestigator, is also using the new AVIRIS data for her ongoing work on remote sensing of water uptake in coastal ecosystems.

Another new mapping project looks back in time and beneath the soil surface. Carol Prentice of the US Geological Survey (USGS) started a study to unearth, literally, the history of earthquakes along the segment of the San Andreas Fault that intersects JRBP. Prehistoric earthquake chronologies are known along many stretches of the San Andreas, but for the San Francisco peninsula, earthquake history essentially begins in 1906. The prehistoric earthquake record can help predict the probability of future quakes.

At Jasper Ridge, the San Andreas is overtopped by wetland areas that accumulate sediment. In such areas a rupture along the fault displaces sediments, and then further sedimentation buries the evidence. Over successive earthquakes, a layering of discontinuities develops. Carol explains that in these areas a deep trench perpendicular to the fault "allows the geologist to 'read' the history of large earthquakes preserved in the sedimentary record."

To precisely locate the fault within JRBP, a team of geologists placed a line of geophones in the



1. Postdoctoral researcher Kevin Pitz examining a millipede, *Tylobolus deses* (order Spirobolida), for studies that will constitute the first phylogenetic revision at the ordinal level ever undertaken within millipedes.

2. Doctoral student May Chui measuring the water level at one of fifteen cased wells installed in the wetland by professor David Freyberg's lab for studying groundwater dynamics.

3. Liz and Gary Nielsen retrieving data from a digital camera trap that Gary developed for Hillary Young's doctoral research on behavior of small mammals.

4. Kris Hulvey of UC Santa Cruz with the potted communities she used for studying competition between yellow star-thistle and other species.

ground every two meters in a candidate area and recorded seismic waves generated by a sledgehammer hitting a metal plate. Michael Rymer, also of the USGS, reports that preliminary results suggest the wetland site has at least two strands of the San Andreas fault about 30 meters apart. The group is working to confirm this result and determine the timing and technology for keeping a trench in the wetland dry enough for examination.

Other new surveys this year included a pilot geomagnetic survey by geophysicist Sheldon Breiner and a survey for millipedes by taxonomist Kevin Pitz at the Field Museum of Chicago. Doctoral student Doug McCauley received approval for a grant from the joint AW Mellon Foundation/Stanford University program to conduct a new survey of snakes.

Watershed Dynamics

The source of sediment carried into Searsville Lake and adjacent wetlands is a watershed that includes half the preserve and roughly 36 square kilometers (14 square miles) of the Coast Range. Roughly ninety percent of the transported sediment never passes over Searsville dam, instead settling out in patterns that shape future water flow.

This year Northwest Hydraulic Consultants (NHC) assessed the distribution and depth of sediment that has accumulated since their last bathymetric (2000) and sedimentation (2003) surveys. Brad Hall of NHC reports that upstream of Searsville Lake, deposition since 2003 has added 0.25 meters of sediment to areas within 30 meters of Corte Madera Creek; farther away from the creek, 0.15 meters of sediment was added. Corte Madera is on the eastern edge of the wetland, so this pattern of sediment buildup creates a west-sloping floodplain, which increases the risk that the lower stretch of the creek will change course and flow west.

Sedimentation in the lake has been highly variable since construction of Searsville dam in the 1890s. Brad reports that since 2000, deposition of 0.5 meters of sediment to the submerged delta at the mouth of Corte Madera Creek has reduced the lake volume by 2,500 cubic meters and the area of open water by 4,900 square meters. Open water has also been reduced as a result of expanding willow and cattail communities along the lake margin.

A question of fundamental importance to the local area is whether dam-induced sediment deposition and the associated changes in topography affect the hydrologic behavior of the watershed. Doctoral research by Chris Heppner (profiled on page 21), working with professor Keith Loague, examined this question with a physics-based model that simulates continuous surface and ground water flows, recharge and discharge, and sediment transport. The long-term simulations consider four dam scenarios—pre-dam, early dam, current, and post-dam-—under realistic climate patterns.

Chris found that on an annual basis, hydrologic effects of the dam and lake are small compared to effects of rainfall variability. In any given year, the four dam scenarios differ little in annual water-balance components such as total surface outflow and evaporation. Year-to-year variations were large and were related to annual rainfall.

For individual storms, peak discharge and flood duration varied across scenarios because newly-deposited sediments, wetland vegetation, and the dam tend to attenuate flood peaks that pass through the system. Under the pre-dam scenario, peak discharge averaged 40 percent higher than in the current scenario, with the early dam scenario intermediate. Intense storms, however, overwhelm flood attenuation by the dam. Thus, weather—more than the presence or absence of the dam—accounts for flood conveyance to the downstream channel.

For over three decades, this wetland area has

been a noted birding site. In 1971, two years before the Stanford Board of Trustees formally designated the Jasper Ridge Biological Preserve, Dave DeSante and students from his ornithology class spent several months in the wetland conducting a breeding bird census. They recorded the highest known breeding density of non-colonial land birds in the US. The next year, Dave obtained similar results, and over the next twelve years, several similar but smaller surveys were conducted. They found that overall bird diversity and density remained very high.

In spring Stanford student Bill Love Anderegg repeated Dave's study for his honor's thesis. Using the original hand-drawn maps and some input from Dave (now director of the Institute for Bird Populations), Bill re-located the transects and conducted three months of observations.

Bill found an overall decline in bird diversity in the wetland and a striking decline in neotropical migrants, especially yellow warblers. In 1972, this migrant was the fourth most common species, with 15 territorial males recorded, but Bill observed only one during his study. Working with Stanford professor Terry Root, Bill is piecing together the factors that may have contributed to the decline in the bird fauna.

Species of Concern

Understanding population change has long been a core component of our research mission. Indeed, fluctuations in the number of Bay checkerspot butterflies (*Euphydryas editha bayensis*) were a source of major discoveries over many years. After their extinction from JRBP's serpentine grasslands, retrospective analyses helped establish that altered climate was a factor in the butterfly's decline.

Current research on "species of concern" continues to examine Bay checkerspots and other species undergoing worrisome trends, either towards rarity or invasiveness. Increasingly, researchers are seeing ways to apply their results to experimental restoration at JRBP. The examples are diverse.

With funding from the Woods Institute for the Environment, Stanford investigators from multiple disciplines completed a second year of studies on the feasibility of reintroducing Bay checkerspots. One component is Jon Christensen's historical research on causes of the butterfly's extinction. Jon's assessment is that during the last five or six decades, the greater Bay Area has lost three fourths of its Bay checkerspot populations. Jon hypothesizes that many of them were victims of the building boom after World War II, but as at Jasper Ridge, many others "went extinct in parks and protected areas, perhaps as the result of the removal of disturbances such as grazing and fire from the habitat." Jon's doctoral research with professor Richard White develops a comparative spatial history of these populations in order to test his hypothesis.

A second line of research examines ways to increase the dominance of native serpentine plants, including food plants of the Bay checkerspot larvae, on both serpentine and non-serpentine substrates. This would help buffer the butterfly population from interacting threats of weather variation and invasive grasses. Work by PhD student Tim Bonebrake on non-serpentine soil, and by Murdoch University professor Richard Hobbs on serpentine soil, suggests that wet years allow exotic grasses to proliferate, but dry years knock them back. The natives fare best in years when the rainy season begins early and is followed by a moderate drought before the real season begins. The early rain triggers germination in exotic grasses more than in natives, and many seedlings in this early cohort succumb to the drought.

These researchers began formulating an experiment to reduce invasive grasses in serpentine grassland. They are converging on a two-pronged strategy that combines watering to induce a "false start" and mowing to simulate the effects of selective grazing.

Poised at the edge of the serpentine grassland is an invasive species that has conquered large areas of non-serpentine grassland, yellow star-thistle (*Centaurea solstitialis*). Kris Hulvey of UC Santa Cruz has focused her doctoral work on reducing star-thistle populations using highly competitive native species such as hayfield tarweeds (*Hemizonia congesta*). Based on results from competition studies at JRBP, Kris piloted a restoration study this year at two other preserves and has proposed adding JRBP. Her study compares two strategies: swamping out star-thistle with heavy seeding of tarweeds, and disturbing the soil to give tarweeds an advantage.

The longest running invasion study at JRBP is the 14-year study of Argentine ants (*Linepithema humile*) by professor Deborah Gordon's lab, most recently Jessica Shors and Katherine Fitzgerald. Although Argentine ants have expanded their range at JRBP since the study began, Katherine reports that since 2000 only two survey sites, among hundreds they examine twice a year, have been newly invaded. She suggests the invasion front may have "stalled or stopped."

Katherine's new dissertation study examines what might have halted the ants. One candidate is insufficient winter nest sites, the best ones being sun-warmed soil on the south sides of trees or shrubs in partial clearings. This is where colonies produce the next generation of reproductive castes.

Another candidate is heavy competition from native *Prenolepis imparis* ants when Argentine ant colonies expand in spring. To test the importance of these factors, Katherine began monitoring, mapping, and modeling colonies in areas that vary in winter nest sites or *Prenolepis* abundance.

When Argentine ants invade, ecological relationships may collapse if the ants do not take on roles left vacant by displaced native species. PhD student Jessica Shors is studying an example, the mutualism in which larvae of the acmon blue butterfly (*Plebejus acmon*) secrete honeydew, while native ants consume the honeydew and protect the larvae from parasitoid wasps. Jessica has been painstakingly observing whether Argentine ants are good substitute tenders or whether they have left acmon blues vulnerable to parasitism. Her results to date suggest a mix of both tendencies at different stages of the butterfly life cycle. Hugo Fenaux, a junior in high school, helped Jessica this summer.

When a species is rare or limited in distribution, a very successful population can be a model system for studying restrictedness. Such is the case with the shrub western leatherwood (*Dirca occidentalis*), a Bay Area endemic that is unusually abundant at JRBP. *Dirca*'s distinctive winter-flowering habit and the low fruit set typical of Jasper Ridge populations brought Iowa State professor Bill Graves back for a third year of studies on the pollinators and fruiting behavior of *Dirca*'s beautiful flowers.

The January 2007 freeze was well-timed for Bill's research and also led to an unexpected opportunity. Previous study had led Bill to hypothesize that sensitivity to cold reduces fruit set, so he experimentally warmed some inflorescences during the lowest temperatures. Surprisingly, heating had no effect and seed set was very robust even by unwarmed flowers, putting to rest the cold-sensitivity hypothesis. Bill also compared fruit set on branches that were open-pollinated with others that were bagged to exclude pollinators. From this he concluded that *Dirca* can self-pollinate but requires pollinators for maximum fruit set. These studies shed new light on the reproductive biology of *Dirca* and also resulted in a collection of several hundred fruits—a tiny fraction of the year's bumper crop but a sizeable number for a species that would otherwise be off-limits for seed collecting. Bill is maintaining the seeds in germinable condition as we weigh several possibilities for restoration experiments. Stanford students Cara Brook and Matthew Gribble, high-school students Hilary Rollins and Lluvia Alcázar, and docent Pierre Martineau helped Bill this year.

These diverse studies on species of concern have a common thread, and it is one that would represent a change in policy for Jasper Ridge—experimental restoration. The significance of this change would be considerable. Studies at JRBP have been conditional on having minimal and reversible impacts, while restoration strives for impacts that are long-term and self-sustaining. A conversation that was repeated many times among researchers this year is whether Jasper Ridge is the right place for such a policy. The preserve's academic advisory committee will formally consider that question in its upcoming meetings. Embedded within that debate will be a question resource managers worldwide are asking—whether to restore to a past condition or to anticipate future environmental change.

Global Change

The Jasper Ridge global change experiment (JRGCE) continues to explore how annual grasslands are likely to look and function decades from now. The core study of 16 global change treatments

5. Herbarium volunteers Liz Schwerer, Ann Lambrecht, John Rawlings, and Toni Corelli identifying plants in the wetland. Carol Zabel and Paul Heiple also contribute to herbarium work.

6. Doctoral student Katherine Fitzgerald examining trees for the presence of ants, both native species and invasive Argentine ants.

7. Stanford sophomore Mike Alyono examining root scans as they are taken by a scanner inside a tube in the ground and displayed on a laptop.

8. Senior scientist Ted Raab and postdoctoral fellow Noel Gurwick collecting soil cores from the global change experiment for studies of carbon turnover and storage.

9. Miko Tsukimoto, a technician and recent Stanford graduate, sampling soil from a study of the effects of global change treatments on phosphorus limitation.

completed its tenth year, and several results emerged from new analyses of this unusually long time series. As well, three companion studies focused on questions raised by the core experiment. The JRGCE was funded this year by the National Science Foundation and by a grant from the US Department of Energy to Chris Field, Hal Mooney, and Peter Vitousek.

PhD student Claire Lunch completed her second full growing season of monitoring carbon exchange and water loss by grassland plots exposed to 16 treatments consisting of factorial additions of CO_2, nitrogen, heat, and precipitation. Claire followed six replicates of each treatment and obtained a statistically rigorous time course of carbon and water balance. Her results bear on many global change issues, such as whether the build-up of atmospheric CO_2 will be offset by greater uptake and retention of carbon in plants and soils. Fortuitously, Claire's work coincided with the JRGCE's wettest and driest years.

Among Claire's major findings is that in the dry year, but not the wet year, elevated CO_2 extended the growing season of the grassland, measured as the period during which uptake of carbon exceeds carbon release. This plot-level result is consistent with studies of single leaves. Under high CO_2, diffusion of CO_2 into a leaf tends to increase relative to the flow of water vapor exiting the leaf. This water-conserving effect of elevated CO_2 should tend to enhance carbon uptake (and, potentially, carbon storage) when water is limited. Claire reports, however, that the lengthened season under elevated CO_2 did not result in greater total carbon uptake because elevated CO_2 reduced uptake earlier in the season.

Postdoctoral fellow Noel Gurwick updated the multi-year analysis of biomass production in the field plots, a study that also bears on carbon storage. The last full analysis found no consistent relationship between elevated CO_2 and standing biomass, but with three additional years of data, Noel found that elevated CO_2 reduced plant production in dry years and increased it in wet years. He did not find this same pattern, however, when he compared JRGCE treatments with and without added precipitation. Noel suggests that "perhaps the real driver is not total rainfall but the seasonal pattern of rainfall," echoing Claire's findings on seasonality.

Work by Stanford student Mike Alyono also helps connect Claire's results and Noel's. Mike took digital images of soil profiles using a scanner he lowered into belowground observation tubes and found that root abundance declines under elevated CO_2, especially at greater soil depths. Thus, leaves under high CO_2 save water, but the plant has less moisture due to a smaller, shallower root system.

Most of the carbon taken up in natural grassland ultimately feeds microbes. A complex trophic web belowground includes many types of microbes that interact with plants and with each other in many ways that shape responses to global change factors. Four laboratories are examining microbes in the JRGCE with different diagnostic assays: membrane biochemistry, evolutionary relationships, nutritional roles, and ability to consume novel compounds.

For example, collaborators at the University of Wisconsin-Madison, professor Teri Balser and her now-graduated PhD student Jessica Gutknecht (profiled on page 20), use signature phospholipids within microbial membranes to reveal both the identity of microorganisms and their role in the carbon cycle. This year they completed an unusually comprehensive study analyzing seasonal and annual changes in microbial communities in the field plots from 2001 to 2006.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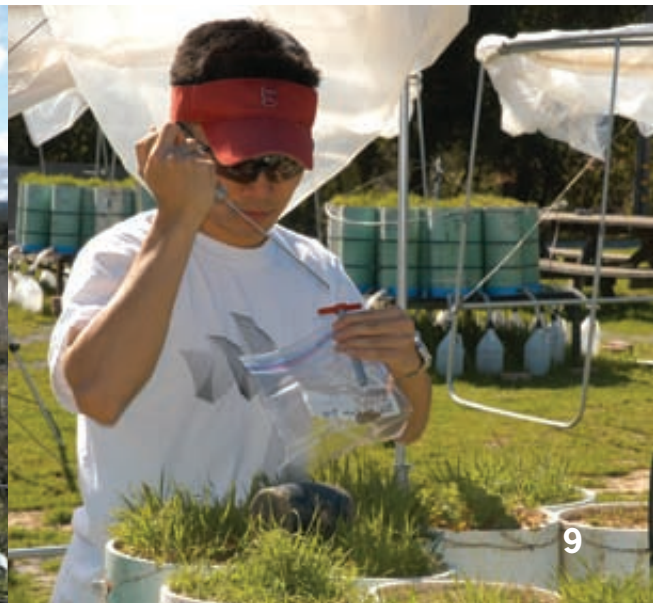
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10. Nigel Crook, a research associate in geophysics, conducting a line of subsurface electrical resistivity measurements perpendicular to Corte Madera creek to look at water content, particle size, and other properties of sediments.

Jessica reports that their work broke new ground in many respects—even the changes they followed in the control treatments are something "virtually no one has looked at on a long-term basis." In addition, they found that although the response to the global change treatments varied greatly over time, nitrogen addition consistently affected the microbial community. For instance, in plots with added nitrogen there was a progressive decrease in the indicator for mycorrhizal fungi, a symbiosis that increases the uptake of phosphorus by plants.

Microbial studies were also conducted by postdoctoral fellows Stephan Gantner and Kathryn Docherty. Stephan finished several years of study at Michigan State University where he examined uptake of substrates labeled with ^{13}C as a way to identify changes in the microbial community. Kathryn began a fellowship this year working on ammonia-oxidizing bacteria with professor Brendan Bohannan at the University of Oregon.

A year ago, the JRGCE began to examine long-term questions, such as whether the gradual changes observed in plant and microbial communities will stabilize or whether they will shift the grassland to a qualitatively different state. Examples of such a shift would be a transition to woody plants, a reordering of resource limitations, or a new disturbance regime. Studies this year addressed the first two possibilities.

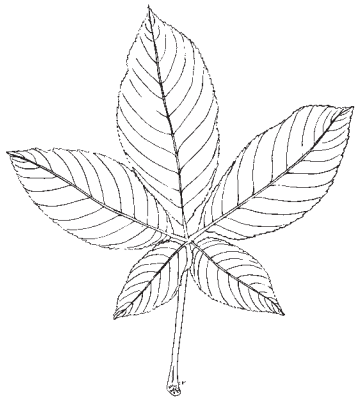
One set of experiments examined whether the JRGCE treatments have tipped the ecosystem towards limitation by phosphorus. To realistically test this possibility, researchers grew plant communities in deep pots with intact soil columns from the field and applied various global change treatments. The response of plant growth to the treatments suggested that nitrogen addition did shift plants toward phosophorus limitation, but elevated CO_2 did not. In further studies, Ben Houlton (profiled on page 20) applied two different isotopes of phosphorus in order to trace the amount of phosphorus going to plants versus microbes. His underlying question is whether nitrogen addition—in quantities that simulate inputs from pollution—may be inducing significant changes in the phosphorus cycle.

A second companion study was a pilot study on whether the global change treatments increase invasibility of grassland by non-native thistles, woody species, or nitrogen-fixing plants. The pilot study was successful and provides a basis for directly testing invasibility in the ongoing field experiment, an experiment that is now underway.

Much of the progress of the JRGCE has depended on technical support of many kinds. Together with supervising most core operations, Todd Tobeck has designed and fabricated a new device almost every year of the project; this year's addition was an automated root washer. Yuka Estrada developed and manages a comprehensive, flexible database for all of the participating laboratories and outside requests. The experiment was also supported this year by technicians Miko Tsukimoto, Mark Rogers and Chris Andreassi. High-school students Jinyoung Choe, Dana Feeny, Sarah Teplitsky, and Carol Tran conducted summer internships.

Research at Jasper Ridge includes studies at a range of different scales. Some of the studies are large-scale, multi-investigator efforts with layers of planned complementarities. Others are independent studies by investigators pursuing the questions they consider most important in their areas of expertise. Despite their independent origins, these studies often link together. One of the most important and rewarding contributions that Jasper Ridge makes to research is enhancing opportunities for new discoveries through collaboration. Sometimes new collaborations are stimulated by spatial overlap, relevance of the same historical data, or dependence on a shared set of technical tools or databases. In other cases the collaborations evolve from the most casual of exchanges. Field stations such as Jasper Ridge strengthen these kinds of links, helping foster a stronger scientific community and broader understanding of both the habitats we study and basic principles in environmental sciences.

In the coming year, experimental restoration will become a greater focus of debate. This will be an opportunity to carefully examine how Jasper Ridge can best continue to make unique contributions that build on long-term studies with fundamental scientific value. One goal of this annual report is to inform that discussion and include our entire community.



GIS and Data Management: Mapping the Preserve in 3D Trevor Hébert

JRBP acquired a light detection and ranging (LiDAR) dataset in 2006–07 that will enable mapping and visualization of the preserve's terrain and ecosystems in greater detail than was previously possible.

LiDAR is an aircraft-based remote sensing technique similar to RADAR (radio detection and ranging), but is able to capture more information at higher resolution. Pulses of laser light are emitted toward the ground; the distance to each point hit by the laser is determined based on the time it takes for the reflected light to travel back to the plane. Once distance is known, latitude, longitude, and elevation can be calculated for each reflection point, which can be bare ground, a leaf on a tree, or any other solid surface. Thousands of pulses per second are emitted, generating millions of data points for a given area.

The dataset purchased by JRBP this year is a portion of a 2005–06 San Mateo County LiDAR project. In the coming year, the LiDAR data will be integrated into Jasper Ridge's geographic information systems (GIS) via a specialized data repository known as a geodatabase. This will not only store information that can be used by GIS software such as ESRI ArcGIS, but it will also be able to implement complex logical functions such as modeling spatial relationships between data.

One of many uses for the LiDAR data will be the creation of a new high-resolution digital elevation model (DEM) of JRBP. This in turn can be used to generate topographic maps and to perform GIS analysis such as watershed delineation, line-of-sight, solar radiation, slope, aspect, and shaded relief maps.

JRBP researchers may also gain access to a similar dataset produced this year by the Carnegie Airborne Observatory.

Complementing the LiDAR data, the preserve has purchased a laser rangefinder, which measures distances with laser beams, then instantly makes trigonometric calculations of height, inclination, and remote coordinates using global positioning system (GPS) technology.

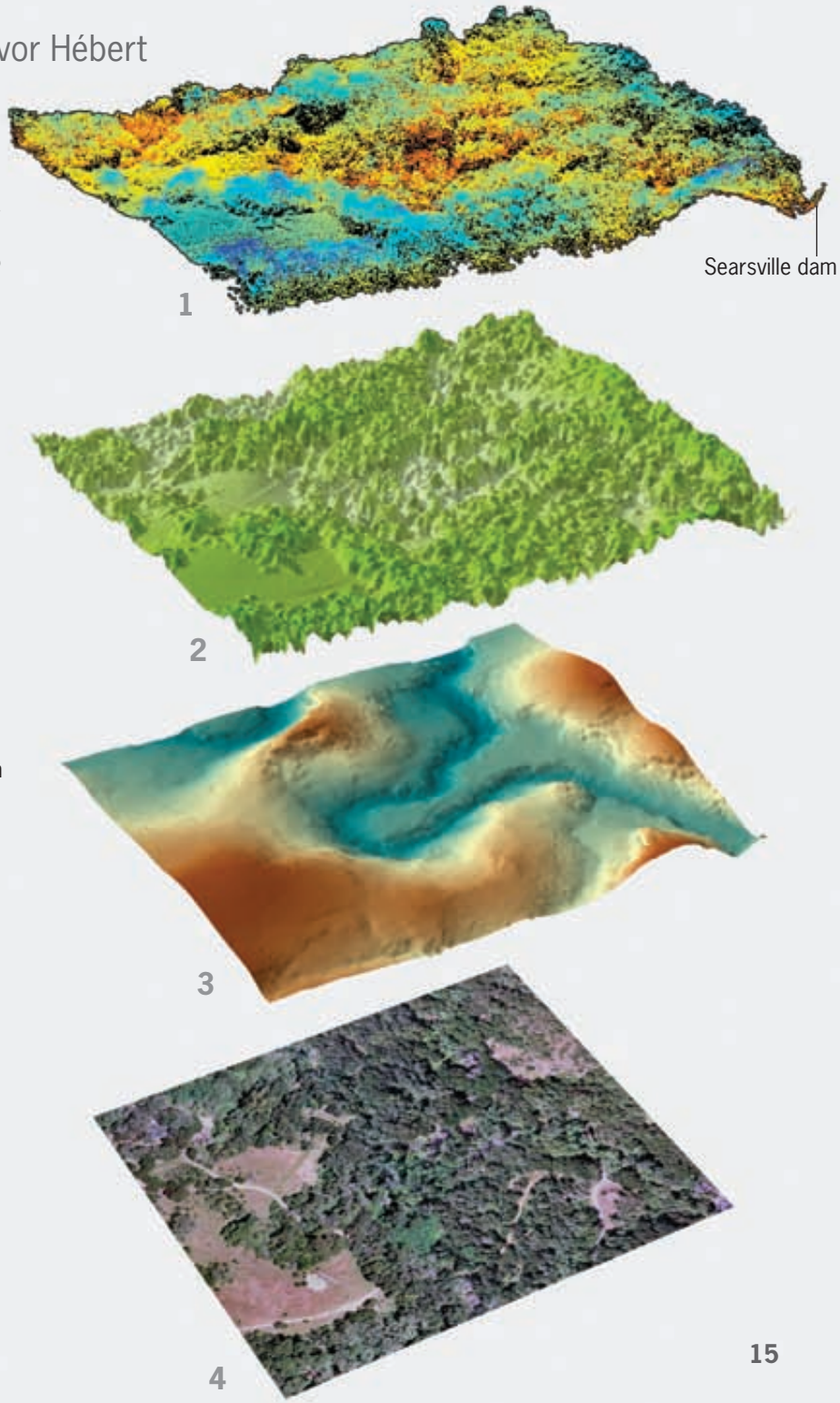
Each of these images shows the segment of San Francisquito Creek between Searsville dam (far right corner) and Bear Creek. The 3D surfaces were generated using the Jasper Ridge/San Mateo County LiDAR data, RSI ENVI, and ESRI GIS software.

1. The LiDAR point cloud, showing all the returns for the area, from canopy to ground surface and points in between. There are nearly 400,000 data points in this relatively small area of Jasper Ridge. The differences in color indicate differences in elevation.

2. A shaded relief image of the canopy, made up of the highest elevations or first returns, which define the treetops and other high points. Note that at the open grassy areas at the left of the image, the ground surface has both the first/last returns, although at a finer scale this data would allow differentiation between low vegetation and the ground surface.

3. A bare-earth, shaded relief terrain model, created by separating LiDAR returns that are higher than ground level (bushes, short trees, structures, etc.) from the laser hits on the ground. A continuous surface model is then generated using only returns from solid ground.

4. The color aerial photo of the same area shows the relative dearth of information provided by a two-dimensional photograph with regard to topography and tree height/canopy structure, as compared to the LiDAR-derived models of the same area.



Civil and environmental engineering professor David Freyberg teaching the Field Studies in Earth Systems class how to survey the elevation of a well they have added to his groundwater monitoring array.

Education and Outreach

Cynthia J. Wilber

During academic year 2006–07, Stanford University classes at Jasper Ridge Biological Preserve included Field Studies in Earth Systems, Jasper Ridge Docent Training, Core Experimental Laboratory for Ecology, Science of Soils, Introduction to Earth Systems, Sophomore College, Introduction to Prehistoric Archaeology, Ecosystems of California, Biosphere/Atmosphere Interactions, and many others. For a complete list of classes, see appendix 3.

The Jasper Ridge community participated in numerous educational opportunities, including the monthly brown bag lunch lecture series, whose topics ranged from coral reef sustainability, to the ecology of cholera epidemics, to the greening of the graduate school of business. Docent-initiated classes like Léo Laporte's fall class on climate change and Pierre Martineau's spring insect identification class also filled the classroom, and two exchange tours with the Año Nuevo State Reserve docents provided a behind-the-scenes glimpse into the coastal reserve and the northern elephant seals that gather there each winter.

The annual Jasper Ridge field trip in October 2006 to the Rocky Mountain Biological Laboratory (RMBL) in Crested Butte, Colorado, provided Jasper Ridge affiliates with an amazing educational opportunity to learn about high-altitude ecology and systems. RMBL Director Ian Billick and a cohort of researchers gave presentations on topics including climate change, butterflies, RMBL history, and avalanches.

The activities and achievements of the JRBP education program reflect the hard work and generous contributions of our affiliates, who further the mission of the preserve by teaching on the trails, leading tours, and assisting with classes ranging from university to K–12, both at the preserve and in the local schools. This vital community also contributes to research, conducts bird censuses, manages the Oakmead Herbarium, builds teaching collections, and willingly contributes hours and hours of work on a host of tasks that help keep the preserve running smoothly.

Outreach

Since 1999, the JRBP education program has been actively working to increase minority participation in the ecological sciences in both formal and informal education through outreach programs, collaborations, and affiliations with local, national, and international groups who share our goals. Our program is now quite broad and includes new partnerships each year. The core philosophy of the education program is to provide underrepresented students with meaningful "real work" scientific field experiences and curricula that are supported by strong ongoing mentor relationships and academic resources.

The JRBP education program employs several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1. Professor Rodolfo Dirzo collecting oak leaves with undergraduate Katie Pickrell, who worked together with Malinda Lee and Nancy Falxa-Raymond on a project investigating plant defenses that protect against herbivory.

2. Ned Henningsen and Cara Brook netting fish in San Francisquito Creek during the docent training class with Alan Launer. Working in waders in the creek, students collected and identified specimens from traps and nets.

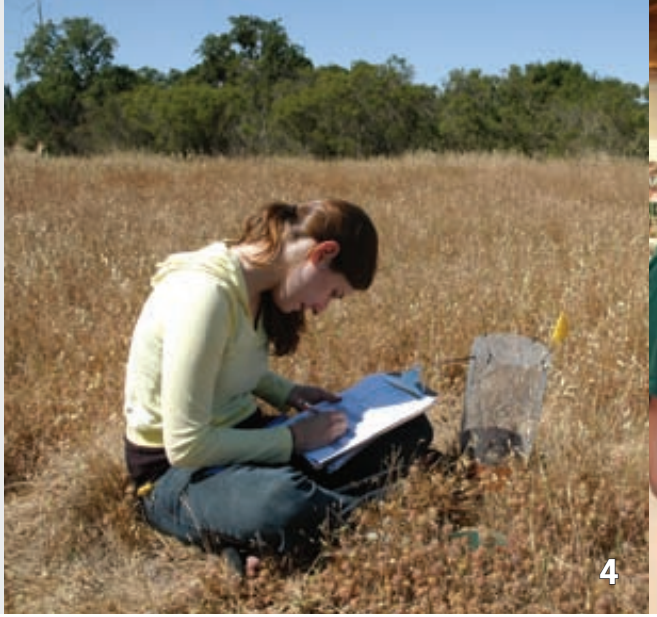
3. Undergraduate Max Romano identifying insects with the help of docent Pierre Martineau.

4. Josephine Valenzuela, a joint major in biology and chemistry, examining shrub establishment in caged and uncaged grassland plots during the Core Experimental Laboratory for Ecology.

5. Eastside School students learning firsthand about reptiles with their Stanford instructor, JRBP docent Chloe Pinkerton.

6. Eastside School sixth graders recording chaparral community data.

7. SEEDS-ESA Leadership Conference participants discussing the challenges and successes of minority researchers in the ecological sciences.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strategies for increasing human diversity here at the preserve and in the field sciences, as illustrated by the following selection of programs.

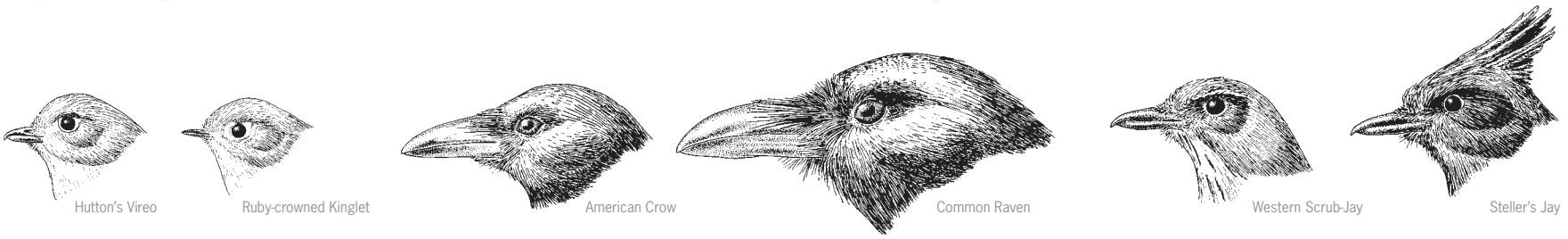
Strategies for Ecology Education, Development, and Sustainability (SEEDS)

The Jasper Ridge education program has worked with the Ecological Society of America (ESA) SEEDS program since 2002 and has hosted SEEDS visits in 2003 and 2007. In February 2007, the SEEDS advisory board and SEEDS fellows participated in a full day leadership workshop at Jasper Ridge with presentations by Rodolfo Dirzo, Meg Lowman, and Cindy Wilber that focused on the challenges faced by young minority scientists.

In collaboration with SEEDS we have developed strong relationships with student researchers from other universities, tribal colleges, and historically black colleges, as well as schools in Puerto Rico, Ecuador, and Mexico. A Stanford student chapter of SEEDS was established in 2007 with Stanford undergrads (and JRBP docents) Christine George and Valentina Fontiveros serving as co-presidents.

Eastside School Field Studies Class

The Eastside School field studies class, which began in 1999, focuses on sixth-grade student researchers working in small groups taught by JRBP-trained Stanford student mentors during spring quarter. Eastside students collect data in their group's assigned ecosystem on air, soil and water temperature, pH, and percent canopy cover, and each student monitors his or her own plant for nine weeks. The course includes weekly special focus classes that are pretaught at Eastside by the Stanford student teachers, who are responsible for the creation of the curriculum and class plans. For example, Laura Nugent and Jill Bible, both Stanford master's students, worked together on a bird class covering bird anatomy and physiology, including beak and feet characteristics and a brief summary of bird evolution involving Darwin's finches, and then assigned each sixth grader a bird to research. Ben Graves, Chloe Pinkerton, and Valentina Fontiveros taught classes on geology, mammals, botany, and insects, both at Eastside and in the field. Eastside students spend four hours working at the preserve each week, ending with a peer-reviewed poster session summarizing the five ecosystems studied. Eastside School is a 100% minority school in East Palo Alto, California.[5]



Other Programs

Other organizations that have participated directly with JRBP in 2006–07 to increase minority participation in the sciences include: American Indian Science and Engineering Students (AISES), Society for the Advancement of Chicanos and Native Americans in Science (SACNAS), the Muwekma Tribe, Stanford Native American Cultural Center, Industry Initiatives for Science and Math Education (IISME), the Stanford Office of Science Outreach, and the Conservation Strategy Fund.

"Jasper Ridge is their science textbook come to life! Everything the 6th graders read and learned throughout the school year, they can now see with their own eyes at Jasper Ridge."

— Suney Park, 6th grade teacher at Eastside School

2006–07 Interns

Jasper Ridge high school interns Hilary Rollins and Lluvia Alcázar made significant contributions to the preserve in 2006–07 while gaining experience in the field sciences and enriching their high school science education.

Hilary Rollins (*top*), now a senior at Palo Alto High School, worked with Cindy Wilber and Bill Gomez each week on the Dirzo lab camera-trapping project, both in the field and in project planning meetings. Hilary also worked with Nona Chiariello on the Jasper Ridge global change experiment, with Jessica Shors investigating the relationship between Argentine ants and Lycaenid butterflies, with Bill Graves on *Dirca* pollination studies, and with Eric Abelson on an animal behavioral response study related to the camera trapping. Hilary was able to adjust her high-school schedule in order to fully participate in BioSci 96 and is the first high-school JRBP docent.

Lluvia Alcázar (*bottom*), now a senior at Eastside College Prep, worked during the academic year on the Dirzo lab camera trapping project, and spent many extra weekend hours working with Bill Graves of Iowa State University to compare the pollination success between *Dirca occidentalis* plants that were self pollinated versus plants that were cross pollinated. During the summer, Lluvia participated in a JRBP-related high-school internship program on campus sponsored by the Office of Science Outreach in Rodolfo Dirzo's lab. She worked closely with postdocs Yolanda Cachú and Eduardo Mendoza on data analysis of the camera project, as well as working on an herbivory study measuring plant competition. In August, Lluvia presented her summer internship work in a poster session on Stanford campus and attended the Ecological Society of America annual meeting in San Jose with ten other Bay Area high-school students.

Profiles

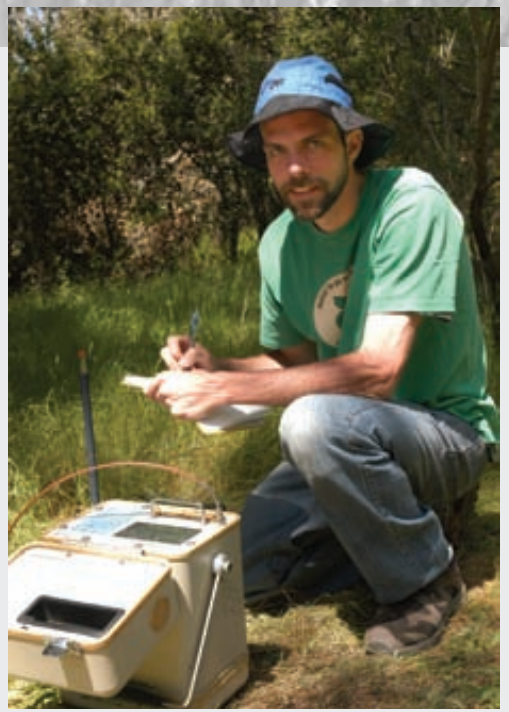
Academic Milestones and Accomplishments

Jessica Gutknecht is one of several students from distant universities whose doctoral work has been integral to the Jasper Ridge global change experiment (JRGCE). In August Jessica completed her dissertation at the University of Wisconsin-Madison, where she focused on microbial responses to the JRGCE treatments. Jessica's approach went beyond simply examining treatment effects. Her goal was to explore a context for understanding microbial responses to future global change, using coarse-scale lipid indicators and enzyme activity to characterize many aspects of microbial response to the JRGCE treatments simultaneously. Her studies compared responses of different microbial groups, long-term versus seasonal changes, structural versus functional changes, and responses to new perturbations. These studies involved analyzing over 1000 lipid extractions. Jessica also took time each year to assist in plant and soil sampling to help the larger collaborative project. Jessica is now a postdoctoral researcher at the University of California at Santa Cruz focusing on climate change related to rhizosphere microbial decomposition and nutrient cycling.

Will Cornwell received his PhD from Stanford in fall of 2006 for research on the woody plant communities at Jasper Ridge. He studied the assembly of these communities in terms of two steps: the first is an environmental "filter" that excludes species whose traits do not allow them to tolerate a given environment; the second is competitive interactions that exclude species that are too similar to one another. Will found evidence for both processes at Jasper Ridge and then went on to study the leaves of many more species in many disparate places. He recently completed a one-year postdoctoral fellowship at Vrije Universiteit, Amsterdam where he was funded by the Dutch government to bring together a global data set of leaf decomposition data and use those data in global carbon-cycling models. Will is also involved in a global herbivory project using the same methods to measure herbivory rates on leaves at sites across the world, including Jasper Ridge. In October he is moving to a postdoctoral position at the University of British Columbia's Biodiversity Centre.

Ben Houlton works at the interface of the life and physical sciences. He investigates interactions among the carbon, nitrogen, and phosphorus cycles, plant functional groups, and global ecosystems. In his postdoctoral studies at Stanford and the Carnegie Institution, he worked on developing and implementing a new generation of terrestrial biogeochemical models, which were based largely on experiments he conducted at Jasper Ridge. For instance, as a collaborator in the Jasper Ridge global change experiment, Ben discovered that nitrogen-fixing organisms employ a nitrogen-rich strategy of phosphorus acquisition, thus allowing them to persist under conditions of low phosphorus in ecosystems. Ben is now an assistant professor in the Department of Land, Air and Water Resources at the University of California at Davis, where his research focuses on understanding global changes in Earth's biogeochemical cycles.

Vicia *plant with nitrogen-fixing nodules*



Chris Heppner came to Stanford in 2000 with the goal of researching the hydrologic processes that shape the earth's surface, an interest he acquired while working for the US Geological Survey in Pennsylvania on a project involving stream scour and channel morphology. At Stanford he discovered that the issue of dams and dam removal, exemplified by the Searsville dam situation, combined the fields of watershed hydrology, sediment transport, and predictive modeling into a timely and important research question. His doctoral studies focused on adapting a numerical hydrologic model to include process-based sediment transport and applying the model to two field sites to explore questions related to the impacts of dams. In collaboration with Stanford geology and civil engineering professors, he collected field data to support the hydrologic simulations of the Searsville watershed. Chris received his PhD in March 2007 having published four papers related to his research, and now works as a consultant in the Bay Area.

Coyote and bobcat captured by Eric's Reconyx cameras.

Eric Abelson began his master's at Stanford having conducted undergraduate research using camera traps to study mammals. His field research and extensive survey of camera-trap literature convinced him that the field needed a rigorous test of possible capture biases of the TrailMaster active infrared monitor, a widely used camera-trap system. For his master's degree, Eric designed such a test. He was particularly interested in whether some mammal species avoid the TrailMaster system, thereby changing the rate of wildlife detection by this system. Eric's study consists of complementary camera systems set up in phases at three locations, one within JRBP. An outgrowth of this work has been his participation in the BioACT project, which is a collaboration between computer scientists and field biologists. Eric has helped develop PhotoSpread, a software application for robust analysis of photographs and metadata integration. Eric completed the master's program and is now pursuing a PhD in biology at Stanford.

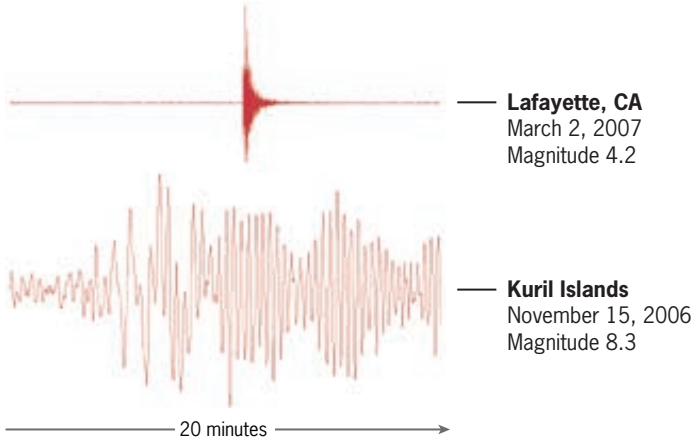
Members of the 2007 docent training class preparing to walk a transect with campus archaeologist Laura Jones. The class of 2007 includes new docents Jill Bible, Cara Brook, Richard Corelli, Matthew Gribble, Elisabeth Hansot, Ned Henningsen, Malinda Lee, Tiffany Lee, Darcy McRose, Joleen Oshiro, Katie Pickrell, Hilary Rollins, Max Romano, Carol Seeds, Chris Seifert, and Carolyn Taylor.

Appendix 1: Research Projects

Project	Principal Investigator(s) or Coordinator	Department or Division	Institution
Spectral imaging and waveform light detection and ranging (LiDAR)	Greg Asner	Fac, Global Ecology	Carnegie Institution
Biosystematics of *Hilara*, *Medetera*, and Tachinidae	Paul Arnaud	SS, Entomology	Cal. Academy of Sciences
Broadband seismic monitoring	Greg Beroza	Fac, Geophysics	Stanford University
	Bill Karavas	SS, Berkeley Digital Seismic Net.	UC Berkeley
Population biology of the butterfly *Euphydryas chalcedona*	Irene Brown	Vol, JRBP	
Volunteer collection and mapping of the flora of Jasper Ridge	Nona Chiariello	SS, JRBP	Stanford University
Multiple resource limitation and top-down versus bottom-up controls on plant community structure	Elsa Cleland	PD	NCEAS
Functional diversity of California woody plant communities	Will Cornwell	GS, Biological Sciences	Stanford University
Mammalian diversity, abundance, and activity	Rodolfo Dirzo	Fac, Biological Sciences	Stanford University
Behavioral response to camera traps via a comparative study of two methods	Eric Abelson	GS, Biological Sciences	Stanford University
Population genetics of *Microtus californicus*	Rachel Adams	GS, Biological Sciences	Stanford University
Camera-trap monitoring of large and medium-sized mammals	Yolanda Cachú, Eduardo Mendoza	PD, Biological Sciences	Stanford University
Small mammal diversity and density across habitats	Hillary Young	GS, Biological Sciences	Stanford University
Dissection and analysis of raptor pellets	Elizabeth Callaway	UG, Biological Sciences	Stanford University
Herbivory and competition between native and exotic plant species	Rodolfo Dirzo	Fac, Biological Sciences	Stanford University
	Eduardo Mendoza, Yolanda Cachú	PD, Biological Sciences	Stanford University

Key to abbreviations used:

Fac = faculty
GS = graduate student
PD = postdoctoral fellow
SS = staff or senior scientist
UG = undergraduate
Vol = docent and/or volunteer



Two of the year's seismic events as recorded by the Jasper Ridge seismic station (JRSC) and displayed here at the same scaling. Each seismic record depicts relative ground motion on the vertical axis.

Top: Bob Uhrhammer of the Berkeley Seismological Laboratory reports that this event near near Lafayette, California, caused the largest local earthquake ground motions recorded by the JRSC broadband seismometer during the year.

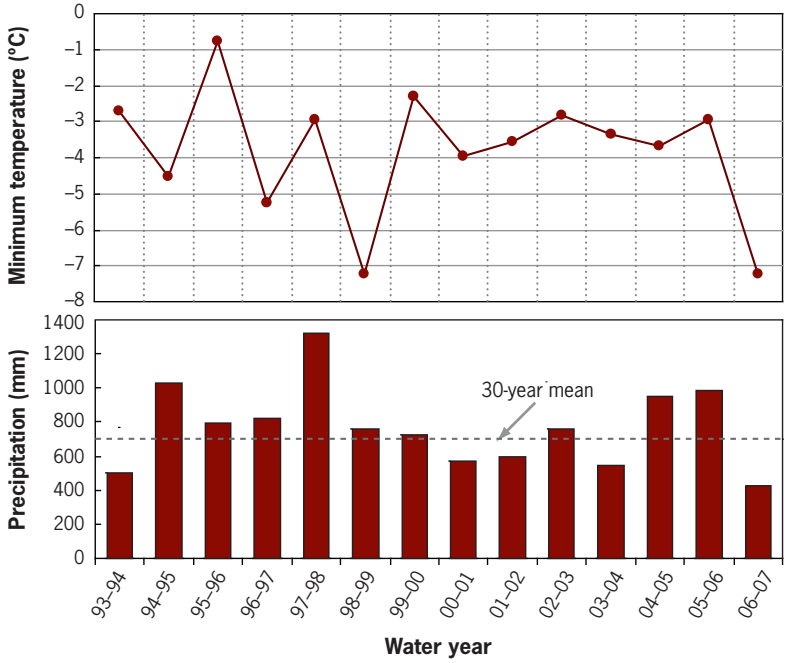
Bottom: Also recorded by the JRSC station, this earthquake was centered in the Kuril Islands, located between Hokkaido, Japan and the Kamchatka peninsula of Russia. It was the world's largest earthquake during 2006–07.

These seismograms were generated by the "make your own seismogram" tool on the website of the Northern California Earthquake Data Center.[6]

Project	Principal Investigator(s) or Coordinator	Department or Division	Institution
Long-term studies of *Euphydryas editha bayensis* and feasibility of reintroduction	Paul Ehrlich	Fac, Biological Sciences	Stanford University
	Carol Boggs	Fac, Biological Sciences	Stanford University
	Scott Fendorf	Fac, Geol. & Environ. Sciences	Stanford University
	Chris Field	Fac, Global Ecology	Carnegie Institution
	Buzz Thompson	Fac, Law School	Stanford University
	Richard White	Fac, History	Stanford University
Feasibility study of serpentine habitat creation	Tim Bonebrake	GS, Biological Sciences	Stanford University
Historical distribution of the Bay checkerspot butterfly and its food plants	Jon Christensen	GS, History	Stanford University
Long-term monitoring of ecosystem processes by eddy covariance	Chris Field, Joe Berry	Fac, Global Ecology	Carnegie Institution
Jasper Ridge global change experiment (JRGCE)	Chris Field	Fac, Global Ecology	Carnegie Institution
	Hal Mooney, Peter Vitousek	Fac, Biological Sciences	Stanford University
	Brendan Bohannan	Fac, Ctr. for Ecol. & Evol. Biol.	University of Oregon
	Jim Tiedje	Fac, Ctr. for Microbial Ecology	Michigan State Univ.
Analysis of rooting profile via belowground observation tubes	Michael Alyono	UG	Stanford University
Impacts of global change on soil microbial community	Teri Balser; Jessica Gutknecht	Fac; GS, Soil Science	Univ. of Wisconsin, Madison
Effects of global change on methane oxidation	Joey Blankinship	GS, Biological Sciences	Northern Arizona Univ.
Spectral measurement of aboveground vegetation dynamics	Nona Chiariello	SS, Biological Sciences	Stanford University
Trace gas fluxes under simulated global changes	Paul Dijkstra	SS, Biological Sciences	Northern Arizona Univ.
Response of ammonia-oxidizing microbial communities to multivariate global change parameters	Kathryn Docherty	PD, Ctr. for Ecol. & Evol. Biol.	University of Oregon
Microbial diversity and breakdown of polyaromatic compounds in soil	Stephan Gantner	PD, Ctr. for Microbial Ecology	Michigan State Univ.
Changes in nitrogen cycling in response to global change treatments	Noel Gurwick	PD, Biol. Sci. & Global Ecol.	Stanford Univ. & Carnegie Inst.
Carbon, nitrogen, and phosphorus interactions and global change	Ben Houlton	PD, Global Ecology	Carnegie Institution
Effects of global change on soil nitrogen cycling	Bruce Hungate	Fac, Biological Sciences	Northern Arizona Univ.
Nitrification and denitrification under altered climate	Paul Leadley; Audrey Niboyet	Fac; GS, Ecol., Systém, Evol.	Université Paris-Sud (France)
Whole-system gas exchange of the JRGCE	Claire Lunch	GS, Biol. Sci. & Global Ecol.	Stanford Univ. & Carnegie Inst.
Soil carbon dynamics	Darcy McRose	UG, Earth Systems	Stanford University
Effects of global change on barley yellow dwarf virus prevalence	Emily Pollina	GS, Ecol. and Evol. Biol.	Cornell University
Chemical characterization of soil organic matter responses to global change	Ted Raab; Noel Gurwick	SS, Biological Sciences; PD, Biol. Sci. & Global Ecol.	Stanford University; Stanford Univ. & Carnegie Inst.
The water balance of Searsville Lake and its sediments under existing and possible future conditions	David Freyberg	Fac, Civil & Envir. Engineering	Stanford University
Numerical modeling of surface-subsurface water flow	May Chui	GS, Civil & Envir. Engineering	Stanford University
Evaporation measurement and estimation	Jun Young Kim	GS, Civil & Envir. Engineering	Stanford University
Monitoring groundwater pressure in the Searsville complex	Gabrielle Puz	GS, Civil & Envir. Engineering	Stanford University
COMET: Coast-to-Mountain Environmental Transect	Michael Gertz	Fac, Computer Science	UC Davis

Project	Principal Investigator(s) or Coordinator	Department or Division	Institution
Argentine ant *(Linepithema humile)* invasion and the response of native ants	Deborah Gordon	Fac, Biological Sciences	Stanford University
Seasonal polydomy, budding, and the spread of the Argentine ant	Katherine Fitzgerald	GS, Biological Sciences	Stanford University
Effects of Argentine and native ants on Lycaenid butterflies	Jessica Shors	GS, Biological Sciences	Stanford University
Determinants of the distribution and reproductive success of *Dirca occidentalis*	William Graves	Fac, Horticulture	Iowa State Univ.
Ground survey of sediment deposition in Searsville Lake and wetlands	Brad Hall	SS	Northwest Hydraulic Consultants
Volunteer long-term monitoring of birds	Trevor Hébert	SS, JRBP	Stanford University
Monitoring of water flow and quality	Barry Hecht, Jonathan Owens, Chris White	SS	Balance Hydrologics, Inc.
Simulation of the upstream effects of dams and dam removal on hydrologic response and sediment transport	Christopher Heppner	GS, Geol. & Environ. Sciences	Stanford University
Effects of rainfall variability and gopher removal on serpentine grassland	Richard Hobbs	Fac, Environmental Science	Murdoch University (Australia)
Native species as a control on grassland invasion by yellow star-thistle	Kris Hulvey	GS, Ecol. and Evol. Biology	UC Santa Cruz
Earthquake prediction from precursory electromagnetic anomalies	Simon Klemperer	Fac, Geophysics	Stanford University
	Darcy McPhee, Jonathan Glen	Geophysical Unit, Menlo Park	US Geological Survey
Regional surveys of annual acorn production and oak phenology	Walter Koenig	Fac, Hastings Natural Hist. Res.	UC Berkeley
	William Carmen		Ctr. for Environ. Citizenship
Repeat of a 1976 analysis of lead in the lichen *Ramalina menziesii*	Léo Laporte	Vol, JRBP	
Survey of San Francisquito Creek and removal of exotics	Alan Launer	SS, Univ. Land & Buildings	Stanford University
Restoration, monitoring, student & public outreach in San Francisquito Creek Watershed	Alan Launer	SS, Univ. Land & Buildings	Stanford University
	Ryan Navratil	SS	San Francisquito Watershed Council
Synergistic anthropogenic effects on riparian avian communities	William Love Anderegg	UG, Human Biology	Stanford University
Monitoring and collection of insects	Pierre Martineau	Vol, JRBP	
Biodiversity and abundance of snakes in California grassland	Doug McCauley	GS, Biological Sciences	Stanford University
Photochemical changes in natural organics in Searsville Lake water	Ted Mill	SS, Chemistry	SRI International

Project	Principal Investigator(s) or Coordinator	Department or Division	Institution
Long-term acoustical monitoring of bat activity	Tom Mudd	Vol, JRBP	
Wetland delineation for Stanford University	Jeff Olberding	SS	Olberding Environmental
Computing support for acquisition, collaborative curation, and dissemination in biodiversity research (BioACT)	Andreas Paepcke	SS, Computer Sciences	Stanford University
Data capture (ButterflyNet) and interactive gigapixel prints (GIGAprints)	Ron Yeh	GS, Computer Science	Stanford University
Molecular phylogeny of millipedes in the order Spirobolida	Kevin Pitz	PD, Zoology-insects	Field Museum of Natural History
Legume-rhizobial interactions in *Lotus wrangelianus* on and off serpentine soils	Stephanie Porter	GS, Population Biology	UC Davis
Paleoseismic study of the peninsula San Andreas fault	Carol Prentice	SS, Western Earthquake Hazards	US Geological Survey
Demonstration and testing of near-surface geophysical instrumentation for watershed hydrological research	David Robinson Nigel Crook	SS, Geophysics SS, Geophysics	Stanford University Stanford University
Analysis and mapping of vegetation water content from remote and ground-based measures	Susan Ustin David Riaño Marco Trombetti	Fac, Land, Air & Water Res. PD, CSTARS GS	UC Davis UC Davis UC Davis & Univ. Basilicata (Italy)
Distribution of *Leptosiphon* on serpentine and sandstone soil	Lorna Watt	Plant Biology	Michigan State University



Jasper Ridge experienced an unusually cold and dry year in 2006–07, which made novel findings possible in research into such topics as the factors influencing *Dirca* fruit set and the effects of global change.

Appendix 2: Publications

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Barnard R, Le Roux X, Hungate BA, Cleland EE, Blankinship JC, Barthes L, Leadley PW. 2006. Several components of global change alter nitrifying and denitrifying activities in an annual grassland. Functional Ecology 20: 557–564.

Bohm BA, Rajakaruna N. 2006. The *Lasthenia californica* story: it started with flavonoids. Natural Product Communications 11: 1013–1022.

Cleland EE, Chiariello NR, Loarie SR, Mooney HA, Field CB. 2006. Diverse responses of phenology to global changes in a grassland ecosystem. Proceedings of the National Academy of Sciences (USA) 103: 13740–13744.

Cleland EE, Peters HA, Mooney HA, Field CB. 2006. Gastropod herbivory in response to elevated CO_2 and N deposition: impacts on plant community composition. Ecology 87: 686–694.

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Dukes JS, Shaw MR. 2007. Grassland responses to the changing atmosphere and climate. In: Stromberg M, Corbin J, D'Antonio C, editors. Ecology and Management of California Grasslands. Berkeley (CA): University of California Press. p. 218–229.

Graves WR, Schrader JR, Sharma J. 2006. Cold hardiness of the rare *Dirca occidentalis*: comparisons to *Dirca palustris* from disparate provenances. Journal of Environmental Horticulture 24: 169–172.

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Heller NE, Gordon DM. 2006. Seasonal spatial dynamics and causes of nest movement in colonies of the invasive Argentine ant (*Linepithema humile*). Ecological Entomology 31: 499–510.

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Henry HAL, Chiariello NR, Vitousek PM, Mooney HA, Field CB. 2006. Interactive effects of fire, elevated CO_2, and N deposition on a California annual grassland. Ecosystems 9: 1066–1075.

Heppner, CS. 2007. A dam problem: characterizing the upstream hydrologic and geomorphologic impacts of dams. Dissertation. Department of Geological and Environmental Sciences, Stanford University.

Hobbs RJ, Yates S, Mooney HA. Long-term data reveal complex dynamics in grassland in relation to climate and disturbance. Ecological Monographs (in press).

Menge DNL, Field CB. Simulated global changes alter phosphorus demand in annual grassland. Global Change Biology (in press).

Moore LA, Field CB. 2006. The effects of elevated atmospheric CO_2 on the amount and depth distribution of plant water uptake in a California annual grassland. Global Change Biology 12: 578–587.

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Oze C, Bird DK, Fendorf S. 2007. Genesis of hexavalent chromium from natural sources in soil and groundwater. Proceedings of the National Academy of Sciences (USA) 104: 6544–6549.

Pellet, J. 2007. Seasonal variation in detectability of butterflies surveyed with Pollard walks. Journal of Insect Conservation (in press).

Peters HA. 2007. The significance of small herbivores in structuring annual grassland. Journal of Vegetation Science 18: 175–182.

Peters HA, Cleland EE, Mooney HA, Field CB. 2006. Herbivore control of annual grassland composition in current and future environments. Ecology Letters 9: 86–94.

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Pieruschka R, Klimov D, Rascher U, Kolber ZS, Berry JA. 2007. Remote monitoring of photosynthetic efficiency using laser induced fluorescence transient (LIFT) technique. Proceedings of the 14th International Congress on Photosynthesis. Glasgow.

Preston KA, Cornwell WK, DeNoyer JL. 2006. Wood density and vessel traits as distinct correlates of ecological strategy in 51 California coast range angiosperms. New Phytologist 170: 807–818.

Wang Y-P, Houlton BZ, Field CB. 2007. A model of biogeochemical cycles of carbon, nitrogen, and phosphorus including symbiotic nitrogen fixation and phosphatase production. Global Biogeochemical Cycles 21: 1–15.

Yeh RB, Liao C, Klemmer SR, Guimbretiere F, Lee B, Kakaradov B, Stamberger J, Paepcke A. 2006. ButterflyNet: A mobile capture and access system for field biology research. Proceedings of the Conference on Human Factors in Computing Systems. http://dbpubs.stanford.edu:8090/pub/2006-3

Yu YY, Stamberger JA, Manoharan A, Paepcke A. 2006. EcoPod: a mobile tool for community-based biodiversity collection building. Joint Conference on Digital Libraries 2006: 244–253.

Zavaleta ES. 2006. Shrub establishment under experimental global changes in a California grassland. Plant Ecology 184: 53–63.

Zavaleta ES, Hulvey KB. 2006. Realistic variation in species composition affects grassland production, resource use and invasion resistance. Plant Ecology 188: 39–51.

Zavaleta ES, Kettley LS. 2006. Ecosystem change along a woody invasion chronosequence in a California annual grassland. Journal of Arid Environments 66: 290–306.

Appendix 3: Educational Use

Stanford University Classes (1320*)

ANTHSCI 3	Introduction to Prehistoric Archaeology (Rick)
APPPHYS 79	Energy Choices for the 21st Century (Geballe, Fox)
ARTSTUDI 179	Digital Art (Wight)
BIOSCI 33N	Conservation Science and Practice (Daily)
BIOSCI 44y	Core Experimental Laboratory for Ecology (Yelton, Malladi)
BIOSCI 96	Jasper Ridge Docent Training Class (Wilber, Vitousek)
BIOSCI 101	Ecology (Vitousek, Dirzo)
BIOSCI 125	Ecosystems of California (Mooney)
BIOSCI 164/264	Biosphere/Atmosphere Interactions (Field, Berry)
CASA 117	Archaeology of the American Southwest: Contemporary Peoples, Contemporary Debates (Wilcox)
CEE 207	Energy Resources (Woodward)
EARTHSYS 10	Introduction to Earth Systems (Ernst)
EARTHSYS 189	Field Studies in Earth Systems (Chiariello, et al.)
GEOPHYS 25	The First New Science of the Late Renaissance: Hands-on Introduction to Astrobiology (Sleep)
GES 175	Science of Soils (Fendorf)
HIST 53C	What Went Down on the Farm: Stanford Campus as a Conservation Science and Practice (Christensen)
ME222	Design for Sustainability (MacPherson)

Stanford Continuing Studies:

BOT 55	California Native Plants: An Introduction to Our Native Flora (Duvall)

Other College and University Classes (40*)

Santa Clara University: Civil Engineering
College of San Mateo: Introduction to Life Sciences
San Jose State University: Plant Communities of California

*Number of visits. One visit = one person entering preserve on one day. These numbers represent an underestimate; they do not include informal use or research use.

Stanford-Affiliated Groups (760*)

American Indian Science and Engineering Society (AISES)
Bechtel International Center
Bill Lane Center for the Study of the North American West
BioACT
Center for Advanced Study in the Behavioral Sciences
Department of Biological Sciences, Ecology and Evolution Faculty
Donner Dorm
Graduate School of Business
Graduate School of Business, alumni
Graduate School of Business, City Management and Urban Planning, Chinese Mayors
Internal Audit Department
Mexican American Student Organization
Office of Science Outreach, high school interns
Pi Beta Phi San Mateo
Stanford Club of Palo Alto
Stanford Community Day/JRBP Open House
Stanford Knitwit Club
Stanford Linear Accelerator Center (SLAC) and United States Geological Survey (USGS) Geologists
Stanford-Singapore Partnership Program
Stanford University Medical Center Alumni Association
Stanford University Medical Center, Office of Medical Development
Students for a Sustainable Stanford
Woods Institute for the Environment

K–12 Groups (503*)

Eastside School Field Studies
Environmental Volunteers
Woodside High Environmental Science Class
Woodside Priory School Ecology Class

Other Groups (1570*)

A Sense of Place
Año Nuevo Natural Reserve Docents
Association of American Geographers
Balance Center
Bridging the Rift
California Lichen Society
Canopy
Classic Residence by Hyatt
Conservation Strategy Fund
Ecological Society of America (ESA)
First Nations' Futures Institute
Insight Meditation Group
Island Conservation
MAP, Inc.
Menlo College
Midpeninsula Environmental Educators Alliance
Midpeninsula Regional Open Space District (MROSD)
National Audubon Society
Natural Capital Project
Northern California Association of Science Writers
Pacific Energy Center
Palo Alto Wastewater Treatment
Qinhuangdao City Mayor and Government Representatives
Rainbow Recreation
Rocky Mountain Biological Laboratory (RMBL) Board of Trustees
San Francisco Bay Bird Observatory (SFBBO)
San Francisquito Watershed Council, Management Advisory Committee
San Mateo County Fire Safe Committee
Strategies for Ecology Education, Development, and Sustainability (SEEDS), Ecological Society of America
St. Aidan's Episcopal Church
Sunnyvale Presbyterian Church
Town of Portola Valley Officials
University of California Natural Reserve System
Western Horticultural Society
Westridge Homeowner's Association

2006–07 Brown Bag Lunch Lectures

October: **Jon Christensen**
Graduate student, Stanford University; JRBP researcher
"Lost California: can historical ecology help piece together the fragments?"

November: **Peter Vitousek**
Clifford G. Morrison Professor in Population and Resource Studies, Stanford University; Senior Fellow at the Woods Institute for the Environment
"Beyond climate change: human alteration of element cycles and species distributions"

November: **Jérôme Pellet**
Postdoctoral researcher, Stanford University
"Butterflies of Jasper Ridge Biological Preserve"

December: **Carol Horvitz**
Professor, University of Miami
"Exotic removal restoration, research and management: after Hurricane Andrew"

January: **David Freyberg**
Associate professor, Stanford University
"A dam, a reservoir, creeks, and mud: hydrologic interactions at Searsville"

February: **Adina Paytan**
Assistant professor, Stanford University
"Submarine groundwater nutrient input and coral reef sustainability"

March: **Kenji Gjovig**
MBA, Graduate School of Business, Stanford University
"The greening of the Graduate School of Business (GSB)"

April: **Rodolfo Dirzo's lab,** Stanford University
"Medium and large mammal camera trapping" (Eduardo Mendoza, Yolanda Cachú); "Camera trapping: behavioral effects of observation" (Eric Abelson); "Small mammal genetics" (Rachel Adams); "Bio 75 tropical ecology in Mexico" (Posy Busby); "Brazil fruit sizes" (Camila Donatti)

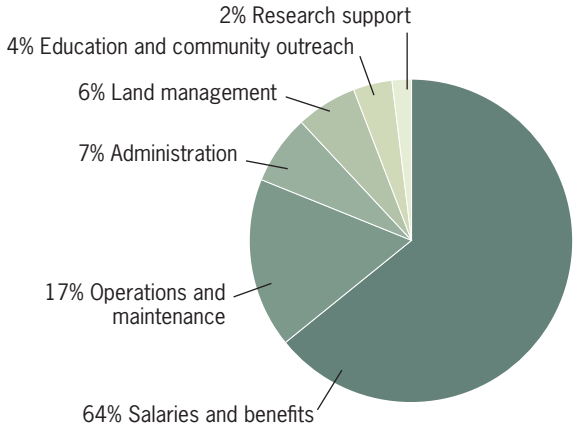
May: **Gary Schoolnik**
Professor, Stanford Medical School; Senior Fellow at the Woods Institute for the Environment
"Cholera: an ecological perspective on an infectious disease"

May: **Michele Minihane**
Graduate student, Stanford University
"Climate change and water resources in California"

Appendix 4: 2006–07 Financial Summary

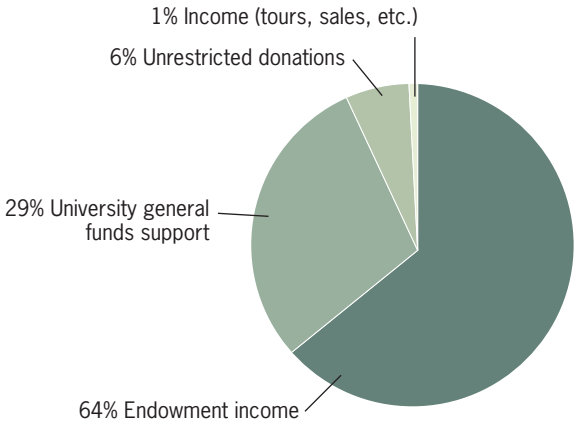
Expense summary

Salaries and benefits	$516,542
Operations and maintenance	137,476
Administration	54,759
Land management	47,775
Education and community outreach	30,279
Research support	17,835
Total	**$804,666**



Revenue summary

Endowment income	$518,814
University general funds support	232,536
Unrestricted donations	45,879
Income (tours, sales, etc.)	11,366
Total	**$808,595**



Appendix 5: Donors

Through most of its history, Jasper Ridge has been able to manage unanticipated challenges and respond in innovative and nimble fashion while supporting a high level of research and educational productivity. That flexibility rests upon the support the community of donors has provided over the years. We offer our sincere gratitude to our donors for your continuing generosity. The following is a list of those who made unrestricted gifts to the preserve from September 1, 2006 to August 31, 2007.

James and Anne Allen
Paul H., Jr., and Madeline L. Arnaud
Leonie F. Batkin
Nancy C. and Clayton W. Bavor
Monika B. and Olle Björkman
Sharon Brauman
Ross D. and JoAnn Bright
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Ruth Buneman
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Sueko and Gustav R. Williges
Paul B. and Jennefer L. Wineman
Woodside-Atherton Garden Club
Jane Woodward
John W. Working
Richard I. Yankwich

Professor David Kennedy with JRBP supporters Jean and Bill Lane at a lunch hosted by the Lanes for hikers "Walking the Farm" with professor Kennedy.[7]

Appendix 6: JRBP Affiliates

Eric Abelson
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Rachel Adams
Ann Akey
Kali Albright
Lluvia Alcázar
Mike Alyono
Kathryn Amatangelo
Christian Andreassi
Chris Andrews
Paul Arnaud
Ron Arps
Gregory Asner
Marianne Austin
Matthew Bahls
Monya Baker
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Sharon Brauman
Sheldon Breiner
Ross Bright
Eben Broadbent
Cara Brook
Irene Brown
Jamie Brown
Bob Buell
Gene Bulf
Mary Bulf
Ruth Buneman
Boyce Burge
Al Butner
Yolanda Cachú
Elizabeth Callaway
William Carmen
Charles Carter
Ted Chandik
Zoe Chandik
Andrew Chang
Mollie Chapman
Yair Chaver
Carl Cheney
Ta-chun Cho
Gina Choe
Jinyoung Choe
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Ting Fong May Chui
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Jean Clark
William Clark
Betsy Clebsch
Elsa Cleland
Robert Coleman
Richard Corelli
Toni Corelli
Will Cornwell
Jenny Creelman
Nigel Crook
Jamie Cundiff
Rig Currie
Gretchen Daily
Rick DeBenedetti
Allison Dedrick
Eva Dehlinger
Marge DeStaebler
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Judy Mason
Pam Matson
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Brigid McCormack
Sarah McMenamin
Darcy McPhee
Darcy McRose
Laura McVittie
Ethel Meece
Betsy Meehan
Sonny Mencher
Eduardo Mendoza
Jessica Mentzer
Tom Merigan
Katherine Mertes
Ted Mill
Linda Bea Miller
Michele Minihane
Harold Mooney
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Jonathan Owens
Andreas Paepcke
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Jérôme Pellet
Halton Peters
Katie Pickrell
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Engineering

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Computer Science

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Acterra

Pam Sturner
San Francisquito
Watershed Council

Regina Wallace-Jones
East Palo Alto

Susan Witebsky
Stanford Linear
Accelerator Center



Birding at Jasper Ridge

The goal of the Jasper Ridge bird monitoring program is to create a body of data that can be used to detect trends in many aspects of avian ecology, both within specific habitats and for JRBP as a whole. A hallmark of the program is the long-term commitment by over 20 expert birders, who conceived the program and have provided consistency and a collective memory. A number of the birders are also Jasper Ridge docents. Data from the program are relevant to questions about trends in diversity, population size, seasonal activity, migration patterns, and habitat associations of avian species.

Marion Smith and Ted Chandik performing a monthly point count at Jasper Ridge. All birds seen or heard within 40 meters of the marked point during a seven-minute period are recorded.

Jasper Ridge birder Phil Leighton leads a group of visiting birders during the San Francisco Bay Bird Observatory annual meeting at Jasper Ridge.

Tess Pierce
Roland Pieruschka
Chloe Pinkerton
Kevin Pitz
Patti Poindexter
Emily Pollina
Stephanie Porter
Ruth Porter (deceased)
Carol Prentice
Katherine Preston
Roberta Preu
Charles Preuss
Charles Quinn
Ted Raab
Mohan Rajasekar
John Rawlings
Margot Rawlins
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Nathan Sanders
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Jessica Shors
Seth Silverman
Gary Smith
Marion Smith
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Samantha Staley
Kathleen Starmer
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Marguerite Stevens
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Mindy Syfert
Matthew Sylvester
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Diane West-Bourke
Christopher White
Richard White
Erik Whitehorn
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Paul Wineman
Adam Wolf
Jane Woodward
John Working
Sunia Yang
Ron Yeh
Melanie Yelton
Pepper Yelton
Hillary Young
Carol Zabel
Shahin Zarafshar
Erika Zavaleta

JRBP Staff

Back, left to right:
Chris Field, PhD, faculty director
Cary Tronson, operations steward
Brooke Fabricant, resident ranger
Front, left to right:
Trevor Hébert, GIS and data manager
Philippe Cohen, PhD, administrative director
Leonard Robinson, resident caretaker
Cindy Wilber, education coordinator
Carolyn Taylor, administrative assistant
Nona Chiariello, PhD, research coordinator
Not pictured:
Deanna Messinger, resident ranger

Endnotes

1. Walking the Farm: http://daily.stanford.edu/article/2007/4/17/walkingTheFarm
2. JRBP research projects: http://jrbp.stanford.edu/db/projects/index.php
3. Carnegie Airborne Observatory: http://cao.stanford.edu/
4. NEON: http://www.neoninc.org/about-neon/overview.html
5. Eastside School: http://www.eastside.org
6. Make your own seismogram: http://www.ncedc.org/bdsn/make_seismogram.html
7. Walking the Farm: http://daily.stanford.edu/article/2007/4/17/walkingTheFarm

Photographs and illustrations

By page number:
Front cover CS **Inside front cover** DM
1 *top* DM; *bottom* EJ **2** *left* NC; *right* CA
3 *top* DM; *bottom* PC **4** *top* DM; *bottom* NC
5 *top left to right* DM, NC, NC;
bottom left to right PC, CA **6** *top strip* PC;
bottom LH **7** *left* PC; *insets top to bottom* NC,
NC, CT **8–13** NC **14** *top* NC; *bottom* CA
15 TH **16** NC **17** CW **18** *top left to right*
NC, CW, CW; *bottom* EJ **19** CW
20 *top strip* DM; *bottom* NC **21** *top* NC;
bottom CW; *insets* EA **22** *top* NC; *bottom*
NC/EJ **24** *left to right* NC, GJ, NC, GJ, NC,
WG **25** NC/EJ **26** *top* PC; *bottom left to right*
GJ, CW, NC, CS **27** *left to right* JM, PC, JM
28 TC **29** CW **30** *top* PC; *charts* PC/EJ
31 *top* JM; *bottom* NC **32** *top* TL; *bottom* DM
34 *top insets* CS; *left middle and bottom* TH;
right JM **35** DM **36** DM **Inside back cover**
left EJ; *right* DM **Back cover** TH

Initials used above:
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CS: Cagan H. Sekercioglu
CT: Cary Tronson
CW: Cindy Wilber
DM: Don Mason
EA: Eric Abelson
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GJ: Gerry Jennings
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TC: Toni Corelli
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In Memoriam

Lincoln Moses
1922–2006

Lincoln spent most of his professional life at Stanford, earning a bachelor's degree in 1941 and a doctorate in statistics in 1950. After joining the faculty in 1952, he became a leader for nearly 40 years in moving statistics from a purely academic discipline to the powerful applied field now known as biostatistics. He loved the central California hills and coast and knew them intimately, and was an avid backpacker who hiked the John Muir Trail. He became a Jasper Ridge docent in 1995 and worked on the bird census project and the ant research project. His connection to Jasper Ridge actually goes back to the late '50s: each summer the Statistics Department held a picnic at Searsville Lake, and the dry ice used to cool the food was a big draw for the children. His interests extended beyond California—he visited Zimbabwe several times to provide statistical consulting services to AIDS prevention programs, and he and his wife Mary Lou traveled the world in pursuit of birds.

Ruth Porter
1934–2006

Ruth's many contributions to Jasper Ridge Biological Preserve were made with a cheerfulness and efficiency that all who knew her will miss for a long time to come. A member of the 1976 docent class, she gained an extensive understanding of the preserve's natural history, with a particular focus on its flora. She became sought after as a teacher, committee member, and organizer. Perhaps most notably, she took on management of the several thousand plant specimens left to the preserve by Stanford professor John Thomas. With Toni Corelli, she shaped these into the Oakmead Herbarium and Collections in the Sun Field Station. Ruth was actively occupied with this work until the end of her life. She was dedicated, effective, and a wonderful friend.

About the covers

Front cover: Acorn woodpeckers (*Melanerpes formicivorus*) in the valley oaks just north of the JRBP main gate; photographed by Cagan H. Sekercioglu.

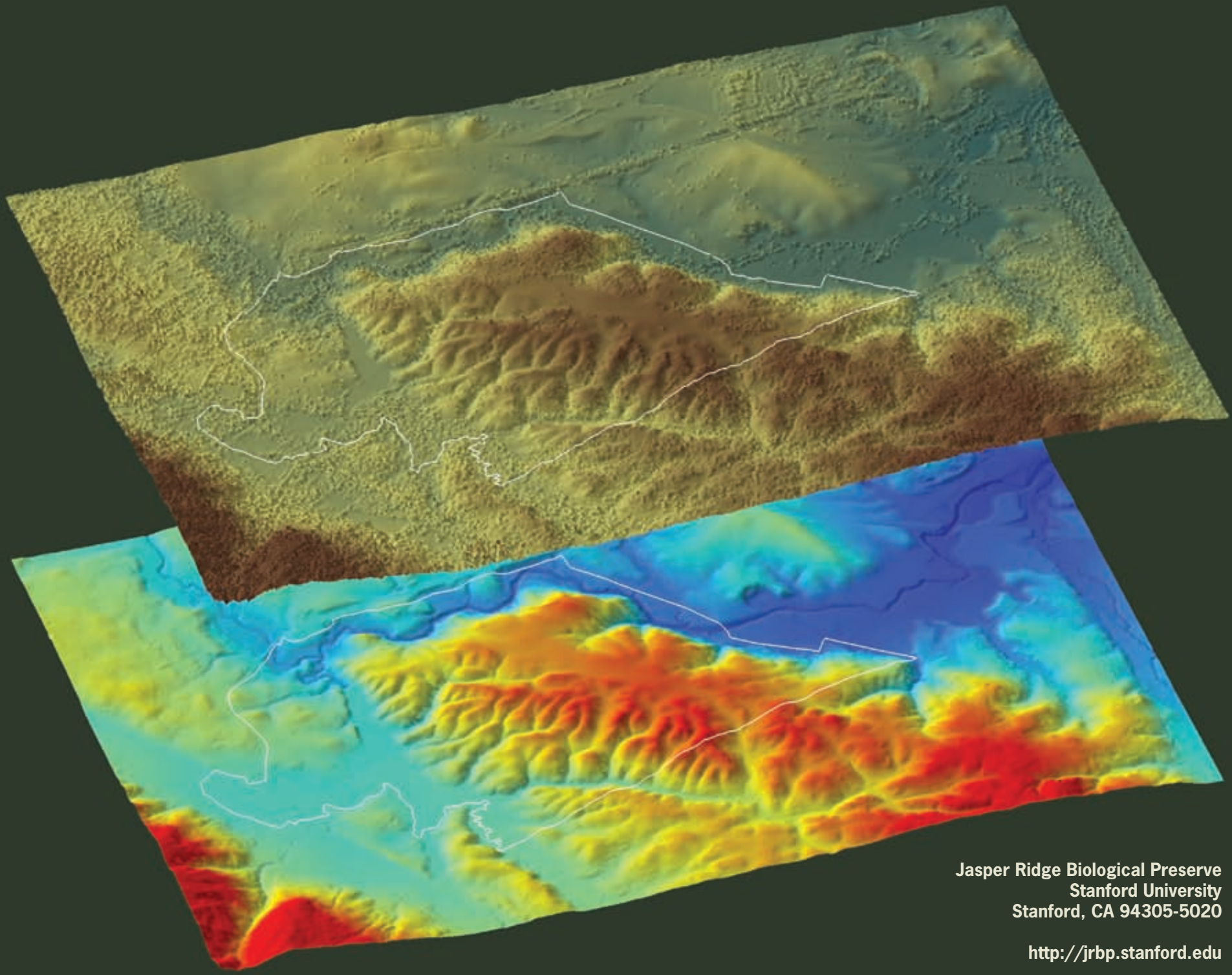
Back cover: Two shaded-relief elevation models, one depicting maximum vegetation cover height (*top*) and the other representing ground surface elevations without vegetation (*bottom*). The gradations of color indicate changes in elevation. The images were created from LiDAR point data obtained from HJW GeoSpatial of Oakland, California, which collected the data in support of a San Mateo county-wide mapping project. For more information about LiDAR, see page 15. The images were created by Trevor Hébert using ESRI ArcGIS and ENVI remote sensing software.

Etheline Robinson
1968–2006

In December 2006, Ethel lost her battle with lupus. Ethel was the seventh child of eight to Jasper Ridge caretaker Leonard Robinson and Bertha Robinson; she grew up on Jasper Ridge Biological Preserve with five brothers and two sisters. She graduated from Woodside High School in 1975. Despite bad health, Ethel continued her education, graduating from Bryman College in San Jose, California. She worked as a fashion coordinator and director of Positive Vibration clothing store in San Jose. Ethel's tireless work ethic and dedication to detail had a profound impact on everyone she touched. Ethel will be missed but never forgotten.

Tom Mudd
1942–2007

Tom was known by the Jasper Ridge community as a man of great wit, charm, craftsmanship, curiosity, and generosity. He combined these traits in his passion for bats as he set up a permanent acoustical monitoring station (and later, four more), trained high school students to collect data, led night-time bat walks, and interpreted a complex, five-year data set consisting of eight million bat calls. Tom was a Jasper Ridge docent and received three degrees from Stanford—a BS, and then a master's and PhD in engineering. This training shaped his approach to a career that spanned air pollution research, conservation, and wine-making, as well as his bat studies at JRBP. He imparted to us a fascination about bats and a monitoring network that will continue to elucidate the abundance and diversity of these vulnerable animals.



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