Jasper Ridge Biological Preserve

Annual Report 2000 - 01 · 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.

This was an outstanding year for the Preserve. By the end of the fiscal year we successfully completed the capital campaign for the Leslie Shao-ming Sun Field Station and began construction of this needed facility; research activity remained high; and our educational programs continued to expand in scope and application. In some ways, events of the past year make it difficult to celebrate. Instead, it is a good time to reflect upon and evaluate how our activities fit into a broader vision for making our world a better, healthier place.

With that in mind, this past year stands out as one in which we have worked hard to achieve a more promising future. Most notable was final approval by the Stanford University Board of Trustees to begin construction of the Leslie Shao-ming Sun Field Station. The Sun Field Station not only addresses many previously unmet Jasper Ridge needs, but also represents our effort to lighten the load we place on the earth's life support systems. I invite you to study the renderings and construction photos in this annual report to see the outlines of that future. We hope to move in soon after you receive this report.

Of course, this is all made possible by the generous donations of many people and organizations, starting with the lead gift from Bill and Jean Lane, the naming gift by Tony Sun, and a closing grant from the David and Lucile Packard Foundation. There was also a grant from the National Science Foundation and many other gifts, both large and small. Each gesture of support reflects a shared commitment to support the programs of the Preserve and to help lead the way toward a more sustainable future.

As construction proceeds, other activities continue to mark important successes and progress this past year. In the research section of this report you will see the remarkable scope, both in terms of temporal and spatial scales, of the diverse array of projects taking place at the Preserve. They range from the molecular to global, with projects varying in length from a single season to decades. All are further evidence that the Jasper Ridge research community continues to make significant contributions to our understanding of the earth's natural systems and how we interact with those systems.

As you review the docent and educational programs at the Preserve, you will also see how broadly their wings have spread in terms of what is learned and how students and docents exercise the knowledge gained at the Preserve. I know that JRBP staff derive enormous professional and personal gratification from seeing docents and students set out with their newly acquired knowledge to make a real difference in the world.

This past year was also marked by important developments in land and resource management challenges facing the Preserve. These challenges are a result of managing a biological field station located in an increasingly urbanized landscape. One of the major challenges facing the Preserve that will likely require much of my attention in the coming years involves the future of Searsville Lake and Dam and its

impact on the Preserve and the San Francisquito Creek watershed. This century-old lake is nearing the end of its life as a reservoir as it fills with sediment. This system provides a fascinating case study of the complexities of managing an aging dam and reservoir, which over its life has become fully integrated into the hydrologic, ecological, political, and social structure of its watershed. It is this rich and complex context that presents significant obstacles and important opportunities. As more reservoirs worldwide lose substantial capacity due to sedimentation, finding methods for managing the transition to a sustainable configuration is going to become a key environmental challenge. Hence, the Searsville reservoir provides a unique multi-disciplinary opportunity to develop innovative strategies for reservoir and watershed issues that have significance throughout the U.S. and the world.

A second management challenge involves efforts to reduce risk from fire. In response to this challenge and in cooperation with the California Department of Forestry, the Palo Alto Fire Department, and the Midpeninsula Regional Open Space District, the Preserve completed its second successful controlled burn in three years. This is part of a long-term strategy to manage fuel loads in order to further reduce fire hazards associated with grass and shrubland communities without undermining their ecological integrity. Potential secondary benefits associated with this prescribed burn strategy include control of invasive species such as yellow starthistle (*Centaurea solstitialis*) and incorporation of this effort into continuing research projects at JRBP.

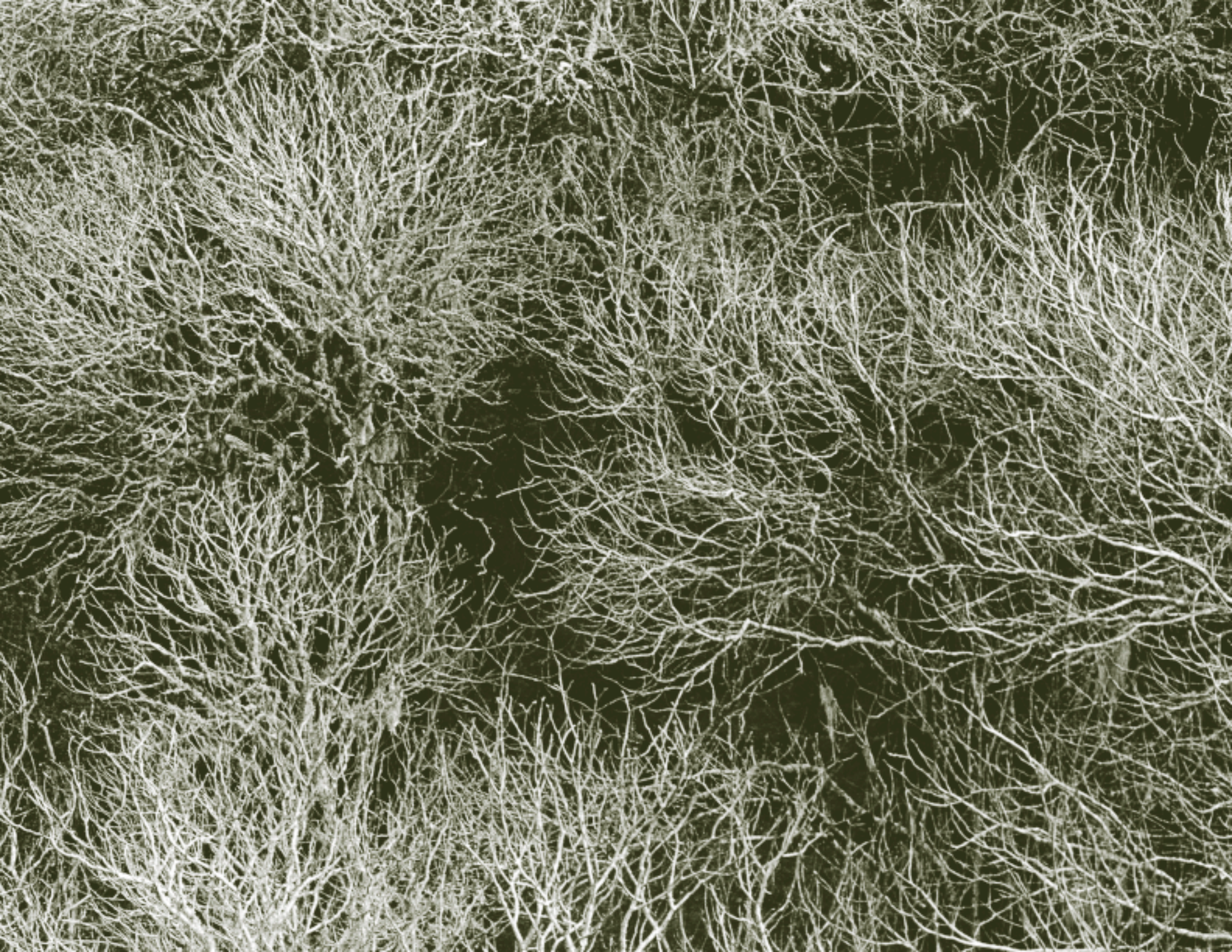
Both the watershed and fire management issues are woven into the fabric of an increasingly anthropogenic landscape and raise many important questions about how best to assure a sustainable future for the biological resources found at the Preserve. We often hear how habitat fragmentation potentially undermines local and regional biodiversity, but there is also a "jurisdictional fragmentation" that results from the numerous interests, agencies, and property owners involved in a human-dominated landscape. In other words, the future of JRBP is intertwined with interests and activities beyond its borders. It is essential that its contributions and value are visible beyond the community of users directly served by the Preserve.

Other important developments include the addition of new equipment and information now available to researchers and students. This includes: completion of a new digital elevation model that provides elevation data for the Preserve accurate to two feet; two new handheld global positioning systems (GPS) for student, researcher, and docent use, purchased with a generous donation by Carol and Art Graham; publication of the latest issue of *Jasper Ridge Views* in the fall of 2000

entitled "GIS/GPS Applications at the Jasper Ridge Biological Preserve"; and an updated and enhanced docent handbook (the most comprehensive source of natural history information about the Preserve) now available through the affiliates section of our website.

Finally, just after the fiscal year closed, an important new program, the Environmental Initiative, was born at Stanford University—an effort to bring the broad resources of the University's faculty to bear on the environment and to raise its visibility as a world leader in environmental research and education. This includes the creation of a new interdisciplinary doctoral program in environmental studies as well as the creation of a centralized website (http://environment.stanford.edu) that provides access to the vast array of environmental resources at Stanford. I believe this initiative will further enhance the value of the Preserve to the University's academic programs, as well as provide important new opportunities for research and education.

As you read through this annual report, I hope you can see the broad outlines of the vision reflected in the activities at the Preserve—research, education, management, and the construction of our new home all providing evidence of progress toward a sustainable future. We hope you share a sense of participation in our continuing record of accomplishments.



The past year recorded milestones for many Jasper Ridge research programs. Studies of elevated carbon dioxide completed their tenth year, the Argentine ant survey turned nine, seismic monitoring finished its eighth year, Walt Koenig conducted his 11th annual survey of Jasper Ridge acorn production, and Richard Hobbs censused his grassland plots for the 19th year. Remarkably, these studies are young by comparison with JRBP research on the chalcedon and Bay checkerspot butterflies, which completed their 34th and 42nd years. These ongoing programs are important not just for their longevity. Several of them provided the framework for most of the new studies at JRBP this year, including new dissertation projects, new faculty collaborations, and new directions.

For the Jasper Ridge Global Change Experiment, the past year was also a milestone in terms of funding. A grant from the Morgan Family Foundation funded the project for the 2000-01 season, and in June, a new three-year grant from the David and Lucile Packard Foundation was awarded. This grant will take the project through its sixth year and allows three additional faculty, Professors Brendan Bohannan, Shauna Somerville, and Peter Vitousek, to join Professors Chris Field and Hal Mooney in directing the project. This phase of the project coincides with an expected shift from primarily short-term, physiological responses to changes in the composition of plant and microbial populations and communities.

Against this year's backdrop of long-term studies and thematic continuity, an important new trend was the expanded use of molecular and genetic tools. JRBP research provides a good introduction to the ecological applications of molecular genetics, demonstrating both the variety of tools now available and the diversity of insights that derive from the distinct properties of different parts of the genome. These approaches provide a powerful new perspective from which to understand the significance of Jasper Ridge research and appreciate the value of long-term studies. The following discussion looks at JRBP studies now employing molecular genetics. Appendix 4 provides a complete list of all JRBP research projects for the year.

One use of genetic tools is to identify samples to the level of species when our eyes cannot, as in Lisa Moore's technique for identifying roots of different species in soil. Lisa's Ph.D. dissertation focuses on a range of ecological properties affected by rooting depth. This area has been difficult to study because techniques for measuring rooting depth are very labor intensive, such as delicately excavating a plant's root system, or indirect, such as finding the soil depth where soil moisture matches a plant's water status.

Lisa developed a new technique that relies on a region of DNA termed the "internal transcribed spacer," which is unique for nearly every species. Working first with root samples from individual species, Lisa found that by selecting the appropriate enzymes for digesting this region of root DNA into pieces, she obtained fragments that segregated on a gel into bands that were distinct for each of her study species. When the technique was applied to a multi-species root sample from the soil of a mixed community, the presence or absence of a particular band was diagnostic

Research activity during 2000-01 included a total of 59 projects involving affiliates of 21 different institutions, including 29 faculty and senior scientists, 13 postdoctoral researchers, 14 graduate students, and 17 undergraduates conducting independent studies. Within Stanford University, six departments or centers in three Schools were represented. Publications for the year included 25 journal articles, four book chapters, three Ph.D. dissertations, and four masters theses. Students who conducted field studies completed eight papers and projects.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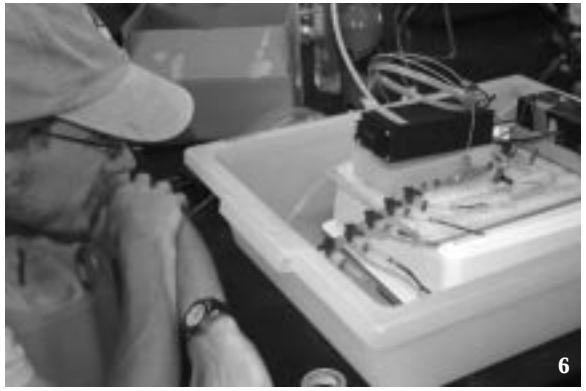
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1. *As part of the Ameriflux network of flux stations, the Jasper Ridge eddy flux tower received a weeklong performance test conducted by Bob Evans (U.S. Forest Service), who points out the duplicate reference sensors he added to the left side of the mast.*

2. *Docent Bill Gomez marks plant pots for soil sampling—one of many contributions he made to Ph.D. candidate Lisa Moore's studies.*

3. *Ph.D. candidate Elsa Cleland studied flowering responses in the global change experiment; she has found that flowering is accelerated in heated treatments and delayed by additions of water and carbon dioxide.*

4. *Ph.D. candidate Brian Wee (U. Texas) conducted feeding experiments with larvae of the California ringlet butterfly* (Coenonympha tullia) *placed in small cages that clip around grass plants in the global change experiment.*

5. *As part of his studies of fire management, Professor Scott Stephens (U.C. Berkeley) monitored the spread of fire and flames in JRBP's second controlled burn.*

6. *Ph.D. candidate Dylan Schwilk observes a pressure gauge during experiments in which water is forced through leafless sections of stems in order to measure their hydraulic properties.*

7. *Under a rain shelter resembling a covered wagon, hand-watered pots of grassland plants were part of Ph.D. candidate Lisa Moore's studies of the relationships among water availability, competition, and rooting depth.*

8. *Ph.D. candidate Nicole Heller and Dr. Michael Greene excavate a colony of Argentine ants to determine the relationship between aboveground activity of ants and nest size.*

9. *Undergraduate intern Meg Andrew scans a plot of the global change experiment with a fiber optic probe connected to a backpack-mounted spectroradiometer.*

10. *Ph.D. candidate Halton Peters cuts a groove around grassland plots with a hammer-shovel so he can install barriers for an herbivore exclusion study.*

for the corresponding species. By sampling soils from a range of depths, Lisa could determine the maximum depth where roots of each species were present.

Studies are also using genetic tools to understand patterns of dispersal and population structure in animals. Dr. Krista Ingram, a postdoctoral fellow working with Professor Deborah Gordon, is studying microsatellite DNA in Argentine ants (*Linepithema humile*) to better understand how these ants are such successful invaders. Microsatellites are stretches of non-coding nuclear DNA consisting of tandem repeats of a simple sequence with one to four nucleotides. Microsatellites have a high mutation rate and therefore vary among individuals of a population. This variation permits both "DNA fingerprinting" of individuals and also measurements of relatedness among individuals, such as members of an ant colony.

Dr. Ingram hypothesized that since new Argentine ant colonies arise by budding, rather than a mating flight by the queens, their population structure should be very viscous, with adjacent colonies having greater genetic similarity and distant colonies having less. She has found, however, that this trend is very weak, suggesting that male dispersal between distant nests may be common. To control for the role of males in the genetic record of invasion, Dr. Ingram is also looking at mitochondrial DNA, which is inherited only from queens and should reveal the genetic structure due solely to the movement of queens. Like microsatellite DNA, some regions of mitochondrial DNA have a high mutation rate, producing sufficient variation within a population to distinguish degrees of relatedness among individuals.

Microsatellite and mitochondrial DNA have also provided clues to the ecological importance of one of JRBP's species of concern, California steelhead trout (*Oncorhynchus mykiss*). The biology of steelhead trout in California is very complex because the species has two life histories, anadromous steelhead and non-migratory rainbow trout. Both forms are found in San Francisquito Creek and are included in the Central California Coast "Evolutionarily Significant Unit" (ESU) listed as threatened under the Endangered Species Act. Their biology is further complicated by human actions, such as transporting both wild and hatchery trout between waterways. Dr. Jennifer Nielsen of the USGS has conducted studies aimed at testing whether the San Francisquito trout are hatchery strays or part of San Francisco Bay's wild steelhead runs. The studies are part of her extensive surveys of Pacific salmonid genetics.

Lessingia glandulifera *and* Lessingia hololeuca

JRBP's Lessingias *were among the 40 populations sampled by Staci Markos (University of California, Berkeley) to construct a molecular phylogeny of the genus* Lessingia *and its closest relatives. Among the findings reported in her recent publication is that petal color has been a conservative trait during* Lessingia *evolution. The two color groups, a "pink-white group" (e.g.,* Lessingia hololeuca*) and a "yellow group" (e.g.,* Lessingia glandulifera*), coincide with the two main lineages identified by molecular genetics. Both lineages are represented at JRBP.*

Dr. Nielsen analyzed samples of fin tissue taken from 47 San Francisquito trout by Dr. Alan Launer, who has monitored the population since 1996. Dr. Nielsen used both microsatellite DNA and mitochondrial DNA to compare the San Francisquito samples with her genetic analyses of California steelhead trout from hatcheries, creeks, and rivers across the state. She obtained two results that indicate a close genetic relationship between San Francisquito steelhead trout and other coastal strains. First, she found that three types of mitochondrial genomes were present in the San

Francisquito population, one of which she has never found in hatchery strains. Second, her analyses of microsatellite DNA indicated that San Francisquito trout are very distinct from hatchery strains; they are most similar to rainbow trout from two other creeks within the Central Coast ESU.

Another JRBP species with a seemingly dual identity is the serpentine wildflower *Linanthus parviflorus*. Two forms of *L. parviflorus*, capable of crossing yet marked by different flower color, are adapted to two distinct soils at JRBP. Professor Douglas Schemske (Michigan State University) has been studying this and other species of *Linanthus* to address a fundamental question in evolution and ecology: does adaptive evolutionary change involve changes in many genes, each with subtle effects, or changes in a few genes, each with dramatic effects? To find out how genetically different the two forms of *L. parviflorus* are, Professor Schemske is making a genetic map.

Through several years of classical breeding experiments with greenhouse populations of *Linanthus* started from Jasper Ridge seeds, Professor Schemske has created multiple generations of crosses of known pedigree. He is now developing molecular markers, which are amplified fragments of the genome where sequence differences among individuals occur. He will use these to determine the genotypes of pedigreed plants and, ultimately, produce a genetic map. Although Professor Schemske is developing far fewer markers than are used for genetic mapping in humans, they will provide the resolution necessary to test for the presence of genes with dramatic effects. His studies thus far demonstrate that the difference in flower color is determined by a single gene, which also affects the uptake of magnesium from soil. Plants adapted to serpentine soil are pink-flowered not because they attract different pollinators than the white-flowered plants, but instead, because the gene for flower color also limits uptake of magnesium.

Molecular techniques are also being used in the Jasper Ridge Global Change Experiment to assess whether ecosystems respond to environmental change primarily through physiological responses, evolutionary changes in the resident species, or species replacements. Professor Shauna Somerville (Carnegie Institution) will survey the genes expressed in wild oats (*Avena*) using a new approach, DNA microarray technology, to identify genes associated with global change parameters. This technology screens thousands of genes for activity, rather than a single gene, and will probe for responses that involve the interactions among many genes.

Dr. Adrian Barbrook, a postdoctoral fellow working with Professor Brendan Bohannan, is studying the response to simulated global change in three important groups of soil bacteria—ammonia oxidizers, methane oxidizers, and denitrifiers. This year, he screened soil samples from two sets of plots, the ambient (control) plots and the plots exposed to increased carbon dioxide, water, heat, and nitrogen. He extracted DNA from the soil samples, produced many copies of a gene associated with ammonia oxidation, and then determined the diversity of sequences present for this functional gene. Dr. Barbrook's results indicate that the dominant population of ammonia oxidizers is different in the two types of plots sampled, suggesting that the simulated global change led to significant changes in the bacterial community.

The results that have been achieved with molecular techniques at JRBP have provided valuable—possibly crucial—information about the biology of species that span the range from threatened to threatening. The findings are both milestones of discovery and potential aids in developing effective strategies for protecting the populations and ecosystems of the Preserve. They are also a credit to the long-term research that brought into focus the precise questions where these tools have been successfully applied. All of these factors underscore the importance of a framework of ecological research and monitoring within and beyond the Preserve.

Education and research are the heart of the mission of Jasper Ridge Biological Preserve, and our many committed volunteers, instructors, researchers, and students carry out this goal. The first docent class met in February of 1975, and has since become a Stanford University class with a formal and ever-expanding curriculum. The Preserve has been home to educational activities for over a century, with the first published thesis from JRBP in 1896 and the first Stanford Zoology Club meeting in 1915. The docent program remains at the core of the educational activities of the Preserve, and since its inception, docents have been instrumental in public outreach, biological monitoring, and assisting with University classes and research.

Increasingly, the role of docents and the docent program reflects the growing demand for environmental education. Biology 96A/B, the JRBP docent training class, has responded to this need by providing more information and more field experience to better equip docents for their roles as students, naturalists, and educators. The expanded curriculum now includes subjects such as water quality testing, geographic information systems (GIS) and global positioning systems (GPS), phenology, water transport in plants, and global climate change, in addition to the traditional class schedule.

Docent achievements for the academic year 2000-01 showcase the amazing and varied talents of our community and demonstrate the enormous resource that the docent community represents. Some ongoing docent efforts include the JRBP bird survey, bat research, water quality monitoring, and the Preserve's herbarium. Docents continued to help with research, assisted with Stanford classes, led tours, transplanted oak trees, helped with the 2001 controlled burn, and provided an endless support system for the program. Student docents continued their teaching/mentoring liaison with Eastside College Preparatory Field Studies classes, and senior Audrey Chang, an Earth Systems student advisor, organized a special event for the Stanford community to visit the Preserve and interact with researchers.

The 2001 Docent Class and creek ecology instructor, Gordon Holtgrieve.

The JRBP community utilizes and supports continuing education opportunities and docents regularly attend the lectures, classes, and seminars that their JRBP affiliation makes available to them. The lifelong learner is well illustrated in the Preserve community with the docents' persistent search for knowledge and insight into the natural world.

In the 2000-01 academic year and tour season, a total of 4,851 individuals toured the Preserve. The broad range of visitors to the Preserve included the general pub-


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1. *A student from Eastside College Preparatory School holds a crayfish (*Procambarus clarkii*) in San Francisquito Creek during her class' creek survey.*

2. *Resident ranger and docent Brooke Fabricant presents his docent class project, "20 Common Trailside Mushrooms of JRBP," along with a map of their distribution.*

3. *Judy Mason, Toni Corelli, Virginia Fryer, Jean Clark, Bill Clark, Marion Smith, Ed Fryer, and Dania Gamble pile into the back of an old Ford pickup truck for an ecological and historical tour of Santa Cruz Island.*

4. *Stanford undergraduate, Molly Aeck, examines a California newt (*Taricha sp.*) during a Biology 96 class.*

5. *The herbarium team meets weekly to work on JRBP's plant collection, plant list, slide collection, and plant database. Sally Casey (left) contributes her expertise on grasses to the ongoing efforts of docents Anne Lambrecht, Ruth Porter, and Toni Corelli.*

6. *University of California at Los Angeles researcher Gary Roemer demonstrates telemetric tracking of endangered foxes during the 2000 fall docent field trip to Santa Cruz Island Reserve.*

7. *Jihan Gearon presents a summary of a research paper written by Nathan Sanders, Kasey Barton, and Deborah Gordon on long-term dynamics of the invasive Argentine ant* Linepithema humile *and native ant taxa as part of the research class in the docent program.*

8. *Docents peer through the rain and clouds for landmarks visible from Escobar Gate before embarking on an extremely rainy docent field class.*

9. *Docent Kathleen Starmer demonstrates the use of a pressure chamber to measure water potential in plants for the docent training class.*

10. *Eastside College Preparatory students learn about fish, reptiles, and amphibians in San Francisquito Creek with teaching assistants Scott Loarie and Nina Robertson.*

lic, Stanford classes, dormitory groups, graduating seniors and their families, alumni and reunion groups, prospective students, Stanford faculty and staff, classes from other colleges, and local high school and elementary school groups. Most of the elementary age school children that visited the Preserve were associated with the Environmental Volunteers Program, which provided educational tours for schools visiting the Preserve.

Educational use of the Preserve in 2000-01 included Stanford University undergraduate and graduate classes, Stanford Continuing Studies classes, classes from other colleges and universities, Eastside College Preparatory Field Studies, as well as elementary and secondary school classes. Appendix 1 provides a complete list of university and non-university classes at JRBP for the year, as well as those organizations and groups that participated in docent-led tours.

Two Stanford University courses are highlighted this year, Earth Systems 189 and Biology 44Y. The Earth Systems course is an example of an expansion of educational use at JRBP that fills a critical need for an ecosystems science field course at Stanford University. Biology 44Y is an example of a continuing course at the Preserve that exposes hundreds of students each year to the principles of ecology and to laboratory techniques.

Earth Systems 189 students run a sampling transect across the contact between chert soils and serpentine soils with instructor Stu Weiss.

Field Studies in Earth Systems (Earth Systems 189) was taught at JRBP for the first time in the spring of 2001. This course focused on investigating the fundamental workings of several different ecosystems by using field and laboratory methods in geology, soils, biogeochemistry, and plant ecology. The class was the idea of Professor Pamela Matson, Director of the Earth Systems Program, who recruited professors Scott Fendorf and Elizabeth Miller, JRBP researcher Stu Weiss, and JRBP Scientific Coordinator Nona Chiariello. Together, the instructors provided a breadth and depth of knowledge about both their individual disciplines and the ecosystems of the Preserve.

Eight students completed three different field experiments as final projects for the course. Gwen Yoshimura and Daniel Nidzgorski compared soil properties and nutrient cycling between young and old willow stands. Emily Goodwin, Sarah Clowes, and Hedy Born analyzed plant and soil composition change due to the presence of coyote bush, *Baccharis pilularis*. Valentina Cabrera-Stagno, Ted Maehr, and Chris Friedel studied the soil effects of leather oak, *Quercus durata*, in a serpentine grassland.

Understanding ecosystems requires knowledge of the interactions among biotic and abiotic components in rocks and soil, chemicals and water, plants, animals, and microbes. This requires a multidisciplinary approach to

the study of ecosystems and the coordinated effort of many instructors from many backgrounds. Earth Systems 189 exemplifies the type of hands-on field work and multidisciplinary ecosystem science essential to undergraduate and graduate science programs.

Biology 44Y is an introductory laboratory sequence required of all biology majors at Stanford University. During the spring of 2001, approximately 250 Stanford students studied an ecology unit at JRBP, which included a macroinvertebrate lab, a docent-led tour, and a global positioning system (GPS) tutorial.

The ecology laboratory section focused on trophic web (food web) dynamics in Searsville Lake by comparing the macroinvertebrate populations found on parrot's feather (*Myriophyllum aquaticum*) taken from enclosures with crayfish, catfish, or a control enclosure with neither consumer. Students learned techniques for the sampling and sorting of macroinvertebrates, as well as statistical analysis. Docents led students on a class-specific tour through the varied ecosystems of JRBP identifying field examples of ecological subjects as varied as succession, invasion of non-native species, endemism, and adaptation.

Earth Systems 189 students Gwen Yoshimura, Valentina Cabrera-Stagno, Sarah Clowes, and Chris Friedel map a geological contact on the JRBP ridgetop.

Biology 44Y students recorded the locations of oak trees at the Preserve using GPS equipment. Students also collected data such as trunk diameter, presence or absence of mistletoe, and presence or absence of galls. These data were then integrated into a geographic information system (GIS), a computer system capable of assembling, manipulating, storing, and displaying geographically referenced information.

Biology 44Y students represent an extremely diverse range of interests within the field of biology. For many students, this class is their only exposure to field biology and ecology while at Stanford. Although most Biology 44Y students will enter a field other than ecology, the exposure to JRBP gives students an understanding of field biology and a basic knowledge of ecosystem functioning.

Jasper Ridge Biological Preserve's greatest educational asset is its people. As JRBP researchers, faculty, students, and staff reach out from their work at the Preserve to other areas of the world they teach in classrooms, in the field, and by example. JRBP is dependent upon the talent and commitment of this extraordinary human resource for the continuation and expansion of its education programs and is grateful to all of those instructors dedicated to furthering environmental education for the JRBP community and beyond.

Biology 44Y students use microscopes to classify aquatic macroinvertebrates as part of their ecology lab.

JRBP Resident Caretaker Leonard Robinson (left) stands next to the causeway boardwalk that he designed and built in the fall of 2000. This raised walkway, made with salvaged steel, makes it possible to cross the causeway even during the wet winter months.

Docent Chris Andrews (right) receives a t-shirt made with three of her drawings at the 2001 docent graduation picnic. Chris has been a docent since 1984, and has donated her talent and artwork for innumerable projects and publications, including the JRBP plant list, Field Notes, Views, and the annual report.

Gustavo Figueroa (left) has worked at JRBP for over two years. He began as Preserve Maintenance Steward and most recently has been working as a research assistant in Searsville Lab. Here he transcribes hourly temperature from weather station data recorded in the 1970s.

Joan Ferguson (right) joined the JRBP staff in 2001 as Administrative Associate for Philippe Cohen. Joan has been working at Stanford since 1986, primarily as a research assistant in the field of child development and psychiatry.

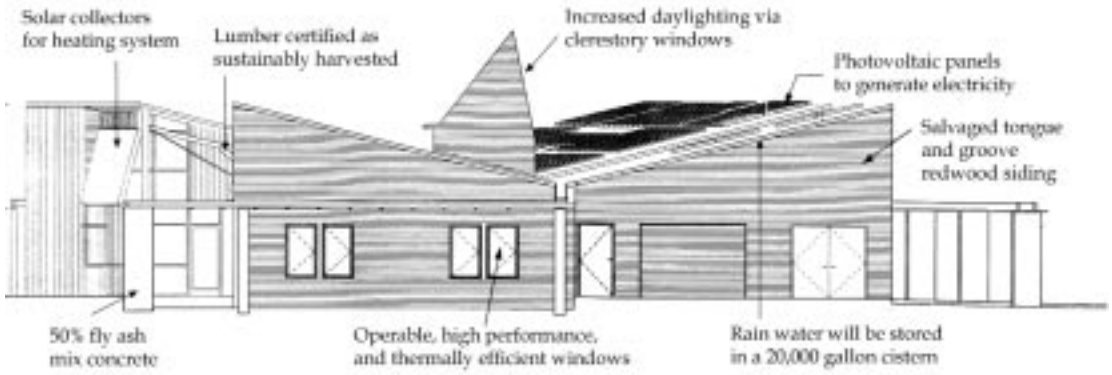
Leslie Shao-ming Sun Field Station

The north face of the Sun Field Station as seen from the nearby oak grove. The main entrance and foyer are marked by the opening in the roofline.

The rendering to the right shows the south face of the building. The dark panels on the face of the building are solar collectors for the active solar heating system. These same collectors provide shading along the south glazing below, thus contributing to summer cooling. North facing light monitors on the roof provide diffuse daylighting, and the south trellis will be covered with native vines.

The image at left shows the concrete slab of the new facility before framing began. The manufacture of cement accounts for 5-8% of global carbon emissions. With this in mind, cement content was reduced in the concrete mix during construction by using more fly ash—a by-product of electricity generation through the burning of crushed coal.

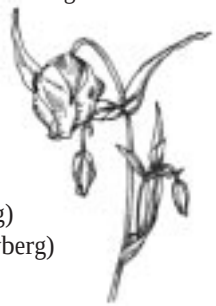
The Sun Field Station as it appeared during construction in late October 2001 from a similar angle as the rendering above.



The Sun Field Station incorporates numerous features that minimize its environmental footprint. In addition to the ones noted in this drawing, this new building includes: structural design that reduces construction material, graywater plumbing, waterless urinals, appliances that all exceed energy star ratings, and the use of recycled materials. The building is designed to annually meet its own energy requirements.

Stanford University Classes (1,456)

Anth Sci 3	Introduction to Prehistoric Archaeological Sites (Rick)
Arch 19	Historical Archaeological Field Methods, Continuing Studies (Jones)
Bio 12	Wildflower Families of the Bay Area, Continuing Studies (Corelli/Mason)
Bio 16	Island Ecology (Vitousek)
Bio 44Y	Core Experimental Lab (Yelton)
Bio 96A/B	JRBP Docent Training Class (Vitousek)
Bio 125	Ecosystems of California (Mooney)
Bio 144	Conservation Biology (Launer)
CEE 162	Hydrology and Water Resources (Freyberg)
CEE 261	Watershed and Wetlands Hydrology (Freyberg)
Esys 10	Introduction to Earth Systems (Ernst)
Esys 189	Field Studies in Earth Systems (Matson)
GES 1	Fundamentals of Geology (Mahood)
History 62S	Unimagined Futures: An Environmental History of the Suburban West (Booker)
-	Function in Art (Ross)
-	Quest Scholars Program, Stanford Youth Environmental Science Program (Ackerly)

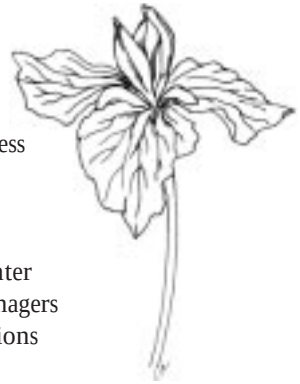


Non-Stanford University Classes (251)

720958X	De Anza College, Natural History of the Bay Area (West-Bourke)
History 144W-95	De Anza College, History of Stanford (Hirsch)
-	Cañada College, Field Botany (Steiner)

Stanford Organizations (335)

Alumni Summer Seminar
Bechtel International Center
Branner Hall
Center for Advanced Study in the Behavioral Sciences
Center for Teaching and Learning
Department of Biological Sciences
Department of Geological and Environmental Sciences
Faculty Women's Club
Florence Moore Hall
Freshman Advisors
Graduate School of Business
Learning Careers Project
Medical School Alums
Provost's Office
Stanford Archaeology Center
Stanford Engineering Managers
Stanford Facilities Operations
Stanford Law School
Stanford Libraries Staff Association
Stanford Linear Accelerator Center
Stanford Management Company
Stanford University Conference Office
Students for Environmental Education with Castaño School
Synergy House

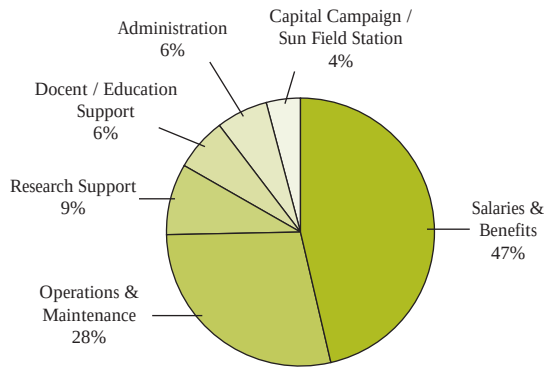


Other Organizations (2,809)

Advanced English as a Second Language, Palo Alto Unified School District
Affymetrix
American Association of Botanical Gardens and Arboreta
Bay Area Action
Burlingame/Hillsborough Garden Club
Canopy
Carnegie Institution of Washington
Center for the Study of Language and Information
Coyote Point Summer Camp
East Palo Alto Charter School
Eastside College Preparatory School
Encinal School
Environmental Volunteers
Exxon Mobil
Filoli Continuing Education
The Forum
The Girls' Middle School
Golden Gate Biosphere Reserve Association
Grand Canyon Gals
The Hewlett Foundation
Hewlett Packard Retired Employees Club
Ladera Garden Club
Leaping Lizards
Lucile Packard Foundation for Children's Health
Menopausal Men's Marching Group
Mount Alverno Zen Meditation Group
Peninsula Open Space Trust
Peninsula School
Phillips Brooks School
Pitzer College Alums
San Francisquito Creek Joint Powers Authority
San Mateo County Firesafe Committee
Santa Clara Valley Audubon Society
Sweet Adeline's A Cappella Group
Trinity School
United States Geological Survey (USGS)

Appendix 2: Financial Summary: 2000-01 Fiscal Year

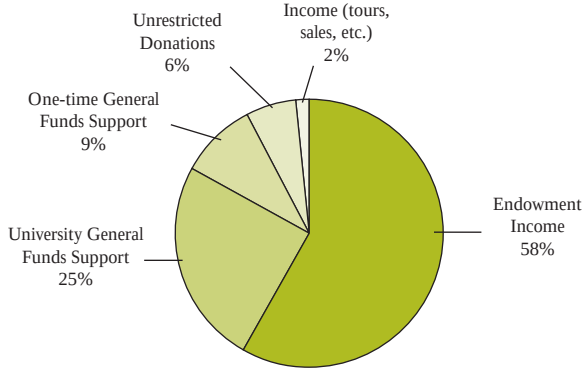
Expense Summary - $689,086



Salaries & Benefits	319,420
Operations & Maintenance	195,221
Research Support	59,119
Docent / Education Support	43,997
Administration	42,929
Capital Campaign / Sun Field Station	28,400

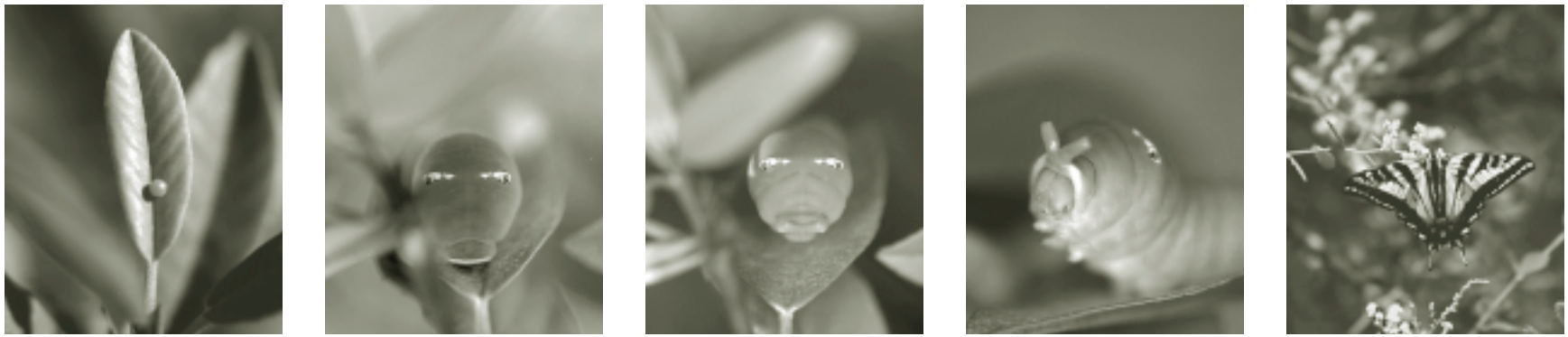
- Capital Campaign / Sun Field Station expenses refers to fundraising events, publications, and activities related to preparations for and during construction.
- Research support includes a one-time charge for contracted digital elevation model (DEM) and associated aerial photos.

Revenue Summary - $713,490



Endowment Income	415,143
University General Funds Support	177,235
One-time General Funds Support	66,299
Unrestricted Donations	43,283
Income (tours, sales, etc.)	11,530

- One-time general funds are carry-over from fiscal year 2000 allocation for deferred maintenance, equipment, and DEMs that continued to be addressed in this fiscal year. Without carry-over of one time funding, revenue total was $647,191.
- Revenue summary does not include the $1.7 million raised for the Leslie Sun Field Station capital campaign during this fiscal year.



*Life stages of the Pale Swallowtail (*Papilio eurymedon*)*

Appendix 3: Publications

Ackerly, D.D., Knight, C.A., Weiss, S.B., Barton, K., and Starmer, K.P. Leaf size, specific leaf area and microhabitat distribution of woody plants in a California chaparral: contrasting patterns in species level and community level analyses. Oecologia (in press).

Brown, M.J.F. and Gordon, D.M. (2000) How resources and encounters affect the distribution of foraging activity in a seed-harvesting ant. Behavioral Ecology and Sociobiology 47:195-203.

Cardon, Z.G., Hungate, B.A., Cambardella, C.A., Chapin, F.S., III, Field, C.B., Holland, E.A., and Mooney, H.A. (2001) Contrasting effects of elevated CO_2 on old and new soil carbon pools. Soil Biology and Biochemistry 33: 365-373.

Dukes, J.S. (2000) Will the rising atmospheric CO_2 concentration affect biological invaders? In: H. Mooney and R. Hobbs (eds) Invasive Species in a Changing World, Island Press (Washington), pp. 95-113.

Dukes, J.S. (2001) Biodiversity and invasibility in grassland microcosms. Oecologia 126: 563-568.

Dukes, J.S. Comparison of the effect of elevated CO_2 on an invasive species (*Centaurea solstitialis*) in monoculture and community settings. Plant Ecology (in press).

Dukes, J.S. (2001) Productivity and complementarity in grassland microcosms of varying diversity. Oikos 94: 468-480.

Dukes, J.S. Species composition and diversity affect grassland susceptibility and response to invasion. Ecological Applications (in press).

Dukes, J.S. and Field, C.B. (2000) Diverse mechanisms for CO_2 effects on grassland litter decomposition. Global Change Biology 6: 145-154.

Dukes, J.S. and Hungate, B.A. Elevated CO_2 and litter decomposition in California annual grasslands: which mechanisms matter? Ecosystems (in press).

Dukes, J.S. and Mooney, H.A. Biological invaders disrupt ecosystem processes in western North America. In: G. Bradshaw, et al. (eds) How Landscapes Change: Human Disturbance and Ecosystem Disruptions in the Americas, Springer-Verlag (Berlin) (in press).

Frey, Caroline (2001) Geomorphic Study of Searsville Lake Watershed, Portola Valley, California. Master's Thesis, Department of Geology, San Jose State University.

Garcia, M. and Ustin, S.L. (2001) Detection of interannual vegetation responses to climatic variability using AVIRIS data in a coastal savanna in California. IEEE Transactions on Geoscience and Remote Sensing 39: 1480 -1490.

Garcia, Monica (2000) Detection of interannual response of vegetation to climatic variability using hyperspectral (AVIRIS) data in a coastal savanna in California. Master's Thesis, Department of Land, Air, and Water Resources, University of California, Davis.

Gee, L., Neuhauser, D., Dreger, D., Pasyanos, M., Uhrhammer, R., and Romanowicz, B. The Rapid Earthquake Data Integration Project. In: W. Lee (ed) Handbook of Earthquake and Engineering Seismology, IASPEI (in press).

Herwitz, S.R., Sandler, B., and Slye, R.E. (2000) Twenty-one years of crown area change in the Jasper Ridge Biological Preserve based on georeferenced multitemporal aerial photographs. International Journal of Remote Sensing 21: 45-60.

Holtgrieve, Gordon W. (2001) Distribution and Abundance of Native and Non-native Fishes in San Francisquito Creek, California. Master's Thesis, Department of Earth Systems, Stanford University.

Hu, S., Chapin, F.S., III, Firestone, M.K., Field, C.B., and Chiariello, N.R. (2001) Nitrogen limitation of microbial decomposition in a grassland under elevated CO_2. Nature 409: 188-191.

Hungate, B.A., Jaeger, C.H., III, Gamara, G., Chapin, F.S., III, and Field, C.B. (2000) Soil microbiota in two annual grasslands: responses to elevated atmospheric CO_2. Oecologia 124: 589-598.

Joel, G., Chapin, F.S., III, Chiariello, N.R., Thayer, S.S., and Field, C.B. (2001) Species-specific responses of plant communities to altered carbon and nutrient availability. Global Change Biology 7: 435-450.

Joel, Geeske (2000) Responses of grassland ecosystems to elevated CO_2: single and multi-species components. Ph.D. Dissertation, Department of Biological Sciences, Stanford University.

Karakelian, D., Beroza, G.C., Klemperer, S.L., and Fraser-Smith, A.C. Analysis of ultra-low frequency electromagnetic field measurements associated with the 1999 M 7.1 Hector Mine earthquake sequence. Bulletin of the Seismologial Society of America (in press).

Karakelian, D., Klemperer, S.L., Fraser-Smith, A.C., and Beroza, G.C. (2000) A transportable system for monitoring ultralow frequency electromagnetic signals associated with earthquakes. Seismological Research Letters 71: 423-436.

Knight, C.A. and Ackerly, D.D. An ecological and evolutionary analysis of

photosynthetic thermotolerance using the temperature dependent increase in steady-state fluorescence. Oecologia (in press).

Markos, S. and B. G. Baldwin. Structure, molecular evolution, and phylogenetic utility of the 5' region of the external transcribed spacer of 18S-26S rDNA in *Lessingia* (Compositae, Astereae). Molecular Phylogenetics and Evolution. (in press).

Markos, Staci Elizabeth (2000) Evolutionary patterns in *Lessingia* and close relatives (Compositae, Astereae): evidence from rDNA, morphology, and biosystematic data. Ph.D. Dissertation, Department of Integrative Biology, University of California, Berkeley.

Markos, S. and Baldwin, B.G. (2001) Higher-level relationships and major lineages of *Lessingia* (Compositae, Astereae) based on nuclear rDNA internal and external transcribed spacer (ITS and ETS) sequences. Systematic Botany 26: 168-183.

Merton, R. N. and Silver, E. (2000) Tracking vegetation spectral trajectories with multi-temporal hysteresis models. Proceedings of the Ninth Annual JPL Airborne Earth Science Workshop. NASA, Jet Propulsion Laboratory, Pasadena, California, USA. 23 - 25 February 2000.

Mill, T. (2000) Photoreactions in surface waters. In: R.S Boethiling and D. Mackay (eds) Handbook of Property Estimation Methods for Chemicals, Lewis Publishers (New York), pp. 355-382.

Rillig, M.C., Wright, S.F., Shaw, M.R., and Field, C.B. Artificial ecosystem warming positively affects arbuscular mycorrhizae but decreases soil aggregation. Oikos (in press).

Sanders, N.J., Barton, K.E., and Gordon, D.M. (2001) Long-term dynamics of the distribution of the invasive Argentine ant, *Linepithema humile*, and native ant taxa in northern California. Oecologia 127: 123-130.

Spanggord, R.J., Yao, D., and Mill, T. (2000) Kinetics of aminodinitrotoluene oxidations with ozone and hydroxyl radical. Environmental Science and Technology 34: 450-454.

Tajima, F., Megnin, C., Dreger, D., and Romanowicz, B. Feasibility of real-time broadband waveform inversion for simultaneous moment tensor and centroid location determination. Bulletin of the Seismological Society of America (in press).

Ward, Kimiora Linda (2000) Quantitative genetic differentiation among adjacent populations of *Linanthus parviflorus* (Polemoniaceae): natural selection or genetic drift? Master's Thesis, Botany Department, University of Washington.

Zavaleta. Erika S. (2001) Influences of climate and atmospheric changes on diversity and ecosystem function in a California grassland. Ph.D. Dissertation, Department of Biological Sciences, Stanford University.

Appendix 4: Research Projects

Project	Principal Investigator(s)	Department or Division	Institution
Chaparral species distributions at local and regional scales	Ackerly, David	Biological Sciences	Stanford University
Diurnal gas exchange and water relations of chaparral plants	Ackerly, David; Bhaskar, Radika	Biological Sciences	Stanford University
Comparative ecophysiology of heat shock protein expression	Knight, Charles	Biological Sciences	Stanford University
Dependence of chaparral species on fire and disturbance	Phillips, Claire	Biological Sciences	Stanford University
Stem-leaf allometry and hydraulic conductivity in chaparral plants	Preston, Katherine	Biological Sciences	Stanford University
Phenology and distribution of certain Diptera (*Hilara*, *Medetera*, and Tachinidae)	Arnaud, Paul	Entomology	Cal. Academy of Sciences
Population biology of the butterfly *Euphydryas chalcedona*	Brown, Irene	JRBP	
Geologic studies of Jasper Ridge Biological Preserve	Coleman, Robert	Geological & Environmental Sciences	Stanford University
Mammalian herbivores as mediators of community structure and soil fertility	Cushman, Hall	Biology	Sonoma State University
Effects of fire on grassland species composition	Dukes, Jeffrey	Biology	Univ. of Utah
Mountain building in San Francisco Bay Area	Dumitru, Trevor	Geological & Environmental Sciences	Stanford University
Long-term studies of *Euphydryas editha bayensis*	Ehrlich, Paul; Launer, Alan	Biological Sciences	Stanford University
Inventory of the bats of Jasper Ridge	Evelyn, Michelle; Stiles, David	Biological Sciences	Stanford University
Hyperspectral landcover classification	Falcone, James	Geography	Univ. of New South Wales
Mapping and evaluation of sediment sources in the Searsville watershed	Frey, Caroline	Geology	San Jose State University
Jasper Ridge Global Change Experiment	Field, Christopher; Somerville, Shauna	Plant Biology	Carnegie Instit. of Washington
	Bohannan, Brendan; Mooney, Harold;		
	Vitousek, Peter	Biological Sciences	Stanford University
Spectral measurements of biomass and vegetation structure	Asner, Greg	Geological Sci. & Environ. Studies	University of Colorado
Response of soil bacterial communities to elevated CO_2	Barbrook, Adrian	Biological Sciences	Stanford University
Spectral measurement of vegetation dynamics	Chiariello, Nona	Biological Sciences	Stanford University
Phenological responses of species and functional groups	Cleland, Elsa	Biological Sciences	Stanford Univ. & Carnegie Inst.
Pilot study of CO_2 effects on gene expression in *Avena*	Finkelstein, David	Plant Biology	Carnegie Instit. of Washington
Isotopic analysis of decomposition and nitrogen cycling	Hungate, Bruce	Biological Sciences	Northern Arizona University
Effects of increased CO_2 on insect growth	Parmesan, Camille; Wee, Brian	Section of Integrative Biology	Univ. of Texas at Austin
Dynamics of carbon, nitrogen, and biomass	Shaw, Rebecca	Plant Biology	Carnegie Instit. of Washington
Herbivore regulation of symbiotic nitrogen fixation	Thomas, Brian	Biological Sciences	Stanford Univ. & Carnegie Inst.
Isotopic analysis of respiratory carbon dynamics	Torn, Margaret	Center for Isotope Geochemistry	Lawrence Berkeley Nat'l. Lab.
Diversity and invasibility of grassland ecosystems	Zavaleta , Erika	Biological Sciences	Stanford University
Long-term conservation of open water habitat in Searsville Lake	Freyberg, David;	Civil & Environmental Engineering	Stanford University
	Cohen, Philippe	JRBP	Stanford University
Using AVIRIS to detect the impact of rainfall variability in JRBP	Garcia, Monica	Land, Air, & Water Resources	Univ. of California, Davis
Argentine ant invasion (*Linepithema humile*) and the response of native ants	Gordon, Deborah	Biological Sciences	Stanford University
Chemical ecology of the Argentine ant	Greene, Michael	Biological Sciences	Stanford University
Population dynamics of the Argentine ant in JRBP	Heller, Nicole	Biological Sciences	Stanford University
Gene flow and sex-biased dispersal in Argentine ant invasions	Ingram, Krista	Biological Sciences	Stanford University

Project	Principal Investigator(s)	Department or Division	Institution
Paleoecological record preserved in woodrat middens	Hadly, Elizabeth	Biological Sciences	Stanford University
Mammals of JRBP	Hadly, Elizabeth	Biological Sciences	Stanford University
Family Farm Road flood and sediment control study	Hall, Brad		Northwest Hydraulics, Inc.
Searsville Lake sediment impact study	Hall, Brad		Northwest Hydraulics, Inc.
	Hecht, Barry		Balance Hydrologics, Inc.
Applied paleoethnoecology of the San Francisco Bay peninsula	Hammett, Julia	Social Science	Truckee Meadows Comm. Coll.
Water-quality assessment for sustaining aquatic habitat, Bear Creek Watershed	Hecht, Barry		Balance Hydrologics, Inc.
Effects of rainfall variability and gopher removal on serpentine grassland	Hobbs, Richard	Environmental Science	Murdoch University, Australia
Ichthyofaunal composition and condition of Searsville Lake	Holtgrieve, Gordon	Biological Sciences	Stanford University
GPS mapping for the San Francisquito Archaeological Research Project GIS	Jones, Laura	Archaeology	Stanford University
Long-term monitoring of ecosystem processes by eddy flux	Kaduk, Jörg; Field, Christopher	Plant Biology	Carnegie Instit. of Washington
Ameriflux comparison of eddy flux monitoring sites	Evans, Robert	Northeastern Experiment Station	USDA Forest Service
Natural barriers to Argentine ant invasion: the role of transitional environments	Kark, Salit; Heller, Nicole;	Biological Sciences	Stanford University
	Young, Rebecca	JRBP	Stanford University
Ultra-low frequency electromagnetic earthquake precursors	Karakelian, Darcy; Klemperer, Simon	Geophysics	Stanford University
Regional surveys of annual acorn production	Koenig, Walter	Hastings Natural History Reserv.	Univ. of Calif., Berkeley
Broad band seismic monitoring	Kovach, Robert	Geophysics	Stanford University
		Berkeley Digital Seismic Network	Univ. of California, Berkeley
			U.S. Geological Survey
Survey of San Francisquito Creek and removal of exotics	Launer, Alan	Center for Conservation Biology	Stanford University
Biofilm development on iron oxide minerals	Lester, Kristin	Geological & Environmental Sciences	Stanford University
Trace-gas emissions from managed and natural grasslands	Marin-Spiotta, Erika	Environ. Science, Policy & Mgmt.	Univ. of California, Berkeley
Photochemistry of dissolved organic materials in Searsville Lake	Mill, Theodore	Atmos. Chem. & Space Physics	SRI International
Mapping plant water uptake using stable isotopes	Moore, Lisa	Biological Sciences	Stanford Univ. & Carnegie Inst.
Stability of Cr(III) in the soil environment	Oze, Christopher	Geological & Environmental Sciences	Stanford University
Slug-plant interactions	Peters, Halton	Biological Sciences	Stanford University
Evolutionary dynamics of flower color polymorphism in *Linanthus parviflorus*	Schemske, Douglas	Plant Biology	Michigan State University
Fire management and prescribed burning	Stephens, Scott;	Envir. Science, Policy, & Mgmt.	Univ. of California, Berkeley
	Cohen, Philippe	JRBP	Stanford University
Long-term studies of phenology and plant composition in serpentine grasslands	Weiss, Stuart		
Long-term acoustical monitoring of bat activity	Young, Rebecca;	JRBP	Stanford University
	Mudd, Thomas	JRBP	

Appendix 5: Donors

Unrestricted Gifts, September 1, 2000 –August 31, 2001

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Leslie Shao-ming Sun Field Station Capital Campaign Donations and Grants

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Jenny Creelman
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Hall Cushman
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Nona Chiariello, Ph.D., Science Coordinator
Cindy Wilber, Program Coordinator
Justin Holl, Assistant Program and Science Coordinator
Rebecca Young, GIS and Data Analyst
Joan Ferguson, Administrative Associate
Leonard Robinson, Resident Caretaker
Gustavo Figueroa, Preserve Maintenance Steward
Brooke Fabricant and Deanna Messinger, Resident Rangers

For More Information about Jasper Ridge Biological Preserve:

Administrative Director
Jasper Ridge Biological Preserve
Stanford University
Stanford, CA 94305-5020
email: philippe@jasper.stanford.edu
URL: http://jasper1.stanford.edu/
Phone: (650) 723-1589
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Charles Comfort, 1
Toni Corelli, 8 (right)
Thomas Elder, 8 (left)
Leo Holub, cover, 3, 4, 10, 16, 18, 28, 29
Gerry Jennings, 21
Alan Launer, 11
Cagan Sekercîoglu, 2
Cindy Stead, 17 (top right)
Cindy Wilber, 12(#1 & #4), 13(#9 & #10)
Woody Woodward, 23

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The David and Lucile Packard Foundation Conservation Grants Program, 11
Rob Wellington Quigley, FAIA, 19

Graphic design and layout by Rebecca Young
Printed by Alonzo Printing on recycled paper with soy-based ink.

In Memoriam

David Regnery - JRBP Researcher, died May 9, 2001. Professor Regnery joined Stanford's biological sciences faculty in 1947 and began research at JRBP years before its designation as a biological preserve. He and his wife Dorothy were among the original residents of neighboring Westridge in Portola Valley, and he became well acquainted with the area soon after moving to Westridge. Professor Regnery's first permit to enter the "Jasper Ridge Biological Experimental Area" was issued in 1966 for collecting small mammals. Over many years he live-trapped voles, mice, brush rabbits, and other small mammals as part of his studies of the genetics of disease resistance and the natural history of viral diseases in native mammals.

Minna Sandmeyer - Docent since 1999, died on July 13, 2001. Minna was loved and admired by many of the people she touched in her active life. She was an avid biker, dedicated forest activist, longtime singer in the Stanford Chamber Chorale, green builder and craftswoman, founding member of the Stanford Organic Farm, and above all, a compassionate friend and loving human being. Minna inspired many of us as she biked across the country, built earthships in a sustainable community, got her hands dirty in the garden, sang, and took the time to listen to friends and family. While at Stanford she served as a docent for Jasper Ridge Biological Preserve. Minna will be missed dearly by all who were blessed by her incredible presence.

-Nina Robertson, friend and JRBP docent