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Systemwide Salutations

Education in the NRS

The mission of the Natural Reserve System is to contribute to the understanding and wise management of the Earth's natural systems by supporting teaching, research, and public service at protected wild areas throughout California. Because instruction is an important part of this mission, our work to strengthen undergraduate and graduate education must continue to improve, even in these trying budget times.

The NRS is central to many University teaching programs. The reserves themselves are viewed by many educators as outdoor classrooms and laboratories that can accommodate a wide variety of disciplines—environmental planning, conservation biology, archaeology, ecology, geology, and marine

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Elliott-Fisk Is Named Permanent NRS Director

In November 1992, DANR Vice President Kenneth Farrell named Deborah Elliott-Fisk permanent director of the Natural Reserve System. Elliott-Fisk, who became NRS interim director in September 1991, has already brought two new reserves on board, implemented a process for budget oversight and augmentation, initiated a program of geographic information systems for the reserves, and begun raising extramural funds.

Besides holding the NRS's chief systemwide administrative post, Elliott-Fisk is a UC Davis professor who feels the reserves should be used extensively and intensively for all levels of education as well as research. Elliott-Fisk is working now to promote student use of the reserves through several grant programs. Her goal is to make the NRS an academic support unit of excellence.



The sun's-eye view of the new passive-solar facility at the Granite Mountains Reserve. In the foreground is the residence building, flanked by two sleeping cabins; behind those is the laboratory.

Innovative, Self-sufficient Research Facilities Completed at the Granite Mountains Reserve

Biosphere II it is not.

But the prototype research and residential facility recently completed at Granite Mountains Reserve will serve as a model of environmental friendliness in addition to a long-awaited necessity for researchers.

Unlike Biosphere II—Arizona's ambitious research project in low environmental inputs and human self-sufficiency—the Granite Mountains facility will not seriously test the hardiness of its human inhabitants. Even so, its passive solar design, use of recycled materials, environmental monitoring, and even its exterior color *were* designed with the Earth in mind. "The buildings look nice, but actually they are quite Spartan inside," says Philippe Cohen, the reserve's resident director. "Come spring and summer when the sun is almost directly overhead, the facility will be almost invisible against the rocks in Granite Cove."

Located in the Mojave Desert about 80 miles east of Barstow, far from any urban power grid, the facility has to be self-sufficient and comfortable despite summer temperatures above 100° F and winter chills as low as 5° F. With their passive solar design and super-insulating materials, the buildings are estimated to be 95 percent efficient, requiring supplemental heating only 5 percent of a typical year.

The largest of the facility's four buildings serves as a laboratory with running water and electricity, lab benches, two double-basin sinks, and ample storage space. Off the main lab are Cohen's office and a library of reserve collections and maps. Constructed around a trailer donated by UC's Kearney Agricultural Center, the building holds 80 photovoltaic panels on its corrugated steel roof to convert sunlight into electricity for

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Instruction and Research Highlights

Desert Buffs Meet at Mojave Symposium

Editor's Note:

On November 7 and 8, 1992, the first East Mojave Desert Symposium convened at UC Riverside. About 100 scientists and managers came to share their understanding of the land within the boundaries of the East Mojave National Scenic Area (whose approximate location appears on the state map above). NRS Science Writer M. L. Herring was there—this is her account.



We gathered for the East Mojave Desert Symposium just three days after the presidential election, optimistic with hope for renewed possibilities. The goals, as stated by organizer Philippe Cohen (NRS Granite Mountains Reserve) in his opening remarks, were to bring together all the players and find out what we know and don't know about the East Mojave Desert. Oddly, there was no mention of the long-anticipated involvement of the National Park Service in the region until the last minutes of the last day. But, like many gatherings, this one did not seem to find its focus until the end.

Howard Wilshire (U.S. Geological Survey) opened the symposium with no mincing of words. Although scheduled to speak on the region's geologic resources, he instead outlined the human threats, beginning with the famous and scary graph showing exponential population growth. He blasted the construction of pipelines that clears a swath up to 230 feet wide to bury a pipe 42 inches in diameter. He called for better monitoring of "mitigated" restoration projects that, without watchdogs, are never done. He indicted the military for continued encroachment into natural areas with their ever-expanding war-games, and he showed the scars of Patton's tanks still visible 50 years later. He questioned the economic value of so much mineral extraction, suggesting that if mining companies are not able to clean up their messes, then they are not economical and should not be in business.

Wilshire, with his corollary, "Everything we do is wrong," catalyzed the meeting. Unfortunately, he left shortly after speaking and did not add his drop of acid to the rest of the discussions.

Peter Rowlands (Northern Arizona University) gave a soup-to-nuts introduction to the natural diversity of the not-so-Lonesome Triangle between Interstates 15 and 40 and

the Colorado River. Although many conflicting classification systems are used in the region, he confirmed that if you see Joshua trees, you're in the Mojave.

Richard Johnson (Bureau of Land Management) held the party line. He reflected on the 25-year history of the BLM's Desert Plan that guides the agency's multi-use doctrine, then fielded questions about cows and ATVs like he'd done it before.

Things got hot with the geomorphologists. Les McFadden (University of New Mexico) gave us a crash course in tracing climate changes through soils and landforms. Nick Lancaster (University of Nevada) described his work dating eolian landscapes at the Kelso Dunes; Eric McDonald (UNM) did the same with alluvial fans, then amazed everyone with the geomorphology of desert pavements.

Barry Prigge (UC Los Angeles), Harry Greene (UC Berkeley), and Al Pfister (BLM) outlined what (little) is known about Mojave plants and animals. Then Frank Davis (UC Santa Barbara) made a strong pitch for standardizing field work in order to support regional studies and interagency management. He described using a

geographic information system in the gap analysis he is coordinating throughout California. Many questions followed, particularly about the need to ground-truth, in time and space, in order to sort the good from the rotten data. Davis stressed the need to be able to extrapolate, since we can't ground-truth everywhere, then called again for a regional effort to standardize classification and monitoring. "Otherwise," he said, "the whole concept of interagency management will become a Tower of Babel."

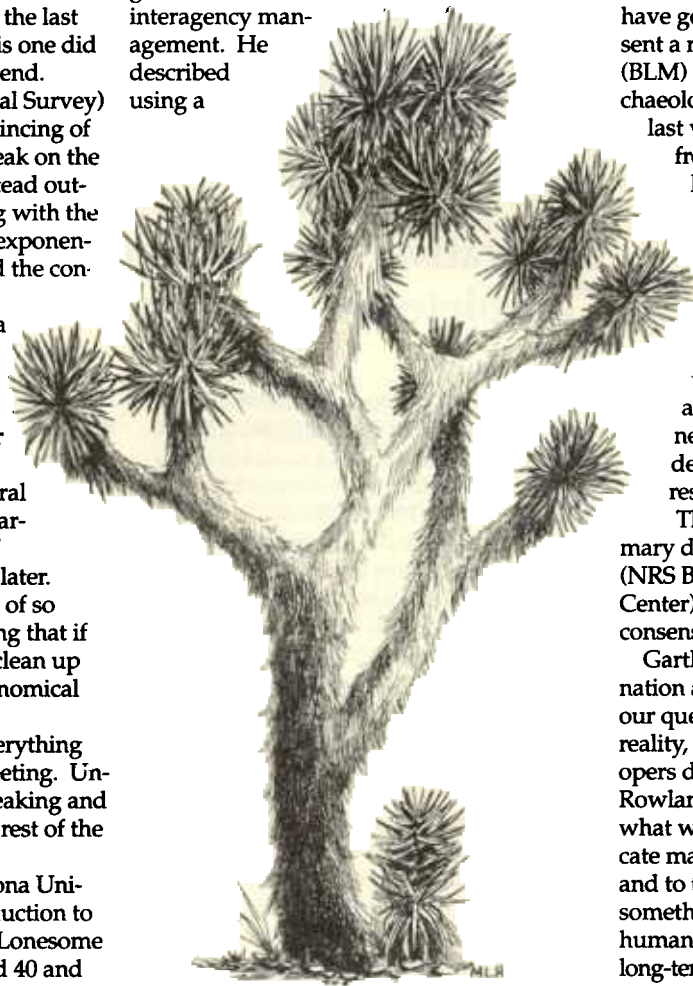
The cultural resources session began with James Cleland (Dames and Moore consulting firm) suggesting much could be learned by studying early human's response to climate change (it seems they moved). Then he pointed out that although the National Historic Preservation Act is meant to guide archaeological research, most work in the Mojave is still driven by mitigation at construction sites and not by organized scientific method.

Lester Ross (Santa Barbara County Museum) stressed the need to document historic land use—orchards, woodlots, local building material. (This made me think of the NRS's collection of old buildings, many of which have gone untouched for decades and present a research opportunity.) Garth Portillo (BLM) reiterated the need to coordinate archaeological studies and to document the last vestiges of cultural interpretation from surviving native elders. (The NRS, too, has surviving elders whose stories should be recorded.)

Meanwhile, out by the coffee pot, a dozen posters ran the gamut from breeding birds to shifting sands. Live bats, straight from old Mojave mine shafts, expanded notions of wildlife habitat beyond grass, trees, and water holes. A description of the new digs at Granite Mountains Reserve detailed appropriate habitat for desert researchers.

The second day was devoted to summary discussion, with moderator Al Muth (NRS Boyd Deep Canyon Desert Research Center) gently prodding everyone toward consensus.

Garth Portillo again appealed for coordination among agencies: "In theory, we know our questions and we know our sites. But in reality, we operate in a vacuum where developers direct emergency investigation." Peter Rowlands stressed the need to figure out just what we are managing for, and to communicate management goals clearly to each other and to the public. Others insisted that until something is done to reshape the curve of human population growth, there can be no long-term ecological solutions in the desert.



The discussion rambled on with themes of coordinated monitoring and ways to get more bang for the elusive buck. Then Steve Ahmann (Fort Irwin) dropped a bombshell. "I have the opposite problem of many of you here," he said. "I have a budget, but no program." He asked for help designing the military's program for baseline environmental monitoring at Fort Irwin, 1,000 square miles and scheduled to increase. He was mobbed after the show.

The symposium wound up with an agreed-upon need for multidisciplinary monitoring, research, and planning. Ken Nagy (UC Los Angeles) suggested the ongoing process be titled, "Designing a National Park" (finally we get to the meat and potatoes), everyone laughed, and it was over.

But not completely over.

With the recent election has come new support for an old idea. The California Desert Bill, which has collected dust in D.C. since 1986, has new Congressional support and stands a good chance of passing this year. It is the largest land bill in the lower 48 states that Congress will consider this century. It creates 74 desert wilderness areas totalling 4 million acres. It adds 234,000 acres to Joshua Tree National Monument and gives it national park status. It enlarges Death Valley National Monument by 1.3 million acres, making it the country's largest national park. And it creates a 1.5 million-acre Mojave National Park out of the East Mojave National Scenic Area. If this bill passes, the new Mojave National Park will completely surround the Granite Mountains Reserve, and the enhanced Joshua Tree National Park will be but a stone's throw from the NRS Burns Piñon Ridge Reserve.

It seemed to many this gathering of expertise at the East Mojave Desert Symposium could set a tone for Congressional consideration of the California Desert Bill. "What a resource for the Park Service to have all these experts on call," says Elden Hughes, chair of the Sierra Club Desert Committee. "So often a park is dedicated, and later an education program is set up. Here is a national park that will begin with education."

"Whether the East Mojave becomes a park, or stays with BLM, or somebody invents a third land agency," says Al Muth, "the management issues in the desert will be the same. I think it is extremely important that we continue this multidisciplinary exchange of information to guide that management."

The next East Mojave Desert Symposium will be held in two years. Stay tuned.

— M. L. Herring
NRS Science Writer



MAPS volunteer Susan Liddle prepares to release a newly banded Anna's hummingbird.

Bird Populations Up at the Motte Rimrock Reserve

Birds on the western edge of the Perris Valley are responding well to the return of the rains. According to Barbara Carlson, resident director of the Motte Rimrock Reserve in Riverside County, the numbers of more than a dozen resident species have increased steadily over the last few years, as has the ratio of newly hatched birds to adults.

Since 1990, Carlson has participated in the Monitoring Avian Productivity and Survival (MAPS) program, a continentwide effort to gather demographic data on landbirds. Now in its fifth year, the MAPS program includes more than 200 stations on public and private lands throughout the United States and Canada. Coordinated by the Institute for Bird Populations, the program seeks to gather data that can be used to understand natural and human-caused factors affecting landbird populations.

At the Motte Reserve, Carlson and a dedicated flock of volunteers spend one day in ten from April through July recording, banding, and measuring birds. They've seen a positive correlation between rainfall and bird productivity since they began monitoring in the last year of the drought. "We've also had a pattern that began to show up with the timing of rainfall," says Carlson. The peak rains of 1992 came about 20 days earlier than those of 1991; so did the baby birds. "There appears to be some kind of precipitation cue," says Carlson. "The birds are starting their breeding season earlier when the rains start earlier."

Carlson believes the MAPS program is a good way to conduct long-term environmental monitoring on reserves. "Because the majority of birds we monitor at Motte are resident species, the results can provide an index of how the environment is doing in the general region without influences caused by migration and wintering grounds elsewhere," she says.

Because the MAPS data span several years, it will also be useful to biologists that perform research in one year only, such as when gathering information for environmental impact statements or habitat conservation plans. Since bird populations fluctuate markedly from year to year, the MAPS data will indicate how a particular year fits in the overall pattern.

The MAPS program at Motte is strictly a volunteer effort. Carlson's banding assistants include Cin Greyraven, Christine Harker, Ardelle Loge, Roy and Jessie Kniffen, Douglas Williams, and Ruth Yoder. *If you're interested in joining the project, call Carlson at (909) 657-3111.* No experience is necessary; the MAPS team will train new volunteers in banding techniques.

For more information on MAPS, contact Ken Burton, Institute for Bird Populations, P.O. Box 1346, Point Reyes Station, CA 94956-1346; (415) 663-1436.

—Sarah Steinberg Gustafson
NRS Transect Editor

Reserve Highlights

A Year in the Life of Sierra Nevada Aquatic Research Laboratory (SNARL)

Editor's note: In our continuing series highlighting reserve research, we focus on the Sierra Nevada Aquatic Research Laboratory (SNARL). Located on the eastern slope of the Sierra near the town of Mammoth Lakes, SNARL provides a base for a wide range of work throughout the region. Administered by UC Santa Barbara, the 55-acre reserve and its modern housing, laboratories, and equipment enable sophisticated studies hundreds of miles from any campus.

Research at SNARL began in the 1930s with the old U.S. Bureau of Sport Fisheries. Experimental stream channels were pioneered here in the 1940s, launching long-term studies of freshwater ecology. These channels were recently expanded, allowing researchers to manipulate flow and depth in nine channels that mimic the meandering structure of natural streams.

Facilities have also expanded with SNARL's new Mammoth Mountain Snow Science Laboratory at an elevation of 9,600 feet, where researchers determine many of the physical and chemical properties of the eastern Sierra snowpack.

The research year at SNARL is as vivid as the seasons in the eastern Sierra. Come winter, the mountain snowpack may reach a depth of 25 feet; at peak accumulation, scientists record an array of measurements in preparation for the spring snowmelt. Several **snow studies** focus on understanding the acid deposition within the pack and its subsequent release in meltwater.

- Roger Bales (University of Arizona) studies the high concentrations of chemical pollutants, particularly acids, that are released from melting snow. Atmospheric pollutants fall with the snow and become distributed throughout the snowpack. But when the snow melts, these pollutants drain out quickly in a pulse of contamination.

- Jeff Dozier (UCSB) and Robert E. Davis (U.S. Army) analyze physical and electromagnetic properties of the snowpack in order to model the process of snowmelt. New facilities allow the researchers to take measurements of an undisturbed part of the snowpack by suspending their instruments above it (see photo). Dozier and Davis will use these measurements to improve methods of radar and microwave imagery.

- John Melack (UCSB) and Dan Dawson (SNARL manager) continue their long-term study of snow and rain chemistry at several high-elevation sites, where they sample snow from deep pits to assess accumulated water and chemical solutes in the snowpack.

- Rick Kattelman (UCSB Ph.D. candidate) examines three-dimensional movement of water through the snowpack as melt begins.

In spring, with snow still on the ground in the Owens Valley, the first of several **animal behavior studies** begin for the season.

- Robert Gibson (UC Los Angeles) continues long-term research on the mating behavior of sage grouse. Females choose mates from a group of males at a lek, a mating display (see photo). Many females choose the same male—in fact, they copy each other's choices. Gibson's work measures the cost of female choice and analyzes the mechanisms of copying.

- Warren Holmes (University of Michigan) investigates kin recognition and kin preferences in Belding's and golden mantled ground squirrels.

The **Mono Lake ecosystem** has been the subject of increasing investigation by SNARL scientists since the late 1970s.

- John Melack and Bob Jellison (UCSB) continue long-term studies of Mono Lake limnology and plankton dynamics (see photo). Their research team uses these data to establish suitable indicators of ecosystem health and to help predict environmental consequences of various water levels now being considered for Mono Lake.

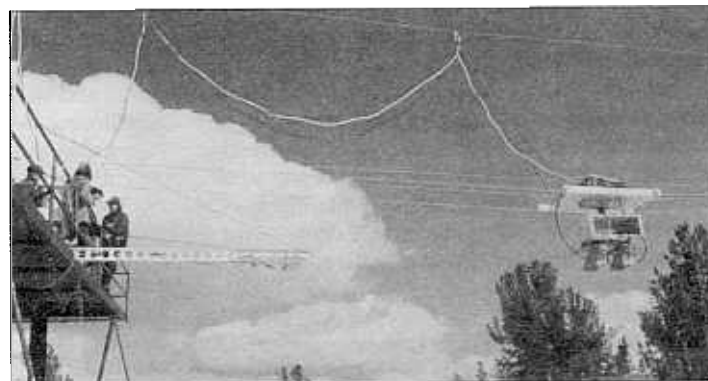
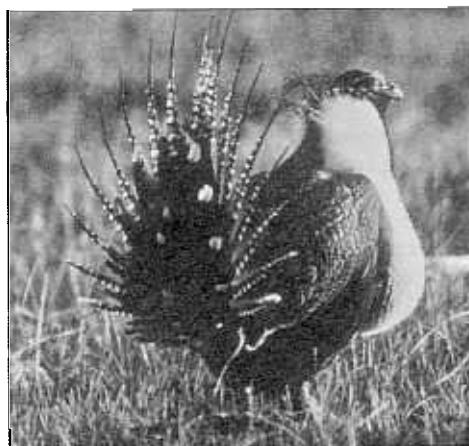
- David B. Herbst (UCSB) examines many aspects of the benthic community in Mono

Lake, including the limiting effect that rising salinity has on growth of algae and insects.

- Catherine Toft, Deborah Elliott-Fisk, and James Richard (UC Davis) research ecosystem development on the north shore of Mono Lake. By identifying processes that control plant establishment, this research should aid in restoration efforts at Owens Lake and other temperate playa systems.

By summer, research at SNARL is in full swing. **Vertebrate studies** begun in the spring continue with new focus, the new **stream channels** are awash with experiments, and **rare plants** blossom in the brief warm summer.

- Gwen Bachman (UCLA) investigates maximum oxygen uptake and stamina in Belding's ground squirrels, following up on her doctoral work on the dynamics of squirrel fat storage. With funds from a Mathias Student Grant, she measured body condition *in vivo* with total body electrical conductivity, the first known use of this technology for field manipulations of a natural population.



Above left: A male sage grouse vying for attention in a mating display.

Above right: Sampling zooplankton at Mono Lake.

Left: Taking radar measurements of the snow pack at Mammoth Mountain Snow Science Laboratory.

- Margaret Rubega (UC Irvine Ph.D. candidate) deciphers the feeding behavior of phalaropes at Mono Lake.

- Scott Cooper (UCSB) and doctoral candidate Kim Kratz vary the numbers of predators and drift of insect prey in SNARL's new experimental stream channels to determine how scale affects population dynamics (see *Transect* 10(2):3).

- Ann Howald (CA Department of Fish and Game) monitors scalloped-leaved lousewort, *Pedicularis crenulata*. Understanding the ecology of this plant, whose only known population west of the Rocky Mountains occurs within SNARL boundaries, will help protect the existing population and establish additional populations nearby.

Investigations of acid deposition continue into the summer as researchers track the movement of ions through high Sierra lakes and streams.

- John Melack and Jim Sickman (UCSB) measure water chemistry in seven Sierra watersheds. In addition to quantifying inputs of acid and assessing the acid-neutralizing capacity of each basin, the researchers will study the impact of acidification on lake plankton.

- David Bradford (U.S. Environmental Protection Agency) surveys amphibians throughout the high Sierra to assess the effects of acid deposition on the declining populations of some high-elevation species.

- Scott Cooper and others examine the effects of increased levels of acid and aluminum on trout, as well as adaptations of aquatic animals living in naturally acidic waters in Kings Canyon National Park.

Crossing through the seasons and much work at SNARL is use of remote sensing.

- John Melack and others employ mathematical algorithms to map plankton concentration in Mono Lake and Lake Tahoe using an imaging spectrometer similar to one planned for NASA's Earth Observing System.

- Robert Davis and others refine remote-sensing data and ground measurements to estimate the volume and distribution of alpine snow cover.

The academic year at SNARL is interwoven with the seasons of research. Field courses from several campuses visit SNARL to study such topics as geography, snow hydrology, and aquatic biochemistry. For more information on the opportunities SNARL provides for university and community education, see page 10.

—M. L. Herring
NRS Science Writer

Long-time Ecologist and Mentor at Hastings Retires

Some scientists lead lives so devoted to their fields of study that it is hard to think of them out of context. Jim Griffin is one such scientist. Recently retired from his post as research ecologist at the Hastings Natural History Reservation, Griffin has long been considered the living repository for information on California oaks.

According to his colleagues, Griffin was among the first to document the problems of oak regeneration in California. By collecting, analyzing, and sharing vast quantities of field data, Griffin has been able to quietly draw attention to the importance of viewing oaks from an ecological perspective.

He helped sow this perspective by nurturing a crop of graduate students, several of whom continue oak research. In his 25 years at Hastings, Griffin mentored more than a dozen young scientists and influenced the careers of many others. "Jim kept the candle lit," says Pam Muick, a recent student whose fellowship from the American Association for the Advancement of Science supports her current work as a biodiversity specialist with the U.S. Agency for International Development. "He passed on such valuable information ... it was like he touched me with a magic wand."

To many, Griffin represents the altruistic side of science. Though very frugal with his time and his words, "he is always incredibly generous with his knowledge and never considers anything 'his turf,'" says Muick. What's more, he truly believes in contributing to the greater body of scientific knowledge rather than to his own advancement. "Instead of publishing lots of little papers, he would wait until he could publish something comprehensive," she says. Among Griffin's major works are the oft-cited *Distribution of Forest Trees of California*, a bibliography of oak literature arranged according to topic as well as species, and the sections on pines and three other families in the new *Jepson Manual* (see page 9).

In addition, Griffin authored several papers that helped define the current understanding of oak ecology. Characterized by one colleague as "always uncovering secrets," Griffin's often innovative research

typically involved extensive field work under difficult conditions. In one study published in *Ecology*, for example, Griffin compared xylem sap tension at the height of summer in 25 stands of oak ranging from rugged canyon bottoms to ridgetops. He found that, contrary to then-current dogma, many trees on northern slopes were dryer than those on southern slopes. A less observant, less patient man might have overlooked the question altogether.

Though Griffin says he thoroughly enjoyed his field work, some of his most satisfying hours at Hastings have been spent teaching the field classes that visit the site from all over the state. Future students and researchers will benefit from the dozens of

research plots Griffin established at Hastings and on adjacent ranches. From these, he has gathered baseline data on plant communities in upper Carmel Valley since the late sixties.

"Jim collected an incredible wealth of information that's going to be extremely helpful to others studying the vegetation and flora of the area," says Nancy Morin, another Griffin protégée, now assistant director of the Missouri Botanical Garden and convening editor of *Flora of North America*. "His records are

especially important because they are so broad. He is always thinking about the total biological context in which the organisms he looks at are operating."

Griffin received his Ph.D. in botany from UC Berkeley in 1962. In addition to his job as research ecologist at Hastings from 1967 until his retirement late last year, Griffin served as resident manager from 1982 to 1988. He and his wife, Joan, a local school teacher, have lived on the reserve for 20 years and raised their two children there.

Unfortunately, the position that Griffin vacated at Hastings will not be refilled due to UC's budget constraints. In many ways, Griffin's work exemplifies the reasons the Natural Reserve System was created. We hope his efforts will be carried on.

—Sarah Steinberg Gustafson
NRS Transect Editor



Mark Steinberg

NRS Grant Programs

Blakey Awards Fund Undergrad Field Trips

At Kendall-Frost Mission Bay Marsh Reserve near UC San Diego, more than 60 UC Irvine undergraduate students, all wearing old tennies or rubber boots, trek through muddy marsh channels to upland zones where they discover a site unexpectedly devoid of ice plant, an invasive exotic. Instead they find a labyrinth constructed of irrigation pipes and a low ground cover of successfully established native upland shrubs.

Recent UCSD graduate Victoria Seidman received an NRS Mathias Student Grant in 1991-92 to design and implement this restoration project, which she now discusses with the students. "The process of habitat restoration always sounds so overwhelming in the classroom," says their instructor, Peter Bowler. "But in the field, students see restoration projects working. That's a very effective learning experience."

Enhancing education through field study is an important part of the NRS mission. The Elizabeth Hall Blakey Travel Grants, named after an NRS fan who provided a \$68,753 bequest, encourage use of the reserves as educational tools. Miss Blakey's interest in the natural world began when she was a young girl living on the family ranch in Los Gatos

and led her to study Landscape Architecture at UC Berkeley. Her gift supports travel to NRS sites by undergraduate classes and by independent study students, enabling them to gain essential field experience.

On the eastern side of the Sierra, UC Santa Barbara students are comparing the aquatic environments available in and around the Sierra Nevada Aquatic Research Laboratory. This site offers access to the most diverse array of aquatic systems found anywhere in the country. According to John Melack, who teaches *Chemical and Physical Methods in Aquatic Environments*, students in this class develop such fascination with the area that up to 20 percent return as researchers or interns. A Blakey travel grant facilitated this experience.

At Burns Piñon Ridge Reserve, small groups of UCI students dot the landscape, craning over one another to conduct experiments on the feeding behavior of ants. They are applying concepts learned in an ecology field methods course taught by Diane Campbell and Stephen Weller. Their experience is real and inclusive—from the data transcriptions for statistical analyses to the rainy evening in camp and surprise sighting of an adolescent desert tortoise. Again, Blakey travel funds made this trip possible.

In California's current budget-cutting climate, educational budgets are under attack and class travel often becomes a prime target. Blakey travel grants augment course funds, making possible requisite field trips that would otherwise be cancelled.

Support for field classes at the Santa Cruz Island Reserve is especially important, because transportation by sea or air is costly. Yet the opportunities offered by this site are invaluable. Ask the 90 students who recently travelled to Santa Cruz Island with Jenifer Dugan's course, *The California Channel Islands*: they rate their trip to the reserve as one of the top learning experiences offered at UCSB.

For two and a half days, these nonscience majors, with Teaching Assistant Kevin Lafferty as their guide, hike through pine groves, search for the once-abundant black abalone, discuss habitat and restoration issues, and attend evening lectures given by a variety of guest speakers. Researchers on site also become involved with the course, taking a break from their studies to discuss their work with students. Blakey travel funds made this trip possible, too.

The experiences of watching leopard sharks forage on sand crabs, seeing peregrine falcons swoop down on their prey, or swimming among harbor seals benefit stu-



Snorkling students explore the abundant subtidal life in the pristine waters at the west end of Santa Cruz Island, the site of a long-term study of black abalone populations.



UCSB students taking Jenifer Dugan's field course, *The California Channel Islands*, make their way on foot from the Santa Cruz Island field station to the coast. Much of the island is inaccessible to vehicles.

dents throughout their lives, especially those who'd never before camped under the stars or strolled in a pristine setting. One particularly innovative course is *Campus and The Biosphere*, created by UCSB's Diana Francis and funded for travel by a Blakey award. In this student-run course, undergraduates work with reserve managers from three NRS sites—Santa Cruz Island, Coal Oil Point, and Carpinteria Salt Marsh—to develop a survey method that assesses impacts of undergraduate use on reserves. The NRS looks forward to the results, which will include recommendations to improve the policies governing educational reserve use.

Courses funded by Blakey grants cover a diversity of subjects and sites. Maureen Stanton's Botany 117 course at UC Davis will use ecophysiological equipment at Stebbins Cold Canyon Reserve to determine whether male and female coyote bush plants have different photosynthetic rates. At Landels-Hill Big Creek Reserve, Deborah Letourneau will lead 40 environmental studies students from UC Santa Cruz on an intensive four-day trip that includes group field problems, student presentations, and independent studies in ecological field methods. Brad Shaffer's UCD herpetology course will travel to the Granite Mountains, Jepson Prairie,

Coast Range, and Hastings Natural History reserves to study the biology and evolution of reptiles and amphibians.

Seven grants, two of them in support of independent studies, were awarded for the fall 1992 term, and 14 grants were awarded for the 1993 winter and spring terms—a total of over \$14,000 in Blakey awards.

Funds from Miss Blakey's gift will be available for the next two years, and the NRS is working to build this pool of monies and strengthen assistance to courses. Awards for class travel range up to \$1,000 (with matching funds from the department required), while independent study grants are limited to \$250. The 1993-94 funding cycle begins in August.

—Joan Brenchley-Jackson
NRS Senior Environmental Analyst

Mathias Grants Fund Student Research Projects

The Mildred E. Mathias Student Research Grants program is delighted to announce the recipients of 1992-93 awards, which total just over \$25,000. This grant program, now in its fifth year, fosters UC student research at NRS reserves with grants of up to \$2,000 for graduate students and \$1,000 for undergraduates. Here are this cycle's 19 awards for 13 graduate and 6 undergraduate student projects:

From UC Berkeley: John Carlos Garza will investigate the genetic structure and population distribution of California voles at Landels-Hill Big Creek Reserve; graduates Mary F. Poteet and Michelle C. Mack will study the effect of a Eurytomid gall on reproduction in California oatgrass at the Northern California Coast Range Preserve; undergraduate Christina Kate Meier will examine ontogenetic diet shifts in a riverine population of rough-skinned newts at Coast Range; undergraduate Adrian Sun will consider the habitat plasticity of two caddisfly genera at the Coast Range.

From UC Davis: Brian L. Fisher will compare ant assemblages on serpentine and nonserpentine soils at the new Donald and Sylvia McLaughlin Natural Reserve; Joan M. Leong will study pollination of a vernal pool plant at Jepson Prairie; Katherine Lee Muller will examine habitat selection and territory establishment in the desert clicker at the Boyd Deep Canyon Desert Research Center.

From UC Irvine: Alice C. Gibb will study the functional morphology of flatfish feeding at Carpinteria Salt Marsh, Kendall-Frost Mis-

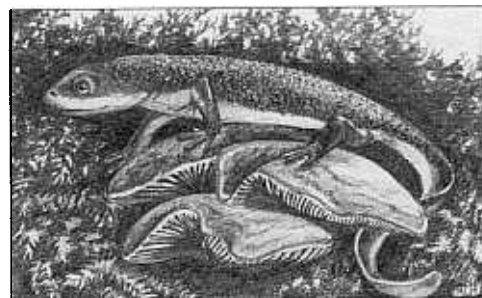
sion Bay Marsh, San Joaquin Freshwater Marsh, and Scripps Coastal Reserve.

From UC Riverside: Elizabeth J. Lawlor will examine archaeobotanical site-formation processes in the Mojave Desert at the Granite Mountains Reserve.

From UC San Diego: Jeff Crooks will research biological invasion of an estuarine ecosystem by Asian mussels at Kendall-Frost; Jeanne M. Messier will study parental provisioning rules and the role of nestling begging in robins at the Valentine Eastern Sierra Reserve and phainopeplas at Deep Canyon.

From UC Santa Barbara: John Cloud will develop an experimental field mapping and data registration system for Sedgewick Ranch Reserve; David Bruce Greenberg will consider overwintering strategies and seasonal movements of rattlesnakes at Deep Canyon; Donna M. Schroeder will evaluate density-dependent growth in blue rockfish at Big Creek; Kathryn Thomas will assemble a checklist of flora for Sedgewick Ranch; undergraduate Jennifer Henry, working out of the Sierra Nevada Aquatic Research Laboratory, will study the physical and chemical characteristics and the distribution of aquatic insects in thermal streams.

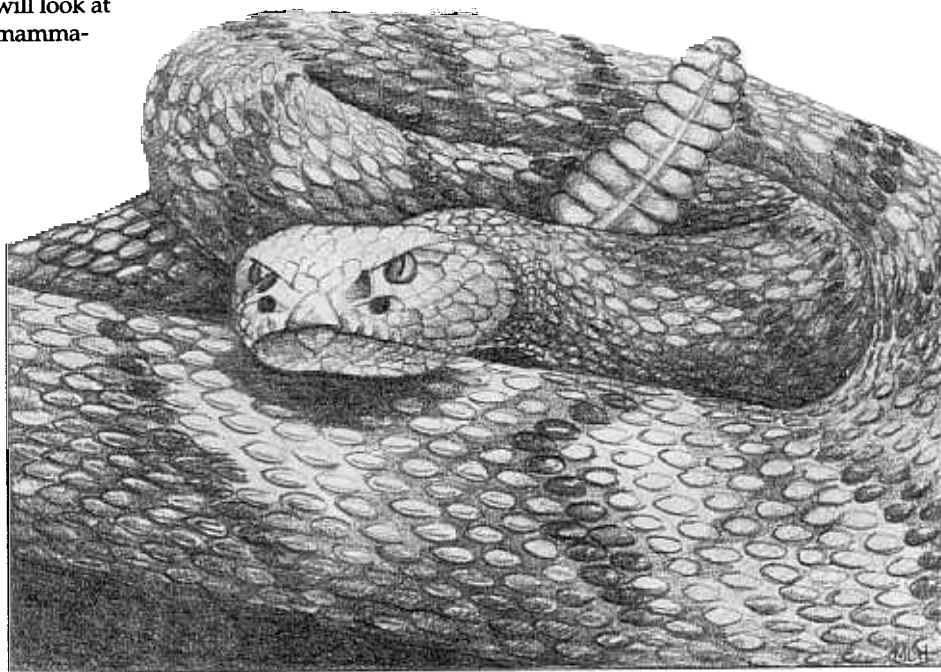
From UC Santa Cruz: The undergraduate team of John Chapman, Teresa Bleisch, and Tangi Meyer will conduct eradication trials on poison hemlock at the Younger Lagoon Reserve; a seven-member undergraduate team (Fawn Bassett, Tim Drew, Kelly Finn, Chelsea Lopes, Kerry Stanton, Adam Rosenberg, and Jason Wright) will look at mamma-



Rough-skinned newt, *Taricha granulosa*

lian species diversity patterns at Younger Lagoon; undergraduate Steven Jon Waldron will study meristic trait variation and asymmetry in side-blotched lizards at Big Creek.

Editor's Note: Davis campus students have an additional source of funds for reserve-based research, thanks to UCD's Public Service Research Program (PSRP), which specializes in studies of biology and policy, and the Davis NRS office, which offers its own grant program. For the last two years, PRSP has added to the Davis grant fund of \$3,000. This year the program contributed \$10,000, allowing the Davis NRS office to support 14 UCD student projects. These inquiries range from an analysis of the role of riparian ecosystems in groundwater recharge at the campus' Putah Creek Reserve to a study of using avian indicator species for monitoring environmental mercury exposure at the Eagle Lake Field Station. To learn more about this funding opportunity, contact NRS Academic Coordinator Jonellen Goddard at (916) 752-7073.



Red diamondback rattlesnake, *Crotalus ruber*

News and Notes

Research

Lost in Space?

NRS Hosts Workshop to Help the Locationally Challenged

Have you ever faced the challenge of trying to locate your research plots in rugged or featureless terrain? The military has developed technology that can help.

As part of its Star Wars Initiative, the U.S. government devised a \$10 billion Global Positioning System (GPS) to provide accurate locational information, 24 hours a day, anywhere in the world, on ground, sea, or air. The GPS network consists of 21 satellites equipped with radio transmitters and atomic clocks that continuously transmit precise time and satellite position data. Using signals from four satellites at once, a mobile GPS receiver can determine a user's position—latitude, longitude, and altitude—quickly and accurately.

Two levels of positioning service are available: a precise, but encrypted one exclusively for the military, and a less-precise one for civilian use. Although civilians can achieve accuracies of less than half an inch with expensive, bulky equipment, accuracies of 33 to 50 feet are possible with two inexpensive GPS receivers, one set at a known location. This compares favorably with the 40-foot accuracy of U.S. Geological Survey 7.5-minute maps. A hand-held GPS unit the size of a walkie-talkie costs about as much as a well-equipped laptop computer.

In January, the NRS hosted a two-day training course on GPS techniques at the James San Jacinto Mountains Reserve. Dan Cassidy of the Magellan Corporation, a GPS equipment manufacturer, taught the course with the assistance of Jerry Freilich, ecologist at Joshua Tree National Monument and steward of the Burns Piñon Ridge Reserve. Freilich has used GPS extensively to monitor desert tortoise populations at Joshua Tree.

Twenty-two people participated, including representatives from 11 NRS reserves,

the U.S. Fish and Wildlife Service Condor Recovery Team, the San Bernardino National Forest, the U.S. Bureau of Land Management, The Nature Conservancy, and the Science Museum of Minnesota.

For further information, contact: Jeff Kennedy, NRS principal environmental planner, at (510) 987-0156 or by e-mail at jkennedy@popserv.ucop.edu.

Pacific Institute Seeks Info on Drought throughout the NRS

With the drought of the last several years coming to an apparent end, this is an appropriate point for reflecting on its biological impacts. I am doing a study of how drought affected aquatic and riparian ecosystems, and how water management exacerbated or mitigated such effects.

If you know of situations in which plant or animal populations have declined, experienced stress, or lost access to habitat, I would greatly appreciate hearing from you. I am particularly interested in sensitive species and threatened ecosystems, as well as in relationships between native and exotic species. Data would be great, but anecdotal information is also welcome.

This information will be used to help plan for future drought, and I hope to give a comprehensive report in a future issue of the *Transect*. Contact me at the Pacific Institute, 1204 Preservation Park Way, Oakland, CA 94612; (510) 204-9138.

—Tom Dudley
Pacific Institute

Contributions

Bunkhouse Rebuilt and Acreage Added at Hastings

Thanks to Fanny Hastings Arnold, graduate students and field assistants now have a comfortable place to live while working at the Hastings Natural History Reservation. Arnold donated funds to rebuild the bunkhouse, one of several historic buildings dating from the late 1920s, when the reserve was a cattle ranch.

While the new facility outwardly resembles the original building, it is modern and energy-efficient within, as well as accessible to people with disabilities. The bunkhouse can accommodate six people in three bedrooms, includes a large kitchen and common living area, and offers reserve users a new laundry facility.

Arnold also donated 80 acres to the reserve, bringing its size to 2,253 acres. With

Stellar Sea Lions— Hunting More, Eating Less?

A Stellar sea lion pup nuzzles its mother at the Año Nuevo Island Reserve. The pair are part of a study on maternal behavior during El Niño—an atmospheric phenomena that brings big winter storms and warm, nutrient-poor surface water to the Pacific Coast. Wendy Hood, a UC Santa Cruz undergraduate, conducted the research for her senior thesis in marine biology. She compared her 1992 data on female feeding cycles and pup suckling time to data gathered by Kathryn Ono in 1973 and Leslie Higgins in 1983, all years of a strong El Niño in California.

Hood found that mother Stellar sea lions spent more time on feeding forays in 1992 than in the past and that pups spent less time suckling. She assumes this change is a result of declining fish populations; with less prey available, the moms must spend more time hunting, while building up less fat reserves to supply their young with milk.

The Stellar sea lion is a threatened species whose population declined steadily from the late sixties to the early eighties. During this time, their range also diminished; Año Nuevo is now the southernmost rookery, whereas the sea lion used to breed on the Channel Islands. Though Stellar numbers have remained fairly stable over the last decade, marine biologists are keeping a close eye on the sea lions' population, as well as on any changes in behavior (such as those Hood observed) that may indicate stress to the species.



Kathryn Ono



UCD Reserve Manager's Job Expands at Work and Home

Stephen Williams accompanies his father, Kevin, on his rounds of the Quail Ridge Reserve. The elder Williams, who became a new father early last year, was reclassified from reserve steward to UC Davis roving reserve manager in the fall. Besides Stephen, his charges include the Davis Campus Putah Creek Reserve and five of UCD's six NRS sites: Jepson Prairie, Stebbins Cold Canyon, Quail Ridge, Donald and Sylvia McLaughlin Natural Reserve, and the Eagle Lake Field Station. Congratulations to Kevin on both promotions!

this addition, the Hastings Reserve now completely encompasses the 316-acre "Robertson Place," which Arnold purchased in 1985 and donated to the University over the years. She also financed the complete renovation of the Robertson House, a large country home that has become an important facility for reserve use.

Granite Mountains Reserve Receives Solar Energy System

The Granite Mountains Reserve will receive \$20,000 worth of photovoltaic materials from Pat Kramer, a local friend of the reserve. Kramer made the donation in the memory of her husband, Fred, who incorporated the photovoltaic system into their home.

Located in the East Mojave Desert, the reserve is too isolated to be on an urban power grid. It will use 12 of the 24 photovoltaic panels and other components to upgrade the solar power systems at the resident directors' house and a nearby researchers' cabin. The remaining materials will be installed at Dorners' cabin, a remote station used by researchers and classes.

The new research and residential facility at the Granites is a model of solar energy use (see page 1). This generous donation allows the reserve to bring more reliable solar-generated electricity to the rest of its facilities. Thank you, Pat Kramer!

People

Dean Van Gundy Takes Five

Seymour D. Van Gundy, UC Riverside's dean of the College of Natural and Agricultural Sciences (CNAS) and key NRS administrative officer at that campus, recently retired after 35 years of University service.

Originally a research nematologist, Van Gundy joined the UCR faculty in 1957. He later held a series of administrative positions and was appointed to the CNAS deanship in 1990. Last year he was chosen by Vice President Kenneth Farrell to represent the UC Division of Agriculture and Natural Resources in Russia for talks with its Academy of Sciences regarding scientific cooperation.

"Van" has been a strong supporter of the NRS; we will miss his enthusiasm and insight!

New Mapmaker Joins NRS Realm

Eric Rainbolt, NRS environmental analyst/cartographer considers geography a gateway through which a dedicated researcher can step at will into the realms of biology, meteorology, anthropology, and numerous other disciplines.

Rainbolt, who joined the NRS systemwide staff this February, graduated from UC Davis in spring 1992. Throughout his senior year and well into the next, he worked for UCD's Planning and Budget Office, helping to develop a geographic information system (GIS) for the campus. Rainbolt now brings that experience to his work on a GIS for the Reserve System (see *Transect* 10(2):6). He fills the position formerly held by Andre Zerger, who returned home to Australia in January to complete his postgraduate studies.

Publications

Long-awaited Jepson Manual Now Available for Purchase

Run—don't walk—to your nearest bookseller: *The Jepson Manual: Higher Plants of California* just came off the University of California Press. Edited by James C. Hickman of UC Berkeley's Jepson Herbarium, this 5-pound,

1,400-page labor of love will provide a starting point for any study that involves California flora. With its combination of descriptive and practical information, it is destined to become an indispensable resource for expert and amateur alike.

Nearly 200 botanists across North America contributed to the *Jepson Manual*, making it the most comprehensive resource and identification guide to the nearly eight thousand varieties of native and naturalized plants growing wild in California. For the first time, the means to identify plants are accompanied by information such as horticultural requirements, toxicity, and notes on the management of sensitive species. Four thousand plants are illustrated, identification keys have been designed for ease of use, and terms have been simplified.

Willis Linn Jepson, born in 1867 near Vacaville, was California's pre-eminent botanist, as well as a leader in the movement to document and preserve the state's environmental riches. Upon his death in 1946, he endowed the Jepson Herbarium to carry on his life work of studying native plants and publishing works that will lead Californians to a greater appreciation of their natural heritage.

To learn more about the Herbarium, join its friends group. Among other benefits, members receive *The Jepson Globe*, a quarterly newsletter that will include errata and additions to the *Manual* as they become available. For more information, contact: Friends of the Jepson Herbarium, University of California, Berkeley, CA 94720; (510) 643-7008.

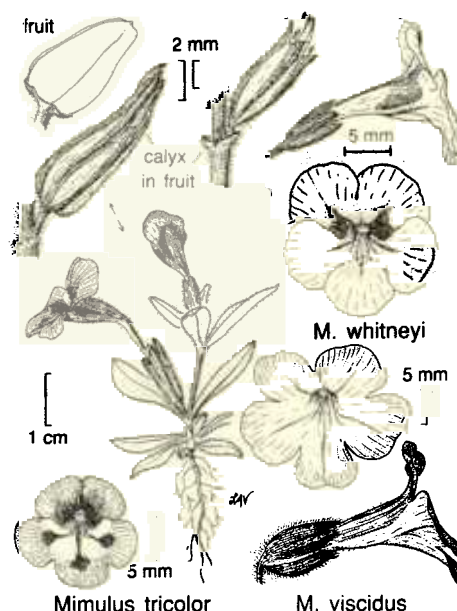


Illustration by Linda Ann Vorobik for *The Jepson Manual: Higher Plants of California* (reproduced with permission of the Jepson Herbarium).

Salutations *continued from page 1*

science, to name a few. In addition to formal University instruction—of the kind represented by the more than 300 classes that used NRS sites in 1991-92—education on reserves takes other forms, such as one-on-one student-faculty collaboration, team research, and informal contacts between students and scientists on site.

In 1991-92, more than \$16 million in extramural grants supported NRS reserve-based research. Participation in such research provides formative educational opportunities to members of the general public volunteering for organizations like the University Research Expeditions Program, to high school students training with University students and scientists, to undergraduate and graduate students working with other graduate students and faculty, and to faculty and professionals collaborating with one another. Team research is becoming increasingly important as we work together to solve complex interdisciplinary problems.

The diversity of educational experiences the NRS offers is apparent at Valentine Camp and the Sierra Nevada Aquatic Research Laboratory (SNARL)—the two components of Valentine Eastern Sierra Reserve, in Mono County. There Dan Dawson, resident reserve manager, and Leslie Dawson, a Mammoth Lakes teacher, encourage broad-based but appropriate educational use of the reserve. Once a year the public is invited on an educational tour of Valentine Camp, an event that serves as a fundraiser for the area's hospital. At SNARL, local high school students serve research internships by participating in various projects.

Undergraduate and graduate students assist UC Santa Barbara's Scott Cooper in his study of predator-prey interactions in SNARL's experimental stream channels. Students also play an integral role in the long-term work of a Mono Lake aquatic research team (headed by David Herbst, Gayle Dana, Tim Bradley, and John Melack of UC Santa Barbara and UC Irvine) and the newer project of a Mono Lake terrestrial research team (headed by Catherine Toft, Deborah Elliott-Fisk, James Richards, and Lisa Donovan of UC Davis).

Connie Millar, a renowned forest geneticist with the U.S. Forest Service, just began a new program for the Inyo National Forest that will further educational outreach. In her role as a Pew Scholar in Conservation and the Environment, Millar works with SNARL staff, UC faculty, and others to bring researchers and managers together to discuss biodiversity and ecosystem management in the eastern Sierra Nevada.

Stories throughout this newsletter relate additional examples of student and public education on NRS reserves across the state.

The best way to learn field science is to carry out sampling, monitoring, and experimentation with mentors and peers. This is how science is fostered and young scientists are trained, how research becomes integrated with education. Our reserves provide excellent opportunities for intensive hands-on instruction.

Dormitories, cabins, and campgrounds make overnight stays possible on 15 of our 32 reserves, enabling extended periods of on-site instruction. Some reserves are booked to capacity for class use; at these sites teaching must be carefully balanced with research. Other sites could accommodate more classes if only they had adequate accommodations. Therefore, we are working to obtain the



At a recent Big Creek Reserve open house, a student from Big Sur's Pacific Valley School teaches visitors what he has learned about local intertidal life while taking part in Project REAL, an innovative ecology program created by teacher Kim Smiley.

funding needed to improve and construct on-site facilities. We are also pursuing the following strategies to further instructional opportunities at NRS reserves:

- *Fundraising to support reserve use by UC, California State University (CSU), and community college courses.* Like UC, CSU and the community college systems have experienced severe budget reductions, and these cuts have almost eliminated field instruction opportunities for their students. As a result, non-UC colleges have become major users of nearby NRS reserves, particularly in Southern California. Our new Elizabeth Hall Blakey Undergraduate Travel Fund provides monies for formal UC undergraduate courses and independent studies to visit reserves, but this fund source must be increased so that we can continue the program, as well as offer grants to courses from outside the University of California.

- *Fundraising to support undergraduate research on reserves, along with the promotion of our new Robert M. Norris Undergraduate Research Scholarship fund.* Learning how to conduct independent research prepares undergraduates for future graduate study, if they wish to pursue it, and gives them an important head start by developing job skills.

- *Fundraising and faculty/staff collaboration to support reserve use by new courses in the areas of conservation biology, environmental management, marine environments, ecosystem ecology, and natural history.*

- *Leadership and participation in environmental education opportunities for our reserve neighbors and friends groups, local elementary and secondary school (K-12) classes, and youth at risk.* We recently initiated this effort by coordinating a workshop at UC's Elkus Youth Ranch near Half Moon Bay for about 30 people employed at north coast NRS sites, by UC's Cooperative Extension (CE), by CSU, in several public and private science education programs, and in California public schools. These diverse participants spent the day brainstorming environmental education opportunities NRS reserves might offer K-12 students. As a result, select sites may be able to provide field science opportunities and field-based curricula to local schools and youth groups, interfacing with CE's SERIES program and such statewide educational efforts as the Department of Fish and Game's Project WILD. Once our objectives are defined and our procedures set forth, we will seek extramural funding for this program.

- *Leadership and participation in resource management working groups for local, state, and federal resource agency personnel, most likely in collaboration with UC's Cooperative Extension.* Riverside area NRS and CE staff are already involved in several important coalitions in Southern California, including the Riverside County Habitat Conservation Agency and the planning group for the Coachella Valley conservation area near Palm Springs, as well as in regional work associated with statewide efforts by the Executive Council on Biodiversity (see *Transect* 10(1):10).

Our 32 reserves across 12 Californian ecological regions in both urban and remote settings offer a wide variety of educational opportunities for students and the general public. Effective on-site training of students in the field sciences provides the tools and insights they will need to address future questions and problems. This instruction, enhanced by educational outreach, encourages citizens to appreciate all aspects of our natural environment and helps ensure that the University will continue to lead in promoting our state's environmental vitality through good science.

—Deborah L. Elliott-Fisk
Director, Natural Reserve System

Granite Mountains *continued from page 1*

the entire facility, along with a passive solar unit for heating water. Skylights provide additional lighting.

Its south wall, painted black, is covered with windows. In winter, the sun superheats the wall, and heat radiates inside the building. Awning windows controlled by electric motors can be programmed to open and close to maintain a comfortable indoor air temperature year round.

The residential portion of the facility consists of three buildings—a main structure with living area, kitchen, bath, and bedroom loft, and two side buildings for sleeping. Seven researchers can be accommodated comfortably.

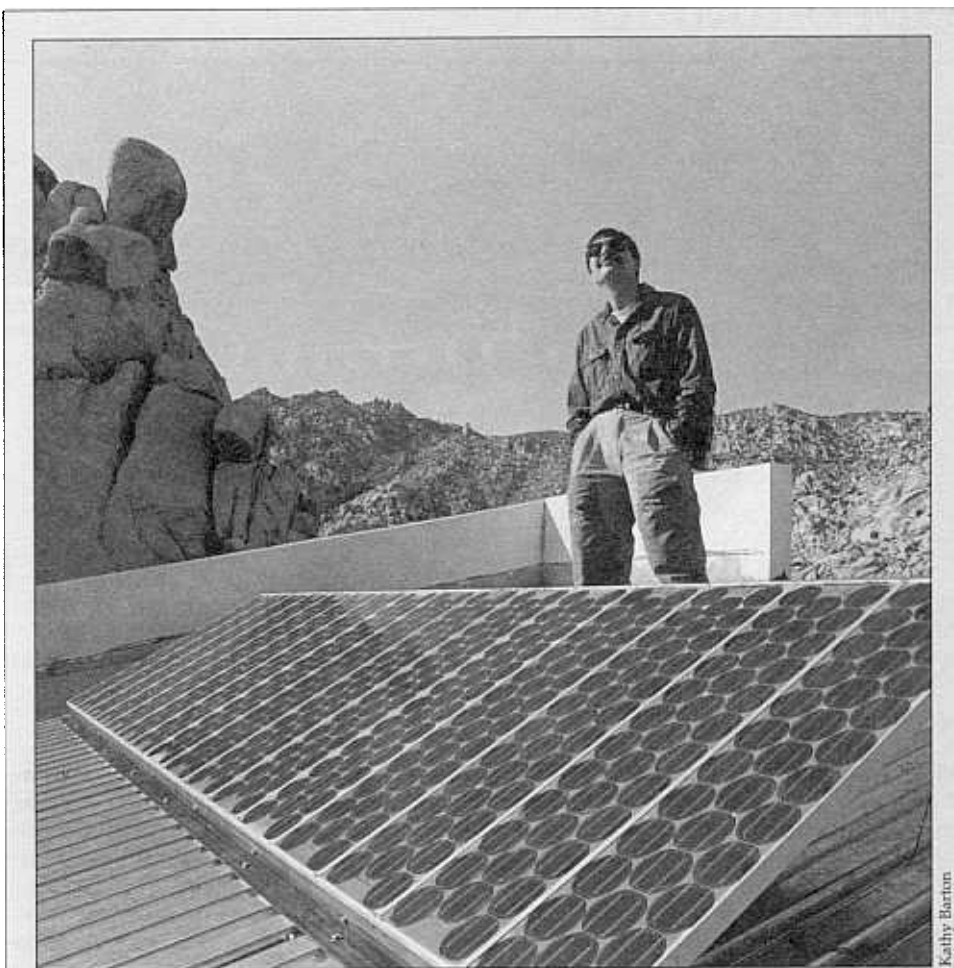
The reserve employed a number of design features, unique materials, and building technologies to make the facility environmentally sound and structurally strong. Walls were constructed from modular panels of insulating materials sandwiched with welded wire mesh frames. Once erected, they were covered with a concrete mixture called shotcrete. Developed by Insteel Construction Systems, of Georgia, this construction method results in a building with superior insulation and seismic strength.

The facility passed its first earthquake test last summer, when the back-to-back Landers and Big Bear shakers hit a wide area of Southern California. "There was no evidence of cracks or damage to any of the buildings, although there were rockslides on the reserve," says Cohen.

Recycled materials were used throughout. Ceilings, covered with board made from recycled newspaper, help dampen sound so that researchers on differing work and sleep schedules can move about without disturbing one another. Aluminum laminate insulation, made from recycled soft drink cans and scrap aluminum, provides greater protection from heat and cold than typical home insulation. Kitchen cabinets, appliances, and railroad ties (used as exterior trim) are just a few of the fixtures living a second life at the Granite Mountains Reserve.

In addition to providing a place for scientists to conduct research, the facility will itself serve as an experiment. Round-the-clock, automatic environmental monitoring of the building interiors will confirm how they perform under real human use. "People open doors and close windows, they cook and take showers," says Cohen. "The question is: how much is the performance of the building design influenced by human activity?"

Sensors implanted in the walls will measure the thermal transfer rate—the speed at which heat moves through walls. An outdoor weather station will collect data to correlate interior conditions with the weather.



Philippe Cohen, Granite Mountains Reserve director, demonstrates how to soak up sunlight while standing on the roof of the site's new lab behind a section of its 80 photovoltaic panels.

The buildings were designed by Cohen and UC Los Angeles architect Richard Schoen, with engineering assistance provided by Richard C. Rust and Lawrence Harris of UC Riverside Architects and Engineers.

According to Cohen, construction would not have been possible without the support of a number of private companies and governmental agencies, including the National Science Foundation and Southern California Edison. Anderson Corporation, of Minnesota, donated all of the facility's 69 windows and nine glass doors, with plans to analyze their long-term performance. Much of the labor was provided by volunteers, who logged some 2,000 hours on the project. As a result, the facility is valued at more than a half million dollars, yet the University provided only \$136,000 for some materials and labor that required professional expertise.

"Building this with volunteer labor was important because we wanted to show it could be done with unskilled labor," Cohen says. "These types of buildings may prove

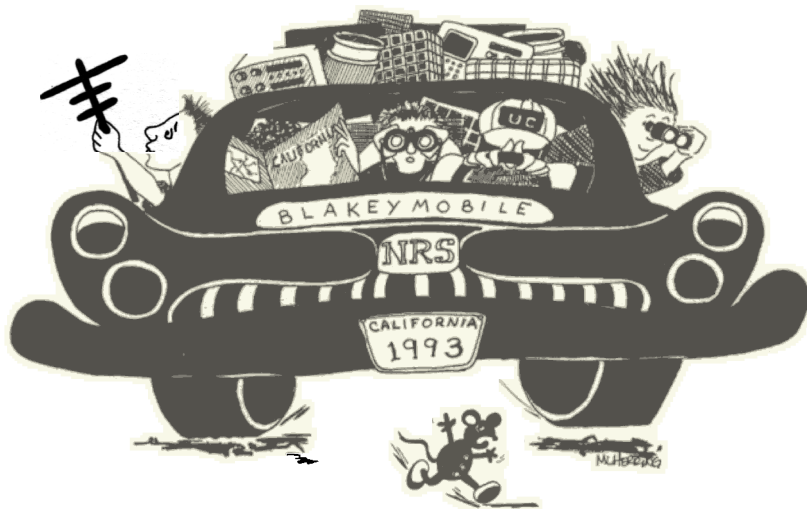
to be the perfect solution for underdeveloped countries where materials are scarce, power is unavailable, and workers have little experience in construction."

For more information on these facilities, contact Cohen at P.O. Box 101, Kelso, CA 92351; (619) 733-4222.

—Kathy Barton
Senior Public Information Representative
UC Riverside

Editor's Note: As the Transect goes to press, Cohen has begun analyzing data on the performance of the lab building. Initial results are very encouraging. "In early March, we had one night when the outside temperature dropped more than 30° F, but the temperature inside the lab dropped less than 1½°," explains Cohen. "When the temperature difference is that big, it's amazing to realize no energy was expended to keep it warm inside."

Opportunities



Want to pursue a Mathias student research grant, Norris undergraduate research scholarship, or Blakey travel award? Information on how and when to apply for these funds will be available in late summer from the NRS systemwide office (see address and phone below).

NRS Plans Poster Art Contest

Science and art will come together this fall at select NRS sites when the systemwide office holds its first-ever art competition.

The contest will be open to all UC undergraduates with art faculty sponsorship. The winning entry will be incorporated into a poster designed to publicize the NRS and promote reserve use by a greater breadth of disciplines. Many people do not realize that the educational opportunities offered by NRS sites are available to instructors and students in such fields as art, photography, literature, and history.

Further information on the upcoming NRS art contest will be available this summer from the NRS systemwide office.

Restorationists to Meet in CA

Irvine will be the site of the fifth annual conference of the Society for Ecological Restoration (SER), scheduled for June 14-20.

Themes of this year's meeting include restoration of arid lands, islands, and animal populations. Attendees can also participate in various workshops and field trips to restoration sites, including the NRS San Joaquin Freshwater Marsh Reserve.

For more information, contact: SER, 1207 Seminole Highway, Madison, WI 53711; (608) 262-9547.

Bibliographic Database on Line for Channel Islands

In the channels off the coast of Southern California, eight ridges on the continental shelf rise above sea level, forming a series of islands. Because they vary so much in size and distance from the mainland, this group of islands serves as an immense natural laboratory of isolation and evolution. Offshore, warm Mexican waters mingle with arctic currents, creating a transition zone for marine organisms in an area of highly diverse underwater geology.

This magnificent natural resource is now even more valuable to the academic and resource management communities with the recent development of the *Channel Islands Bibliographic Database*. A cooperative effort between the Channel Islands National Marine Sanctuary (CINMS) and the Santa Cruz Island Reserve, the database catalogs more than 3,600 publications of research, almost 400 of which were based on work at the reserve.

The database, formatted in ProCite, is up and running in the Santa Cruz Island Reserve library. It will also be available at several mainland sites, including the CINMS headquarters in Santa Barbara and the Channel Islands National Park headquarters in Ventura.

Students, researchers, and land managers can also use the bibliography on their own PC or Macintosh computers. CINMS is distributing floppy-disc-based copies of the references, along with a ProCite search format that allows users to sort, search, and print entries.

To obtain a free copy, send unformatted 3 1/2" double-sided, double-density discs (three for a Macintosh version or four for a PC version) to CINMS, Attn: Channel Islands Bibliography, 113 Harbor Way, Santa Barbara, CA 93109. Reserve users can also make copies on site.

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