Jasper Ridge Biological Preserve

Annual Report 2003-04 · Stanford University

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.

From the Director

When I took my first ecology course in 1971, the research literature was composed almost exclusively of studies of organisms and ecosystems in "pristine" locations—an effort to understand the natural world unsullied and undistorted by the presence of humans. The existence of pristine systems may have been myth then and is certainly myth now. As was unequivocally illustrated in the 1997 Science article, *Human Domination of Earth's Ecosystems*: Many ecosystems are dominated directly by humanity, and no ecosystem on Earth's surface is free of pervasive human influence." (Vitousek, et al, Science 277: 494-499)

Whatever one's values or thoughts, the notion of a natural world unmarked by the hands of humans is quaint at best, and misleading in a time when human influences are global in scale and interwoven into the very fabric of habitats, watersheds, and biogeochemical cycles.

It is no longer accurate to think of humans as external agents that impact the environment. For better or for worse, we are integral components in the functioning of ecosystems. Understanding who we are as a species, how we pursue our own best interests, and how we will insure a future that protects our highest ideals demands that we look at the human enterprise as a sustainable part of the natural systems upon which we depend for so many essential services. If we only value nature to the extent that it is pristine, I fear that we will value far too little of this planet.

Replacing the "pristine system" perspective with a new model that incorporates humans as integral to the environment has many implications for how questions are formulated, how new challenges are approached, and what land management entails. For Jasper Ridge, that means understanding the urban presence of humans as an integral dimension of the Preserve. Events and activities from this past year demonstrate this shift with remarkable clarity.

Looking back, I am stunned by how much has taken place and the many important milestones that both trace the path of this past year and reflect our changing understanding of how we fit into the landscape. After reviewing a number of ongoing management issues, I will focus on the most significant expression of our changing perspective—the strategic planning effort conducted this past year.

One event that epitomizes the complexity of managing ecosystems that are integral components of an urbanizing landscape was the arrival of West Nile Virus (WNV) to the region. Historically, the Preserve has worked with the county mosquito abatement district to employ larvicides in an effort to reduce mosquito populations, the WNV vector. However, with increasing media and public attention on this new invader, this spraying has become more aggressive and now covers the entire Searsville Lake system. Particularly problematic is that the Preserve must bear the costs of this expanded activity. Since the wetlands are difficult to access on foot, the larvicide treatments must be applied by helicopter.

These costs are significant and it appears that this will be an on-going component of managing Jasper Ridge Biological Preserve and any aquatic or wetland habitat within a human-dominated landscape.

Even now, as we struggle with how best to manage mosquito abatement in the wetlands, it is in reference to a habitat with a history of larvicide use and a long complex history of human activities. The presence of Searsville Lake and the size of the associated wetlands are closely connected to Searsville Dam. Searsville Dam—although an "artificial" structure—is itself fully integrated into the current hydrological, ecological, political, and social structure of its watershed. In other words, the management goals for the watershed can't be cast in terms of protecting pristine/natural habitat. Rather, the continued presence of the wetlands or any other component of the Searsville Reservoir system rely on the human aspirations and activities we choose to value most.

Another continuing challenge faced by the Preserve is that of fire and managing associated risks. The Preserve has been proactive as we reach out to local communities, planning commissions, city and county representatives, and other groups to discuss and exchange ideas about risk reduction. We now dedicate the last two weeks of June to tours for local fire crews. This past year, Preserve staff and docents helped familiarize 18 fire crews from 3 different responding districts with Preserve roads, habitats, infrastructure, and program activities. In addition, the Preserve has partnered with the San Mateo County Fire Safe Committee to make presentations to planning commissions, city councils, and county representatives to educate them about how their decisions impact both future risk from fire and the resulting effects on land use. For instance, allowing a new house to be built within 100 feet of a natural area boundary near a steep slope assures that in the future there will be conflicts as the homeowner tries to create a defensible space (in order to qualify for fire insurance and properly protect the home) by intruding into the natural area. By being proactive in educating and reaching out to neighboring communities, we can begin to shrink the range of potential conflicts between adjacent land uses and the Preserve, as well as other open space lands.

In a different arena and on a larger scale, this past spring I participated in a Congressional Visits Day sponsored by the American Institute of Biological Sciences (AIBS). I was one of five members of the Organization of Biological Field Stations invited to participate in this effort to educate members of Congress and their staffs about the importance of basic research in the field sciences. Personally, this was an enlightening experience and exposed me to the profound need

to further educate the public about how science operates, the many benefits that accrue from basic research, and its importance for insuring a sustainable future. Of course, I was well armed with statistics, anecdotes, and other important information to make our case. I hope to participate in a repeat of this effort in the coming year.

But whether in Washington, D.C. or working with local fire districts, my focus is the future sustainability of Jasper Ridge. In that regard, the strategic planning effort was of paramount importance. But before diving into a summary of the findings of the strategic plan and external reviewer comments, I want to note that one of the more inspiring changes this past year has been the beginning of a new tradition of displaying the art work of members of the Jasper Ridge community. Specifically, this past year, we have displayed the paintings of Carol Hake and the line drawings of Chris Andrews. Many others and I have derived enormous satisfaction and delight in seeing their talent and creativity adorning the walls of the Sun Field Station.

The Strategic Planning Committee, composed of faculty, staff, graduate students, and docents was tasked with enhancing JRBP's record of success by providing guidance for its effective management over the next several decades. The External Review Committee, composed of five nationally distinguished environmental scholars, visited the Preserve in early June and was asked to review the draft of the strategic plan, the vision articulated by the plan, and to evaluate current operations. The final Strategic Planning Committee report, including incorporation of the External Review Committee findings and recommendations, was completed this past year and I am convinced the resulting report will help assure that the Preserve will continue its tradition of world-class research and education while also protecting its resources.

To give a feel for the tone and approach of the Strategic Planning Committee as well as the External Review Committee, I have highlighted some of the specific recommendations of the draft strategic plan. For a more in-depth review, the report is available at jasper1.stanford.edu/home/stratplan.html. We began by taking a critical look at Jasper Ridge Biological Preserve's mission to contribute to the understanding of the Earth's natural systems through research, education, and protection of the Preserve's resources. The three elements of the mission—research, education, and conservation—have historically been viewed as interdependent in the sense that research and education ultimately depend on the long-term health of the Preserve's ecosystems. Faced by increasing demands from research, education, and a location within an urbanizing landscape, it is not always obvious which strategies are best suited for fulfilling this mission. For this reason, one of my first new endeavors upon moving into the completed Leslie Shao-ming Sun Field Station was the formation of a Strategic Planning Committee.

In sharpening the focus of the Preserve's mission, both the Strategic Planning Committee and the External Review Committee recommended greater integration through a new perspective that emphasizes scientific discovery as both the core of the Preserve's mission and the focus for connecting and strengthening all aspects of the mission. They also clarified that the role of the Preserve is to provide and sustain a research environment, not to set a future research agenda. The research environment should be one that places a high priority on significant research, adheres to a philosophy of sustainability, engages the community in studying land management issues, and renews the value of past research through data management and access policies.

Two of the major recommendations concern data management. These included building a knowledge base for long-term research and management and assessing the current state of the Preserve's natural and

historical resources to provide a reference point for future research and management. The Strategic Planning Committee recommended that the above should be undertaken together, so that the methods and focus of the assessment build on the results of previous studies. This updating and integrating of both natural resources and information resources maintains and strengthens the connections between research, education, and conservation by serving as a basis for future research, a baseline for future assessments, and a guidepost for management activities. A "State of the Preserve" assessment would also contribute to determining the level of activity the Preserve can support—its "programmatic carrying capacity." Research at the Preserve dates back to the founding of the University and provides important benchmarks for interpreting current and future studies. Making this archive and assessment accessible also enhances the conservation value of the research activities taking place at the Preserve.

Another important and far-reaching recommendation is the call to increase the priority of undergraduate research opportunities at the Preserve. Both Committees strongly recommended that Jasper Ridge work with the University to explore a variety of approaches for increasing both independent undergraduate projects and undergraduate participation in established projects. It was also noted that the Preserve is ideally suited for establishing a program to provide students with hands-on experience in resource management. The Committee recommended that the training of the docents be further integrated into this enhanced education and research mission.

The Committees also made several organizational recommendations, including appointment of a faculty director, enhancing the Jasper Ridge Committee, and the creation of additional committees.

Establishing a Faculty Director position was viewed as essential in order for the Preserve to have an academic spokesperson within the University, and specifically, within the Faculty Senate. Such a person would lead efforts to translate broad strategic plans into specific objectives for research, education, and conservation without being encumbered by the day-to-day operations and management of the Preserve.

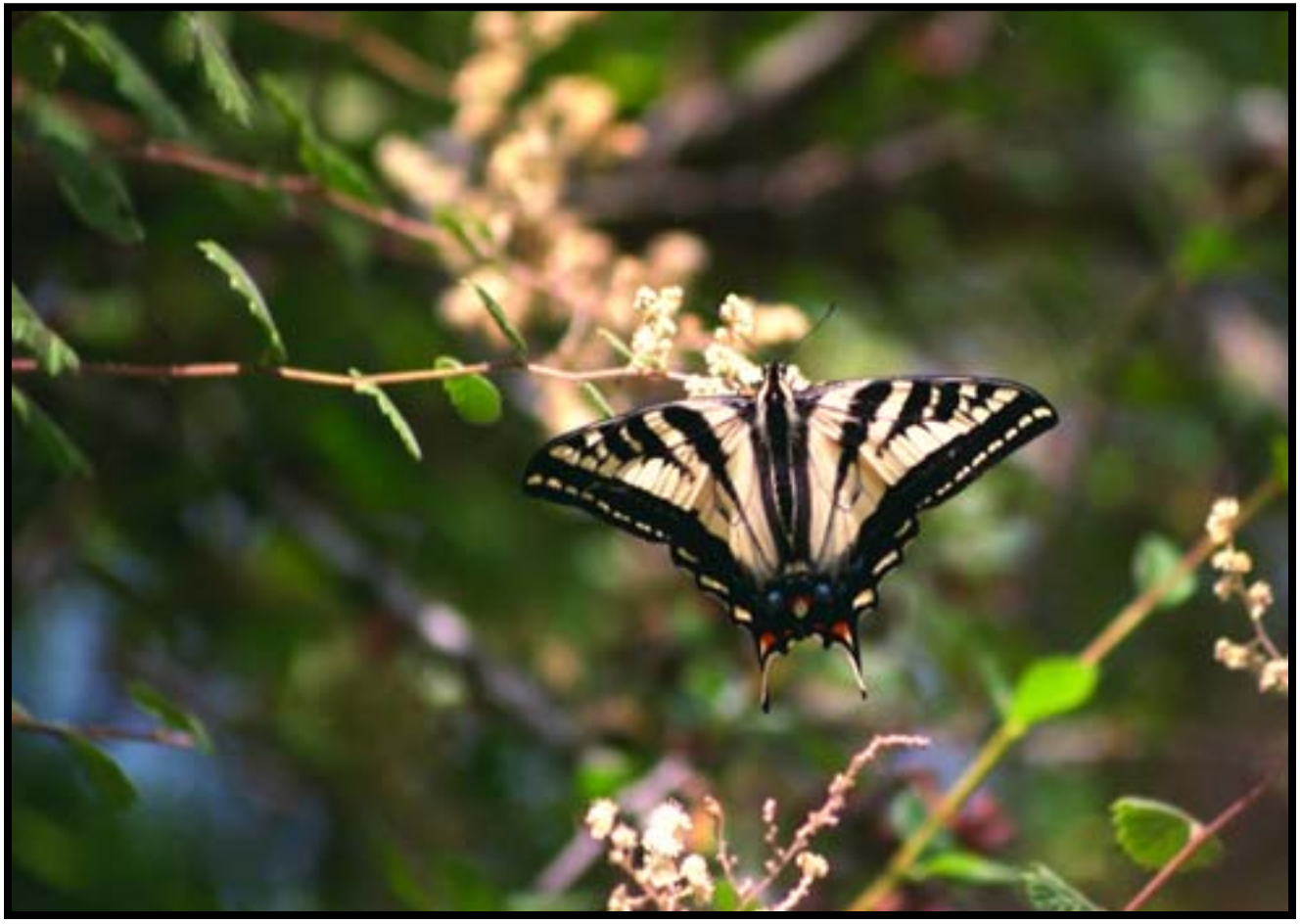
The Jasper Ridge Biological Preserve Committee would also be enhanced by broadening its membership within the University in order to play a more active role in assuring that research and education programs are better integrated with related programs on campus. One of the new committees recommended would be designed to provide a forum for various stakeholders (docents, researchers, students, neighbors, fire districts, water districts, local officials, fish & wildlife agencies, etc.) to clarify management is-

sues facing Jasper Ridge, and identify officials that should be included in the forum such as officials from the University, counties, cities, etc. This committee would serve as a conduit of information on imminent issues as well as a forum for coordinating responses to a range of threats and opportunities.

There were many other insightful recommendations. I was especially pleased that the Strategic Planning and External Review Committees immediately and intuitively grasped the immense challenges and opportunities entailed in the Preserve's urban/wildland interface. Keep in mind that both the Committees were enthusiastic in their support and assessment of the Preserve to date. Their efforts were targeted at enhancing the Preserve's already impressive record of success by providing guidance for its effective management over the next several decades.

I want to thank all those who gave so much of their time and energy to develop the strategic plan and to the members of the External Review Committee (for detailed information about committee members and background, please visit jasper1.stanford.edu/home/erc.html). Their commitment, insights, and recommendations have significantly impacted my own thinking about Jasper Ridge and will solidify the Preserve's success in future years.

On a more personal note, this entire effort was exciting, challenging, and anxiety producing. When I first embarked on this adventure, I knew there would be times when I would inevitably be faced with my own parochial constraints—bounded by what is familiar and my eleven years of negotiating success within the status quo. When all was said and done, I was surprised and amazed by the creativity, vision, commitment, and passion demonstrated by the authors of the reports. I have been involved in several strategic planning efforts at other field stations, and I can say that the products of this effort are the finest I have encountered. I am honored to have been part of the process and to be in a position to see many of the recommendations take hold.



Research activity, during the 2003-04 year, included sixty-seven studies that ranged from molecular biology to geophysics. More than half of the year's studies were part of large research programs that have been active for five years or longer. In total, this year's research involved 62 scientists and 23 students from Stanford University and 19 other institutions (Appendix 1). Thirty-four papers were published or accepted for publication (Appendix 2).

Some themes stand out in the year's accomplishments. One is the importance of research by graduate students and postdoctoral fellows, which is reflected in their senior authorship on a majority of the year's publications. A second is the pioneering nature of research at JRBP, as evidenced by three new grants for studies that could scarcely have been imagined a dozen years ago. Finally, the publication of a major synthesis volume on checkerspot butterflies by Paul Ehrlich (Stanford) and colleagues, many of whom summarize their work at JRBP, illustrates one of the long-term rewards to scientific pioneers.

The Global Change Experiment

The Jasper Ridge Global Change Experiment (JRGCE) completed its seventh year of studying grassland responses to four global environmental changes: elevated CO_2, temperature, precipitation, and nitrogen deposition. The study is directed by Chris Field, Shauna Somerville (Carnegie Instit.), Brendan Bohannan, Hal Mooney, Peter Vitousek (Stanford), and Jim Tiedje (Michigan State Univ.), and included over thirty collaborating faculty, students, postdoctoral fellows, and technicians. Their studies examine responses from the molecular to the ecosystem level, and are funded by the National Science Foundation and the David and Lucile Packard Foundation.

A major focus of the year was the belowground environment, especially the way microbes metabolize substrates ranging from substances exuded by plant roots to breakdown products of litter decomposition. Metabolic properties constitute an ecologically meaningful way of looking at microbial diversity and adaptation, and are key to ecosystem processes such as long-term storage of carbon in the soil and regulation of nutrient availability for plant growth. Seven laboratories are contributing to this aspect of the JRGCE.

Studies led by Brendan Bohannan (Stanford) and Bruce Hungate (Northern Arizona Univ.) are yielding one of the most integrated pictures of belowground function and microbial diversity obtained for any single ecosystem. Bohannan's lab has documented a remarkable diversity of bacterial genes associated with oxidation of methane and ammonia, key steps in the cycling of carbon and nitrogen. One lineage of ammonia oxidizers that is abundant in plots with added nitrogen also occurs in nutrient-rich environments elsewhere, suggesting adaptation to this type of habitat. Bohannan received a new, three-year Frank E. Terman Fellowship for these studies, and postdoc Sharon Avrahami joined the team.

Complementary studies on soil microorganisms were started by Teri Balser (Univ. Wisconsin) and postdoc Stephan Gantner (Michigan State Univ.). Balser and her student Jessica Mentzer are using signature phospholipid compounds from microbial membranes to reveal both the identity of microorganisms as well as their role in the carbon cycle. Gantner is determining the identity of bacteria that consume particular carbon compounds, using a novel technique that labels the bacterial DNA whenever certain compounds are consumed.

To relate microbial diversity to ecosystem processes, the Bohannan and Hungate labs tracked metabolic activity in the field. Paul Dijkstra (Northern Arizona Univ.) organized multi-day measurements of how much methane, CO_2, and nitrous oxide are released or consumed by soil under the different treatments. These "trace gases" have low atmospheric concentrations but are nonetheless important controllers of climate and atmospheric pollution. To help confirm major results, PhD student Joey Blankinship studied the same gas fluxes in field soils under controlled incubations in the laboratory.

Stable isotopes provide another way to track nitrogen and carbon in the ecosystem. Using ^{15}N, Hungate's group has found that under elevated water or nitrogen, competition for nitrogen shifts in favor of plants, reducing microbial uptake, while under elevated heat or CO_2, microbes are favored. For combinations of treatments that include elevated CO_2, masters student John Juarez and PhD student Lisa Moore used ^{13}C to track carbon turnover in the soil, a measure of the average time carbon is retained before being respired. Juarez's results on carbon in the soil, and Moore's results on carbon loss, together indicate that carbon turnover under elevated CO_2 is accelerated by water addition. The plant component of CO_2 exchange was also studied by PhD student Claire Lunch, who fine-tuned the devices for measuring rates of carbon dioxide and water vapor exchange by the ecosystem, and began monitoring in spring. Stanford undergrad Wing Man Yeung analyzed root abundance in belowground digital images.

A second major focus of the year was understanding how plants adjust to the global change treatments through changes in the genes they express. Sue Thayer and Shauna Somerville (Carnegie Instit.) began this study several years ago, and their enormous progress was recognized with a new National Science Foundation grant to expand their study. Using microarray technology for *Arabidopsis thaliana*, a model system in plant molecular biology, Thayer found that over 5,000 genes in the common forb *Geranium dissectum* responded to one or more global change factors, often with coordinated changes in genes that code for enzymes of well-studied metabolic pathways. Added water, for example, caused many genes to be downregulated, especially those related to drought, desiccation, and senescence. Postdoc Sam St. Clair joined the lab to investigate responses in a common grass, *Avena barbata*.

Studies this year also focused on why elevated CO_2, under some conditions, dampens increases in plant production induced by other global change factors. In 2004, for example, nitrogen addition increased plant production under ambient CO_2 by a third, but had no effect under elevated CO_2. PhD student Elsa Cleland and postdoc Hugh Henry traced several lines of evidence that point to changes in phosphorus cycling. Cleland found that elevated CO_2 slows the release of phosphorus from decomposing plant litter, while Henry identified chemical properties that make the litter less decomposable. Over time, slower decomposition of litter may lead to phosphorus limitation.

A test of the phosphorus-limitation hypothesis was made possible when plant litter was converted to ash by the wildfire that burned a quarter of the JRGCE in July 2003. Hugh Henry found that as the grassland regenerated from buried seeds, elevated CO_2 amplified (rather than dampened) the growth response to nitrogen, and plant tissues had

higher phosphorus levels. While these results suggest the fire relieved phosphorus limitation, other explanations are also being studied.

Changes in the nutrient balance of grasses, forbs, and legumes alter their relative palatability to herbivores. Halton Peters' dissertation concluded that the grassland is something of a salad bar to gastropods (slugs and snails), which eat enough tissue, and vary their preferences sufficiently across treatments, that their feeding accounts for most of the changes in plant community observed in the JRGCE treatments. The main exception was the heated treatment, which may have impacted the gastropods themselves so severely that changes in food plants were less relevant.

Imagine what would happen if a plant that responds strongly to global changes is also a delicacy to herbivores—as appears to be the case for an invasive, yellow starthistle. Jeff Dukes (Univ. of Massachusetts, Boston) and Scott Loarie sowed yellow starthistle inside protective cages in all of the JRGCE plots, and found that plants under elevated CO_2 grew to be six-fold bigger than plants under ambient CO_2, while unprotected starthistle plants in separate test plots were all eaten. Thus herbivory can alter, or even eliminate, potentially large ecosystem responses.

Another starthistle experiment was completed by Erika Zavaleta and Kris Hulvey (U.C. Santa Cruz). In large pots, they grew plant communities that reflected the reduced diversity observed under some global change treatments, and found that these non-random losses of diversity facilitated growth of starthistle, even without the global change treatments. Hulvey's dissertation work will follow up this result.

Results from the JRGCE illustrate the diverse, complex, and interacting effects of realistic global environmental changes. To synthesize results and identify causal pathways, two new projects started this year. Lisa Moore led a collaboration with ecosystem modelers at the Univ. of Alberta to adapt their model to Jasper Ridge, and Ying Ping Wang (CSIRO, Australia) used data from the eddy flux station to model the JRGCE results. Both efforts seek to identify critical gaps in knowledge and suggest new hypotheses and experiments.

Argentine Ant Invasion

Since 1993, Deborah Gordon's lab (Stanford) has tracked the invasion of JRBP by Argentine ants, a nearly unstoppable species whose effects in California include indirect damage to crops and threats to the native ant fauna of natural communities. This year's results present new challenges to the prevailing dogma for the ants' success as invaders. Several of these discoveries deal with colony structure, a term that incorporates nest density, ant density, and the behavioral interactions among ants of different nests.

Understanding the invasiveness of a non-native species often boils down to identifying constraints in the native habitat that are missing in new habitats. Some researchers have argued that Argentine ant colonies in their native habitat fight so much with each other that it reduces their impacts to the biotic community, allowing other ant species to persist. As part of her PhD dissertation, Nicole Heller tested this theory by comparing Argentine ant colonies in parts of northeast Argentina with colonies at Jasper Ridge and the Stanford campus. Contrary to the theory, Argentine ants in nearly all sites of both regions were uni-colonial; they occupied multiple, interconnected nests with little aggression among them. Nonetheless, native ant diversity was higher in Argentina than in California, so colony structure alone cannot explain the Argentine ants' devastating impacts on other ant species at JRBP. In addition, Heller's studies have shown that the concept of an ever-expanding Argentine ant supercolony is also incorrect. Instead, each colony tends to aggregate in winter and disperse in the summer, in a cycle that is shaped by weather. Heller was awarded a Switzer Environmental Fellowship in 2004 for her studies.

An honors thesis by Arietta Fleming-Davies highlights the spatial complexity of interactions between native and Argentine ants.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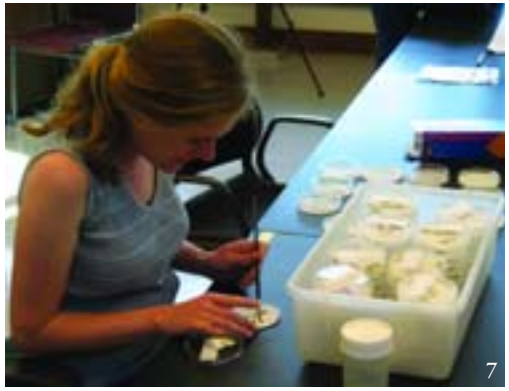
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1. *Undergrad Wing Man Yeung analyzing root abundance in digital photographs of root profiles from the Global Change Experiment. The study was part of a summer research internship in Biological Sciences.*

2. *Kathleen Brizgys monitoring soil moisture using a personal digital assistant to operate a device, similar to a cable tester, which connects to a pair of steel rods in the soil.*

3. *Jeff Dukes locating starthistle plants he sowed into the Global Change Experiment. Measurements of height, and later on, dry mass, were used to assess responses to the treatments and herbivory.*

4. *PhD student Joey Blankinship preparing hundreds of incubation bottles for laboratory-based studies of trace gas fluxes of grassland soils.*

5. *John Juarez recording data as Olivia Sinaiko and Todd Tobeck census biodiversity in the Global Change Experiment.*

6. *After a summer working with the USDA Forest Service mapping Sudden Oak Death (SOD) in California, senior Ian Monroe applies his skills at JRBP by mapping, examining, and testing trees to see whether and where SOD might be present along San Francisquito Creek. None of his samples tested positive. Since graduating, Ian has shifted gears from SOD research to general watershed management.*

7. *Jeannie Stamberger monitoring survival and changes in weight of ringlet butterfly larvae in a study of food preference she conducted with fellow PhD student Halton Peters.*

8. *Simon Klemperer demonstrating his hands-on approach to research by digging the trenches for new sensors that monitor the Earth's electromagnetic field.*

9. *Reyes Tirado characterizing the light environment of chaparral understory using a device that records what fraction of a light-sensitive bar is well-lit. Shade ameliorates the environment on dry, South-facing slopes, enabling seedlings of holly-leaved cherry to persist.*

10. *Preparing for studies monitoring uptake and release of trace gases, Brendan Bohannan tests chambers and air sampling protocols.*

11. *Ted Mill observing high school student Matthew Prior's technique in using a reflecting disk as part of their study monitoring the clarity of Searsville Lake water.*

She found that in study sites where native and Argentine ants both occurred, their foraging activities were confined to separate shrubs. Argentine ants did not appear to exclude native ants by outcompeting them for food.

Postdoc Krista Ingram's work casts doubt on another theory about Argentine ants—that the invasion in California is essentially one enormous supercolony of genetically homogenous ants. Analysis of microsatellite DNA has revealed significant genetic differences between nests that are inside JRBP and nests that are, literally, just across the road. This suggests that the appearance of one continuous colony might result from separate colonies having expanded until they reached a common boundary, such as the paved Sand Hill Road.

Colony structure may even be shaped by organisms that live inside the ants. The endosymbiont *Wolbachia* is common in ants, but its effects are known only for other arthropods. If present in Argentine ants, *Wolbachia* might affect multiple aspects of the ants' reproduction and spread, including the relatedness of colonies. This summer, masters student Patrick Hsieh began screening for *Wolbachia* in several species of ants, and found it in one ant species (*Formica moki*) both at JRBP and on campus. A joint Stanford/Mellon Foundation grant program, which provides small grants to most students conducting research at JRBP, has funded Hsieh to continue the screening.

PhD student Jessica Shors joined the Gordon lab and will continue the Argentine ant survey in the coming year.

Chaparral Ecophysiology

Continuing seven years of studies of chaparral ecophysiology and evolutionary diversity, two new studies were started by members of David Ackerly's lab. Both draw on Ackerly's conceptual model of adaptation, which is based on correlations among physiological traits, natural disturbances, and modes of regeneration.

Postdoc Reyes Tirado began a study of holly-leaved cherry, *Prunus ilicifolia*, whose distribution provides a good test for conceptual models. *P. ilicifolia* is common in the understory across much of the chaparral, but as a canopy species, it is far more common on mesic, North-facing slopes than dry, South-facing slopes. Tirado is testing whether *P. ilicifolia*'s physiological limits require dual modes of regeneration—burl sprouting and seedling banks—in order to take advantage of canopy openings resulting from natural disturbances.

Recently scientists have begun to ask whether disturbances can be promoted by the plants themselves, and PhD student Peter Cowan is applying this question to chaparral and fire. This year, Cowan began testing a hypothesis posed by former Ackerly student, Dylan Schwilk, who reasoned that plant traits contributing to flammability should be more characteristic of species that regenerate via seed germination than of species that resprout from a burl. Traits contributing to flammability might include thin branches with small leaves of low water content. Cowan is testing whether such traits are more typical of three chaparral species that are "seeders" than of three "sprouters." His test is strengthened by the fact that some flammability traits are hard to explain in other ways, as they would worsen the plants' susceptibility to drought.

At the Ecological Society of America meeting this year, PhD student Will Cornwell was recognized for "significant advancements in physiological ecology" for his presentation on plant functional diversity. In June, Postdoc Nishanta Rajakaruna became an assistant professor of Botany at his alma mater, the College of the Atlantic.

Hydrology

Hydrologic studies continued to monitor multiple processes in the San Francisquito and Searsville Lake watersheds, and installed new monitoring equipment in several key points.

Upstream of Searsville Lake and JRBP, Barry Hecht, Jonathan Owens, and Chris White (Balance Hydrologics, Inc.) completed their ninth year of monitoring stream flow and sediment in Corte Madera Creek, the largest creek in the Searsville watershed. In wetland areas nearer the Lake, David Freyberg

(Stanford) and PhD student Christie May installed additional piezometers to expand their spatial picture of ground water changes. The results will contribute to Freyberg's model of ground water flow.

Where Bear Creek enters JRBP, the Balance team installed a permanent stream gage that continuously monitors stream flow and specific conductance. It is the fourth station in the Long Term Monitoring and Assessment Program for the San Francisquito Watershed, which also gathers water quality data to detect and evaluate diverse contaminants with the goal of reducing pollutant levels.

New monitoring was also added to Ted Mill's (SRI) long-term studies of the photochemistry of Searsville Lake water. Since June, high school junior Matthew Prior has collected both field data and samples for assessing relationships between the quantity of suspended sediment and *in situ* optical properties of lake water.

Geophysics and Computer Science

The National Science Foundation funded two additional awards this year for studies at Jasper Ridge. Simon Klemperer (Stanford) received a new grant that allows him, along with collaborators Darcy McPhee and Jonathan Glen (USGS), to upgrade and expand their electromagnetic monitoring. The goal is to test whether, and how, changes in the Earth's electrical and magnetic fields precede—and might be used to predict—earthquakes. The monitoring at JRBP coordinates with the Jasper Ridge seismic station, which is maintained by Bill Karavas (U.C. Berkeley) as part of the Berkeley Digital Seismic Network. The seismic station provides conventional and highly sensitive earthquake detection, and allows Klemperer to distinguish electromagnetic fields caused by shaking of the sensors from fields created in the Earth. Both programs transmit continuously to a public data archive.

A new grant from the National Science Foundation was also awarded to computer scientists Hector Garcia-Molina and Andreas Paepcke (Stanford) to collaborate with biologists, and involve students, in developing new ways of acquiring, curating, and disseminating biological data. The program includes Rodolfo Dirzo (Stanford) and postdoc Karina Boege, who will set up a network of motion- and heat-activated cameras to monitor large mammals. Computer science students will also participate in other research and educational programs at JRBP.

We congratulate the research community on these new grants, on the year's many achievements, and on the prospects for continued pioneering studies by both scientists and students.

Education and Docent Program Highlights

During academic year 2003-04 Jasper Ridge Biological Preserve hosted a broad range of classes, lectures, workshops, outreach partnerships, and both formal and informal educational opportunities. Stanford University classes included the Jasper Ridge Docent Training Class (Biology 96AB), Core Experimental Laboratory for Ecology (Biology 44Y), Science of Soils (GES 175), Introduction to Earth Systems (Earth Systems 10), Island Ecology (Biology 16), Biology and Global Change (Biology 117), Ecosystems of California (Biology 125), Sophomore College, Quest Scholars Program, and others. The JRBP community profited from continuing education opportunities that ranged from the October 2003 field trip to the Kenneth S. Norris Rancho Marino Reserve in Cambria, California to monthly brown bag research discussions, and focused field review hikes on a variety of topics. Additionally, teacher workshops, international conservation groups, and numerous science outreach programs contributed to a very busy educational year at the Preserve. For a complete list of instructional use of the Preserve by classes and organizations see Appendix 3.

In recent years, partnerships have fostered new avenues for education at the Preserve and this trend continued to thrive in 2003-04. The ongoing liaison with the Stanford Teacher Education Program (STEP) provides an effective framework for researchers and graduate students to work directly with local teachers as well as STEP student teachers and has resulted in a network of ecology outreach professionals who teach thousands of students each year.

Hydrologist and instructor Gary Kittleson examining sediment size with the 2004 Jasper Ridge Docent Training Class in Corte Madera marsh.

The Jasper Ridge Global Change Experiment (JRGCE) began an ecology outreach partnership with Woodside High School in 2002 that continues to connect climate change researchers with local ecology students. JRGCE participants Nona Chiariello, Chris Field, and Bill Gomez developed an interactive curriculum based on current questions and lectured in Ann Akey's Environmental Studies classes. In April 2004, the students visited the JRGCE for demonstrations and field contact with researchers, and were able to independently analyze field data such as digital images of root growth. The goal of the JRGCE outreach is to provide science training through curriculum support, demonstration tours, field exercises, opportunities to analyze field data, and internship positions.

Beginning in June 2004, two local high school students, Matt Prior of Gunn High School and Tim Sun of Menlo High School assisted with research projects at the Preserve. Matt Prior worked with Ted Mill of SRI, in a project on Searsville Lake, and Tim Sun worked with researcher Peter Cowan in a study that examined the relationship between post-fire seed germination and plant flammability.


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1. *Biology 96 student Christine George testing water potential of chaparral plants with the help of researcher Radika Bhaskar.*

2. *Biology 44Y student Bob Moulton setting sampling plates for a macroinvertebrate study examining pools with and without filamentous algae.*

3. *California sea otter researcher Christine Alfano discussing her work with Jasper Ridge docents during the October 2003 field trip to Cambria, California.*

4. *Raihaana Ali from Trinidad and John Sengo from Papua New Guinea, along with representatives from 15 countries, visited the Preserve as part of the Conservation Strategy Fund's International Training.*

5. *Students from Woodside High School's Environmental Studies class learn how to take spectral measurements of aboveground vegetation as part of a partnership with the Jasper Ridge Global Change Experiment.*

6. *Eastside School students identifying and recording invertebrate species in the oak grassland.*

7. *Docent and Biology 96 instructor Gary Smith training Cary Tronson and Charles Carter on how to use the Global Positioning System equipment.*

8. *A very special 2004 wildflower tour with Cindy Wilber, Bill Kirsher, Ed Fryer, and Maria Comsa.*

9. *SUCCESS (Stanford's Ultimate Choice Camp for Exciting Summer Science) participants from Belle Haven School, their Stanford student mentors, and Laura Jones in front of the tule hut they constructed during their archaeology workshop.*

In 2003-04 Jasper Ridge researcher Dylan Schwilk worked together with faculty and students of the Woodside Priory High School to conduct a post-fire herbivory study at the Preserve. The students in teacher Hovey Clark's Advanced Placement Ecology class investigated the effect of rabbit and deer herbivory on grassland community composition in a two-factor experiment: 1) burned and unburned grassland and 2) enclosed and non-enclosed plots. The students constructed the wire exclosures and placed them at the site of an accidental burn that occurred in July 2003. Students conducted plant censuses of the plots in November 2003, February 2004, and April 2004. Schwilk, a postdoctoral fellow in David Ackerly's lab, assisted the students on the design and implementation of their study. In 2004-05, Priory students will study the San Francisquito watershed, with an emphasis on the tributaries that drain into the Corte Madera creek that flows through both the Priory campus and the Preserve.

During spring quarter 2004, students from Eastside College Preparatory School again worked side by side with their Stanford student mentors (Jasper Ridge docents Molly Aeck, Lisa Ehrlich, Zoë Friedman-Cohen, Simha Reddy, Tawni Tidwell, Josh Traube, and Tim Varga). For ten weeks, 20 Eastside sixth-graders collected and analyzed data in their five ecosystems, and presented their results to classmates and staff in June of 2004. In its sixth year this program continues to provide meaningful ecology education experiences both for the Eastside School students and for their Stanford student teachers.

The 2004 Jasper Ridge Docent Class. From left to right: Charles Carter, Ben Graves, Tawni Tidwell, Ardis Walling, Harris Fienberg, Christine George, Susan Gold, Will Bishop, Michele Minihane, John Juarez, John Rawlings, Kimi Narita, Gary Nielsen, Trevor Hébert, and Léo Laporte. Not pictured: Targe Lindsay and Mollie Chapman.

In June 2004, together with the Stanford Office of Science Outreach, Jasper Ridge helped to sponsor the SUCCESS program (Stanford's Ultimate Choice Camp for Exciting Summer Science). Twenty-four 7th and 8th grade girls from Belle Haven School in East Menlo Park participated in the program and spent a week at Stanford in various departments working side by side with women scientists and Stanford students. The girls and their mentors, including JRBP researchers Radika Bhaskar and Reyes Tirado, spent a full day at Jasper Ridge. SUCCESS students participated in a hands-on archaeology project with Carnegie Foundation Senior Scholar Dr. Laura Jones that resulted in the construction of a new tule hut and spent the afternoon studying the flora and fauna of the riparian ecosystem of San Francisquito Creek.

The growing trend toward partnerships and liaisons is evident within the JRBP community as well and is highlighted by the amazing versatility and productivity of the Preserve's affiliates. Increasingly, Jasper Ridge community members find ways to work in multiple arenas as docents, class instructors, researchers, rangers, editors, bird monitors, and more.

In 2003-04 Jasper Ridge affiliates contributed invaluably to the Preserve's education program. They led educational tours, produced teaching materials, patrolled the Preserve as rangers, participated in outreach programs, and organized and taught classes, workshops, lectures, and reviews. Additionally, they assisted with research projects, presented research at conferences, compiled records of flowering times and species locations, maintained the bird census program, and trained new birders. Others curated JRBP collections, collected global positioning system data, produced photographic records, and in late summer, JRBP affiliates worked side by side with staff and removed hundreds of exotic *Ailanthus* trees. These contributions and more like them continue to be key elements in the success and growth of the JRBP education program.

The enthusiasm for collaboration and the willingness of the community as a whole to teach, learn, and explore new possibilities has once again yielded rich rewards. We are enormously grateful.

Irene Brown (above) and Tawni Tidwell (below) are examples of volunteers who wear many different hats at the Preserve. Irene has been a researcher, Jasper Ridge academic consultant, docent, instructor, strategic planning committee member, and trail expert as well as earning her PhD studying Euphydryas chalcedona *butterflies at JRBP. Tawni has been an instructor, research assistant on the Jasper Ridge Global Change Experiment (JRGCE), docent, and ranger as well as developer of outreach materials. Above left, Irene is excavating a rattlesnake den and above right, teaching an ecology class for Biology 96. Below left, Tawni is explaining to Woodside High School students how to use a scanner to take digital pictures in root observation tubes and below right, harvesting aboveground biomass.*

Appendix 1: Research Projects

Project	Principal Investigator(s)	Department or Division	Institution
Comparative ecology and life history of chaparral shrub species	Ackerly, David	Biological Sciences	Stanford University
Functional diversity of California woody plant communities	Cornwell, Will	Biological Sciences	Stanford University
Relationship of post-fire ecological strategy and plant flammability	Cowan, Peter	Biological Sciences	Stanford University
Community assembly on serpentine chaparral	Rajakaruna, Nishanta	Biological Sciences	Stanford University
Transition from the understory to the canopy by *Prunus ilicifolia*	Tirado, Reyes	Biological Sciences	Stanford University
Reference surveys for Stanford Foothills Restoration Project	Anderson, Sean	Center for Conservation Biology	Stanford University
Biosystematics of *Hilara*, *Medetera*, and parasitoids of Tachinidae	Arnaud, Paul	Entomology	Cal. Academy of Sciences
Carbon burial and preservation in Searsville and other lake environments	Berhe, Asmeret Asefaw	Environ. Sci., Policy & Mgmt.	Univ. of California, Berkeley
Population biology of the butterfly *Euphydryas chalcedona*	Brown, Irene	JRBP	
Magnesium cycles in California serpentine areas: Edgewood Park and JRBP	Coleman, Robert	Geological & Environmental Sciences	Stanford University
	Oze, Christopher	Earth Sciences	Dartmouth College
	Skinner, Catherine	Geology & Geophysics	Yale University
Taxonomic study of the genus *Orobanche* of the U.S.	Colwell, Alison	Biological Resources Division	U.S. Geological Survey
Mammalian herbivores as mediators of community structure and soil fertility	Cushman, Hall	Biology	Sonoma State University
Spectrum survey at GPS (global positioning system) frequency band	Do, Juyong	Aeronautics & Astronautics	Stanford University
Long-term studies of *Euphydryas editha bayensis*	Ehrlich, Paul; Boggs, Carol	Biological Sciences & Ctr. for Cons. Bio.	Stanford University
Jasper Ridge Global Change Experiment	Field, Christopher	Global Ecology	Carnegie Instit. of Washington
	Bohannan, Brendan; Mooney, Harold; Vitousek, Peter	Biological Sciences	Stanford University
	Somerville, Shauna	Plant Biology	Carnegie Instit. of Washington
	Tiedje, James	Center for Microbial Ecology	Michigan State University
Impacts of global change on a soil microbial community	Balser, Teri; Mentzer, Jessica	Soil Science	Univ. of Wisconsin, Madison
Global change, potential nitrification and denitrification	Barnard, Romain	Biological Sciences	Northern Arizona University
Effects of global change on methane oxidation	Blankinship, Joey	Biological Sciences	Northern Arizona University
Spectral measurement of aboveground vegetation dynamics	Chiariello, Nona	Biological Sciences	Stanford University
Population and species effects on biogeochemistry	Cleland, Elsa	Biological Sciences & Global Ecology	Stanford Univ. & Carnegie Inst.
Trace gas fluxes under simulated global changes	Dijkstra, Paul	Biological Sciences	Northern Arizona University
Response of yellow starthistle plantings to global change treatments	Dukes, Jeff; Loarie, Scott	Biology	University of Massachusetts
Analysis of root dynamics in minirhizotrons	Ferreira, Aristotelino		UFRN (Brazil)
Microbial diversity and breakdown of polyaromatic compounds in soil	Gantner, Stephan	Center for Microbial Ecology	Michigan State University
Plant organic compounds and microbial functional diversity	Henry, Hugh	Biological Sciences & Global Ecology	Stanford Univ. & Carnegie Inst.
Response of soil bacterial communities to elevated CO_2	Horz, Peter; Avrahami, Sharon	Biological Sciences	Stanford University
Effects of global change on soil nitrogen cycling	Hungate, Bruce	Biological Sciences	Northern Arizona University
Responses of soil carbon to global change	Juarez, John	Biological Sciences & Global Ecology	Stanford Univ. & Carnegie Inst.
Whole-system gas exchange of the JRGCE	Lunch, Claire	Biological Sciences & Global Ecology	Stanford Univ. & Carnegie Inst.
Belowground effects of multiple global changes	Moore, Lisa	Biological Sciences & Global Ecology	Stanford Univ. & Carnegie Inst.
Changes in gene expression in *Geranium dissectum* and *Avena barbata*	Thayer, Sue	Plant Biology	Carnegie Instit. of Washington
Isotopic analysis of respiratory carbon dynamics	Torn, Margaret	Center for Isotope Geochemistry	Lawrence Berkeley Nat'l. Lab.
Minirhizotron analysis of root abundance under global change treatments	Yeung, Wing Man	Biological Sciences & Global Ecology	Stanford Univ. & Carnegie Inst.
Rapid evolution in response to global climate and atmospheric change	Zavaleta, Erika; Andonian, Krikor	Environ. Studies; Ecol. & Evol. Bio.	Univ. of California, Santa Cruz

Project	Principal Investigator(s)	Department or Division	Institution
Hydrology of Searsville Lake watershed	Freyberg, David	Civil & Environmental Engineering	Stanford University
Ground water flow in Searsville Lake sediments and lake-ground water exchange	Kim, Dongkyun	Civil & Environmental Engineering	Stanford University
Climate synthesis for hydrologic modeling	Woolley, Olivia	Civil & Environmental Engineering	Stanford University
Climate-vegetation relationships in Mediterranean ecosystems	Garcia, Monica	LAWR/Agricultural Sciences	U.C. Davis/UPM (Spain)
Computing support for acquisition, collaborative curation, and dissemination in biodiversity research	Garcia-Molina, Hector; Paepcke, Andreas	Computer Sciences	Stanford University
Camera-trap monitoring of mammals	Dirzo, Rodolfo; Boege, Karina	Biological Sciences	Stanford University
Argentine ant (*Linepithema humile*) invasion and the response of native ants	Gordon, Deborah	Biological Sciences	Stanford University
Effects of tending by Argentine ants on Homoptera abundance	Fleming-Davies, Arietta	Biological Sciences	Stanford University
Population dynamics of the Argentine ant in JRBP	Heller, Nicole	Biological Sciences	Stanford University
Survey of ants for bacterium *Wolbachia* and effects on reproduction	Hsieh, Patrick	Biological Sciences	Stanford University
Gene flow and sex-biased dispersal in Argentine ant invasions	Ingram, Krista	Biological Sciences	Stanford University
Mammals of JRBP	Hadly, Elizabeth	Biological Sciences	Stanford University
Applied paleoethnoecology of the San Francisco Bay peninsula	Hammett, Julia	Social Science	Truckee Meadows Comm. Coll.
Monitoring of water flow and quality	Hecht, Barry; Owens, Jonathan; White, Chris		Balance Hydrologics, Inc.
Simulation of hydrologic response and sediment transport after dam removal	Heppner, Christopher	Geological & Environmental Sciences	Stanford University
Effects of rainfall variability and gopher removal on serpentine grassland	Hobbs, Richard	Wildlife & Ecology	CSIRO (Australia)
GPS mapping for the San Francisquito Archaeological Research Project GIS	Jones, Laura	Campus Archaeology	Stanford University
Earthquake prediction from precursory electromagnetic anomalies	Klemperer, Simon,	Geophysics	Stanford University
	McPhee, Darcy; Glen, Jonathan	Geophysical Unit, Menlo Park	U.S. Geological Survey
Regional surveys of annual acorn production and phenology	Koenig, Walter	Hastings Natural History Reserv.	Univ. of California, Berkeley
	Carmen, William		Ctr. for Environ. Citizenship
Carbon cycling in shrub and grassland landscapes invaded by exotics	Koteen, Laurie	Energy and Resources Group	Univ. of California, Berkeley
Broad band seismic monitoring	Kovach, Robert	Geophysics	Stanford University
	Karavas, Bill	Berkeley Digital Seismic Network	Univ. of California, Berkeley
Survey of San Francisquito Creek and removal of exotics	Launer, Alan	Center for Conservation Biology	Stanford University
Long-term monitoring of ecosystem processes by eddy flux	Merchant, George; Field, Christopher	Global Ecology	Carnegie Instit. of Washington
	Kaduk, Joerg		University of Leicester (England)
Simulation of ecosystem responses to global change	Wang, Ying Ping	Atmospheric Research	CSIRO (Australia)
Photochemical changes in natural organics in Searsville Lake water	Mill, Theodore	Atmos. Chem. & Space Physics	SRI International
Investigation of *Phytophthora ramorum* distribution	Monroe, Ian	Earth Systems	Stanford University
Long-term acoustical monitoring of bat activity	Mudd, Thomas	JRBP	
Larval host plant preference and development rates in the ringlet butterfly (*Coenonympha tullia*)	Peters, Halton	Biological Sciences & Global Ecology	Stanford Univ. & Carnegie Inst.
	Stamberger, Jean	Biological Sciences	Stanford University
Energy performance of the Leslie Shao-ming Sun Field Station	Scofield, John	Physics & Astronomy	Oberlin College
Digital terrain and elevation models of San Francisquito Creek watershed	Vogel, John	Geography	U.S. Geological Survey
Passive cumulative monitoring of nitrogenous atmospheric pollutants and ozone	Weiss, Stuart; Luth, David		
Biodiversity and grassland invasions	Zavaleta, Erika; Hulvey, Kris	Environmental Studies	Univ. of California, Santa Cruz

Appendix 2: Publications

Ackerly, D.D. (2003) Community assembly, niche conservatism and adaptive evolution in changing environments. International Journal of Plant Sciences 164: S165-S184.

Ackerly, D.D. (2004) Adaptation, niche conservatism, and convergence: comparative studies of leaf evolution in the California chaparral. American Naturalist 163: 654-671.

Ackerly, D.D. (2004) Functional traits of chaparral shrubs in relation to seasonal water deficit and disturbance. Ecological Monographs 74: 25-44.

Coleman, R.G. (2004) Geologic nature of the Jasper Ridge Biological Preserve, San Francisco Peninsula, California. International Geology Review 46: 629-637.

Dukes, J.S. and Mooney, H.A. (2004) Disruption of ecosystem processes in western North America by invasive species. Revista Chilena de Historia Natural 77: 411-437.

Ehrlich, P.R. and Hanksi, I., Eds. (2004) *On the Wings of Checkerspots: A Model System for Population Biology*. Oxford University Press.

Evelyn, M., Stiles, D. and Young, R. (2004) Conservation of bats in suburban landscapes: roost selection by *Myotis yumanensis* in a residential area in California. Biological Conservation 115: 463-473.

Gee, L., Neuhauser, D., Dreger, D., Pasyanos, M., Uhrhammer, R., and Romanowicz, B. (2003) The Rapid Earthquake Data Integration Project. In: W. Lee (Ed) International Handbook of Earthquake Seismology Part B, IASPEI.

Heller, N.E. (2004) Colony structure in introduced and native populations of the invasive Argentine ant, *Linepithema humile*. Insectes Sociaux 51: 378-386.

Heller, N.E., Sanders, N.J., and Gordon, D.M. Linking temporal and spatial scales in the study of an Argentine ant invasion. Biological Invasions (in press).

Hellmann, J.J., Weiss, S.B., McLaughlin, J.H., Boggs, C.L., Ehrlich, P.R., Launer, A.E., and Murphy, D.D. (2003) Testing short-term hypotheses with a long-term study of a butterfly population. Ecological Entomology 28:74-84.

Henry, H.A.L., Cleland, E.E., Field, C.B., and Vitousek, P.M. Interactive effects of elevated CO_2, N deposition and climate change on plant litter quality in a California annual grassland. Oecologia (in press).

Horz, H.- P., Rich, V., Avrahami, S. and Bohannan, B.J.M. Methane-oxidizing bacteria in a Californian upland grassland: diversity and response to simulated global change. Applied and Environmental Microbiology (in press).

Horz, H.- P., Barbrook, A., Field, C., and Bohannan, B.J.M. (2004) Ammonia-oxidizing bacteria respond to multifactorial global change. Proceedings of the National Academy of Sciences (USA) 101: 15136-15141.

Huxman, T.E., Smith, M.D., Fay, P.A, Knapp, A.K, Shaw, M.R., Loik, M.E., Smith, S.D, Tissue, D.T., Zak, J.C., Weltzin, J.F., Pockman, W.T, Sala, O.E., Haddad, B.M., Harte, J., Koch, G.W., Schwinning, S., Small, E.E. and Williams, D.G. (2004) Convergence across biomes to a common rain-use efficiency. Nature 429: 651-654.

Ingram, K.K. and Gordon, D.M. (2003) Genetic analysis of dispersal dynamics in an invading population of Argentine ants, *Linepithema humile*. Ecology 84: 2832-2842.

Koenig, W. D., Kelly, D., Sork, V.L., Duncan, R.P., Elkinton, J.S, Peltonen, M.S., and Westfall, R.D. (2003) Dissecting components of population-level variation in seed production and the evolution of masting behavior. Oikos: 581-591.

Oze, Christopher (2003) Chromium geochemistry of serpentinites and serpentine soils. Ph.D. Dissertation, Department of Geological and Environmental Sciences, Stanford University.

Oze, C., Fendorf, S., Bird, D., and Coleman, R. (2004) Chromium geochemistry of serpentinized ultramafic rocks and serpentine soils from the Franciscan complex of California. American Journal of Science 304: 67-101.

Peters, H.A., Chiariello, N.R., Mooney, H.A., Levin, S.A., and Hartley, A.E. Native harvester ants threatened with widespread displacement exert localized effects on serpentine grassland plant community composition. Oikos (in press).

Peters, Halton (2004) Consumer control of animal-structured plant communities under current and future environmental conditions. Ph.D. Dissertation, Department of Biological Sciences, Stanford University.

Preston, K.A. and Ackerly, D.D. (2003) Hydraulic architecture and the evolution of shoot allometry in contrasting climates. American Journal of Botany 90: 1502-1512.

Rajakaruna, N. (2003) Edaphic differentiation in *Lasthenia*: A model for studies in evolutionary ecology. Madroño 50: 34-40.

Rajakaruna, N., Baldwin, B.G., Chan, R., Desrochers, A.M., Bohm, B.A., and Whitton, J. (2003) Edaphic races and phylogenetic taxa in the *Lasthenia californica* complex (Asteraceae:Heliantheae): an hypothesis of parallel evolution. Molecular Ecology 12: 1675-1679.

Rajakaruna, N., Bradfield, G.E., Bohm, B.A., and Whitton, J. (2003) Adaptive differentiation in response to water stress by edaphic races of *Lasthenia californica* (Asteraceae). International Journal of Plant Sciences 164: 371-376.

Rajakaruna, N., Siddiqi, M.Y., Whitton, J., Bohm, B.A., and Glass, A.D.M. (2003) Differential responses to Na^+/K^+ and Ca^{2+}/Mg^{2+} in two edaphic races of the *Lasthenia californica* (Asteraceae) complex: A case for parallel evolution of physiological traits. New Phytologist 15: 93-103.

Sanders, N.J., Gotelli, N.J., Heller, N.E., and Gordon, D.M. (2003) Community disassembly by an invasive species. Proceedings of the National Academy of Sciences 100: 2474-2477.

Scofield, J.H., Cohen, P.S., Tronson, C., and Gould, S. Real-time, web based energy monitoring system for a solar academic building. Solar 2004 Conference Proceedings (in press).

Stephens, S.L. and Fry, D.L. Fire history in coast redwood stands in the northeastern Santa Cruz Mountains, California. Fire Ecology (in press).

Zavaleta, E.S. and Hulvey, K.B. (2004) Realistic species losses disproportionately reduce resistance to biological invaders. Science 306: 1175-1177.

Zavaleta, E.S. and Kettley, L.S. Ecosystem change along a woody invasion chronosequence in a California annual grassland. Journal of Arid Environments (in press).

Zavaleta, E.S, Shaw, M.R., Chiariello, N.R., Mooney, H.A., and Field, C.B. (2003) Additive effects of simulated climate changes, elevated CO_2, and nitrogen deposition on grassland diversity. Proceedings of the National Academy of Sciences 100: 7650-7654.

Zavaleta, E.S, Shaw, M.R., Chiariello, N.R., Thomas, B.D., Cleland, E.E., Field, C.B., and Mooney, H.A. (2003) Grassland responses to three years of elevated temperature, CO_2, precipitation, and N deposition. Ecological Monographs 73: 585-604.

Zavaleta, E.S., Thomas, B.D., Chiariello, N.R., Asner, G.P., Shaw, M.R., and Field, C. B. (2003) Plants reverse warming effect on ecosystem water balance. Proceedings of the National Academy of Sciences 100: 9892-9893.

Appendix 3: Docent Tours & Instructional Use

Stanford University Classes (1,967)

Bio 11SI	Fire Policy and Ecology in the Western U.S. (Carlson, Palmer)
Bio 13	Wildflower Families of the Bay Area, Continuing Studies (Corelli)
Bio 16	Island Ecology (Vitousek)
Bio 44Y	Core Experimental Lab (Malladi, Yelton)
Bio 96A/B	JRBP Docent Training Program (Vitousek)
Bio 101	Ecology (Ackerly, Bohannan)
Bio 117	Biology and Global Change (Mooney, Vitousek)
Bio 120	General Botany (Preston)
Bio 124	Plant Physiological Ecology: From Leaf to Globe (Berry, Field, Mooney)
Bio 125	Ecosystems of California (Mooney)
Bio 139	Biology of Birds (Root)
CEE 166B	Floods and Droughts, Dams and Aqueducts (Freyberg)
CEE 299	Independent Study in Civil Engineering (Freyberg)
Esys 10	Introduction to Earth Systems (Ernst)
GES 175	Science of Soils (Fendorf)
ME 222	Beyond Green Theory (Chapin, McPherson)
SophColl 10SC	Green Buildings (Masters)
SophColl 11SC	Constitutionalism (Casper)
SophColl 11SC	The Ecology of Invasions (Gordon)

Non-Stanford University Classes (118)

760358X	De Anza College, Natural History of the Bay Area (West-Bourke)
Anth 279	Truckee Meadows Community College, Paraprofessional Skills in Social Science (Hammett)
Arch 625	California College of the Arts, Green Building Design (Lehrer)
Bio 103	Cañada College, Native Plants and Wildflowers (Steiner)
Bio 110	Cañada College, Principles of Biology (Boyett Anderson)
CE 140	Santa Clara University, Water Resources Engineering (Maurer)

Stanford Organizations (668)

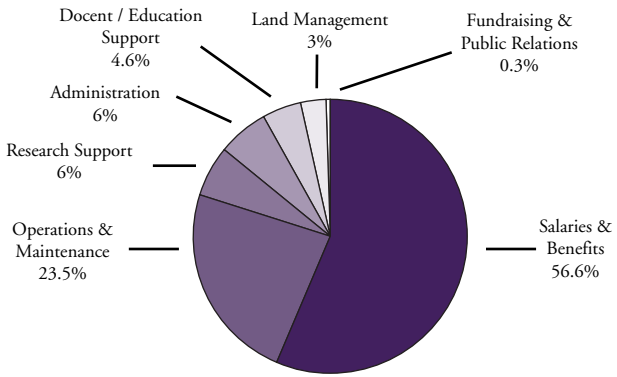
Bechtel International Center
Branner Hall
Catholic Community at Stanford
Center for Advanced Study in the Behavioral Sciences
Department of Biology
Digital Vision Fellowship Program
Edward L. Ginzton Laboratory
Environmental and Natural Resources Law & Policy Program
Escondido Village
Graduate School of Business
Hopkins Marine Station Miller Library of Marine Biology
Medical School Alumni Association
Office of Development
Office of Undergraduate Admission
Quest Scholars Program
Robinson House
Roble Hall
School of Education
School of Humanities & Sciences Administrators
Stanford Alumni Association
Stanford Club of Palo Alto
Stanford Dining
Stanford Environmental Law Society & Journal
Stanford Facilities and Operations, Zone Management Administration
Stanford Libraries Staff Association
Stanford Teacher Education Program
Stanford Women's Club of the East Bay
Students for a Sustainable Stanford
Utilities Division, Water Resources and Environmental Quality

Other Organizations (1,957)

Acterra High Schools Group
Año Nuevo State Reserve
Buchanan Partners
California Native Plant Society
Canopy
Castilleja School
Center for Science & Engineering Education, Lawrence Berkeley National Laboratory
Christ Church Episcopal, Portola Valley and Woodside
City of Cupertino Planning Office
City of San Francisco Department of Environment
Conservation Strategy Fund
David and Lucile Packard Foundation Conservation and Science Program
East Palo Alto High School
Eastside College Preparatory School
Environmental Volunteers
Foundation for Global Community
Gamble Garden
Gulf of the Farallones Marine Sanctuary Volunteers
Hidden Villa
Holy Trinity Episcopal Church
Los Altos Sunset Rotary Club
Men's Menopausal Marching Group
National Marine Fisheries Service
Oakland Museum of California Natural Science Docents
Ohlone School Parent Teacher Association
Portola Valley Ranch
Resources Legacy Fund
Riekes Center
Rocky Mountain Biological Laboratory
San Mateo County Fire Safe Committee
Santa Clara Valley Audubon Society
The William and Flora Hewlett Foundation Building Project
Town of Portola Valley
U.S. Fish and Wildlife Service
Walter Hays Elementary School
Wild Bird Center of Los Gatos
Wild Bird Center of San Carlos
Woodside High School
Woodside Priory School

Appendix 4: Financial Summary: 2003-04 Fiscal Year

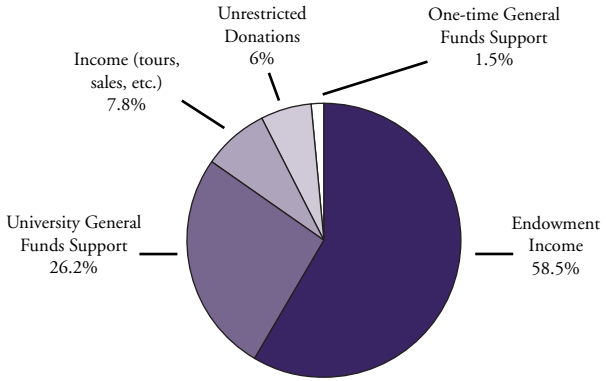
Expense Summary - $779,959



Salaries & Benefits	441,678
Operations & Maintenance	182,947
Research Support	46,868
Administration	46,678
Docent / Education Support	35,799
Land Management	23,299
Fundraising & Public Relations	2,690

Expenses exceeded revenue due to increased land management costs associated with tree removal, mosquito abatement activities, and additional fire management projects. Research Support includes $36,531 for repair of damage to Jasper Ridge Global Change Experiment from July 2003 fire.

Revenue Summary - $738,726



Endowment Income	432,244
University General Funds Support	193,964
Income (tours, sales, etc.)	57,475
Unrestricted Donations	44,113
One-time General Funds Support	10,930

Increase in income reflects insurance reimbursement of $36,531 for fire damage to the Jasper Ridge Global Change Experiment. The shortfall between expenses and revenue was covered by unrestricted donor account reserves.

Appendix 5: Donors

Unrestricted Gifts, September 1, 2003 – August 31, 2004

John Allan
Jim Allen
Anonymous
Paul H. & Madeline L. Arnaud, Jr.
Richard K. & Mary Blair Arnold
James V. & Deborah L. Ash
Rhea P. Bain
Leonie Batkin
Nancy & Dr. Clayton Bavor
Bay Nature Institute
Kathleen Bennett & Thomas J. Malloy
Monika & Olle Björkman
Irene L. Brown
Robert R. Buell
Susan M. & Stephen R. Carpenter
Joanne Tsaian Chou
Bill & Jean Clark
Philippe S. Cohen & Cynthia I. Stead
Toni Corelli
Rigdon Currie & Trish Johnson
Barbara J. & Antonio Decampo
Robert L. & Patricia R. Dengler
Joan M. & Robert M. Desky
Mary H. & Robert Dodge
Nancy J. & Thomas John Fiene
Ed & Virginia Fryer
Lindy G. Gardiner
Johanna Gendelman
Carol W. & Arthur Graham
Carol & Dexter Hake
Karen Hamilton
Dr. Benjamin C. and Ruth Hammett
Mary C. Henry & Rajpal Sandhu Foundation
Leo M. & Florence Holub
Patricia L. & John A. Hooper
Mary Page Hufty
Dirk & Charlene Kabcenell
Suzy King
Sara L. Koenig
Diana B. Koin
Tony Kramer
Margaret Krebs
Mr. & Mrs. Marcus A. Krupp, M.D.
Léo Laporte
Peter LaTourrette
Mark Lavelle & Mary Petrosky
Martha H. Lennihan & Paul D. Thayer
Mary Anna & Franklin M. Matsumoto
Arthur Matula
Betsy & Bill Meehan
Ms. Whitney Mortimer
Lincoln E. Moses
Denise O'Leary
Professor Douglas Osheroff
John R. Page, Jr.
Jane N. Partanen
Lenore L. Roberts
Margie & Don Runge
F. Tracy Schilling
Jessie Schilling
Earl F. & Patricia Schmidt
Jeanne Campbell Sedgwick
Ramona L. & Max S. Simpson
Marion E. & Kendric Smith
Stanford University Women's Club
Colleen & Geoff Tate
Sara Timby
John Tonnesen
Ruth Troetschler
Lysbeth Warren
Alison D. & Edwin Wells
Gustav R. & Sueko Williges
Jennefer L. Wineman
Paul B. Wineman
Eleanor J. Wood
John Working
Richard I. Yankwich

Appendix 6: The JRBP Community

David Ackerly
Molly Aeck
Ann Akey
Kathryn Amatangelo
Sean Anderson
Krikor Andonian
Chris Andrews
Michael Anthony
Alison Appling
Paul Arnaud
Ron Arps
Greg Asner
Marianne Austin
Sharon Avrahami
Monya Baker
Teri Balser
Romain Barnard
Mary Baron
Leonie Batkin
Nancy Bavor
Kathleen Bennett
Asmeret Asefaw Berhe
Joseph Berry
Radika Bhaskar
Will Bishop
Monika Björkman
Joey Blankinship
Kindel Blau-Launer
Karina Boege
Carol Boggs
Brendan Bohannan
Sharon Brauman
Kathleen Brizgys
Bill Brown
Irene Brown
Jamie Brown
Bob Buell
Gene Bulf
Ruth Buneman
James Burns
Al Butner
Kim Cahill
Kim Carlson
William Carmen
Charles Carter
Nicholas Casey
Sally Casey
Ted Chandik
Zoe Chandik
Andrew Chang

Audrey Chang
Mollie Chapman
Aleksendr Chebanov
Carl Cheney
Nona Chiariello
Jack Chin
Jean Clark
William Clark
Hovey Clark
Betsy Clebsch
Elsa Cleland
Brian Cohen
Philippe Cohen
Robert Coleman
Alison Colwell
Heather Cooley
Toni Corelli
Will Cornwell
Stella Cousins
Peter Cowan
Margaret Cowan
Jenny Creelman
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Philippe Cohen, 1
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For More Information about Jasper Ridge Biological Preserve

Administrative Director
Jasper Ridge Biological Preserve
Stanford University
Stanford, CA 94305-5020
email: philippe.cohen@stanford.edu
URL: http://jasper1.stanford.edu/
Phone: (650) 851-6814
Fax: (650) 851-7334

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In Memoriam

Bill Kirsher
1910 - 2004

Bill was a remarkable man, loved and admired by the docents and staff of Jasper Ridge and greatly appreciated by visitors to the Preserve. He had a contagious enthusiasm and an enduring curiosity about the natural world and a broad knowledge of it. An effective and energetic teacher, he delighted in sharing that knowledge with others. We shall miss this unique friend and colleague.

Written by Bob Buell

Robert Shelby
1920 - 2004

Robert B. Shelby, longtime Portola Valley resident and JRPB docent since 1987, died at The Forum in Cupertino, June 27, 2004 following a short illness. He was 83. A native of Colorado, Bob had a lifelong interest in natural history and a passion for music. He was leader of a "Barber Shop Quartet" and played several instruments including the piano. A respected psychiatrist at the Palo Alto Medical Clinic from 1954 to 1986, he changed his focus, after retirement, to his love of natural history as a member of the docent class of 1987. He was a familiar figure on the Preserve in his khaki vest (pockets bulging with books and demonstration specimens), field hat, and graced with his warm, welcoming smile. Bob loved the Preserve and its people and will be missed.

Written by Bill Clark