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In this issue:

Report of the Director: A long view from 30 years of NRS

This year, 1995, the NRS completed its third decade since it was created by The UC Regents. As ever, day-to-day site and system administration keep the entire "NRS family" busy. Over the past few months alone, research and instruction have been booming, facilities have been completed and even dedicated, and we have had to say goodbye to one of our "founding parents," Professor Emeritus Mildred E. Mathias, who passed away at age 88. Having this much history allows us to take a long view of resource management for the sake of instruction and research.

Our lead story for this Transect *concerns fire ecology and management in the framework of NRS science and stewardship. Fire is a natural process in all California terrestrial ecosystems. Yet humans have tried to manage fire and its effects on the landscape for thousands of years. During the 1920s, as we dispersed into California's wildlands — especially, as we began to manage forest resources for commodity production — the suppression of all wildfires became the norm. In contrast, many resource managers and scientists today support the reintroduction of fire through such actions as prescribed burnings.*

On NRS reserves, researchers have long studied fire's role in maintaining various populations, in seral stages of plant communities, and in biogeochemical cycling. We have experimented with small-scale prescribed burning, largely to enhance native species while reducing exotics, for example, in grasslands. Careful fire management is always a concern: we don't want to lose facilities or endanger our neighbors and users.

Understood in this broad context, the recent actions of Big Creek's reserve steward in responding to an incident of wildfire are exemplary and even heroic.

— Deborah L. Elliott-Fisk
Director of the NRS

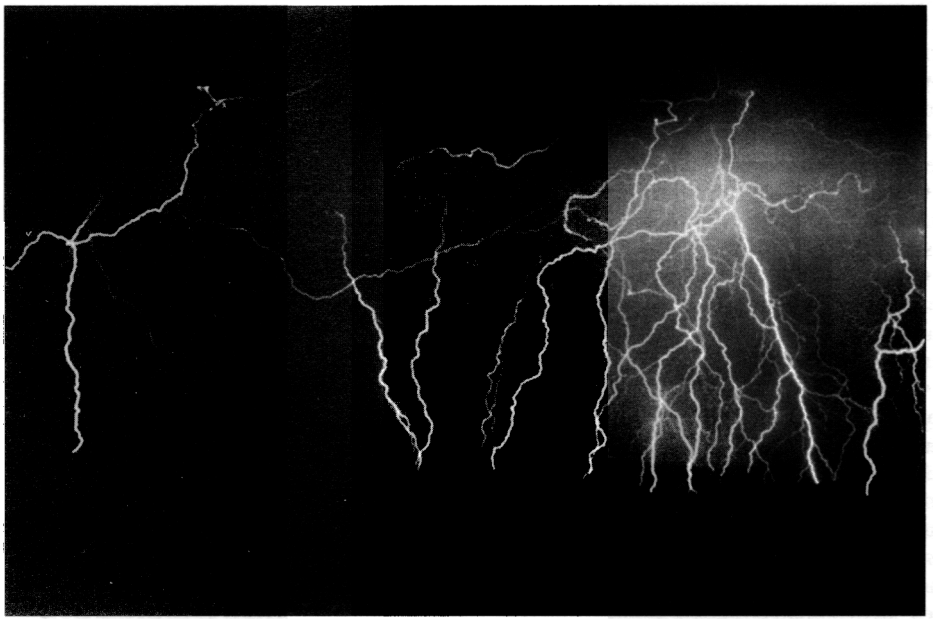

Photo by Feynner Arias-Godenez

Wildfire is often started by a lightning strike. This electrical storm caused the fall fire at the Big Creek Reserve near Big Sur. Fortunately, able stewardship at a critical time saved the secluded site.

Fire ecology and management make good news at Big Creek

"It was just pure luck that I was in the perfect place at the right time," says Feynner Arias-Godenez, resident reserve steward at the Landels-Hill Big Creek Reserve in Big Sur. It is frightening to imagine what could have happened had he not been there last fall when Highlands Peak, the highest point in the Big Creek Reserve, went up in flames.

Arias explains: "For some reason — I don't know why — I decided to leave the NRS annual meeting a day early, so I was the only one back at Big Creek when the wildfire started." On the morning of October 9, he awoke and spotted through his bedroom window a narrow column of smoke rising from Highlands Peak.

Arias immediately alerted the U.S. Forest Service (USFS). He was unaware that Forest Service fire trucks had already been called to the site by boaters, who could see the flames from the ocean. Yet Big Creek is so rugged and overgrown that fire fighters were unable to see the blaze from the reserve's main road.

Without Arias's guidance, the fire fighters may not have been able to reach the fire in time to save the site. After Arias met up with USFS Assistant Fire Management Officer Kelly Collins, the two men led the fire trucks as close to the blaze as the road would take them.

From there, Arias and Collins trailblazed their way up to the flames, swinging machetes through thick, dried-out manzanita and madrone. A team of fire fighters, loaded down with essential equipment, followed closely behind. To reach the fire, they had to climb four

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Reserve Highlights

New National Preserve embraces NRS site

On October 8, 1994, in its last hours before adjournment, the United States Congress passed the California Desert Protection Act, thereby concluding eight long years of efforts to redesign the management mandate of over three million acres of federal lands in California's desert. In addition to converting jurisdiction from the U.S. Bureau of Land Management (BLM) to the National Park Service in many parts of the desert, the act:

- designates nearly 70 new wilderness areas on remaining BLM lands;
- adds a quarter of a million acres to Joshua Tree National Monument and designates it as a National Park;
- adds 1.4 million acres to Death Valley National Monument and designates it as a National Park (now the largest National Park System unit outside of Alaska);
- creates a new 1.5-million-acre Mojave National Preserve from lands formerly managed by BLM as the East Mojave National Scenic Area. The act as originally written would have designated the East Mojave area as a National Park, but opponents successfully lobbied for continued hunting, grazing, and other such "traditional uses" in designated areas and thus changed the status of the site. It is the first National *Preserve* to be established.

Set in one of California's most scenic areas, the new Mojave National Preserve surrounds one of the fastest growing research sites in the Natural Reserve System (NRS), the Granite Mountains Reserve. Reserve Directors Jim André and Claudia Luke wasted no time welcoming their new neighbors. In January, they hosted new Superintendent Marvin Jensen with an informal reserve tour, talks with visiting scientists, and a night at Dorner's Cabin, the reserve's base camp for classes.

Within the Granite Mountains Reserve, the University owns 2,200 acres in three disjunct parcels; the National Park Service owns the interweaving 6,720 acres, which were transferred from BLM and will be managed as part of the reserve. Legislative language of the California Desert Protection Act calls for a cooperative management agreement to "ensure continuation of arid lands research and educational activities of the University of California." This agreement, formerly held by UC and BLM, ensures that the reserve is managed by the University as a contiguous parcel. As University and park representatives met this spring to plan cooperative management of the reserve, new opportunities also were discussed in establishing a cooperative, applied-research agreement that involves the surrounding 1.5-million-acre National Mojave Preserve.

The vision for the park, and for the entire California desert, is just now being crafted. Planners propose to use the California desert as a pilot project of the National Performance Review for ecosystem management and planning. They have formed a desert managers steering group that will coordinate management in response to ongoing collection of scientific information. The University's role will be increasingly important in providing information and analysis to the process of ecosystem management.

The California desert has become, in the words of U.S. Vice President Al Gore, an "innovative management laboratory," where scientists and managers are encouraged to work together to plan and implement long-term ecosystem management. In the East Mojave, University scientists and the NRS are involved in the "birth" of a new unit of the National Park Service — as well as a new approach to land management — with the Granite Mountains Reserve at its center.

— Margaret L. Herring
Systemwide Senior Science Editor

Granite Mountains graced by generous gift of endowment

The Granite Mountains Reserve, sporting innovative new facilities and nestled within the newly created Mojave National Preserve, is poised to become a center for Mojave Desert scientific research and education. Its potential will be realized with the help of a generous endowment from Jack Sweeney, a trustee of the University of California, Riverside Foundation, his wife, Marilyn, a long-time supporter of the arts in Riverside, and their business partners, Mark and Pam Rubin, both UCR campus supporters.

The Sweeneys have been quietly contributing in many ways to the University and to the community in Riverside. When they were planning a gift to the University, they wanted part of that gift to be an endowment for the Granite Mountains Reserve, which Jack Sweeney had visited years earlier. He recalls:

"My son and I went out there a few years ago, before they had expanded the facilities. I remember the sight of White Fang [a prominent landmark on the reserve] and the other granite outcrops. The land is remote, untouched, unspoiled. I was impressed by the people who work there, who take care of the land. … I am glad the University is involved in this kind of thing. California is basically a desert. Out there [at the Granite Mountains] is the convergence of three deserts. It is interesting to see the overlap, a fascinating place to study."

The Sweeneys' gift will be the basis for an endowment to provide Granite Mountains Reserve with sufficient funding to add more new facilities, upgrade older ones, and further assist academic programs, accommodating increasing use by researchers and educators. Last December, UCR Chancellor Raymond L. Orbach proposed to name the reserve after the Sweeneys in honor of their generous gift — this spring, that proposal was approved by The UC Regents. Starting this summer, the site will be known as the "Jack and Marilyn Sweeney Granite Mountains Desert Research Center."

— Margaret L. Herring
Systemwide Senior Science Editor

Photo by Steve Walag

Marilyn and Jack Sweeney, long-time contributors to the UC Riverside campus and, now, to the Granite Mountains Reserve.

A year in the life of the Heath and Marjorie Angelo Coast Range Reserve

Editor's note: In this issue, we continue our series highlighting reserve-based research by focusing on the Heath and Marjorie Angelo Coast Range Reserve. This site, located along the South Fork of the Eel River in Mendocino County, encompasses lands originally acquired by the Angelo family to protect them from timber harvest and development. In 1959, The Nature Conservancy (TNC) established a preserve here, the first TNC site in the western United States. In 1994, TNC transferred these lands in fee title to the NRS.

Photo by Bill Trush

Large numbers of fish spawn at this location on Elder Creek — thus, its nickname: Passion Pool.

Known under The Nature Conservancy's ownership as the Northern California Coast Range Preserve, this protected site became an increasingly important benchmark as logging beyond its borders whittled away at the ecological resources of the region's late-successional native forests and streams. Today the reserve contains one of California's largest remaining old-growth Douglas-fir forests, several pristine stream systems, and a stretch of the South Fork of the Eel River. Contiguous with a 3,000-acre U.S. Bureau of Land Management Elder Creek Watershed Area of Critical Environmental Concern, the 4,055-acre Angelo Coast Range Reserve is now owned by the University of California and administered by the Berkeley campus.

* * *

The past twelve months have been a watershed year at the Coast Range Reserve. After a very successful, three-year period with a use-agreement and following negotiations with The Nature Conservancy (TNC), the University of California received title to the reserve from TNC and dedicated the site as the Heath and Marjorie Angelo Coast Range Reserve (see "Old Growth [Reserve] Gets New Name, New Owner," *Transect* 12:1 [Fall 1994], p. 16). Last fall, 80 people gathered to celebrate both the dedication and the site's long-standing importance to research and teaching.

The Coast Range Reserve has long been a site for state-of-the-science research on an **old-growth forest watershed**. The uncut forest, free-flowing river, and several fully contained tributaries within the reserve offer the opportunity to study systems where natural processes have not been destabilized by human impacts. Here researchers can design experiments, altering single variables, and collect data relatively unclouded by cumulative perturbations.

These site capabilities attracted a team of researchers, led by Mary Power (UC Berkeley), with funding from the National Science Foundation (NSF) and elsewhere, to investigate various aspects of **productivity and trophic structure in riverine systems**, including:

• Power's **pioneering studies of river food webs**, initiated at the Coast Range Reserve in the late 1980s, continue to elaborate on ecological theory that involves the cascading effect of predators on the greening of the earth. Experiments have shown that, in the presence of insectivorous fish, filamentous green algae are reduced to low, prostrate webs infested with the larvae of tuft-weaving midges. When fish are excluded, invertebrate predators (upon which fish prey) are free to consume more of the midge larvae, allowing a dramatic increase in algal biomass and associated diatoms and cyanobacteria — increasing the primary productivity of the river ecosystem. This was the first experimental study in a river community of odd-numbered versus even-numbered trophic levels and their effect on productivity. (For a more comprehensive description of this research, see *Transect* 9:1 [Spring 1991], p. 4: William K. Stevens, "Theory on the Number of Links in Food Chain Is Upheld in River Test," reprinted from *The New York Times*.)

• Studying the **effects of shade on river productivity**, Jane Marks (UC Berkeley) and others have shed more light on the structure of food webs in rivers. Blooms of algae often occur in clear, rocky, sunlit rivers during periods of low flow. A series of experimental treatments from full shade to full light has shown that shade reduces algal growth, thus reducing available food for grazing insects. This reduction may concentrate the chosen feeding sites of armored grazers (those protected from fish predation) and increase availability of marginal sites for mobile grazers (those more vulnerable to fish predation).

• Measuring the **effects of hydrologic disturbance on river productivity**, Tim Wootton (University of Chicago) and others have found a link between scouring floods and trophic networks in rivers. Winter floods, common to many free-flowing rivers in Mediterranean climates, including the South Fork of the Eel River, tend to annually flush the established community and reset it at a lower trophic level. Reduced invertebrate populations permit large blooms of algae in spring, when the dominant primary consumers are pioneering, mobile species (such as mayflies). As densities of predators (fish) increase, these fast-growing prey species are replaced by predator-resistant consumers (such as caddisfly and midge larvae). It is in this late-successional aquatic community that the biomass of algae and its associated nutrition-rich diatoms and cyanobacteria are dramatically reduced.

In free-flowing hydrologic regimes, the trophic level is regularly reset following winter floods. But researchers have found that in regulated channels with artificially stabilized flows, scouring is inhibited, the late-successional community persists, and

Continued on next page

A Year in the Life *continued*

the productivity of the river is chronically suppressed.

• Documenting the **effects of changing climate and invading species on river communities**, Sarah Kupferberg (UC Berkeley) and others have been able to follow the earliest entry of alien fishes and bullfrogs into the pristine reaches of the South Fork of the Eel River. Annual snorkel surveys have recorded the steady progress upstream toward the reserve of several alien species, including the piscivorous large-mouth bass. Although winter scouring tends to flush these warm-water fishes back downstream, invading bullfrogs have become resident in the reserve, where researchers are monitoring their impact on diminishing populations of native yellow-legged frogs, western pond turtles, and others.

• The **effects of river productivity on terrestrial consumers** is the latest investigation into the trophic complexities of this aquatic ecosystem. Early-successional trophic structure allows algal turfs to grow large and heavy, eventually breaking off into floating mats. These mats provide extensive substrate for nitrogen-fixing epiphytes, forming food-rich, sun-warmed, floating incubators for invertebrates. Densities of aquatic insects increase by an order of magnitude, and the floating mats become an important channel for productivity from the river to the land. Preliminary monitoring by Michael Parker (Southern Oregon State College) and others has revealed dispersal of aquatic insects as far as 200 meters from the riverbanks into the forest, where these insects become a part of terrestrial food webs. Learning the linkages between river communities and their surrounding uplands, particularly via insect-eating bats and birds, will add much to our understanding of productivity and nutrient-cycling through old-growth forest watersheds.

Mathias Grants and other NRS funds have supported several student research projects at the Coast Range Reserve this year:

• Morgan Hannaford (UC Berkeley) contributes to the growing understanding of trophic dynamics in the watershed with his study of the Dicosmoecus (caddisfly) habitat plasticity and its impact on the sessile macroinvertebrate community.

• Mary Poteet and Michelle Mack (both UC Berkeley undergraduates) have taken their work beyond the reaches of the river to study of the effect of Eurytomid gall on the reproductive flowers of native bunchgrass in the reserve's upland meadows.

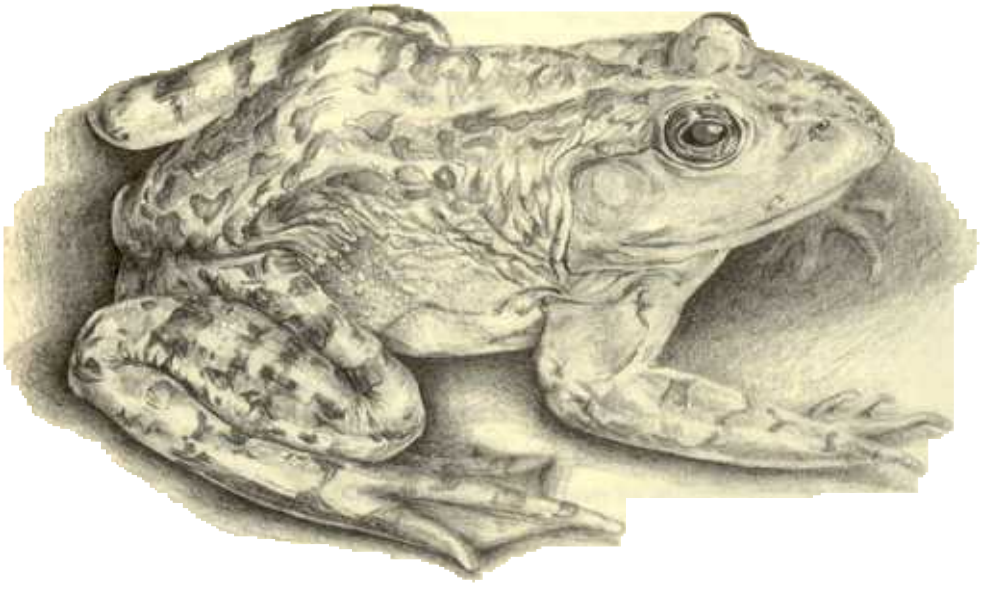
Every spring since the early 1980s, the Coast Range Reserve has hosted groups of local school children in a series of **environmental education field courses**. With coordination from the reserve manager, teachers from primary and middle schools follow an environmental curriculum developed specially for the reserve. Through this model program, scores of school-age children in the Laytonville/Willits area have been introduced to the study of natural systems in the forest, streams, and meadows of the Coast Range Reserve.

In time for the dedication, reserve manager Peter Steel put polishing touches on his **remodel of Wilderness Lodge**. Formerly a relic from the site's resort days during the 1930s, the lodge got a complete makeover from Steel, transforming it into fit accommodations for visiting researchers. This face-lift for the lodge is the latest of many ongoing improvements that Steel is making to the reserve's housing and laboratory facilities, including a recent refurbishment of the headquarters building at the entrance to the reserve. Restoration is being considered for the White House, an architectural chronicle of the reserve's rich past, registered as a National Historic Site.

Just as streams collect into a larger river, the insights gained by faculty, staff, and students working at the Coast Range Reserve collect into a much larger understanding of the way the world works. In this watershed year, we recognize the Angelo and Steel families, along with TNC, and thank them for the important opportunities they made possible for the University at the Angelo Coast Range Reserve.

— Margaret L. Herring
Systemwide Senior Science Editor

Bullfrog invaders: Leaping into a river near you?

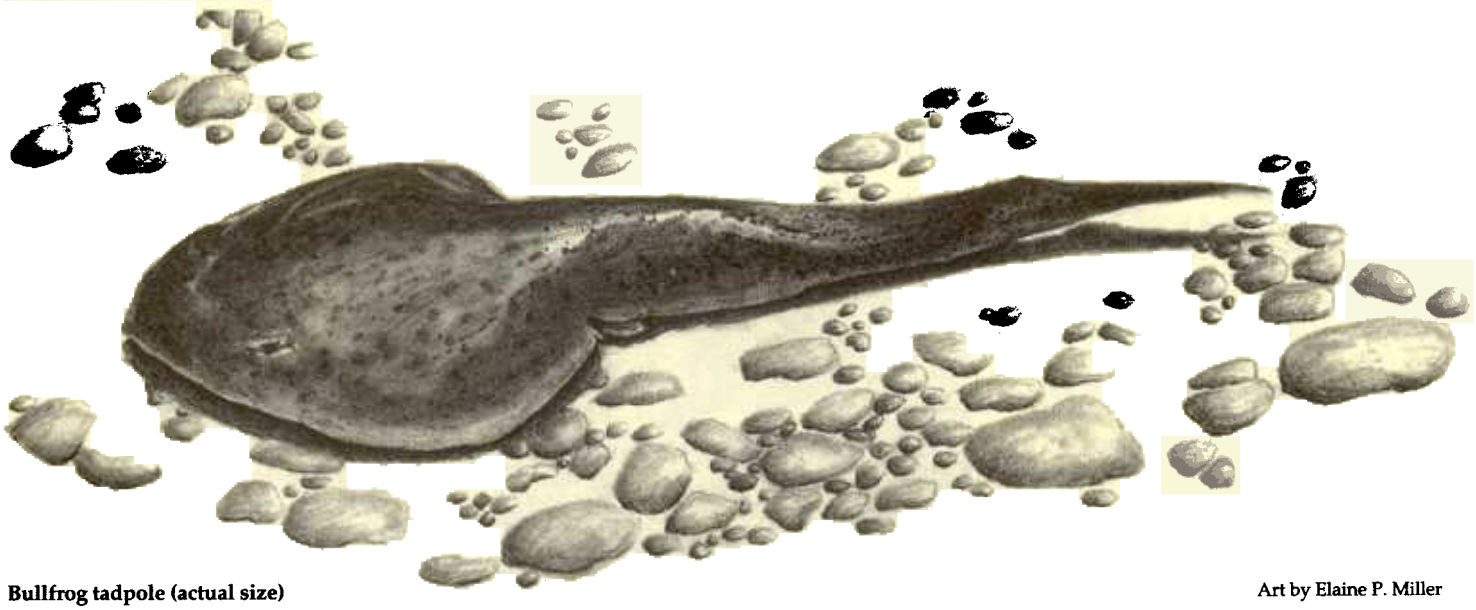


Adult female bullfrog (*Rana catesbeiana*) Art by Elaine P. Miller

Imagine camping out one fall evening at the NRS's Angelo Coast Range Reserve in Mendocino County and being awakened unexpectedly the next morning by a strange, deep, throaty croak: "Jug o'rum, jug o'rum!" This reverberating voice, which can be heard for more than a quarter mile, belongs to the bullfrog (*Rana catesbeiana*). The largest frog in North America, this webbed-footed invader first was detected on site in 1990 and has since created more than cacophony: its disturbance is causing decreases in native frog populations along the South Fork of the Eel River.

The bullfrog's introduction to California dates back to the turn of the century, the height of the state's frogging industry. Native to the Eastern United States, the bullfrog's "manifest destiny" was to feed California's booming population, which quadrupled between 1860 and 1900.

"It all goes back to the Gold Rush," says Sarah Kupferberg, a Ph.D. candidate from UC Berkeley studying the bullfrog invasion. "There was a huge influx of people into California and not enough food for them all to eat." Measuring a whopping eight inches



Bullfrog tadpole (actual size)

Art by Elaine P. Miller

from nose to vent, the meaty bullfrogs were brought to California because, by the late nineteenth century, frog harvesting had seriously depleted populations of a smaller native, the red-legged frog (*Rana aurora draytonii*). Because of continued loss of riparian habitat, today that indigenous frog's weak, throaty notes remain faintly heard in California, with the species officially listed as threatened.

Bullfrogs first appeared in the South Fork of the Eel River during the recent drought. While working at the Coast Range Reserve, Kupferberg became interested in studying bullfrogs in much the same way that she discovered them: quite by accident. She says, "I got very intrigued with native tadpoles and their role as grazers in the algal-based food web. Then I noticed there were bullfrog tadpoles around that weren't supposed to be there. It's like they suddenly just arrived. It was an opportunity I couldn't pass up, a rare chance to actually *observe* the invasion *as* it occurred." Researchers seldom get to witness an invasion as Kupferberg has. Indeed, she found it easy to identify the bullfrog tadpoles. Fully six inches long, they are hard to overlook.

Kupferberg believes grazing in the surrounding region has encouraged the bullfrog invasion of the Eel River. Numerous stock ponds provide temporary watery homes for the bullfrogs, but when these habitats dry up during drought years, the hearty amphibians will travel miles over dry land, searching for a new water source. Mark Twain described these colossal leaps in his famous short story, "The Notorious Jumping Frog of Calaveras County": "[G]ive him a little punch behind, and the next minute you'd see that frog whirling in the air like a doughnut."

The bullfrogs quickly multiply in the Eel River. Each bullfrog egg cluster, or clutch, contains between 10,000 and 20,000 eggs, five to ten times more eggs per clutch than that of another native, the Foothill yellow-legged frog (*Rana boylei*). "All you need are two bullfrog females [plus mates, of course], and you have an instant population," says Kupferberg. To monitor this influx, she meticulously counts bullfrog tadpoles several times each year. Although it sounds like slippery business — and one tadpole could easily be mistaken for another — Kupferberg manages to tally them up by setting out a series of one-meter quadrats across the river and counting the pollywogs in each square.

Less-adapted than native frogs to California's Mediterranean climate, bullfrog tadpoles overwinter in California waterways. After emerging from eggs laid in July, bullfrog tadpoles swim their way through the winter, eventually metamorphosing into adult frogs the following August. However, even the pollywog's hefty size cannot save it from being washed away during winter floods. Thus, bullfrog tadpoles in the Eel River suffer high mortality rates during flood years. In contrast, native frogs mature before wintertime and thus escape the fate of many bullfrog tadpoles. Also, while the invader takes almost fourteen months to mature, the yellow-legged frog metamorphoses in under four months, and the native Pacific tree frog (*Hyla regilla*) goes from egg to frog in just three weeks.

Spending much of her research time wading and snorkeling in the river, Kupferberg studies the effects of the pollywog invaders on the aquatic ecosystem. She focuses on the impacts of bullfrog tadpoles on the native yellow-legged frog, which is listed as a species of special concern. She has discovered that yellow-legged frog populations decrease when bullfrogs abound. Through a series of experiments conducted in the river channel, Kupferberg found that bullfrog tadpoles graze heavily on high-quality algae, depriving yellow-legged frog tadpoles of this food source and changing the nutrient balance in the river. The invaders have less effect on Pacific tree frog tadpoles. Due to their small size and speedy metamorphosis into adults, tree frogs require less algae.

Parallel studies have begun on the impact of the full-grown bullfrogs' appetite. Mark Twain remarked that all Dan'l Webster, the enterprising bullfrog in his story, ever wanted was an education. Unfortunately, that is not the case with the Coast Range Reserve's bullfrogs. All they want is food — and they will eat just about anything. In addition to their standard fare of insects, fish, and other frogs, they have been known to devour snakes and small birds. Already Kupferberg has discovered a 50-percent reduction in insect populations during heavy bullfrog seasons. Despite the invaders' effects on the Eel River ecosystem, Kupferberg opposes introducing a new species to control them: "If you introduce a bullfrog predator, it will also be a predator of the native frogs." Efforts made elsewhere along the West Coast to eradicate the bullfrogs by hunting them have been largely unsuccessful.

Kupferberg, who refuses to keep live animals in her lab or kill them to perform research, relies heavily on undisturbed wildlands like the Coast Range Reserve. Underscoring the value of conserving natural habitats for research, she states: "It is paramount to understanding how we impact our environment to have relatively pristine places for comparison."

— Elaine P. Miller
Systemwide Senior Science Writer

Instruction and Research Highlights

No kidding: Coyotes in your backyard can actually help endangered birds

The howling of coyotes is music to the ears of those who work to protect endangered coastal birds in Orange County. It may sound strange, since the coyote (*Canis latrans*), on occasion, may prey on such birds as the native light-footed clapper rail (*Rallus longirostris levipes*) and the California least tern (*Sterna albifrons*). However, scientists who study these and other shorebirds in this region know that coyotes can actually help reduce the number of endangered birds lost to their primary predator, the non-native red fox (*Vulpes vulpes*). To determine whether the coyotes themselves can long survive in this rapidly developing coastal region, a study is underway at four remaining coastal wetland sites in Orange County, including the NRS's San Joaquin Freshwater Marsh Reserve.

For his master's work at Humboldt State University in Arcata, California, Shane Romsos, traveled south to head up the "Orange County Cooperative Coyote Project." Working with volunteers provided by UC Irvine, through Reserve Manager Bill Bretz, and by the U.S. Fish and Wildlife Service, Romsos monitors the small coyote populations at the San Joaquin Freshwater Marsh Reserve, Upper Newport Bay Ecological Reserve, Seal Beach National Wildlife Refuge, and Bolsa Chica Ecological Reserve. Though Romsos has focused his research on the coyote, his goal is to protect the birds. He says: "The four study sites represent the last few remaining habitats for these birds in Orange County. Urban development is the primary reason for these birds' endangered status, because it means a major loss of critical nesting habitat. Add non-native predators — especially red fox — to the pot, and the birds are in serious trouble."

An English import, the red fox was shipped to America during the mid-1700s by East Coast landowners who enjoyed riding to the hounds. Distinguishable from other North American foxes by the white tip on its bushy tail, the red fox can now be found prowling across much of the United States and Canada. A red fox subspecies from the Northern Great Plains (*V. vulpes regalis*) was introduced to fox-fur farms in California 100 years ago. Today's cunning predators are the descendants of red foxes who survived the hunt, escaped from fur farms, or were raised as pets and intentionally released.

Red foxes are omnivorous, but in this region they have learned to hunt clapper rails and least terns. These furry predators are extremely cautious and can be hard to

Photo by Mike Couffer

Shane Romsos radio-collars a female coyote at the NRS's San Joaquin Freshwater Marsh Reserve. If having coyotes in your backyard seems frightening, remember that any danger they pose is primarily to pets. For maximum safety, cats and dogs, as well as pet food, should be kept indoors at night. According to Newport Bay Animal Control, coyotes have not attacked any humans.

spot, but they are not shy about preying on native birds. The least tern is a ground nester, and according to a 1993 state Department of Fish and Game report, a single red fox can take, in an extreme case, between 43 and 53 newly hatched least tern chicks in one night. The crafty canids can catch a great number of clapper rails and least terns, because they do not stop to eat. Instead, they hunt continually throughout the night, storing their prey in underground mounds. The native birds have not developed defenses against this introduced predator.

The coyote, a larger native relative of the red fox, does not pose the same threat to the birds. Although the coyote may occasionally take clapper rails and least terns, this generalist typically eats a far wider variety of prey and vegetation, preferring small mammals and smaller predators — including red foxes! Its home range extends over a broader area than that of the red fox, and this, too, provides the coyote with a more diverse menu. In addition, Romsos says, "Coyotes are not the most efficient hunters. Their prey capture rate is only between 8 and 50 percent." (No wonder Wile E. Coyote (*Eatius birdius*) never catches The Roadrunner (*Accelleratii incredibus*) in the Warner Brothers cartoons!) Finally, the coyote manages to outcompete its deft cousin for food resources by having larger litters of up to nineteen young.

Because of this competition between coyote and red fox, their home ranges tend to overlap only along their borders. Thus, the two species are said to *naturally exclude* each other. It is this natural exclusion that Romsos views as the basis for a humane way to preserve endangered shorebirds. He explains the complex interspecies triangle at work: "At Seal Beach, the number of clapper rails increased due to fox removal by euthanasia. To avoid euthanizing them, we're trying to decrease the fox by managing for coyotes, which exclude them naturally. By removing red foxes in this way, we can be certain to reduce added pressure on the endangered birds."

Romsos hopes his project will shed light on the number of coyotes that make their homes at his four study sites. It is already known that few coyotes are living in heavily urbanized Orange County. In fact, Romsos reports, during the 1970s researchers thought coyotes had disappeared completely from Seal Beach, and plans were considered to reintroduce them. Romsos is studying whether coyotes, which have recently returned to the area on their own, can survive over the long haul. Since his four study sites are disjunct, he fears the coyotes living in these open spaces will become isolated by development and be forced to inbreed. Such inbreeding reduces the genetic diversity of the species and gradually degrades the viability of the local population. Thus, in order to persist, coyotes from all four sites must be able to find one another through corridors between urbanized areas.

Romsos tracks the movements of coyotes between study sites using radio-telemetry and other techniques. Since last winter, he has placed radio collars, donated by the U.S. Fish and Wildlife Service, on a total of 11 coyotes from his sites. Rain or shine, Romsos follows the curious canids on their nightly group excursions. He finds it relatively easy to track most of the radio-collared coyotes. But then there is the one he calls "Wiley." This older male really gets around, even crossing freeways. Sometimes Wiley ducks into deep crevasses, and Romsos loses his radio signal all together, almost as though this trickster were playing some sort of game. Romsos says, "The project has really

Map by Eric Rainbolt

Researcher Shane Romsos keeps track of coyote populations at four study sites juxtaposed with developed areas in increasingly urban Orange County: Seal Beach National Wildlife Refuge, Bolsa Chica Ecological Reserve, Upper Newport Bay Ecological Reserve, and the NRS's San Joaquin Freshwater Marsh Reserve.

given me a chance to see how coyotes have individual personalities."

As Romsos tracks the animals, he enters his data into a computer-based geographic information system (GIS). Using this technology, he creates a series of map layers, each depicting a different factor, such as home ranges, travel routes, and land parcel types (natural, residential, under development, etc.). By superimposing various map layers, Romsos hopes to determine the critical corridors that coyotes use to move around Orange County. He will give his final report to the organizations that funded his work: The Irvine Company, the U.S. Fish and Wildlife Service, and the California Department of Fish and Game. These groups are expected to use his conclusions to help manage open space and the coyotes' continued survival in the region.

Romsos was surprised by the coyotes' ability to adapt to the urban environment. He says: "I've seen them move through gated communities and residential areas even when open space was available. What's interesting is that they don't hang around there. They do what they have to do in the areas of human disturbance — and then they move on."

Yet it is critical that open space be protected. While the coyote seems able to make its way through the urban landscape, other species, such as the light-footed clapper rail and California least tern, depend on our vanishing coastal wetlands. "Ninety-nine percent of California's coastal wetlands have been developed," says Romsos. "It's amazing how the San Joaquin Marsh Reserve is super-saturated with species — from raptors to raccoons — and I appreciate that it harbors diverse wildlife for study."

— Elaine P. Miller
Systemwide Senior Science Writer

Photo by Mike Couffer

At Seal Beach Refuge, Craig Knight of Animal Control releases a radio-collared coyote to obey "the call of the urban wild."

New reports out on exotics in natural areas

The Pacific Institute, a nonprofit natural resources research group, recently published two reports on problems with nonindigenous or introduced species of plants and animals in aquatic, riparian, and wetland habitats in different California regions:

- *Biological invasions in California wetlands*
- *Nonindigenous species in wilderness areas.*

The reports are based on surveys of resource managers throughout the state, including several NRS reserves. They include lists of introduced species and clarify the subtle, but critical, threats that such species pose to native biodiversity.

Both of these publications are available from:

Tom Dudley, Pacific Institute, 1204 Preservation Park Way, Oakland, CA 94612; phone: (510) 204-9138; e-mail: **tdudley@violet.berkeley.edu**. (Although the reports are provided free of charge, a $3 donation would help defray mailing costs.)

Symposium upcoming on CA oak woodlands

A symposium on "Oak Woodlands and Urban Interface Issues" is being planned for next spring, on March 19-22, 1996, at California Polytechnic State University, San Luis Obispo. The call has gone out for both papers and posters on scientific, technological, economic, sociological, and legal phenomena relevant to the management of California's oak woodlands and urban interface.

Each prospective participant must submit his or her paper or poster title, along with an abstract of 250 words or less, *by August 10, 1995*, to:

Oak Symposium, c/o John Bryant, Natural Resources Management Department, California Polytechnic State University, San Luis Obispo, CA 93407; phone: (805) 756-2702; fax: (805) 756-1402; e-mail: **jbryant@trumpet.calpoly.edu**.

Federal funds and NRS site support paleoclimate studies on alluvial fans

How would you like to receive *more money than you requested* in your research proposal?

That's precisely what happened to Eric McDonald when he sought funding — from the National Aeronautics and Space Administration (NASA) and from the National Science Foundation (NSF) — for his UC Riverside doctoral dissertation research on the influence of climate on alluvial fan systems in the East Mojave Desert. "We were very surprised in 1991 to get almost 25 percent over the proposed amount from NASA," says McDonald. "It was definitely a pretty big vote of confidence." For this important work, the NRS's Granite Mountains Reserve, near his study site at the base of the Providence Mountains, provided the perfect field base.

McDonald's doctoral project was an extension of long-time collaborative research in the East Mojave Desert region by Stephen Wells (UC Riverside) and Leslie McFadden (University of New Mexico). McDonald used several dating techniques to determine when the alluvial fans formed. He then correlated these estimated time frames with known climatic episodes during the Quaternary (last 1.6 million years). "This gave us an initial estimate of fan ages and the climatic conditions at the different times when the fans were formed," says McDonald.

Methods used by McDonald, Wells, and McFadden to date alluvial fans included soil-stratigraphic correlations, infrared stimulated luminescence dating, and radiocarbon dating. This last method, radiocarbon dating, can be difficult when applied to material from desert soils. Even so, McDonald believes in using as many techniques as possible — and in looking for agreement among them — to estimate most accurately the ages of the fans. "We're not just looking at one thing or using one technique, and that's what is so exciting," explains McDonald. "We're trying to look at a whole system and deal in a systematic way with as many variables as possible."

The alluvial apron (or *bajada*) that skirts the Providence Mountains extends for twenty miles and is comprised of seven individual fans of different ages. McDonald estimates that the oldest fan, which is highly eroded, is over one million years old. The youngest fan began forming between five hundred and one thousand years ago. The largest and most well-defined fan, which shows up as a major landform on satellite images, dates back approximately 650,000 years. In general, the formation of alluvial fans results from a combination of climate change and tectonic activity. However, McDonald says there is little evidence of fault activity in the Providence Mountains

What's an alluvial fan?

Alluvial fans, like the one illustrated here, are most commonly found in desert and semi-arid environments. The lack of vegetative protection in drylands allows infrequent, heavy rains to flush large amounts of rock debris down slopes. It is this transported material, or *alluvium*, that makes up an alluvial fan.

A fan is formed as a mountain stream, loaded with sediment, rushes through a steep, deeply cut valley and then spills out onto an open plain. At the canyon mouth, the rapid water flow suddenly slows down and spreads out, losing kinetic energy and the ability to carry sediment.

With this loss of energy along the lower grade mountain front, the stream dumps its load. The coarsest debris is deposited first, closest to the canyon mouth. Finer sediments are transported further away from the apex and deposited at a distance. Even large boulders can be transported downhill by water and scattered over an alluvial fan.

Neighboring fans sometimes coalesce into a continuous corridor of alluvium, called an *alluvial apron* or *bajada*. In California's Death Valley, these debris aprons can reach as high as 2,000 feet (600 meters) and span a horizontal distance of 5 miles (8 kilometers).

Abundant groundwater is usually present at the base of alluvial fans along the bedrock contact, making them favored locations for settlement and agriculture. Well-known examples of cities built on alluvial fans include Salt Lake City, Utah, and Las Vegas, Nevada.

— *E. P. M.*

Art by Elaine P. Miller

for at least the last 700,000 years. He believes, therefore, that these mountains provide an especially good opportunity to isolate climate change as a main factor in local alluvial fan formation.

Now a post-doctoral researcher at the UC Los Alamos National Laboratory, McDonald plans to apply what he has learned about alluvial fans and climate change in East Mojave Desert to other desert regions around the world. Given that approximately 35 percent of the earth's land surface is already arid or semi-arid, his work has broad implications for the wise future management of desert landscapes. McDonald hopes his research will help shed light on desertification, a widespread process that is driven, in part, by climatic fluctuation. He says: "The [global] climate is definitely changing. The question is: are we causing it? If you look backward and get an idea about what climate can do to the landscape by itself, it makes it easier to figure out (1) if humans are causing change now and (2) if we can come close to calculating what might happen in the next fifty to one hundred years."

Over the four-year period of his doctoral studies, McDonald spent one full year's worth of days using the Granite Mountains Reserve as his field base. "It's such a nice place," he says, "it's hard to leave." In particular, he expressed appreciation for the interdisciplinary support he received from on-site NRS staff and other visiting researchers: "Facilities like this one are critical, because they link people of different scientific fields together. I couldn't have done it without [former NRS reserve manager and reserve associate] Philippe Cohen and Cindy Stead. Getting feedback from them and the other scientists out there was the nicest part of the project."

— Elaine P. Miller
Systemwide Senior Science Writer

This aerial oblique shot was taken from an airplane, not from a space shuttle. However, the photograph does offer a high and wide look at some of the same dramatic landscape at Mammoth Pass (sans snowpack) that NASA's *Endeavor* "observed."

Photo by Bart Walters & Associates

Snow science at SNARL gets a big boost from outer space

Scientists at the Sierra Nevada Aquatic Research Laboratory (SNARL) have reached new heights with their cutting-edge research of the Sierra Nevada snowpack. In April and again in October of last year, the crew of the space shuttle *Endeavor* conducted remote sensing of the Mammoth-area landscape using a sophisticated new radar system. This radar system provided SNARL scientists with an array of information they can use to measure the amount of water stored in the mountains' seasonal snowpack.

Between 75 and 85 percent of the annual precipitation in the western United States falls as snow and is stored in deep snowpacks until spring and summer. But not all snow holds the same amount of water. Water resource managers need to predict the annual volume of runoff into rivers and reservoirs, and this has been an important topic of snow science studies since the early part of this century. The ultimate goal of the SNARL study, led by UC Santa Barbara scientists Jeff Dozier, John Melack, and Jiancheng Shi, is to develop a more accurate method of calculating the amount of water stored in a snowpack and the timing of its release.

The SNARL scientists operate a snow station at 9,600 feet on Mammoth Mountain as part of a broad network of monitoring stations that encompasses most of mountainous West to measure the volume and chemistry of water held in reserve in mountain snow. This network provides samples taken at discrete points across the landscape. The new spaceborne radar system provides continuous remote images across the entire Sierra Nevada snowpack. Taken together, data from the ground (SNARL's) and data from space (NASA's) can be used to calculate a much more accurate measure of how much water is contained in the snowpack and when it will melt.

As part of NASA's Earth Observing System program, the *Endeavor* carried aboard a Spaceborne Imaging Radar-C/X-Band Synthetic Aperture Radar (SIR-C/X-SAR) to collect images from 150 miles above the earth's surface. This is the first spaceborne radar system to gather data at multiple wavelengths and polarizations simultaneously. This new capability allows images to be taken through cloud cover and can provide a measure of snow density in rough terrain.

In both the April and October flights, the shuttle flew over the Eastern Sierra Nevada to collect images from a stretch of landscape 10 to 55 miles wide. Images of bare ground taken in October were used to clarify images taken in April of the snowpack just before spring melt, allowing SNARL scientists to calculate the water content in the upper layers of snow to an accuracy of 98 percent. They found that the snow's water content was higher on south-facing slopes and at lower elevations, a discovery that will help them to predict which basins will receive a greater proportion of the runoff.

Combining ground-based measurements with remote-sensing data has enabled scientists to develop a much more detailed model of the snow-water equivalent across the entire Sierra Nevada snowpack. One more shuttle flight has been scheduled, and the SNARL scientists look forward to a deeper understanding of the snowpack and its relation to California's water supply.

— Margaret L. Herring
Systemwide Senior Science Editor

Photo by Dan Dawson

Editor's note: The Snow Hydrology group at UC Santa Barbara maintains a frequently updated electronic description of its research, including information about the investigators, recent results, images, and a list of publications. All this is available via the World Wide Web at **http://www.icess.ucsb.edu/hydro/hydro.html**.

Field Notes

• Two-thirds of a mammoth's tooth was uncovered last summer at San Joaquin Freshwater Marsh Reserve. This fossil from the Pleistocene Epoch (10,000 to 1.6 million years ago) was originally about 20 centimeters long and 10 centimeters wide. It probably came from a baby animal weighing a hefty 850 pounds. Adults grew to 3,600 pounds. Pygmy mammoth remains have also been found on Santa Cruz Island Reserve. Mammoths are believed to have gone extinct in California between 10,000 and 12,000 years ago.

Also found at San Joaquin Freshwater Marsh Reserve was a prehistoric shark's tooth about 3.5 inches long. Archaeologist Gary Hurd believes this fossil is older than the 17-million-year-old deposit in which it was found. The tooth probably belonged to a leviathan ancestor of the great white shark, weighing about 3,600 to 6,000 pounds (three times the size of today's great white). Hurd says both fossil teeth were probably transported to the reserve from the Santa Ana Mountains by a deep stream, which long ago filled in with sediment and now is underground.

• The *New York Times* reported last fall on research performed at Bodega Marine Reserve by UC Davis ecologist Richard Karban. He observed that some seaside daisies on site were teeming with tiny parasitic bugs called thrips, while other daisies, growing just a few yards away, remained uninfested. According to Karban, the short-lived thrips, like some other insects, can adapt, in an evolutionary sense, to a single plant! See "The Environment" section in the September 27, 1994 issue of *New York Times* for Carol K. Yoon's article entitled "Insects adapted to a single twig: Specialization in the extreme."

• Contiguous with Landels-Hill Big Creek Reserve, which provides facilities for visiting researchers and educational groups, the new Big Creek Marine Ecological Reserve is proving a popular, productive research site. The protected marine reserve was established in 1994 by the California Fish and Game Commission. It offers opportunities to study, for example, rockfishes, elephant seals, hydrocorals, and sustainable fisheries. Last fall, the marine reserve waters were full of tiny creatures that appeared to fly through the ocean on half-inch wings, almost like miniature bat rays. The creature, a kind of swimming pteropod snail called a sea butterfly, uses its sticky "wings" (actually, a modified foot) to swim and gather food. It feasts on microscopic plankton that stick to its "wings."

• Last winter a prescribed burn of bishop pine habitat was conducted at Santa Cruz Island Reserve, part of a program organized by The Nature Conservancy (TNC). The December 7th burn was intended to stimulate regeneration of the island's bishop pine forest. Not much is known about the response of bishop pines to fire, but it is expected to be similar to that of other closed-cone pine forests. Results from the site's first prescribed fire, in December 1993, are helping the NRS and TNC develop strategies to restore native perennial grasslands and eradicate exotic fennel.

• One of the largest grants ever offered by the National Science Foundation (NSF) for facilities and equipment for field stations and marine labs — nearly $300,000 — was recently awarded to Director James S. Clegg and Reserve Manager Peter Connors of the Bodega Marine Laboratory. A new six-room visiting scientist lodge, made possible by these funds, is expected to open in late 1996 on Bodega Marine Reserve. Construction of a new greenhouse preparatory room (headhouse) was recently completed at the site.

• With an $8,000 grant from the National Science Foundation (NSF) to Reserve Manager Mark Stromberg, Hastings Natural History Reservation purchased a ground-positioning system (GPS) this spring. This equipment provides the exact longitudinal and latitudinal location of a given point on the ground. With great precision, the GPS will help on-site researchers to map known nesting sites of acorn woodpeckers, western bluebirds, and orioles; create grids and transects for small mammals; and enhance the reserve's computer-based geographic information system (GIS). The neighboring Oak Ridge and Boekenoogen ranches also made contributions toward the GPS purchase; they plan to use it, in cooperation with reserve management, to pinpoint common property boundaries.

• The NRS is pleased to announce that Mary E. Power, associate professor of integrative biology at UC Berkeley, has been appointed new chair of the NRS Universitywide Advisory Committee. She is currently Berkeley campus representative to the Universitywide Committee, as well as chair of UCB's campus NRS committee. In addition, Power has served as faculty reserve manager for Angelo Coast Range Reserve (formerly, Northern California Coast Range Preserve) since it joined the NRS in 1989. Her goals for her new three-year chairpersonship include enhancing cross-ecosystem research in areas such as the biology and control of invasive species and fire ecology and management.

Other members of the NRS Universitywide Advisory Committee for fall 1995 include: Harry Greene (UCB), Sid England (UCD), Peter Bowler (UCI), Robert Gibson (UCLA), John Rotenberry (UCR), Scott Cooper (UCSB), Dan Costa (UCSC), Peter Connors and Virginia Boucher (reserve managers' representative [UCD] and alternative [UCSB]), Margaret Fusari (campus coordinators' representative [UCSC]), Tim Bradley (at-large memory [UCI]), and Harrison Dunning (at-large President's representative [UCD]). Appointment of a UCSD campus representative to replace long-time committee member Paul Dayton is pending.

New VP to guide UC's DANR

W. R. ("Reg") Gomes has been appointed new vice president for UC's Division of Agriculture and Natural Resources, which oversees the NRS. On September 1, he will replace Kenneth R. Farrell, who is retiring after eight years of service.

Since 1989, Gomes has been the dean of the College of Agriculture at the University of Illinois at Urbana-Champaign. He has headed both the departments of Dairy Science and of Animal Sciences, and he holds the rank of professor in both fields.

Gomes, a California native (Modesto-born), is a distinguished science leader, with a multitude of publications to his name. He has been a member of the Illinois Board of Natural Resources and Conservation and the U.S.-Israeli Bi-National Agricultural Research and Development Fund. He served as vice chair of the American Society of Animal Science Foundation.

Creative manager receives award

Paul Dayton, faculty reserve manager of UC San Diego's Kendall-Frost Mission Bay Marsh Reserve, has been awarded $150,000 from the Pew Scholars Program in Conservation and the Environment. The program supports outstanding individuals dedicated to the conservation of biological diversity and the sustainable use of global natural resources. Over a three-year period, Dayton will work to conserve biodiversity along the coasts of Southern California and Baja California.

Dayton, a long-time member of the NRS Universitywide Advisory Committee, was selected, in part, for his creativity in taking action to bring about change. For this effort, he will form advisory boards, lead workshops, and collaborate with existing managers and governmental authorities. Though his initial focus will be wetlands and bays (including Mission Bay and the Kendall-Frost Reserve), he hopes eventually to extend his project to all immediate coastal habitats. He will be assisted by two graduate students, one from the United States and the other from Mexico.

Boyd patroness passes on at 92

The NRS mourns the loss of Dorothy Marmon Boyd, who died on March 13 at age 92. She and her husband Philip L. Boyd, who was a state assemblyman and a UC Regent, helped generate the legislative support needed to build UC Riverside campus. Long active in community affairs, the Boyds donated approximately 3,500 acres, which later became the Philip L. Boyd Deep Canyon Desert Research Center. The family requests donations be made to the Living Desert in Palm Desert, the Riverside Art Museum, and the UC Riverside Foundation.

Photo by Susan Gee Rumsey

Al Muth, reserve director at Boyd Deep Canyon Desert Research Center, holds up a photograph of UCR Professor Emeritus Bill Mayhew, while the real Bill Mayhew himself looks on. The Mayhew photo will hang in the Mayhew Building, a new onsite residence facility. On November 4, 1994, a celebration was held to honor Mayhew and his many years of field instruction and to dedicate his namesake facility.

Photo by Nicholas M. Waser

The staff at Granite Mountains Reserve — Reserve Directors Jim André (shown above sitting) and Claudia Luke and Reserve Steward David Lee — recently celebrated the opening of the site's new passive-solar, super-insulated research facilities (see *Transect* 11:1 [Spring 1993], p. 1). At that event, they recognized the many volunteers who made the facilities possible by putting in some 2,000 hours and, especially, former Granites Reserve Manager Philippe Cohen (shown above standing) and Reserve Associate Cindy Stead, who, along with UCR Professor Nicholas Waser, designed, fund-raised for, and organized the entire project.

Boyd Deep Canyon director appointed to new national board

"It all started when I didn't have sense enough to be quiet," jokes Allan Muth, director of the NRS's Boyd Deep Canyon Desert Research Center in Palm Desert (see photo at left). After speaking up about research and ecological monitoring at a meeting of the U.S. Man and the Biosphere Program (MAB),* Muth was appointed to serve on its new national Directorate of Biosphere Reserves. MAB was established in 1970 by the United Nations Educational, Scientific, and Cultural Organization (UNESCO) to balance conservation efforts with sustainable use and development.

At its first meeting, this ten-member directorate reviewed criteria for accepting new MAB biosphere reserves across the country. Closer to home, Muth views MAB as a unifying force for managing California's ecosystems. He says, "California is well-advanced in planning and environmental legislation, more so than most other states in the country. Here in the Coachella Valley, for instance, we have a number of overlapping, interlocking layers of governmental agencies and environmental groups. One coordinating entity, like MAB, is all we need now." Because he directs research at Boyd Deep Canyon, Muth can provide much of the scientific knowledge MAB needs for environmental decision-making in the region.

The directorate's regional goal is to make its expansive Mojave-Sonoran Desert Biosphere Reserve conform more closely to MAB's own ideal model — with well-defined transitional areas, buffer zones, and a highly protected core. Boyd Deep Canyon has been nominated as the core. Consequently, Muth expects the time he spends serving on the directorate will enhance, rather than detract from, his NRS duties. He explains: "One of the jobs of the reserve director is to maintain contact with various governmental agencies that have an impact on your borders and on biological processes on your reserve. If we can implement the biosphere model, it will just make my job easier."

Editor's Note: In addition to Boyd Deep Canyon, several other NRS sites lie within Man and the Biosphere Reserves. These include the Bodega Marine Reserve, in MAB's Central California Coast Biosphere Reserve, and the Angelo Coast Range Reserve and the Big Creek Reserve, in MAB's California Coast Ranges Biosphere Reserve.

*The Man and the Biosphere Program (MAB) sounds like, but should not be confused with, the highly publicized Biosphere II, an experimental, enclosed ecosystem (also called an "eco-bubble") in Arizona.

Photo by Norden H. (Dan) Cheatham

For 20 years, Mildred Mathias led UCLA Extension study tours through the Amazon basin. Here is how she appeared in June 1979 on the Amazon River between Iquitos and Leticia.

The NRS bids fond adieu to its "founding mother"

Internationally recognized botanist, conservationist, educator, and NRS "founding mother" Dr. Mildred Esther Mathias passed away February 16, 1995, in her Brentwood home near Los Angeles. She was 88.

Mathias was born September 19, 1906, in a small town in the Missouri Ozarks. She entered Washington University, St. Louis, with the intention of becoming a high school teacher of mathematics and science. However, scheduling problems during her junior year caused her to enroll in some botany courses instead. The direction of her life changed forever; she never returned to math.

She received her A.B. in 1926, her M.A. in 1927, and her Ph.D. in 1929. She was then 22.

In August 1930, Mathias married Gerald L. Hassler, a fellow student at Washington University who was to become a thermodynamic engineer. She didn't change her name because it would have been inconvenient: she was already a published professional. Her husband said it was because she didn't plan to stay married. They were on vacation together in Mexico when Hassler passed away. That was in May 1992. They'd been married for over sixty years.

After Mathias got her doctorate, she spent several years as a researcher at the Missouri and New York botanical gardens. Her service to the University of California started in 1937 as a research associate at UC Berkeley. During this period, she also raised four children: Jane, John, Julia, and James.

In 1947, she joined the UCLA faculty, and, in 1974, she "retired." UCLA's eight-acre botanical garden, which she directed, is named for her. Three decades of UCLA alumni remember her as an energetic professor who always had time for her students.

Mathias was one of this nation's foremost authorities in botanical taxonomy, the science of classification. For years she helped UCLA's pharmacology department locate and identify plants in South America and Africa that affect the central nervous system, as possible sources of new drugs. One genus (*Mathiasella*) and at least five species of plants bear her name. Her specialty was the carrot family, Umbelliferae.

In the early 1960s, Mathias worked diligently to found the UC Natural Reserve System. As chair of the NRS Universitywide Faculty Advisory Committee from June 1969 through December 1991, she was able to guide the growth of the NRS from the original fledging program of eight reserves to a nearly complete system of over 30 sites now used by thousands of scholars annually.

Beyond UC and the NRS, Mathias contributed her expertise and energy to numerous organizations devoted to education, conservation, and horticulture — and she received numerous honors. For two decades, she was on state and national boards for The Nature Conservancy (TNC). She was a founder, board president, and teacher with the Organization for Tropical Studies (OTS). She was the first woman to be president of the American Society of Plant Taxonomists. For two years, she co-starred on a weekly NBC-TV gardening program. She was a Los Angeles *Times* "Woman of the Year." Lincoln Constance, UC Berkeley botanist emeritus, with whom Mathias published papers, said in 1988: "She wins another award about once a month. If we were living in the British Empire, she'd be a Dame."

Mathias traveled widely. In "retirement," she led over a 1,000 participants on UCLA Extension tours to natural areas, gardens, and musea in more than 30 countries. She favored the tropics, and, around the UCLA campus, she was known as "the Jungle Queen." In her eighties, she had a reputation for being able to outwalk practically anyone. One follower was quoted as saying: "I don't care where Mildred is going, I'll go. I will follow her to the ends of the Earth." In 1990, the UCLA Emeriti Association named her Emeritus of the Year, the first time that award had been given for post-retirement contributions to the University.

Mildred Mathias is survived by a sister, two daughters, a son, and eight grandchildren. In her lifetime, she was much admired, much loved, and she will be very, very much missed by thousands of friends and colleagues throughout the world.

— Susan Gee Rumsey
Principal Publications Coordinator

It's time now to start planning your proposal for an NRS student grant

Again this year, the NRS systemwide office will issue calls for proposals for three student funding programs: (1) the Mildred E. Mathias Graduate Research Grants, (2) the Elizabeth Hall Blakey Travel Grants, and (3) the Robert M. Norris Undergraduate Research Grants. What follows are a description of the conditions of each grant and a list of NRS campus coordinators to whom proposals must be submitted. Good luck!

Mathias Graduate Research Grants

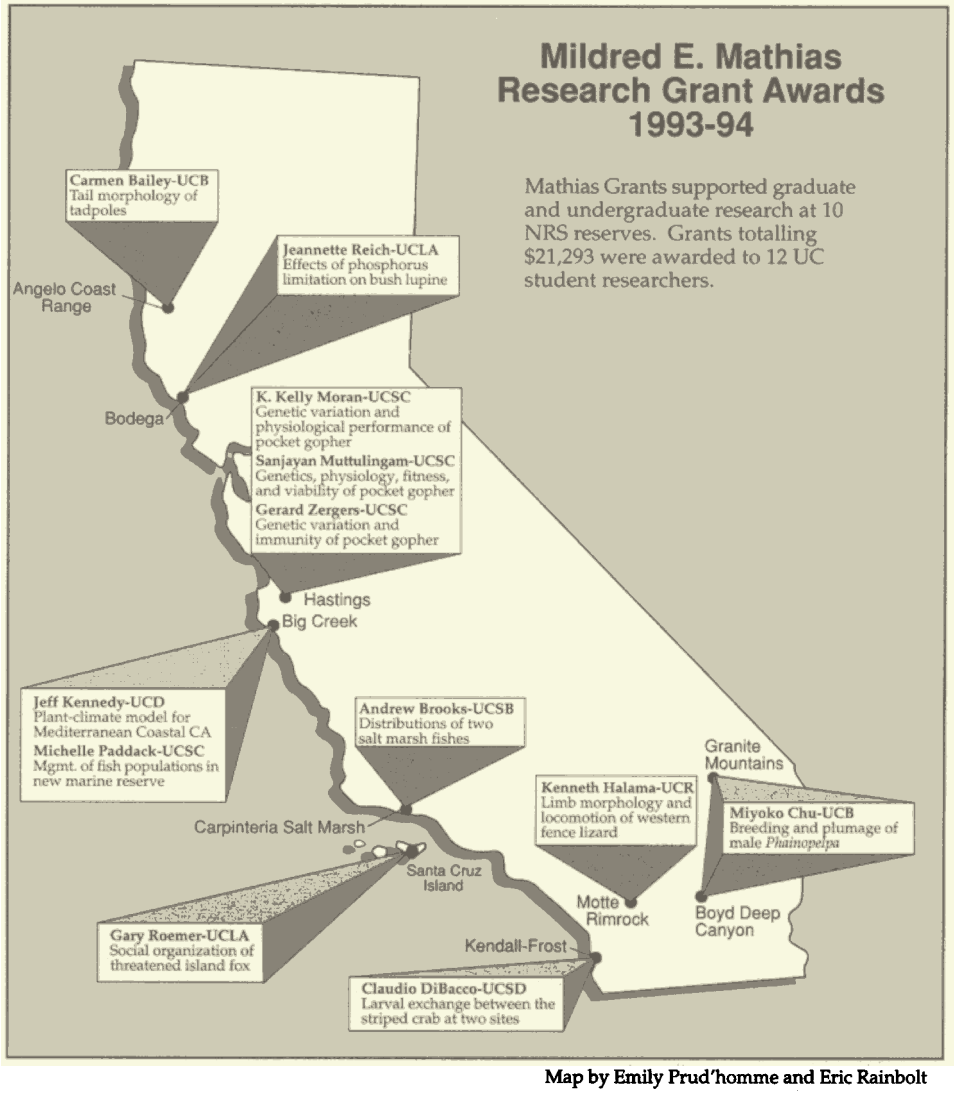
Mathias grants support graduate student research at reserves. Maximum award: $2,000. *Research must be done on UC NRS reserves.* Funding pool of $20,000 available. Call for proposals will be issued September 15, 1995. **Student applications due to campus coordinators by November 3, 1995**. Awards announced by December 15.

Blakey Travel Grants

Blakey grants support undergraduate use of NRS reserves by covering reserve-related travel expenses of undergraduate classes and undergraduate independent (and small group) studies. Maximum grant for undergraduate course travel expenses: $1,000; for undergraduate student's independent study travel expenses: $250. *A fiscal match must be provided by the department, college, or other sources* (grantees are encouraged to seek a 1:1 match). Funding pool of $12,000 available. **Applications for winter, spring, and summer 1996 terms accepted until December 8, 1995.** Awards made December 22.

Norris Undergraduate Research Grants

Norris grants support undergraduate student research at reserves. Maximum award: $1,000, issued directly to students. *Research must be done on UC NRS reserves.* Funding pool of $5,000 available. Call for proposals will be issued by November 24, 1995. **Student applications should be given to the NRS campus coordinator by January 12, 1996**. Awards announced by February 12.



Map by Emily Prud'homme and Eric Rainbolt

1995-96 Campus Contacts for Grants

UC Berkeley:

Mary E. Power, Integrative Biology; (510) 643-7776; e-mail: **MEPOWER@garnet.berkeley.edu**.

Harry W. Greene, Integrative Biology, Museum of Vertebrate Zoology; (510) 642-3567; e-mail: **CROTALUS@uclink.berkeley.edu**.

UC Davis:

Jeanne MacKenzie, Office of Vice Chancellor/Research; (916) 752-7073; e-mail: **jrmackenzie@ucdavis.edu**.

A. Sid England, Planning and Budget; (916) 752-2432; e-mail: **asengland@ucdavis.edu**.

UC Irvine:

Peter Bowler, NRS Academic Coordinator, Ecology and Evolutionary Biology; (714) 824-5183; e-mail: **pabowler@uci.edu**.

Timothy J. Bradley, Ecology and Evolutionary Biology; (714) 824-8483; e-mail: **Tbradley@uci.edu**.

UC Los Angeles:

Robert Gibson, Biology; (310) 825-6459; e-mail: **inz0gib@mvs.oac.ucla.edu**.

UC Riverside:

John T. Rotenberry, Biology; (909) 787-3953; e-mail: **rote@ucrac1.ucr.edu**.

UC San Diego:

Isabelle Kay, Scripps Institution of Oceanography; (619) 534-2077; e-mail: **ikay@ucsd.edu**.

UC Santa Barbara:

Wayne R. Ferren, Museum of Systematics and Ecology, Department of Biological Science; (805) 893-2506; e-mail: **ferren@lifesci.lscf.ucsb.edu**.

Scott Cooper, Biological Sciences; (805) 893-4508; e-mail: **scooper@lifesci.ucsb.edu**.

Donna Moore, Natural Reserve System, c/o Marine Science Institute; (805) 893-4127; e-mail: **donnam@msi.ucsb.edu**.

UC Santa Cruz:

Margaret H. Fusari, Campus NRS Office, 272 Applied Sciences; (408) 459-4971; e-mail: **fusari@ucsco.ucsc.edu**.

Dan Costa, Biology; (408) 459-2786; e-mail: **costa@biology.ucsc.edu**.

Photo by John Smiley

The elusive smoke beetle made a special appearance at the Big Creek Gamboa fire.

Some like it hot: Smoke beetles on site!

The smoke beetle is hot stuff. Stimulated by heat and smoke, the *Melanophila* smoke beetle is attracted to fires, because this insect bores into scorched wood to lay its eggs. During the recent Gamboa Fire at the Big Creek Reserve, hundreds of smoke beetles were found crawling over hot ashes and burned stumps.

At first, fire fighters thought they were being bitten by the beetles. In fact, they were being burned by the intense heat of insects' bodies. These beetles can tolerate very high body temperatures. A couple of days after the Gamboa blaze, the insects suddenly disappeared.

Rarely encountered in nature, the smoke beetle is extremely difficult to study. It is practically impossible to predict when the elusive insects will be drawn to heat, and attempts by researchers to entice them with flames usually fail. Yet, the beetles have been known to fly in uncountable numbers to forest fires, smoldering refuse dumps, refineries, smoke stacks, power plants, and barbecues. They have even swarmed UC Berkeley's Memorial Stadium, annoying football fans during the "Big Game" with Stanford University. A 1943 issue of *California Insect Survey* (vol. 4, no. 1) explains this event that made entomological history: the beetles were attracted to the estimated 20,000 cigarettes being smoked in the stadium!

— E. P. M.

Fire Ecology *continued from page 1*

thousand feet — the distance measured out by the length of unwieldy hose the fire-fighting team carried.

"You would not believe how hard it was to get to the fire," says Arias. "Since the terrain is so rough and steep, it took us almost two hours, by truck and by foot, to cover just three miles." As they ascended the mountain, they could see Forest Service aircraft attacking the fire from above. Circling airplanes doused the blaze with fire retardant, which hampered fire fighters on the ground nearly as much as it did the flames. "The last one hundred meters of bushwhacking were really difficult and slow, because everything was wet and slippery with thick yellow liquid," recalls Arias. "I thought I was going to lose hold of my machete."

Arias had never before fought a fire, but his nervousness was extinguished once he arrived on the scene. "The fire fighters quickly took control and worked as a team," he says. "I was amazed by their professionalism. They knew exactly what to do." To keep the blaze from spreading, they went right to work, cutting down dead trees within the fire's reach. They also dug a trench around the blaze to capture burning embers as they rolled downhill. Daredevil fire-fighting specialists, called "Hot Shots," dropped in and worked feverishly to contain the flames. Using ropes, they fearlessly lowered themselves into the fire zone from Forest Service helicopters.

"It was wonderful to see how they do it," says Arias. "The fire fighters worked for three days without stopping. They even brought in lamps so they could work through the night." Within twenty-four hours, the fire team had the blaze fully contained. They spent the next two days cooling down hot spots and monitoring the fire zone. Remarkably, the fire fighters confined the blaze to just half an acre, saving the nearby weather station and, potentially, the entire reserve.

"Feynner [Arias] was the hero of the day," says UC Santa Cruz's NRS Academic Coordinator Margaret Fusari. "If he had not been there to lead the Forest Service, there is no doubt the whole place would have gone up in smoke." The fire came dangerously close to a forest of dead pines, the scorched remains of the devastating Rat Creek Fire of July 1985. That 1985 fire consumed more than 57,000 acres, including almost all of the 7,648 acres that make up the reserve and the adjacent Gamboa Point Properties. Arias believes the recent blaze, now named the Gamboa Fire, could not have been contained within reserve boundaries had the pines ignited. The neighboring Gamboa Point Properties, containing several homesteads, were most at risk.

Surprisingly, the Gamboa Fire was kindled by an electrical storm that had occurred almost a full week before the blaze actually began. During a three-day downpour, lightning struck a dead tree that was then too drenched to ignite. However, an ember managed to smolder inside the tree for several days until the bark dried out. By then, warm, dry winds had blown in from the east, fanning the flames. Back in 1985, after the Rat Creek Fire, rejuvenating vegetation had sprung up. Yet the drought years that followed had left the overgrown reserve like the inside of a tinderbox. Everything was high and dry.

Arias says he was able to pinpoint the secluded fire, because he enjoys spending most of his time getting to know the reserve in its every detail. Even during his days off, he stays on site, exploring the reserve's most remote reaches. Ultimately, his love of Big Creek, his nature savvy, and his sharp eyes saved that site.

— Elaine P. Miller
Systemwide Senior Science Writer

Photo by Larry Ford

Big Creek Reserve from Gamboa Point, where disaster was averted.

Photo by Susan Gee Rumsey

The life and slides of Feynner Arias-Godenez

The cover photograph of a lightning storm is among the many striking images Feynner Arias has shot at the Landels-Hill Big Creek Reserve. Perfecting the art of photography to educate others about nature has been his lifelong dream. He says: "Since I spent all of my money buying up the best equipment, my friends think I have sold my soul to the devil to be a photographer."

However, students visiting the reserve think Arias is more like a saint. He uses photography to capture the little things — an insect or a leaf — that might otherwise be overlooked. Arias has been invited several times to give slide shows at primary and secondary schools in Berkeley. In order to give students a broad-based understanding of natural processes, he incorporates photographs from his homeland, the rain forests of Costa Rica, into his presentations.

Arias provides many of his images to professors and researchers. Once he caught a close-up of a fence lizard eating another lizard. The photograph so astonished a UC Berkeley professor that the academic was inspired to publish a paper on this previously undocumented behavior.

This spring Arias won a staff development award from the Division of Natural Sciences at UC Santa Cruz for his outstanding work at the reserve. The award included a stipend to further his photographic work.

— Elaine P. Miller
Systemwide Senior Science Writer

Feynner Arias-Godenez, Big Creek's savvy steward, appears here with the golf cart he adapted especially for travel up and down the extremely steep terrain of this reserve.

Hopland Center offers NRS reserve users an alternative DANR resource

For more than thirty years, scientists and educators have gladly made use of NRS wildlands sites throughout California. As part of UC's Division of Agriculture and Natural Resources (DANR), the NRS invites its reserve users to investigate additional resources within DANR. One such resource is the Hopland Research and Extension Center (formerly, the Hopland Agricultural Field Station). It is located in Mendocino County, within the Russian River watershed in between the NRS's Angelo Coast Range Reserve, Bodega Marine Reserve, and McLaughlin Natural Reserve.

Since the days of European settlement, the area has been grazed by livestock, primarily sheep. In 1951, the University bought the 4,630-acre Roy L. Pratt Ranch, which became Hopland Center. Subsequent transfer of property from the U.S. Bureau of Land Management to the University in the 1960s increased the center's size to its present 5,358 acres.

Over four decades, research at the Hopland Center has focused on several areas: sheep management and biology; range improvement (with emphasis on vegetation management and soil nutrition); wildlife science (with emphasis on Colombian black-tailed deer and coyote), and entomology (with emphasis on public health and veterinary science). More than 800 publications have been based on research at the center. Currently under way are over 40 active research projects.

The diversity of soils, elevations, and plant communities makes the Hopland Center representative of many parts of the Coast Range in northwestern California. The center property ranges from approximately 500 to over 3,000 feet, with 17 recognized soil series. The four principal vegetation types (grass, woodland-grass, dense woodland, and chaparral) found there represent more than 600 species.

The Mediterranean climate at the Hopland Center is characterized by hot, dry summers and mild, rainy winters. Climatic records are maintained from five weather stations at various elevations at the center, with some records extending for more than 40 years.

Hopland also serves as an educational center, where students and the interested public can interact with researchers who come from around the world to share and obtain information. Many tours, workshops, and field days are offered.

Visiting researchers and students may stay in a modern bunkhouse, which has cooking and laundry facilities and 22 beds. Other available facilities include an all-purpose laboratory, 950-square-foot greenhouse, and 72-tank lysimeter.

For more information, contact Center Superintendent Robert M. Timm at (707) 744-1424.

NRS goes online!

The NRS has left the on-ramp and is merging onto the great Information Superhighway. Now anyone with Internet access can learn more about the NRS by linking with our home page on the World Wide Web (WWW). Our Internet address is: **www.ucop.edu/DANR/nrs/nrs.html**.

Upon linking with the NRS's full-color home page, text on the following topics — accompanied by graphics — are just a click away:

- NRS Special Announcements
[including information on grants available]
- Map and Information about NRS Reserves
- The NRS Publications Program
  - Information on NRS Publications Program
  - Currently Available NRS Publications
  - Latest Edition of NRS Transect Newsletter
- NRS GIS Projects
[geographic information system]
- Other NRS Information
  - E-mail Contacts for NRS Family
  - List of Reserves and Contacts by Campus
- Interesting Ecological Links
[links to other ecological organizations]
- Interesting California Links
[links to other California organizations]

The NRS's Web site was designed to be used with the NCSA Mosaic, Mosaic Netscape, or other WWW browser software. NCSA Mosaic is available for use with most operating systems. To get a copy, FTP (File Transfer Protocol) to **ftp.ncsa.uiuc.edu** and go to the directory **/Mosaic**. Here you will find different versions of Mosaic. When downloading these files, be sure to get "READ ME" files as well. Also, note that NCSA Mosaic, like everything else in E-World, is changing rapidly, and that some of the versions available are Alpha versions. For starters, try downloading a Beta version.

To connect to the NRS's WWW site, you'll need to enter the appropriate URL (Universal Resource Locator) address from within Mosaic or another browser, such as Netscape. For Macintosh computers, Netscape is more stable and can be accessed at: **ftp.mcom.com/Netscape/**. Within this, there are folders for Windows and Macs. At the "Open URL" prompt, give the address: **http://www.ucop.edu/DANR/nrs/nrs.html**.

In the case of some packages like Netscape, you can disregard the **http://** part of the address. From this point on, you can wander around forever inside the Web. If you have any questions about accessing NRS information through WWW, contact the NRS's Web coordinator, Eric Rainbolt, at: **eric. rainbolt@ucop.edu**.

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University of California

100% Recycled paper printed with soy-based inks
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New reserve brochure available

The reserve brochure for the Hastings Natural History Reservation, located in the Carmel Valley in Monterey County, is hot off the press. Designed for reserve users, this six-page publication contains information about the reserve's history, natural resources, facilities, and research projects, plus a full-page site map.

To receive this brochure and any of the NRS's other fine publications (or a publications list), please contact the NRS systemwide office by writing or calling: Editor, UC Natural Reserve System, 300 Lakeside Drive, 6th floor, Oakland, CA 94612-3560; (510) 987-0150. All NRS systemwide publications are sent upon request and free of charge.

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