University of California

Natural Reserve System

UC Courses Hosted by
UC Natural Reserves
Santa Cruz Island Reserve is protected, owned, and managed by The Nature Conservancy (TNC). Angelo Coast Range, Jenny Pygmy Forest, Jepson Prairie, and Emerson Oaks Reserves are protected by TNC, as is Oasis de los Osos, a satellite site of James San Jacinto Mountains Reserve. TNC is involved in the protection of Blue Oak Ranch Reserve and Landels-Hill Big Creek Reserve. Año Nuevo Island Reserve is a 25-acre portion of the 4,000-acre Año Nuevo State Reserve, which is owned and operated by California State Parks.

UC Natural Reserve System 2009

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Año Nuevo Island Reserve* 14 Fort Ord Natural Reserve
Blue Oak Ranch Reserve* 13 Hastings Natural History Reservation
Bodega Marine Reserve 9 James San Jacinto Mountains Reserve*
Box Springs Reserve 27 Jenny Pygmy Forest Reserve*
Boyd Deep Canyon 30 Jepson Prairie Reserve*
    Kendall-Frost 29
    Desert Research Center 26
Burns Piñon Ridge Reserve 26 Mission Bay Marsh Reserve
Carpinteria Salt Marsh Reserve 22 Landels-Hill Big Creek Reserve*
Chickering American River Reserve 6 McLaughlin Natural Reserve
Coal Oil Point Natural Reserve 21 Morro Rimrock Reserve
Dawson Los Monos Canyon Reserve 33 Kenneth S. Norris
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Overview

On the occasion of the twentieth anniversary of the UC Natural Reserve System (NRS), in 1985, Professor and NRS co-founder Kenneth S. Norris foresaw that

…the specific educational value of the NRS will always be unpredictable. Experience teaches us that scholars of many kinds will use the reserves. There will be botanists, geologists, entomologists, naturalists, and scientists from many other disciplines as well. Writers, photographers, and poets should also feel free to apply.

These people are going to uncover new stories of the animals and plants and the geology and soils of natural systems. We can’t know now what scientific questions might arise, but we can make sure that resources to answer those questions are available. What we are doing is opening the doors and providing the opportunities for those who will follow in our footsteps. (Natural Reserve System / The First Twenty Years. Regents of the University of California, 1985, p. 24.)

This publication presents an account of the use of NRS sites by University of California courses. Instructional use of the NRS after its second 20 years remains remarkably faithful to the Norris vision. Appendices to this report offer course titles (and descriptions), tabulated by campus (Appendix A) and by reserve (Appendix B). More detailed accounts of the experiences offered to students in ten such courses, representing a broad range of disciplines, comprise the report’s middle section.

Distribution of Courses by Discipline

In 2005-06, the most recent year for which near-complete instructional data were available, 150 University of California undergraduate courses (including one extension course) utilized NRS reserves. The extensive instructional use of NRS reserves by many other academic institutions is not documented here. We have classified UC courses into five categories: biology, physical sciences, environmental sciences, arts and humanities, and education. Below are listed the disciplines or subjects included within each of these broad categories. Where a course included material appropriate to classification within more than one category, it was placed on the basis of the area of primary emphasis in the course description. The distribution of courses among the five categories is shown in Figure 1 (right).

The biology category encompasses courses in biogeography, botany, bryology, conservation biology, ecology, entomology, evolutionary biology, general biology, herpetology, horticulture, ichthyology, invertebrate biology, limnology, marine biology, mycology, ornithology, parasitology, plant biology, plant pathology, population biology, restoration biology, taxonomy, and zoology.

The physical sciences category encompasses courses in atmospheric sciences, geology, geomorphology, introduction to physical sciences, landscape ecology, oceanography, petrology, physics, soil science, and scientific diving.

The environmental sciences category includes analysis of environmental data, environmental engineering, fundamentals and application of geographic information systems (GIS), natural resource management, and human impacts on the global environment.

The arts and humanities category is particularly broad and includes archaeology, nature and culture, geography, global sustainability, drawing and painting, and photography.

The education category was represented by courses in science education for college teachers.
Courses were taught at 29 of the 35 reserves that comprised the NRS in 2005-2006. (Blue Oak Ranch Reserve joined the NRS in 2007.) Many courses utilized two or more reserves. Figure 2 (below) shows the distribution of courses by reserve.

**Instructional Use of NRS Reserves in the Context of National Goals for Environmental Research and Education**

Since its creation by the Regents in 1965 at the request of University President Clark Kerr, the NRS has enabled the teaching of a broad range of undergraduate courses through the establishment of reserves and field stations that provided facilities and access to protected ecosystems reflective of the exceptionally rich natural diversity of the California, its mountains, deserts, grasslands, coastline, and off-shore islands. This report documents the extraordinary breadth of disciplines that utilize this unique resource. Examination of the recommendations of advisory bodies that guide the national environmental research and education effort and draw up blueprints for such activities in the twenty-first century leads us to the conclusion that the instructional and research use of the NRS has anticipated these needs and objectives by some four decades. This conclusion is evident from perusal of a guidance document provided to the National Science Foundation (NSF) in 2003 by the Advisory Committee for Environmental Research and Education (AC-ERE), established in 2000 at the recommendation of the National Science Board. The following excerpt from the AC-ERE 2003 report could easily be taken as a 1965 template intended to define the spectrum of activities that utilize NRS reserves:

**Coupled human and natural systems research seeks to understand the complex web of environmental feedbacks at diverse temporal and spatial scales. The principal questions are how the environment functions, how people use the environment, how this use changes the environment, sometimes irreversibly, and how the resultant environmental changes affect people. It involves consideration of the natural and human dimensions of environmental change, including different configurations of human social systems, political and institutional structures, and class, race, and gender relationships.**

The topic builds on, supports, and integrates many existing disciplines and tools, including geography, demography, civil and environmental engineering, sociology, population ecology, geology, economics, anthropology, ecosystem ecology, genomics, hydrology, limnology, and oceanic and atmospheric systems science. The integration of these and other tools and disciplines leads to new research questions that go beyond discipline-based inquiry.

Ecologically, California is a “state of extremes” where varied topography, temperatures, and weather patterns produce a range of ecosystems that support an incredible variety of plants and animals. Designed primarily for upper division students, this course provides firsthand experiences with a diversity of California ecosystems, from salt marshes and coastal redwoods, through vernal pools and oak woodlands, to the High Sierra.

The course consists of one evening lecture each week, followed by a half-day field trip each Friday to nearby reserves. It also features three extended weekend trips to more distant reserves. Most recently, these field trips have brought students to the McLaughlin Natural Reserve, where they focused on serpentine ecosystems; to Hastings Natural History Reservation, where they studied oak woodlands and native grasses; and to the Sagehen Creek Field Station, where they learned about the animals and plants of the High Sierra.

Postdoctoral researcher Rebecca Cheeks taught the course in 2006. “I’m new to California,” she explained, “and to teach a course about the state’s diverse ecosystems required that I take a crash course myself. Fortunately, the NRS reserve managers were more than willing to share their knowledge and experience – talking to the students, arranging lecturers, suggesting hikes and activities that allowed us to explore a large number of ecosystems. They were really key to the success of our trips and the course.” (Professor Paul Fine taught the course in 2008-09 and will teach it in subsequent academic years.)

Most of the students are juniors and seniors interested in learning about fieldwork and how ecologists collect their data. Because many are considering academic careers, Cheeks asked them to maintain field journals, review and analyze journal articles, attend seminars on campus, and present a lecture to the class. Rather than giving a final exam, she had them write a proposal related to their career goals. The results ranged from funding proposals to the National Science Foundation, to educational grant applications, to a business plan for an organic farm.

The class is a real eye-opener for most students. Cheeks mentioned their visit to Sagehen Creek Field Station as a good example: “We had an opportunity to look at mammals in their environment. Most people think these animals are gone, but we saw their tracks in the snow. And we could ask what animals are living here, how they’re living, what they’re subsisting on, and how their loss would affect the entire ecosystem.”

Cheeks was very pleased with the student response: “Three students, all graduating seniors, told me this is the best class they’ve taken at Berkeley. And even if their careers are more lab-focused, they’ll always have an understanding of the importance of fieldwork.”
Developed from the realization that we need to look for new ways to address our increasingly complex environmental and social problems, the Program in Nature and Culture (NAC) at UC Davis offers an integrated curriculum steeped in natural science, social science, arts, and humanities. NAC 180 is the capstone experience for the major, bringing students from its scientific and humanities tracks together to work on a single site. Some NRS reserves that have hosted the class are the McLaughlin Natural Reserve, a former gold mine; the Sagehen Creek Field Station, where students investigate Sierra ecosystems and the increasingly developed Truckee river watershed; and the Quail Ridge Reserve, where students study the impacts of grazing and recreation, along with water reclamation issues related to these uses.

Each course begins with a week of fieldwork at an NRS site. “This work then becomes the basis for the creative and analytical projects the students work on for the remainder of the quarter,” explains course co-teacher Virginia “Shorty” Boucher. “It sets the backdrop for looking at the world through an interdisciplinary set of glasses. You have all these layers of geologic and hydrologic history molding the biology. But, on top of that, you have an overlay of trails and roads and water diversions. It’s very difficult to look at a landscape and figure out what you’re seeing.”

As program founder and course co-teacher David Robertson explains: “The natural reserves, without exception, have really intriguing human interests. These are places where we can take students who are interested in nature, in the wild, and show them that what you see on the ground is often fundamentally, crucially determined by what humans have been doing there before they became natural reserves and, in some cases, even while they are reserves.”

Complexity is one of the key lessons from the course. “We want to show students that situations are almost hopelessly complicated,” Robertson continues, “and that you need to know a lot and understand a lot of different things. Once you do, you can actually begin to get a handle on the problem, which may not allow you to solve it completely, but will allow you to do some things that are genuinely helpful for plants, animals, and humans.”

And Boucher adds: “After taking this course, people realize that they don’t write the same papers based on the same data, and they don’t create the same artwork looking at the same landscape. Life is a creative enterprise.”
The 202-acre San Joaquin Freshwater Marsh Reserve, adjacent to the UC Irvine campus, is a small remnant of what was once a vast wetland that drained into nearby Newport Bay. Condominiums and research parks crowd its edges. The movement of water through the marsh, once determined by stream flow and tidal movements, is now more dependent on pumps and pipes. The coastal sage uplands at the marsh perimeter have been restored, often using native plants rescued from on-campus construction sites.

Yet the marsh is flourishing, both ecologically and educationally. Award-winning teacher Peter Bowler (students have selected him five times as the “Outstanding Professor in the School of Biological Sciences”) has made it the centerpiece for a number of classes, ranging from large lecture classes like Environmental Ethics, to much smaller, but no less important advanced labs and seminar programs.

“Students love to get out here and get their hands dirty,” Bowler says. “For most of my classes, visiting the marsh is a built-in component, because it’s such a wonderful opportunity to show them nature and the way we can restore nature. Reality is worth a thousand pictures.”

Bowler and his colleague Bill Bretz carefully design and maintain the marsh to serve as a living laboratory. In the older cattail wetlands, they control the seasonal flow of water to create natural soil sequences students can document, while in the restored areas, they created 11 experimental bulrush-dominated ponds with varied depths so students can study habitat selection and zonation. Each area offers a totally different habitat used by different waterfowl and other organisms.

BIO SCI E179L, Field Freshwater Ecology, offers a great example of how Bowler uses the marsh. Each quarter, 30 to 60 students opt for this upper division lab class to get valuable field experience. “The marsh allows them to go out and sample,” explains Bowler. “They can compare the restored areas of the marsh with the older sections and see how wetlands grow and develop. On this one site, they can study all stages of marsh development, from an old remnant of what was once a much larger historical wetland to the new areas we’ve created essentially from scratch.”

Our students have led mostly urban lives. They don’t have a sense of geologic place or a natural history identity. Being able to come to the marsh to write reinforces their relationship with nature. Many of them find feelings that they’ve never had before.

—Peter Bowler, UC Irvine
There’s an old saying that the best geologist is the one who has seen the most rocks. At UC Riverside, the process of transforming students into field geologists begins with Earth Sciences 100. Michael McKibben has taught the class since 1984. “Whether a student is interested in teaching, prospecting for resources, or dealing with seismic hazards,” he explains, “it’s critical that we get them out in the field to see the layout of the rocks, and faults, and landforms in three dimensions. The Granite Mountains reserve is ideal for this.”

Sweeney Granite Mountains Desert Research Center provides access to a diversity of geologic sites. “The reserve itself contains some of the deepest exposed crustal rock in the Mojave,” McKibben notes, “and a huge alluvial fan that is probably the largest geomorphic landform in the desert. Nearby, there are the basalt cinder cones in the Cima field and a thick sequence of Miocene volcanic rocks in the Van Winkle Mountains. These are spectacular deposits laid down by explosive events on the scale of Mount St. Helens. Then there are iron-ore deposits at the nearby Vulcan Mine. And for fossils, we head to a famous trilobite locale in the Marble Mountains with some of the oldest large fossils in the geologic record. Even the Kelso Dunes, which are geologically very young, get much of their sand from the Granites.”

During their time in the field, McKibben challenges the students, mostly juniors and seniors, to expand their vision. “They’ve spent a lot of time reading and in labs, studying hand specimens of rocks and minerals. But on these trips, you can throw them on a mountain range and ask them to figure out what all the rock types are, and what all the minerals are, and how this mountain got here. That’s a big step for them. It’s a step in spatial scale, and in integrating all this lab and book work that they’ve done, and applying it in the field.”

As well as giving access to rocks, the reserve also provides a base for resting and teaching. “Unlike much of the Mojave, you have the whole place to yourself, it’s inexpensive, and the Norris cabin (in an isolated section of the reserve) is great for a small class. It has room for 14 people, and a kitchen with two refrigerators and a stove. In the dining room there’s a huge table where people can eat and also lay out their books and maps. There’s even a campfire outside and the nighttime sky is spectacular. It has a lot of appeal practically and logistically, as well as philosophically and emotionally.”

Fieldwork at a place like the Granite Mountains is essential for any geology student. It prepares them to be real geologists in the real world. These students, especially if they go into mineral or oil exploration, may end up in a Third World country that’s never been studied or mapped very well. And they have to figure out what the rocks are and where the interesting rocks are that may contain resources. It’s not an easy transition to make from the lab to the field.

–Michael McKibben, UC Riverside
When Bill Mayhew came to UC Riverside in 1954 as a founding faculty member, one of the first classes he established was a field biology course that included weekend field trips. “I was trying to teach the students the habitats in which animals live and how the animals were able to develop and successfully live in those habitats,” he told an interviewer over four decades later. “I averaged about a thousand miles a semester on field trips.”

But as more and more of his key teaching sites were lost to southern California development during the fifties and sixties, Mayhew came to work with Ken Norris to establish the NRS in 1965. When Mayhew retired from teaching in 1989, his field class continued, first under Marlene Zuk and then under John Rotenberry, who continues to teach it today.

The focus remains the same. “The purpose isn’t to turn all our students into ecologists,” explains Rotenberry, “but to educate them about the natural world. Vertebrates are good tools for teaching about evolution, ecology, animal behavior and physiology. We touch on all those areas. The labs focus on identifying animals, primarily birds and secondarily lizards and other reptiles, because these are the animals students are most likely to see.”

After a few indoor lab sessions working with prepared specimens, the students begin venturing out to observe the animals in nature. “Our first trip is across campus to the botanic gardens,” Rotenberry explains. “It opens the students’ eyes. Suddenly the campus is swarming with animals they never knew were there. It’s literally a world made new.”

Each succeeding field trip ventures a little further afield. “We visit the Motte Reserve two or three times each year,” notes Rotenberry, “where staff members demonstrate mist netting and bird banding, as well as small mammal trapping. We’ll also talk to any researchers working there. But most of our time is spent learning to observe and identify animals.”

This process continues on two subsequent weekend trips. The first is to the Boyd Deep Canyon Desert Research Center and the nearby James San Jacinto Mountains Reserve. “It’s a real contrast,” explains Rotenberry. “We usually go to Boyd in the morning before it gets too hot, and then up the hill to the James, where it can be snowing.”

The final trip is to the Sweeney Granite Mountains Desert Research Center. “It’s a three-and-a-half-hour drive, but it’s worth it, because it introduces these largely urban students to a whole new world filled with toads, snakes, lizards, and birds. At first, they’re worried, but most of them grow to like it. It’s funny how a couple of good snakes can make a field trip.”

For the most part, these are urban kids, and it’s clear that many of them aren’t acquainted with the natural world. We aren’t going to turn most of them into ecologists, but they are going to vote someday and we want them to have an appreciation of the natural world so they’ll understand the implications of the decisions they’re making.

—John Rotenberry, UC Riverside

Instructor:
John Rotenberry

Reserves Used:
Boyd Deep Canyon Desert Research Center
James San Jacinto Mountains Reserve
Motte Rimrock Reserve
Sweeney Granite Mountains Desert Research Center
At the first session of each new class, Kaustuv Roy warns his students that this 6-unit course won’t be just “a day at the beach.” He explains: “I tell them, when it’s pouring rain, we’ll be out collecting. When it’s cold and miserable, we’ll be out collecting. And when we’re not collecting, we’ll spend a lot of time peering down microscopes.”

Later that day, the group meets at the Scripps Coastal Reserve near the San Diego campus, and Roy proves his opening point – by having his students wade out into waist-deep water to look at the pier pilings. A few drop out, but those who remain are committed. “It’s a great learning environment,” observes Roy. “I know each of the 20 to 25 students. They feel comfortable knocking on my door when they have a question. And the student approval ratings this year were 100 percent.”

The class meets two days each week. There’s a morning lecture from eleven to twelve o’clock; after lunch, there’s a full afternoon in the field or in the laboratory. “We start from ground level,” Roy explains. “Identifying the animals and plants, learning different sampling techniques, and then bringing everything back to the lab to do the analytical work on the computer.”

The Scripps Coastal Reserve continues to play a key role throughout the course. Its pier pilings provide a clear example of intertidal zonation, something that’s often hard to find in southern California. Another trip focuses on collecting meiofauna. “This is the really tiny stuff that lives in algae and sediment,” says Roy. “It’s a wow! moment, because this is a world none of them has ever seen, yet it accounts for most of the intertidal biomass. This year one of the students wanted to look at them live, so we brought back some seawater, put it in Petri dishes, and watched them interacting. Even I learned things from that.”

The Scripps shoreline also provides a boulder-field environment where students conduct both transect and exhaustive surveys. They then compare these to a nearby bench habitat to learn about the differences in diversity and habitat structure. “I try to make the labs practical,” Roy explains. “I tell them that, in real life, time and money are limited, so they need to find the most efficient way to collect the data they need.”

The final weeks of the course focus on human impacts — mostly trampling and illegal harvesting. For these sessions, Scripps serves as a “semi-protected site” (the rocks receive a lot of visits from students attending classes at the nearby aquarium), which students compare to other sites that are both more and less protected. “These comparisons provide perfect examples of the impacts humans are having on both community structure and the sizes of individual animals,” Roy notes. “The activity really raises their awareness.”
This innovative course resulted from a friendly conversation between a scientist and a landscape painter on the unity of science and art. As Bruce Tiffney, botanist and Dean of the College of Creative Studies at UC Santa Barbara, recalls, “[Artist] Hank Pitcher and I ended up agreeing that art and science are really about the same thing: they are about observation. The distinction was in how you record those observations.”

Inspired by this realization, Tiffney and Pitcher collaborated on a number of courses on the UCSB campus that eventually culminated in CS Art 101, Field Painting with an Artist and a Botanist on the UC Reserves. “We both appreciated the fact that we have these incredible reserves here,” Pitcher explains, “and that it would be interesting to introduce the students to these areas. Most students have never had this opportunity.”

The class usually involves about 15 students, the two professors, and a number of professional painters who work alongside the students, demonstrating their techniques and sharing their solutions to the problems involved in capturing a locale on canvas. Painting en plein air involves a number of logistical challenges, from easel maintenance, to selecting paints that won’t “seize up” too quickly, to capturing the constantly changing light, to dressing properly for a day exposed to the elements. These issues are the primary focus of the class’s first Saturday at the Coal Oil Point Reserve, where students get their equipment into shape and begin their first day of painting. The class spends the next two weekends at the Sedgwick Reserve, where the students are totally immersed in painting, from the moment they wake up to catch the sunrise to the moment they collapse into bed late that night.

While Pitcher and the other painters work with students on their techniques, Tiffney focuses on making the students aware of the natural landscape that lies before them: that the trees vary dramatically in branching, leaves, and color; that the vegetation changes with the soils; and that different geologic deposits produce differently shaped mountains. “I explain to them,” he notes, “that they don’t have to faithfully record everything that’s out there, but if they truly want to capture the sense of a place, they must capture what constitutes that place. As artists, they can alter a setting to fit their particular visions. But if this is going to be a painting somehow derived from a southern California oak woodland, they can’t paint everything like palm trees, with straight trunks and round crowns.”

At the end of the class, the students hang all of their paintings in the order in which they were created. Almost without fail, each student has dramatically improved both in painting techniques and in powers of observation. “The Sedgwick Reserve’s availability to campus is a huge asset,” notes Tiffney. “We know the people up there, they know us, and it’s a magnificent natural setting.”
Anthropology 181 is the first opportunity most UCSB students have to learn the basics of archaeological fieldwork. The class, made up largely of juniors and seniors, visits both the Sedgwick Reserve and the Santa Cruz Island Reserve to experience all phases of an archaeological investigation, from survey to excavation and formal documentation.

“We begin with an archaeological survey,” explains Professor Michael Glassow, “where we systematically locate relatively level areas of ground, where prehistoric activities could have occurred, and then look for items on the surface that would indicate that something happened there prehistorically. Most of what we have found at Sedgwick is on the upper part of the reserve,” he continues. “Chert quarries or scatters of chert flakes, where the Chumash were making and using cutting and scraping tools, are common. Some sites may just be spots where a hunter killed and butchered a deer.”

Sedgwick Reserve also provided an excavation opportunity. “Five years ago, we worked on a habitation site located on the southern margin of the property,” Glassow recalls. “This is a site where people were actually living and where they probably had houses. So we dug a series of test pits, giving the students a chance to learn how we excavate, screen, and document a site. We then brought the material back to campus where we use it as for senior’s honors and master’s theses.”

Prehistoric habitation sites are much more common and easier to identify on Santa Cruz Island Reserve. “There are probably around 3,000 sites on the island,” Glassow notes. “Thus far, researchers and classes have documented about 800, so we have a ways to go. Sites on the island are a lot easier to find because people were usually eating shellfish, which they carried as they traveled across the landscape. We find shell middens everywhere, from the interior to the coast. This is a great place to take students if we want to guarantee they’re going to find sites they can formally record so we can introduce them to that process.”

Glassow believes the class is valuable for all students, even those who don’t go into archaeology as a career: “Of course, field-class experience is fundamental for anybody who has a strong interest in pursuing archaeology. But even if they don’t have that interest, the students come to understand what archaeological fieldwork is about and gain a stronger appreciation for archaeological endeavor and how we piece together the past.”

Finding a distinctive object, maybe a stone bowl or a projectile point, something that’s been manufactured by a human being, really piques the students’ interest in archaeology.

–Michael Glassow, UC Santa Barbara
Don Croll makes clear that Biological Sciences 141 is more than a natural history class. “The course is offered by the Ecology and Evolutionary Biology department, so we're focused on doing rigorous science and learning field research techniques. Research provides a motivation for learning things fast. The students learn natural history and a lot of other skills as well.”

NRS reserves play a key role in the class's exploratory design. “I don't have a set of labs where the students will do X, Y, and Z,” he explains. “When the class begins, I don't know what the students will want to do. Logistically, it's much easier within the reserve system. If they want to do a transect or some trapping, rather than having to negotiate with a private landowner or getting a state park permit to do that, we work with the reserve managers. This allows the students much more freedom in developing their own field research projects from the ground up.”

The whole course is based on the UC reserves, because I never know what questions the students will want to explore. I don't have a standard set of labs. It's more exploration-based, and the reserves give us the flexibility to pursue whatever grabs the students' interest.

–Don Croll, UC Santa Cruz

The course includes both afternoon lectures and morning sessions dedicated to fieldwork. The lectures focus on giving the students the tools they need for their research. Seven classes, for example, focus solely on statistics. “Almost all of the students have taken statistics before,” he notes, “but they don't remember it. Now they have a motivation to learn. By the end of the quarter, I'll hear them comparing the value of different statistical methods, and it feels good because you know they didn't know any of this stuff coming into the class.”

The fieldwork begins with a morning at Younger Lagoon Reserve, right next to UCSC’s Long Marine Laboratory, where the students do some simple habitat mapping. From there, they move up the coast to the Año Nuevo Island Reserve for more elaborate correlative and mapping studies. Later in the quarter, they take a four-day trip to the Landels-Hill Big Creek Reserve in Big Sur, where they conduct behavioral studies and manipulative research projects. Each research project requires the student teams to develop a question, conduct the fieldwork, analyze the data, write up their results, and make an oral presentation.

Croll’s research-first approach obviously works. Even though the class consumes a lot of time, it’s very popular with students. “We're oversubscribed every year,” Croll notes. “We're limited to 24, but I could probably fill it up twice. And that's just with seniors. I'd actually love to include more juniors, because this class sets them up perfectly for working on their senior thesis, which they need in order to graduate.”
The course most identified with the history of the UC Natural Reserve System is UC Santa Cruz's Spring Natural History Field Quarter. Established by NRS founder Ken Norris in 1973, Field Quarter takes students on a natural history journey across the state. Though the exact itinerary changes from year to year, the trip always begins in the Mojave Desert at Sweeney Granite Mountains Desert Research Center and moves northward with stops that might include the Channel Islands at Santa Cruz Island Reserve, the Big Sur coast at Landels-Hill Big Creek Reserve, the Carmel Valley at Hastings Natural History Reservation, and the redwoods of Mendocino County at Angelo Coast Range Reserve, before ending in the Sierra Nevada mountains.

Norris’s goal was to teach students how to observe critically and see patterns in nature. His philosophy is carried on today by Steve Gliessman and Breck Tyler. As Gliessman explains: “We put students in the field for an extended time, and they’re able to disconnect from the daily pressures of life. By immersing themselves in a natural environment, they begin to slow down and take note of the environment in ways they just can’t do otherwise.”

Adds Tyler: “We start doing natural history as soon as we get up in the morning – observing, identifying, and thinking about the plants and animals around us. We continue to do natural history all day long, and we’re still doing it at ten o’clock at night. And the students think that’s great. They bring energy and curiosity to the task each day. They turn off the filters and take the time to understand what an organism is telling them.”

Where students once all piled into a battered blue school bus for their journey, conducting natural history presentations as they traveled, today’s students travel in the relative comfort of passenger vans. But even on the road, no time is wasted, as students work on their field journals, do background readings on the next habitat, or rehearse a presentation they’ll make in camp that evening.

Field Quarter has been a life-changing experience for generations of students. “People come out really motivated in lots of different ways,” explains Gliessman. “There’s a powerful part of Field Quarter that makes them all naturalists, no matter what walks of life they enter in the future. Some choose to go into it head on and become involved in conservation projects or policies. Others just carry it with them into whatever career they choose. But the course changes the way they treat nature. It’s wonderful to see. It’s one of those transformational experiences that really works.”

Every site we visit is unique and filled with interesting things to observe. These students are bright, but they have very little field experience. They’ve mostly been in classrooms, studying policy or theory. Now they get to actually do science, and every bit of success they experience really encourages them. They realize they can figure things out.

—Breck Tyler, UC Santa Cruz
Concern about climate change ranks high on the global agenda. The Earth’s growing human population, equipped with ever-more-powerful technologies, is placing huge and unsustainable demands on its natural resources. At no time in human history has there been greater need for college and university courses that bring students with a wide diversity of backgrounds and interests into contact with the natural world. Students emerge from these courses and enter the general public more aware of the urgency of the need to manage the life-support systems of the Earth in sustainable ways and more able to do so. The complex scientific, social, and political problems posed by our deepening environmental crisis require that we train large numbers of professionals who will be able to advance knowledge and to implement effective adaptive management that will minimize the increasing human impact on the planet.

In confronting this rapidly expanding need for instruction and research on the environment, the UC Natural Reserve System’s 36 reserves are a priceless resource. The NRS makes relatively undisturbed samples of California’s natural ecosystems, and the facilities to support research and teaching, available to students, teachers, and researchers. Other universities and colleges may have one or more sites for fieldwork, but none can match the size, scope, and ecological diversity of the NRS’s assemblage of sites.

While working at a reserve, students interact with researchers and staff who are expert in many different disciplines. This interaction is an important element of the field experience, one that is particularly valuable for graduate students. Most of the major challenges in the environmental sciences and management require multidisciplinary solutions. The National Research Council (NRC) report on Grand Challenges in Environmental Sciences strongly emphasizes this point:

1. biological diversity and ecosystem functioning
2. hydrologic forecasting
3. infectious disease and the environment
4. land-use dynamics
5. biogeochemical cycles
6. climate variability
7. institutions and resource use
8. reinventing the use of materials.

The conclusions of this NRC report are in broad agreement with those of numerous recent assessments by panels of experts. Guided by this report, the NSF has supported for a number of years the conceptual development and implementation of a national and global infrastructure that would gather and integrate the information needed to understand and confront the “grand challenges.” Examples of the roles of components of this infrastructure are shown in the table to the right.
One among the many positive, hoped-for outcomes from the research enabled by the various observatory networks is improved integration of water-resource management. It is estimated that human beings currently use about 55 percent of the world's renewable stores of freshwater, and, even so, a large percentage of people have no access to dependable supplies of freshwater. Another hoped-for research outcome is a more sophisticated adaptive approach to climate variability and change. Other outcomes include enhanced biodiversity conservation, sustainable land-use and management, and much greater public understanding of environmental factors affecting human health and well-being.

The distribution of field courses taught at the NRS reserves corresponds well to areas emphasized in the NRC report and in other recent studies. Examination of NRS-hosted biology courses (see Appendix A, page 20) shows the marked dominance of those focused on ecology. The NRC report highlights the central importance of ecology:

Throughout its history, the field of ecology has focused on understanding the factors that produce and control biological diversity. Success would be a substantial intellectual prize. It would represent a pinnacle of knowledge of the Earth’s living systems comparable to the goal of cosmology to discover the events and processes that determine and guide the development of the physical universe. The practical value of such understanding would appear to be inestimable.

The physical sciences are also prominently represented, with courses in climate studies, geology, and geomorphology. These courses, as well as others included under the rubric of environmental management, are directly relevant to meeting the grand challenge of hydrologic forecasting, with the ultimate objective of the ability to predict changes in freshwater resources caused by floods, droughts, sedimentation, and contamination. The match between this ensemble of courses and the vision provided in the NRC report is evident in the following quote from that report. With respect to hydrologic forecasting, the NRC report envisages:

In meeting this challenge, science would draw on new high-resolution atmospheric, surface, and subsurface data obtained as a result of rapid advances in remote sensing and geophysical technology. Multidisciplinary collaboration, field measurements and experiments, and data integration would enable the development of a new body of hydrologic science, linking traditional hydrology, geomorphology, and aquatic/riparian ecology.

At NRS reserves, many graduate students are involved in research directly relevant to addressing the “grand challenges.” For example, graduate students at the Angelo Coast Range Reserve (<http://nrs.ucop.edu/SP1-Airborne-Laser-Mapping.htm>; <http://nrs.ucop.edu/SP6-Earth-Surface.htm>; <http://nrs.ucop.edu/Keck_HydroWatch1.htm>), the Sagehen Creek Field Station (<http://nrs.ucop.edu/Keck_HydroWatch1.htm>), and the James San Jacinto Mountains Reserve (<http://nrs.ucop.edu/SP2-Embedded-Sensing.htm>) are deeply involved in multidisciplinary research that explores various aspects of the grand challenge of hydrologic forecasting.

With the exception of the above example, the foregoing discussion focused on undergraduate instruction. However, it is the graduate-student training in research that is urgently needed to prepare a large cadre of creative, skilled professionals who can staff state and federal natural resources agencies, manage the Earth observatories, provide stewardship for public lands, assure sustainable use of the planet, and, assume the critical role of mentors of future generations of scientists and teachers. The speed of climate change has taken both scientists and the general public by surprise. The needs for sophisticated adjustments to a very different future are many. In the present situation, the value of the Natural Reserve System in meeting the twin goals of multidisciplinary training and advancing knowledge in critical areas cannot be overstated.
Among academic degrees, the doctorate is the highest level conferred by the University of California. Research doctorates, awarded in recognition of academic research of a publishable standard, are earned through original research conducted by the individual PhD candidate, who documents his or her work in a dissertation. The process is arduous and can require several years of full-time work; support is typically much needed, but can be hard to come by.

A major goal of the UC Natural Reserve System is to provide settings where UC graduate students, particularly those in field sciences, can train. In addition, for more than 20 years, the NRS has awarded grants, under its Mildred E. Mathias Graduate Student Research Grant Program, to support graduate students at all UC campuses* for independent field science studies conducted at NRS reserves. These grants, initiated in 1988, not only encourage students to carry out research of their own design, but also give them experience in applying for funding, meeting deadlines, managing a budget, and mastering other, similar skills that will be expected of them as professionals — in short, growth and mastery along the same lines as their doctoral requirements.

A recent NRS systemwide follow-up on the 20+ years of Mathias winners revealed that fully half — 152 of 303 awardees — between 1988 and 2008 did in fact complete their graduate programs and receive their doctoral degrees. In many cases, their Mathias-supported projects evolved into the original research that later fulfilled their doctoral degree requirements.

Moreover, of the 108 (40 percent) of 272 Mathias grant recipients who completed graduate degrees and whose career choices could be determined, it was discovered that 51 percent became teachers, mostly at the college or university level. Another 21 percent accepted university research positions, including postdoctoral appointments. A third large group — 13 percent — found jobs with governmental agencies, both state and federal. Figure 3 (facing page) shows a breakdown of career choices made by 108 Mathias winners.

*Except UC San Francisco, which specializes in medical sciences education and training.

Mildred Esther Mathias (1906-1995), internationally recognized botanist, conservationist, and educator, is considered to have been the “founding mother” of the UC Natural Reserve System. In 1947, she joined the UCLA faculty and, in the early 1960s, worked diligently with founding fathers Ken Norris and Bill Mayhew to establish a UC reserve system. The NRS was created by the UC Regents in 1965; from June 1969 through December 1991, Mathias chaired the NRS Universitywide Faculty Advisory Committee, helping to guide the growth of the original fledging program of eight reserves.

Though Mathias retired from UCLA’s faculty in 1974, she never slackened her pace or ceased to contribute her expertise and energy to numerous organizations devoted to education, conservation, and horticulture. She was one of the greatest field instructors of all time and, in “retirement,” led over 1,000 participants on UCLA Extension tours to natural areas, gardens, and museums in more than 30 countries. Around the UCLA campus (where the botanical garden is named in her honor), she was known as “the Jungle Queen,” and, in her eighties, she had a reputation for being able to outwalk practically anyone.
When the “home” UC campuses of Mathias grant recipients were compared to the reserve sites where they chose to conduct their research, the importance of maintaining a UC reserve system quickly became apparent. Just as an instructor from one UC campus often decides to teach his or her classes at NRS reserves administered by other UC campuses, so too do Mathias winners looking for research sites often pick NRS reserves managed by UC campuses that are not their home UC campuses. It comes as no surprise that Mathias recipients have been discovered to be clearly more inclined to follow their research interests—for example, a specific species or habitat—to the locations where their subjects are available, rather than settle upon an interest for the sake of its proximity to them. The NRS reserve system is a resource shared by students from all UC campuses. (For a complete listing, by reserve or by year, of all Mathias winners and their projects, visit the NRS website at: http://nrs.ucop.edu/Mathias-Grant.htm.)

The annual Mathias grant competition is announced in September and closes in mid-October. Proposals are evaluated by an intercampus UC faculty committee, and awards are determined by mid-December. The maximum award is currently $3,000; a total of $38,000 is awarded each year. Since its inception, the Mathias grant program has given a total of $525,491 to 272 UC graduate students. With the guidance of 157 faculty advisors, these recipients have thus far conducted 386 projects at 33 NRS reserves.

Because proposals are selected for Mathias funding partly on the basis of their anticipated future contributions to the management of their chosen reserves, the program encourages synergy between the student researchers and the reserve system. NRS reserve managers, therefore, tend to welcome Mathias student researchers, because they anticipate that the knowledge and insights these graduate students will contribute will ultimately make their own jobs easier.

In recent years—2002, 2004, 2006, and 2008—recipients of the NRS’s annual Mildred E. Mathias Graduate Student Research Grants have been invited to attend the Mathias Symposium, a weekend-long event held every other year at one of the NRS’s 36 reserves. This symposium (http://nrs.ucop.edu/Mathias-Symposium.htm) is supported by the Kenneth S. Norris Endowment Fund for the California Environment, which was provided to the NRS by the David and Lucile Packard Foundation. In addition to honing their presentation skills, the graduate students are provided with an opportunity to meet and share experiences with colleagues from other UC campuses. If the range and quality of their presentations at the Mathias Seminars are any indication, the future of field research at NRS sites is in capable hands.

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**Figure 3. Eventual career choices made by 108 Mathias grant recipients who received their PhDs and whose professional paths were determined from information in public databases.**

<table>
<thead>
<tr>
<th>Career Area</th>
<th>Total (count)</th>
<th>Percent of Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Academic/Administrative Support-UC</td>
<td>2</td>
<td>2%</td>
</tr>
<tr>
<td>Governmental Agencies</td>
<td>14</td>
<td>13%</td>
</tr>
<tr>
<td>Faculty-Abroad</td>
<td>5</td>
<td>5%</td>
</tr>
<tr>
<td>Faculty-CA State Universities</td>
<td>2</td>
<td>2%</td>
</tr>
<tr>
<td>Faculty-CA State University Research (including postdoc)</td>
<td>1</td>
<td>1%</td>
</tr>
<tr>
<td>Faculty-Other CA</td>
<td>5</td>
<td>5%</td>
</tr>
<tr>
<td>Faculty-Other U.S.</td>
<td>34</td>
<td>31%</td>
</tr>
<tr>
<td>Faculty-UC</td>
<td>7</td>
<td>6%</td>
</tr>
<tr>
<td>K-12 Teacher</td>
<td>1</td>
<td>1%</td>
</tr>
<tr>
<td>Resource Management/Conservation</td>
<td>8</td>
<td>7%</td>
</tr>
<tr>
<td>Private Science/Environmental Consultant</td>
<td>3</td>
<td>3%</td>
</tr>
<tr>
<td>Pursuing Nonscience interests</td>
<td>1</td>
<td>1%</td>
</tr>
<tr>
<td>UC NRS</td>
<td>2</td>
<td>2%</td>
</tr>
<tr>
<td>University Research (including postdoc)</td>
<td>23</td>
<td>21%</td>
</tr>
<tr>
<td><strong>Total (count)</strong></td>
<td><strong>108</strong></td>
<td><strong>40% of 272 Total</strong></td>
</tr>
</tbody>
</table>

Percentage who are teaching: 51% of 272 Total Grant Recipients
Earth and Planetary Science / College of Letters and Science

**EPS 217. Fluvial Geomorphology**
Application of fluid mechanics to sediment transport and development of river morphology. Form and process in river meanders, the pool-riffle sequence, aggradation, grade, and base level.
*Reserve used: Sierra Nevada Aquatic Research Laboratory (SNARL) – Valentine Eastern Sierra Reserve*

Environmental Science, Policy, and Management / College of Natural Resources

**ESPM 100. Environmental Problem Solving**
Analysis of contrasting approaches to understanding and solving environmental and resource management problems. Case studies and hands-on problem-solving that integrate concepts, principles, and practices from physical, biological, social, and economic disciplines. Their use in environmental policies and resource and management plans.
*Reserve used: Hastings Natural History Reservation*

**ESPM 101A. Sierra Nevada Ecology**
Hands-on introduction to field ecology, exploring the structure and function of the complex Sierra Nevada ecosystem to understand how it changes in space and through time.
*Reserve used: Sagehen Creek Field Station*

**ESPM 140. General Entomology**
Biology of insects, including classification of orders and common families, morphology, physiology, behavior, and ecology.
*Reserve used: Angelo Coast Range Reserve, Stebbins Cold Canyon Reserve*

**ESPM 147. Field Entomology**
Field observation, recording, and interpretation of insect relationships to habitats, their behavior, and plant-insect interactions. Collection and preparation of specimens with important biological data.
*Reserve used: Angelo Coast Range Reserve, Hastings Natural History Reservation*

Integrative Biology / College of Letters and Science

**IB 1B. General Biology**
General introduction to plant development, form, and function. Population genetics, ecology, and evolution.
*Reserve used: Angelo Coast Range Reserve, Sweeney Granite Mountains Desert Research Center*

**IB 103. Invertebrate Biology**
An introductory survey of the biology of invertebrates, stressing comparative functional morphology, phylogeny, natural history, and aspects of physiology and development.
*Reserve used: Bodega Marine Reserve*

IB 157L. Ecosystems of California
Visits to sites representative of diverse grassland, chaparral, scrub land, forest, desert, river, marsh, and intertidal ecosystems of California. Natural history and ecological patterns, ecological issues relevant to processes and patterns exemplified at a given site, collection of quantitative data that test hypotheses about processes influencing species distributions and abundances.
*Reserves used: Bodega Marine Reserve, Hastings Natural History Reservation, Jepson Prairie Reserve, McLaughlin Natural Reserve, Sagehen Creek Field Station*

IB C158. Biology and Geomorphology of Tropical Islands
Natural history and evolutionary biology of island terrestrial and freshwater organisms, and of marine organisms in the coral reef and lagoon systems will be studied, and the geomorphology of volcanic islands, coral reefs, and reef islands will be discussed. Features of island biogeography will be illustrated with topics linked to subsequent field studies on the island of Moorea (French Polynesia).
*Reserve used: Bodega Marine Reserve*

IB 175. Herpetology
Introduction to the diversity of amphibians and reptiles worldwide, with emphasis on behavior, ecology, functional morphology, evolutionary history.
*Reserve used: Angelo Coast Range Reserve, Sweeney Granite Mountains Desert Research Center*

IB 175L. Herpetology Laboratory
Laboratories will teach students the diagnostic characteristics and some functional attributes of amphibians and reptiles on a worldwide basis. Field trips will acquaint students with techniques for collecting, preserving, identifying, and studying amphibians and reptiles.
*Reserve used: Angelo Coast Range Reserve*

IB 257A. Current Topics in Behavioral Physiology: Animal Behavior
Students will each select a related topic in the field of behavioral ecology and explore in detail the current issues of interest and point of view for further study. Oral presentation focusing on chosen topics will be presented during a weekend symposium at Hastings Reservation. Discussions include consideration of techniques, statistical analysis, theoretical basis, implications, and further directions related to the selected problem.
*Reserve used: Hastings Natural History Reservation*

Physical Education Program

**PHYS ED 47. Introduction to Scuba Diving**
Introduction of non-divers to scuba diving as a future tool for research. Topics relate to working in the marine environment, including diving physics and physiology, life-support equipment, environment, diving safety, dive planning, and emergency preparedness.
*Reserve used: Bodega Marine Reserve*
Animal Science / College of Agricultural and Environmental Sciences

AVS 16LA. Raptor Migration and Population Fluctuations
Identification of raptors. Study of effects of weather, crops, and agricultural practices on fluctuations in raptor species and numbers. 
*Reserve used: Jepson Prairie Reserve*

Art Studio Program / Art, Art History, and Technocultural Studies

ART 110. Photography I (or: Graduate Seminar in Art)
Photography as an art form. Experiments with camera and light-sensitive materials. 
*Reserve used: Sweeney Granite Mountains Desert Research Center*

Atmospheric Sciences (Land, Air, and Water Resources) / College of Agriculture and Environmental Sciences

ATM 290. Graduate Seminar
Current developments in selected areas of atmospheric research. 
*Reserve used: Sweeney Granite Mountains Desert Research Center*

Biological Sciences

BIS 1B. Introductory Biology
Introduction to evolution and animal diversity, including transmission and population genetics, micro- and macro-evolution, systematics, classification, and a survey of major animal groups. 
*Reserve used: Bodega Marine Reserve*

BIS 1C. Introductory Biology
Survey of diversity within the plant, protista, and fungi kingdoms, emphasizing flowering plant structure, function, evolution, and ecology. Ecological principles, including population dynamics, life-history patterns, community interactions and composition, ecosystems, and world biomes. 
*Reserve used: Bodega Marine Reserve*

BIS 10. General Biology
Concepts and issues in biology. Emphasis on composition and structure of organisms; regulation and signaling; heredity, evolution and the interaction and interdependence among life forms and their environments. 
*Reserve used: Stebbins Cold Canyon Reserve*

BIS 122. Population Biology and Ecology
Biological and physical processes affecting plant and animal populations in the rich array of habitats at the Bodega Marine Laboratory ecological preserve. Emphasis on field experience, with complementing lectures to address population and community processes. 
*Reserve used: Bodega Marine Reserve*

BIS 122P. Population Biology and Ecology / Advanced Laboratory
Training in scientific research, from hypothesis testing to publication, including methods of library research. Research related to topic covered in lecture/lab course. Final presentation both oral and written. 
*Reserve used: Bodega Marine Reserve*

BIS 124. Coastal Marine Research
Independent research on topics related to the accompanying core Bodega Marine Laboratory summer courses. Students will select one instructor to be primary mentor, but integrative topics that draw on the expertise of several BML faculty members will be encouraged. 
*Reserve used: Bodega Marine Reserve*

BIS 199. Special Study in Biological Sciences
An opportunity to gain practical research experience. 
*Reserve used: Bodega Marine Reserve*

Center for Population Biology

ECO/ENT/PBG 225. Terrestrial Field Ecology
A field course conducted over spring break and four weekends at Bodega Bay, emphasizing student projects. Ecological hypothesis testing, data gathering, analysis, and written and oral presentation of results. Same course as Ecology 225/Population Biology 225. 
*Reserve used: Bodega Marine Reserve*

Ecology — A Graduate Group

ECL 200A-B. Principles and Application of Ecological Theory
Critical evaluation of ecological theory and applications to ecological management. Emphasis on historical development of ecological theory. Critical evaluation of ecological principles pertaining to the structure and dynamic properties of ecological systems, their organization and evolution. 
*Reserve used: Sagehen Creek Field Station*

Principles and techniques of vegetation analysis, including structure, composition, and dynamics. Emphasis on sampling procedures, association analysis, ordination, processes and mechanisms of succession, and classification. Most techniques are demonstrated or conducted during field trips and laboratories. 
*Reserve used: Jepson Prairie Reserve, Quail Ridge Reserve, Stebbins Cold Canyon Reserve*

ECL 214. Marine Ecology: Concepts and Practice
Critical review and analysis of concepts and practices in modern marine ecology at the interface of several fields of study, including oceanography, evolution, behavior, and physiology. 
*Reserve used: Bodega Marine Reserve*

English / College of Letters and Science

NAC 180. Fieldwork in Nature and Culture
Natural scientific, social scientific, and literary/artistic approaches to the study of nature and culture in one place. Nature and culture as human constructs, conditioned by both time and place; the importance of nature in human thought, both scientific and spiritual; scientific and literary views of the relation between nature and culture, including forms of observation and methods of analysis. 
*Reserve used: McLaughlin Natural Reserve, Quail Ridge Reserve, Sagehen Creek Field Station, Sierra Nevada Aquatic Research Laboratory (SNARL) and Valentine Camp – Valentine Eastern Sierra Reserve, Stebbins Cold Canyon Reserve*

Entomology / College of Agricultural and Environmental Sciences

ENT 104. Behavioral Ecology of Insects
Basic principles and mechanisms of insect behavior and ecology. An evolutionary approach to understanding behavioral ecology of insects. 
*Reserve used: Stebbins Cold Canyon Reserve*

ENT 107. California Insect Diversity
Survey of the diversity of insects from selected ecological zones in California with emphasis on collection, identification, and natural history. 
*Reserve used: Stebbins Cold Canyon Reserve*
Environmental Science and Policy / College of Agricultural and Environmental Sciences

ERC 98. Directed Group Study
Primarily for lower division students. P/NP grading only. Prerequisite: consent of instructor. Reserve used: Quail Ridge Reserve

ESP 121. Population Ecology
Development of exponential and logistic growth models for plant and animal populations, analysis of age structure and genetic structure, analysis of competition and predator-prey systems. Emphasis on developing models and using them to make predictions and solve problems. Reserve used: Bodega Marine Reserve

ESP 123. Introduction to Field and Laboratory Methods in Ecology
Introduction to methods used for collecting ecological data in field and laboratory situations. Methods used by population ecologists and community ecologists. Emphasis on experimental design, scientific writing, and data analysis. Reserve used: Angelo Coast Range Reserve, Eagle Lake Biological Field Station, Jepson Prairie Reserve, Quail Ridge Reserve, Sedgwick Reserve, Stebbins Cold Canyon Reserve

ESP 124. Marine and Coastal Field Ecology
Study of current ecological theory and problems with emphasis on marine populations and communities. Techniques and evaluation of quantitative field research. Reserve used: Bodega Marine Reserve

ESP 125A. Terrestrial Field Ecology
Value and approaches of experimental research, using the hypothetico-deductive experimental approach. Reserve used: Bodega Marine Reserve

ESP 150A. Physical and Chemical Oceanography
Physical and chemical properties of seawater, fluid dynamics, air-sea interaction, currents, waves, tides, mixing, major oceanic geo-chemical cycles. Same course as Geology 150A. Reserve used: Bodega Marine Reserve

ESP 152. Coastal Oceanography
Oceanography of coastal waters (shelf, bay, river plume, near-shore, estuary). The focus is on transport patterns, how they are forced and what implications they have for ecological and environmental problems. The course has a West Coast bias and will use field-based learning in addition to lectures and assignments. This experience will be of interest to students in oceanography, ecology, environmental engineering, geology, and hydrology. Reserve used: Bodega Marine Reserve

Environmental Toxicology / College of Agricultural and Environmental Sciences

ET 127. Environmental Stress and Development in Marine Organisms
Study of the impact that environmental stressors, both natural (nutritional and/or toxicological) and anthropogenic, have on early life stages of marine and aquatic organisms. Emphasis on contaminants of concern in aquatic environments and effects of combined stressors on developmental success. Developmental biology in model systems and use of experimental approaches to answer basic and applied questions. Reserve used: Bodega Marine Reserve

PTX 230.4. Experimental Approaches to Problems in Coastal Toxicology
Graduate Group in Pharmacology and Toxicology. Environmental toxicology is concerned with the environmental fate and health effects of toxic chemicals and their metabolites in terrestrial, aquatic, and atmospheric environments. Research often is multidisciplinary and frequently addresses chemical fate and effects from the molecular to the population level of biological organization. (Offered jointly through the Davis, Santa Cruz, and Los Angeles campuses.) Reserve used: Bodega Marine Reserve

Evolution and Ecology / College of Biological Sciences

EVE 112. Biology of Invertebrates
Survey of invertebrate phyla, emphasizing aquatic forms and focusing on morphology, development, natural history, and phylogenetic relationships. Reserve used: Bodega Marine Reserve

EVE 114. Experimental Invertebrate Biology
Functional biology, ecology, and evolution of local marine invertebrates, with an emphasis on adaptations to physical and biological factors encountered on the California coast. The course will offer a strong field and lab component and will emphasize testing hypotheses that are generated by the class. Reserve used: Bodega Marine Reserve

EVE 115. Marine Ecology
Examination of the factors affecting distribution and abundance of plant and animal life in the sea, including both physical and biological processes at scales from individuals to entire ecosystems. Also addressed are human impacts on marine ecosystems, including fisheries exploitation, invasive species, and global climate change. Examples drawn from a variety of habitat types, including coral reefs, kelp forests, rocky shores, mud flats, estuaries, and the open ocean to introduce students to the diversity of marine organisms and ecosystems. Reserve used: Bodega Marine Reserve

EVE 211. Workshop in Applied Phylogenetics
Applications of phylogenetic methods to fields outside of systematics. Core lectures/labs in remedial phylogenetics, phylogeography, conservation, and comparative morphology. Special topics vary yearly. Reserve used: Bodega Marine Reserve
Freshman Seminar — Environmental Science and Policy / College of Agriculture and Environmental Sciences

FRS 2. Plant Ecology of the Northern California Coast Range
Introduction to plant ecology, using the Coast Range region west of Davis as an example. Field trips to some major plant communities of this region in order to observe how plant life is shaped by such factors as topography, soils, fires, and exotic species. Evolutionary adaptations of plants to climate and soils; evolutionary origins of California’s outstanding botanical diversity. Relevant conservation and management issues, such as livestock grazing, prescribed fires, exotic species control, and land-use changes.
*Reserve used: McLaughlin Natural Reserve*

Geography Graduate Group

GEO 298. Group Study
Graduate-level study group.
*Reserve used: Jepson Prairie Reserve*

Geology / College of Letters and Science

GEL 109. Earth History: Sediments and Strata
Principles of stratigraphic and sedimentologic analysis. Evaluation of historical and modern global changes in sedimentation within terrestrial and marine environments. Examination of the plate tectonic, climatic, and oceanographic factors controlling the distribution and exploitation of economic fluids within sedimentary rocks.
*Reserve used: Bodega Marine Reserve*

Land, Air, and Water Resources / College of Agricultural and Environmental Sciences

SSC 105. Field Studies of Soil Resources in California Ecosystems
Field-based studies of soils in California ecosystems, away from campus, with travel throughout much of California. Emphasis on description and classification of soils; relationships among soils, vegetation, geology, and climate; physical, chemical, and biological processes active in soils and landscapes; and the role of soils in land use. The course is approximately three weeks in length each summer, and alternates annually between northern and southern California.
*Reserve used: Eagle Lake Biological Field Station, Jepson Prairie Reserve, Sedgwick Reserve*

Landscape Architecture Program

LDA 50. Site Ecology
Introduction to ecological concepts, including nutrient dynamics, population regulation, community structure, ecosystem function. Principles applied to human activities, such as biological conservation, ecological restoration, landscape planning, and management.
*Reserve used: Jepson Prairie Reserve*

Neurobiology, Physiology, and Behavior / College of Biological Sciences

NPB 141. Physiological Adaptation of Marine Organisms
Introduction to principles of and research on biophysical and biochemical adaptations to the environment. Students gain familiarity with instrumentation used in this area of research by carrying out formal experiments, using local marine organisms.
*Reserve used: Bodega Marine Reserve*

NPB 141P. Physiological Adaptation of Marine Organisms / Advanced Laboratory Topics
Scientific research from hypothesis to publication, including training in methods of laboratory research. Research related to topics covered in NPB 141. Physiological Adaptation of Marine Organisms.
*Reserve used: Bodega Marine Reserve*

Physical Education / College of Letters and Science

PE 29. Basic Scuba
Introduction to basic knowledge required for scuba diving, function and maintenance of equipment, physics and physiology of diving, diver first-aid and CPR, oceanography and marine life, and underwater communication.
*Reserve used: Bodega Marine Reserve*

PE 128A-B. Research Diving Techniques
Diver safety, rescue, accident management, and patient care. Search and light salvage, night diving, research techniques, cold-water, low-visibility diving, blue water, deep and altitude diving.
*Reserve used: Bodega Marine Reserve*

Plant Biology / College of Agriculture and Environmental Sciences

PLB 102. California Floristics
Survey of California flora, with emphasis on field recognition and identification of important vascular plant families and genera characterizing the major floristic regions. Taxonomic diversity, evolutionary relationships, and geographical patterns.
*Reserve used: Stebbins Cold Canyon Reserve*

PLB 117. Plant Pathology
Study of the interactions between plants, plant populations or vegetation types, and their physical and biological environment. Special emphasis on California. Four full-day field trips and brief write-up of class project required.
*Reserve used: Jepson Prairie Reserve*

PLB 118. Introductory Phycology and Bryology
Comparative morphology, physiology, development and reproduction of cyanobacteria, major algal groups, bryophytes. Focus on structure-function and evolutionary relationships. Ecological factors and commercial uses considered.
*Reserve used: Stebbins Cold Canyon Reserve*

PLB 145. Sierra Nevada Flora
Introduction to the flora of the Sierra Nevada. Basic plant identification, the principal plant communities and species of the Sierra Nevada.
*Reserve used: Sagehen Creek Field Station*

PLB 147. Survey of Plant Communities of California
Analysis of selected plant communities for structure and relationship of their component species to the environment.
*Reserve used: Jepson Prairie Reserve*

Plant Biology — A Graduate Group

PBI 224. Water in Physiology and Ecology of Plants
*Reserve used: Stebbins Cold Canyon Reserve*
Plant Pathology / College of Agricultural and Environmental Sciences

PLP 135. Field Identification of Mushrooms

PLP 224. Advanced Mycology
Systematics, evolution, and ecology of the fungi. Topics include modern techniques and theories on classification of fungi, species concepts, sexual compatibility and vegetative compatibility. Laboratories emphasize various approaches to fungal identification. Offered in alternate years. Reserve used: Stebbins Cold Canyon Reserve

Population Biology — A Graduate Group

PBG 298. Monte Carlo Seminar
Seminars sponsored by the Center for Population Biology and Population Biology Graduate Group. Participation required of all students in the Population Biology graduate program. Reserve used: McLaughlin Natural Reserve

Teaching Resources Center

EDU 398. Seminar on College Teaching
Quarterly course in college teaching for graduate students, offered during this cycle experimentally as a retreat. Reserve used: Sagehen Creek Field Station

Wildlife, Fish, and Conservation Biology / College of Agricultural and Environmental Sciences

WFC 10. Wildlife Ecology and Conservation
Introduction to the ecology and conservation of vertebrates. Complexity and severity of world problems in conserving biological diversity. Reserve used: Quail Ridge Reserve, Stebbins Cold Canyon Reserve

WFC 100. Field Methods in Wildlife, Fish, and Conservation Biology
Introduction to field methods for monitoring and studying wild vertebrates and their habitats, with emphasis on ecology and conservation. Reserve used: McLaughlin Natural Reserve, Quail Ridge Reserve, Stebbins Cold Canyon Reserve

WFC 102. Field Studies in Fish Biology
Emphasis on theory of quantitative fish capture methods and design of individual research projects on ecology, behavior, physiology, or population biology of fishes. Reserve used: Bodega Marine Reserve

WFC 102L. Field Studies in Fish Biology: Laboratory
Field investigations of fish biology, including quantitative capture methods and individual research projects on ecology, behavior, physiology, or population biology of fishes at field site in relation to their habitats. Reserve used: Bodega Marine Reserve

WFC 110L. Laboratory in Biology and Conservation of Wild Mammals
Morphology, systematics, species identification, anatomy, and adaptations of wild mammals to different habitats. Reserve used: McLaughlin Natural Reserve, Quail Ridge Reserve

WFC 111. Biology and Conservation of Wild Birds
Phylogeny, distribution, migration, reproduction, population dynamics, behavior, and physiological ecology of wild birds. Emphasis on adaptations to environments, species interactions, management, and conservation. Reserve used: Quail Ridge Reserve

WFC 111L. Laboratory in Biology and Conservation of Wild Birds
Bird species identification, anatomy, molt, age and sex, specialized adaptations, behavior, research, with emphasis on conservation of wild birds. Reserve used: Quail Ridge Reserve

WFC 120. Biology and Conservation of Fishes
Evolution, ecology, conservation of marine and freshwater fishes. Reserve used: Bodega Marine Reserve

WFC 155. Habitat Conservation and Restoration
Analysis of characteristics of wildlife and fish habitats. Conservation of habitats, and restoration. Reserve used: Jepson Prairie Reserve, Stebbins Cold Canyon Reserve

WFC 156. Plant Geography
Survey of the geographical distribution of vegetation types and habitats, with consideration of the environmental and historical factors that determine these patterns. Conservation and management approaches. Analytical field and lab techniques introduced. Reserve used: Jepson Prairie Reserve

UC IRVINE

Earth System Science / School of Physical Sciences

ESS 114. Earth System Science Laboratory and Field Methods
Introduction to methods used to measure exchange of gases and energy between the atmosphere and terrestrial ecosystems. Data acquisition and isotopic and chromatographic analysis. Field measurements include microclimate, hydrology, trace-gas exchange, and plant growth. Reserve used: Burns Piñon Ridge Reserve, San Joaquin Freshwater Marsh Reserve

ESS 134. Fundamentals of GIS for Environmental Sciences
Introduction to Geographic Information Systems (GIS). Topics include fundamentals of cartography, creating/editing GIS data, linking spatial and tabular data, geo-referencing, map projections, geo-spatial analysis, spatial statistics, and the development of GIS models. Examples from hydrology, ecology, and geology. Reserve used: San Joaquin Freshwater Marsh Reserve

ESS 218. Terrestrial and Marine Ecology
A mechanistic perspective of the structure and functioning of terrestrial and marine ecosystems. Includes the processes that control plant growth and community structure, nutrient cycling, and role of ecosystem dynamics in local and global biogeochemical cycling. Reserve used: Burns Piñon Ridge Reserve, James San Jacinto Mountains Reserve, San Joaquin Freshwater Marsh Reserve

Ecology and Evolutionary Biology / School of Biological Sciences

BIO SCI 2A-B. Freshman Seminar: Desert Ecosystems
Faculty presentations and readings focused on structure, function, opportunities, and current issues in biological sciences. Introduction to a diversity of desert habitats. Reserve used: Burns Piñon Ridge Reserve

BIO SCI 9E. Horticultural Science
Scientific principles of horticulture. Taxonomy, plant-life history strategies; experiments with seed dormancy; morphological
adaptations for specialized sexual and clonal reproduction; basics of plant propagation and ecological restoration.

**Reserve used:** San Joaquin Freshwater Marsh Reserve

**BIO SCI 9K. Global-Change Biology**
Addresses ways in which humans are altering the global environment, with consequences for the ecology of animals, plants, and microbes. Discussion on how these biologically oriented questions relate to human society, politics, and the economy. Same as Earth System Science 13.

**Reserve used:** Burns Piñon Ridge Reserve, San Joaquin Freshwater Marsh Reserve

**BIO SCI E107. Seminar in Ecology and Evolutionary Biology**
Invited speakers, graduate students, and faculty present current research in ecology and evolutionary biology. Open only to upper-division Ecology and Evolutionary Biology majors. Concurrent with Ecology and Evolutionary Biology 201. Formerly, Biological Sciences 165A.

**Reserve used:** Burns Piñon Ridge Reserve

**BIO SCI E150. Conservation Biology**
Examines current trends in deforestation, environmental degradation, natural and induced extinctions, principles of preserve design and management, legislation, conservation genetics, and *ex situ* methods of conservation. Formerly, Biological Sciences 150.

**Reserve used:** Burns Piñon Ridge Reserve

**BIO SCI 166L. Field Methods in Ecology**
Field studies of major concepts in plant and animal ecology, with emphasis on experimental design, field sampling methods, statistical analysis, and scientific writing. An independent project and one weekend camping trip are required.

**Reserve used:** Burns Piñon Ridge Reserve

**BIO SCI 175. Restoration Ecology**

**Reserve used:** San Joaquin Freshwater Marsh Reserve

**BIO SCI 179. Limnology and Freshwater Biology**
Biology of freshwater environments (lakes, ponds, rivers), their biota, and factors that influence distribution of organisms.

**Reserve used:** San Joaquin Freshwater Marsh Reserve

Highlighted course, page 8:

**BIO SCI E179L. Field Freshwater Ecology** (formerly Limnology and Freshwater Biology Laboratory)
Analytical techniques for common water-quality variables of lakes, streams, rivers. Benthic fauna, vertebrates and invertebrates, algae, and aquatic plants. Emphasis on field methods with an experimental approach.

**Reserve used:** San Joaquin Freshwater Marsh Reserve

**BIO SCI E182. Mediterranean Ecosystems: Biodiversity and Conservation**
Biodiversity, history of human impacts, and conservation efforts are examined in the five Mediterranean-type ecosystems. The extent of remaining natural habitat, approaches to ecological habitat restoration, control of exotic species, and predicted consequences of global climate change are described.

**Reserve used:** San Joaquin Freshwater Marsh Reserve

**BIO SCI 184. Entomology**
Central features of the Insecta reviewed in an evolutionary and ecological context. Topics include external and internal morphology, systematic relationships among insect orders, insects in ecological communities, and impacts of agricultural and medical pests.

**Reserve used:** San Joaquin Freshwater Marsh Reserve

**BIO SCI 189. Environmental Ethics**
History of evolution of environmental ethics in America. Management problems in national parks, wilderness areas, wild and scenic rivers, national forests. Contemporary and historical aspects/contributors to the field. Mitigation, endangered species, habitat restoration, biodiversity, and environmental activism.

**Reserve used:** San Joaquin Freshwater Marsh Reserve

**BIO SCI E190. Conservation, Ecology, and Evolutionary Biology**
Studies in selected areas of ecology and evolutionary biology.

**Reserve used:** Burns Piñon Ridge Reserve, San Joaquin Freshwater Marsh Reserve

**BIO SCI 191A-B. Senior Seminar on Global Sustainability I, II**
Current issues in global sustainability.

**Reserve used:** Burns Piñon Ridge Reserve, San Joaquin Freshwater Marsh Reserve

**BIO SCI 199. Independent Study in Biological Sciences Research: Wetland Ecology**
Individual experimental laboratory or field research under a professor's direction (1 to 5 units per quarter).

**Reserve used:** Burns Piñon Ridge Reserve, San Joaquin Freshwater Marsh Reserve

**BIO SCI 199. Independent Study in Biological Sciences Research: Restoration Ecology**
Individual experimental laboratory or field research under a professor's direction (1 to 5 units per quarter).

**Reserve used:** Burns Piñon Ridge Reserve, San Joaquin Freshwater Marsh Reserve

**BIO SCI PE221. Topics in Plant Ecology**
Weekly discussion of current topics in plant population biology and ecology.

**Reserve used:** Burns Piñon Ridge Reserve

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**UC LOS ANGELES**

**Civil and Environmental Engineering**

**CEE 194. Hydrology**
Field course seminar designed for undergraduates who are part of research group. Discussion of research methods and current literature in field or of research of faculty members or students.

**Reserve used:** Sagehen Creek Field Station

**Earth and Space Sciences**

**ESS 103A. Igneous Petrology**
Mineralogy, chemical composition, and field occurrence of igneous rocks with reference to their origin by melting in earth. Introduction to thermodynamics as applied to petrology. Formation of magma, its movement, eruption, crystallization, and chemical evolution. Petrologic structure of crust and mantle and its relation to seismology. Overview of petrological and chemical evolution of Earth, moon, and other planets from their origin to the present.

**Reserve used:** Sierra Nevada Aquatic Research Laboratory (SNARL) – Valentine Eastern Sierra Reserve

**Ecology and Evolutionary Biology**

**OBEE 106. Experimental Marine Invertebrate Biology**
Advanced course of natural history, physiology, biochemistry of invertebrates, with emphasis on independent laboratory and
field investigations. Presented as part of UCLA’s Marine Biology Quarter, a field program planned to give advanced undergraduates an opportunity to gain intimate and firsthand knowledge of marine communities, their constituents and their structure. Formerly, Invertebrate Zoology. Reserve used: Bodega Marine Reserve, Kenneth S. Norris Ranchero Marino Reserve

OBEE 114B. Field Ornithology
Biological, particularly ecology and behavior, of birds in their natural habitat. Reserve used: Stunt Ranch Santa Monica Mountains Reserve

OBEE 122. Ecology
Introduction to population and community ecology, with emphasis on growth and distributions of populations, interactions between species, and structure, dynamics, and functions of communities and ecosystems. Designed for departmental majors specializing in environmental and population biology. Reserve used: Stunt Ranch Santa Monica Mountains Reserve

OBEE 123. Marine Ecology
Survey of current topics in marine ecology, including analysis of primary research literature combined with field study of ecology of marine organisms, populations, communities, and ecosystems. Original research project required. Presented as part of UCLA’s Marine Biology Quarter, a field program planned to give advanced undergraduates an opportunity to gain intimate and firsthand knowledge of marine communities, their constituents and their structure. Reserve used: Bodega Marine Reserve

OBEE 124. Field Ecology: Island Biogeography
Field and laboratory research in ecology; collection, analysis, and write-up of numerical data, with emphasis on design and execution of field studies. Concepts, models, patterns, and consequences to biology in terms of ecological and evolutionary shifts on islands. Reserve sites used to illustrate plant distribution on rock habitat islands. Reserve used: Burns Piton Ridge Reserve, Santa Cruz Island Reserve

OBEE 128. Plant Physiological Ecology
Study of plant/environment interactions under natural conditions. Transpiration and photosynthesis, leaf temperatures, and water movement in soil/plant/atmosphere continuum. Reserve used: Boyd Deep Canyon Desert Research Center

OBEE 132. Field Behavioral Ecology
Field research in behavioral ecology, emphasizing animal communication. Design and execution of individual and small-group field projects during extended field trip. Offered only as part of Field Biology Quarter. Reserve used: Sierra Nevada Aquatic Research Laboratory (SNARL) – Valentine Eastern Sierra Reserve, Sweeney Granite Mountains Desert Research Center

OBEE 134B. Field Physiological Ecology of Desert Animals (Field Biology Quarter)
Two weeks of off-campus research projects with two-week lecture course (four hours per day) and offered only as part of Field Biology Quarter. Consideration of physiological, behavioral, morphological, and ecological mechanisms desert animals use to enhance their survival in an arid habitat. Students carry out supervised research projects, then write up and orally present their results in seminar fashion. Reserve used: Sweeney Granite Mountains Desert Research Center

OBEE 154. California Ecosystems
Introduction to structure, biodiversity, and dynamics of California ecosystems, with focus on southern California, and impact of human activities on these systems. Reserve used: Stunt Ranch Santa Monica Mountains Reserve

OBEE 164. Field Biology of Marine Fishes
Selected aspects of natural history, ecology, and behavior of the diverse assemblage of local marine fishes. Fieldwork strongly emphasized. Presented as part of UCLA’s Marine Biology Quarter, a field program planned to give advanced undergraduates an opportunity to gain intimate and firsthand knowledge of marine communities, their constituents, and their structure. Reserve used: Bodega Marine Reserve

OBEE 165. Ecological Physiology of Marine Vertebrates
Introduction to physiological adaptations of marine vertebrates to major physicochemical variables in the oceans of the world and to major marine habitats. Presented as part of UCLA’s Marine Biology Quarter, a field program planned to give advanced undergraduates an opportunity to gain intimate and firsthand knowledge of marine communities, their constituents, and their structure. Reserve used: Bodega Marine Reserve

OBEE 265. Special Topics in Plant Ecology: Mediterranean-Climate Ecosystems
Graduate student seminar. Reserve used: Stunt Ranch Santa Monica Mountains Reserve

General Education Cluster

GE CLST M1A. The Global Environment
Course focuses on the conflict between human activities and the environmental protection and restoration essential to the long-term well-being of Earth’s human population. Reserve used: Stunt Ranch Santa Monica Mountains Reserve

GE Env 1. The Global Environment: A Multidisciplinary Perspective
This cluster addresses one of the most pressing social issues our time: relations between the world’s rapidly growing human population and the global environment that makes human existence possible. Faculty and students examine the many interactions between the environment and humankind; the worldwide environmental degradation currently being wrought by human activities, and the environmental protection and restoration essential to the long-term well-being of Earth’s human population. Reserve used: Santa Cruz Island Reserve

GE 70CW. (Earth and Space Sciences) Life in the Cosmos Seminar
Interdisciplinary, year-long introduction to life and physical sciences. Examination of issues surrounding such questions as: what are the prospects of life elsewhere in the universe? how do we search for evidence of this life? Major topics include: the “Drake equation” and prospects for extraterrestrial intelligence; the origin and evolution of life in the extraterrestrial context; life in the solar system; searching for other planetary systems; and SETI — the Search for Extra-Terrestrial Intelligence. Reserve used: Landels-Hill Big Creek Reserve

Geography

GEOG 100. Principles of Geomorphology
Study of processes that shape the world’s landforms, with emphasis on weathering, mass movement and fluvial erosion, transport, deposition, energy and material transfers, space and time considerations. Reserve used: Stunt Ranch Santa Monica Mountains Reserve
GEOG 100A. Principles of Geomorphology: Field and Laboratory
Investigations of weathering, mass movement, fluvial erosion, transport, deposition, related geomorphic phenomena.
*Reserve used:* Stunt Ranch Santa Monica Mountains Reserve

GEOG 101. Coastal Geomorphology
Study of the origins and development of coastal landforms, emphasizing past and present changes, hydrodynamic processes, sediment transfers, and such features as beaches, estuaries, lagoons, deltas, wetlands, dunes, seacliffs, and coral reefs, together with coastal zone management.
*Reserve used:* Stunt Ranch Santa Monica Mountains Reserve

GEOG 101A. Coastal Geomorphology: Field and Laboratory
Investigations of coastal landforms, emphasizing past and present changes, hydrodynamic processes, sediment transfers, and such features as beaches, estuaries, lagoons, deltas, wetlands, dunes, and seacliffs, together with coastal zone management.
*Reserve used:* Stunt Ranch Santa Monica Mountains Reserve

GEOG 159D. Problems in Geography
Physical geography seminar course in which students carry out intensive research projects developed from courses within a concentration.
*Reserve used:* Sierra Nevada Aquatic Research Laboratory (SNARL) – Valentine Eastern Sierra Reserve

GEOG 163. Field Analysis in Biogeography
Examination of field procedures and intellectual concepts used in observation, measurement, analysis, and interpretation of phenomena pertinent to biogeography and interrelated human influences.
*Reserve used:* James San Jacinto Mountains Reserve, Santa Cruz Island Reserve, (2005-06) Sierra Nevada Aquatic Research Laboratory (SNARL) – Valentine Eastern Sierra Reserve

Physics and Astronomy

ASTRONOMY 3. (Nature of the Universe:)
Astronomical Observation
Development of ideas in astronomy and what has been learned of the nature of the universe.
*Reserve used:* Stunt Ranch Santa Monica Mountains Reserve

UC MERCED

Biology / School of Natural Sciences

BIS 90X. Freshman Seminar: Marine Biology
Examination of a topic in the biological sciences.
*Reserve used:* Bodega Marine Reserve

UC RIVERSIDE

Biology

Highlighted course, page 10:

BIOL 163. Evolutionary Ecology of Terrestrial Vertebrates
*Reserve used:* Boyd Deep Canyon Desert Research Center, James San Jacinto Mountains Reserve, Motte Rimrock Reserve, Sweeney Granite Mountains Desert Research Center

BIOL 166. Conservation Ecology
Introduction to ecological concepts and strategies for conserving biodiversity. Genetics and evolution in small populations, community assembly, landscape structure, ecosystem processes, human impacts, and global change.
*Reserve used:* James San Jacinto Mountains Reserve

Botany and Plant Sciences

BPSC 31. Spring Wildflowers
General approach to the study of vegetative and floral features of plants as a means of identification and botanical classification of major plant families in southern California. Secondary emphasis on the field biology of flowering plants.
*Reserve used:* Emerson Oaks Reserve, James San Jacinto Mountains Reserve

BPSC 133. Taxonomy of Flowering Plants
Introduces the principles and methods of identifying, naming, and classifying flowering plants. Surveys selected flowering plant families in California and shows their interrelationships.
*Reserve used:* Emerson Oaks Reserve

BPSC 146. Plant Ecology
Study of fundamentals of plant ecology, emphasizing community ecology, environment, life histories, population dynamics, species interactions, succession, disturbance, and special topics in applied ecology.
*Reserve used:* James San Jacinto Mountains Reserve

Earth Sciences

Highlighted course, page 9:

GEO 100. Introductory Petrology
Introduction to the nomenclature and classification of igneous and sedimentary rocks and their metamorphosed equivalents. Identification of the major rock-forming minerals and common rocks in hand samples and thin sections, and interpretation of rock fabrics and textures. Exploration of tectonic setting and the origins of major rock types.
*Reserve used:* Sweeney Granite Mountains Desert Research Center

Environmental Sciences

(In 2003-04, a new joint program with CA State University at Fresno.)

ENSC 176. Acquisition and Analysis of Environmental Data
General principles of environmental sampling. Sampling and analysis of air, water, and soil, hydrologic and limnological measurements, and biological characterization of soils and surface waters. Also, principles and use of geographic positioning systems (GPS), basic surveying and cartographic techniques for site characterization, and interpretation and presentation of field and laboratory data using computer software.
*Reserve used:* Sierra Nevada Aquatic Research Laboratory (SNARL) – Valentine Eastern Sierra Reserve

Extension

X 406. A Field Study of Birds
Spring birds during the spring migration and in their breeding territories. Emphasis on identification of breeding plumages in field and museum. Field trips include Mystic Lake, Imperial Beach, Salton Sea, Imperial Valley, Morongo Valley, High Desert, and San Jacinto Mountains.
*Reserve used:* James San Jacinto Mountains Reserve
**UC SAN DIEGO**

**Ecology, Behavior, and Evolution / Division of Biological Sciences**

**BIEB 102. Introductory Ecology – Organisms and Habitat**
General principles in ecology and conservation that shape organisms, habitats, and ecosystems, with emphasis on the unique organisms and habitats of California. Topics include population regulation, physiological ecology, competition, predation, and human exploitation.
*Reserve used: Scripps Coastal Reserve*

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**Scripps Institution of Oceanography**

**SIO 10. The Earth**
Introduction to geology. Concepts of Earth structure and the processes that formed it and continue to modify it. Emphasis on material that every educated citizen should know for appreciation and enjoyment of the world, for understanding geological events as reported in the news, and for participating in making intelligent decisions regarding the future of the environment.
*Reserve used: Scripps Coastal Reserve*

**SIO 15. Natural Disasters**
Introduction to environmental perils and their impact on everyday life. Exploration of geological and meteorological processes, including earthquakes, volcanic activity, large storms, global climate change, mass extinctions throughout Earth's history, and human activity that causes and prevents natural disasters.
*Reserve used: Scripps Coastal Reserve*

**SIO 87. Freshman Seminar: The Physics of Surfing**
Program designed to provide new students with the opportunity to explore an intellectual topic with a faculty member in a small setting. Topics vary from quarter to quarter. Enrollment is limited to fifteen to twenty students, with preference given to entering freshmen. (The 2005-06 class blended coursework in physics with hands-on experiments. Students learned how waves form, how they travel through the world's oceans, and that surfboards follow the laws of fluid mechanics. Then they got to go to the beach and see how physics works in the real world.)
*Reserve used: Scripps Coastal Reserve*

**SIO 100. Introduction to Field Methods**
Mapping and interpretation of geologic units. Fieldwork done locally; data analyzed in laboratory.
*Reserve used: Scripps Coastal Reserve*

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**SIO 295L. Introduction to Marine Biodiversity and Conservation**
Laboratory work on major biological taxa, field trips on biodiversity *in situ*, computer labs for informatic tools.
(Corequisite SIO 295 offers lectures on ecological, economic, social, and legal issues related to marine biodiversity and case studies on socioeconomic and legal issues.)
*Reserve used: Kendall-Frost Mission Bay Marsh Reserve*

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**Physics**

**2BL. Physics Laboratory: Mechanics and Electrostatics**
Experiments include gravitational force, linear and rotational motion, conservation of energy and momentum, collisions, oscillations and springs, gyroscopes. Experiments on electrostatics involve charge, electric field, potential, and capacitance. Data reduction and error analysis are required for written laboratory reports.
*Reserve used: Scripps Coastal Reserve*

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**Anthropology**

**ANTH 162. Prehistoric Food Production**
History of the process of plant and animal domestication in the Americas, the Near East, Asia, and Africa. Focus on the specific biological changes in the major domesticates, as well as associated social changes in human life.
*Reserve used: Sedgwick Reserve*

**Bren School of Environmental Science and Management**

**ESM 201. Ecology of Managed Ecosystems**
(formerly Ecological Principles)
Principles of individual ecology, population ecology, community ecology, and ecosystem ecology. Emphasis on applications — conservation, resource management, ecological effects of pollution and habitat fragmentation.
*Reserve used: Sedgwick Reserve*

**ESM 212. Biological Community Survey and Analysis**
Design and execution of field sampling campaigns to characterize, map, and inventory plant and animal communities. Includes review of basic sampling theory, measurements for terrestrial vegetation, vertebrate and invertebrate survey methods, multivariate analysis of community data, vegetation and species habitat mapping and modeling.
*Reserve used: Sedgwick Reserve*

**ESM 215. Landscape Ecology**
Relationships between spatial patterns in landscape structure (physical, biological, and cultural) and ecological processes. Role of ecosystem pattern in mass and energy transfers, disturbance regimes, and species’ persistence, and applications of remote sensing and GIS for landscape characterization and modeling.
*Reserve used: Sedgwick Reserve*

**ESM 235. Watershed Analysis**
Hydrologic and geomorphic basis of environmental management problems concerning land surfaces and channels in small drainage basins, including effects of land use and engineering. Emphasis on use of theory and field methods.
*Reserve used: Sedgwick Reserve*

**ESM 236. The Mountain Snowpack**
Intensive field, laboratory, and classroom study of physical processes in the mountain snowpack. Snow accumulation and ablation, metamorphism, physical and chemical properties, and remote sensing. Role of snow in watershed hydrology, water resources and recreation. Normally offered spring break.
Appendix A • 29

UC COURSES Hosted by NRS Reserves • Presented by Campus

**College of Creative Studies**

**Highlighted course, page 12:**

**Art CS 101. Landscape Painting with an Artist and a Naturalist**

Art and science both require careful observation and understanding of what is being observed in order to yield good results. In this class, an artist and a botanist/geologist help students to examine the natural landscape with eye and brush. Demonstrations and brief lectures focus upon the biological, geological, and artistic aspects of two of UCSB's great natural reserves.

**Reserves used:** Coal Oil Point Natural Reserve, Sedgwick Reserve

**Biology CS 101. Models and Experiments**

Interplay between models and experimentation in the development of an understanding of the principles of biology. “Conducting Experiments in Ecology” (winter/spring quarters). Students visit terrestrial and aquatic habitats to make observations and to conduct experiments. They learn how to design and carry out studies in field ecology, by learning to identify patterns in nature, how to ask questions and develop hypotheses, how to collect and analyze data, and how to use library resources. “Walking Biology” (spring quarter): Field course designed to introduce non-biologists (and biology freshmen) to the region's diverse “wild” natural habitats. Students observe patterns, learn about natural history, and discuss ecological and evolutionary questions.

**Reserve used:** Sedgwick Reserve

**Earth Science**

**GEOL 118. Summer Field Geology**

Mapping field course for undergrads. Intensive hands-on training in the collection, interpretation, and presentation of geologic field data. Preparation of geologic maps, sections, and a professional report as tools to understanding geologic processes. Area and focus of investigation changes each year.

**Reserve used:** Sierra Nevada Aquatic Research Laboratory (SNARL) – Valentine Eastern Sierra Reserve

**Ecology, Evolution, and Marine Biology**

**EEMB 106. Biology of Fishes**

Evolution, systematics, biogeography, and ecology of fishes.

**Reserve used:** Kenneth S. Norris Rancho Marino Reserve

**EEMB 112. Invertebrate Zoology**

Introduction to the classification, structure, life histories, and habits of the major phyla of invertebrate animals (excluding annelids and arthropods), with emphasis on the marine fauna of the Santa Barbara area.

**Reserve Used:** Coal Oil Point Natural Reserve, Kenneth S. Norris Rancho Marino Reserve

**EEMB 113L. Ecology and Evolution of Terrestrial Vertebrates: Laboratory and Fieldwork in Vertebrate Biology**

Introduction to such techniques as trapping and banding to study vertebrates in the field. Weekly field trips to numerous locations and laboratory work emphasizing classification, identification, and observation of local terrestrial vertebrates. Concurrent enrollment required in EEMB 113: Evolution and Ecology of Terrestrial Vertebrates.

**Reserve Used:** Carpinteria Salt Marsh Reserve, Coal Oil Point Natural Reserve

**EEMB 116. Invertebrate Zoology: Higher Invertebrates**

Introduction to classification, structure, life histories, and habits of annelids and arthropods, with emphasis on aquatic fauna of the Santa Barbara area.

**Reserve used:** Coal Oil Point Natural Reserve, Kenneth S. Norris Rancho Marino Reserve

**EEMB 120A-120L. Field and Laboratory Studies in Ecology**

Practical studies in ecology in both field and laboratory. Individual projects emphasized. Concurrent enrollment required in EEMB 120: Introduction to Ecology.

**Reserve used:** Carpinteria Salt Marsh Reserve, Coal Oil Point Natural Reserve

**EEMB 128. Ecological Constraints to Ecosystem Restoration**

Integrates ecological principles with practical issues involved in ecosystem restoration. Beginning with the challenge of selecting goals and establishing a target trajectory, students evaluate how ecological knowledge can guide restoration and whether sustainable states or trajectories can be achieved.

**Reserve used:** Coal Oil Point Natural Reserve

**EEMB 133. Biodiversity and Conservation Biology**

Field methods, literature, computer use, and underlying theory important to biodiversity research. Use of preserved and living collections by ecologists, conservation biologists, and evolutionists to detect evolutionary processes and threats to biological communities; to measure ecological processes and biodiversity.

**Reserve used:** Coal Oil Point Natural Reserve

**EEMB 138. Ethology and Behavioral Ecology**

Animal behavior and social organization viewed from evolutionary and whole animal perspectives. Specific topics stress environmental influences and natural selection and include: classical ethology, development and learning, communication, foraging, aggression, territoriality, mating systems, parental care, altruism, and sociobiology.

**Reserve used:** Kenneth S. Norris Rancho Marino Reserve

**EEMB 140L. General Plant Ecology Laboratory**

Field and laboratory research techniques.

**Reserve used:** Carpinteria Salt Marsh Reserve, Coal Oil Point Natural Reserve, Sedgwick Reserve

**EEMB 141. Physiological Plant Ecology**

Study of the environmental and physiological parameters of plant distributions and niches.

**Reserve used:** Sedgwick Reserve, Sweeney Granite Mountains Desert Research Center

**EEMB 142BL. Chemical and Physical Methods of Aquatic Environments**

Survey of physical and chemical methods used by limnologists and oceanographers supplemented with field observations.

**Reserve used:** Coal Oil Point Natural Reserve

**EEMB 166. Field Approaches to Terrestrial Plant and Ecosystem Sciences**

Intensive lecture and field course in local habitats examining biological invasions, resource cycling, vegetation succession, fire ecology, and seed banks. Lectures introduce ecological principles; field labs demonstrate methodology. An additional weekend lab or outside project is required.

**Reserve used:** Carpinteria Salt Marsh Reserve, Sedgwick Reserve, Sweeney Granite Mountains Desert Research Center

**EEMB 166FT. Terrestrial Plant and Ecosystem Ecology: Weekend Mini Course**

A Friday-to-Sunday field trip to desert, alpine, and sagebrush ecosystems in California. Field projects examine questions posed in EEMB 166 (concurrent enrollment required).

**Reserve used:** Carpinteria Salt Marsh Reserve, Sweeney Granite Mountains Desert Research Center

**EEMB 170. Biology/Ecology of the Marine-Land Interface**

Influence of physical factors on adaptations of shoreline organisms, with emphasis on the arthropods.

**Reserve used:** Carpinteria Salt Marsh Reserve, Santa Cruz Island Reserve
Environmental Studies Program

ES 1. Introduction to Environmental Studies
Global effects of human activities that raise important questions about the future of the human and other species. Examination and analysis of representative views on the dynamics of global environmental change and the implications for present and future generations. Reserve used: Coal Oil Point Natural Reserve

ES 111. The California Channel Islands (Summer Session)
Discussion of biological, geological, ecological, anthropological, and oceanographic characteristics of the Channel Islands area, as well as the management and human uses of this region. Emphasis on islands and ocean waters off southern California. Reserve used: Santa Cruz Island Reserve

ES 114B. Soil Genesis and Classification
Introduction to chemical, physical, and biological processes that produce soils and influence their management. Emphasis on morphology, genesis, classification, and global distribution of soils. Reserve used: Sweeney Granite Mountains Desert Research Center

ES 119. Ecology and Management of California Wildlands
Explore ecological processes in California habitats and the challenges of their management through field trips, discussions with land managers, lectures and readings. Focus on regional habitats, including specialized habitats, such as coastal salt marsh and vernal pools, and more widespread ones, such as oak savanna and chaparral. Reserve used: Sedgwick Reserve

ES 193SP (in the 193AA-ZZ series). Special Topics in Environmental Studies: Shoreline Preservation
One-time courses, each focusing on a special area of interest in environmental studies. Course titles and topics announced each quarter by the Environmental Studies Program. Reserve used: Coal Oil Point Natural Reserve

Geography

GEOG 194. Field Studies in Geography
Field-based investigation of the geographic characteristics of specific places and regions. Human and/or physical phenomena may be emphasized. Field trips may include visits to parks, industrial sites, government facilities, wildlands, or urban areas. Scope, emphasis, and requirement subject to change. Reserve used: Santa Cruz Island Reserve

GEOG 199. Independent Studies: Internship
Independent geographical research conducted under the guidance of Geography faculty. Topic and scope vary, to be specified by student and supervisory faculty member prior to registration. Reserve used: Santa Cruz Island Reserve

GEOG 277. Spatial Environmental Modeling (Graduate Field Spectrometry)
Seminar covering topics in spatial environmental modeling. Integrates techniques such as remote sensing and GIS into modeling of spatial processes. Topics include biogeochemical cycles, hydrology, species distribution, and habitat disturbance. Reserve used: Sedgwick Reserve

Gevirz Graduate School of Education
(teacher Education Program)

ED ST 390. Curriculum and Instructional Procedures and Materials Used in the Teaching of Science
Consideration of secondary school, science curriculum materials, along with objectives and teaching strategies appropriate to these materials. Reserve used: Sedgwick Reserve

ED ST 390M. Procedures for Teaching Science: Secondary
Admission to the Single Subject Credential. Consideration of secondary-school, science-curriculum materials, along with objectives and teaching strategies appropriate to these materials. Reserve used: Carpinteria Salt Marsh Reserve, Sedgwick Reserve

ED 393. Science Professional Issues
Student science teachers participate in inquiry-based lessons to further their understanding of how junior high and high school students experience science. Reserve used: Carpinteria Salt Marsh Reserve

Interdisciplinary Humanities Center

INT 91. Interdisciplinary Issues in Aquatic Sciences and Policy
Seminar-style course examining biological, environmental, political, and economic issues in aquatic topics, including oceanography, marine pharmacology and biotechnology, coastal geology and coastal processes, fisheries and ocean policy. Reserve used: Coal Oil Point Natural Reserve

Summer Institute in Mathematics and Science

SIMS 2005. Summer Institute in Mathematics and Science
Students entering the University of California are exposed to the broad range of academic research that exists at the Sedgwick Reserve, as well as given an opportunity to participate as active learners within UC's natural reserves. The program seeks to inspire and nurture students towards pursuing degrees in science, technology, engineering and mathematics (STEM) through multi-tiered, articulated academic mentorship. Talented and motivated students who can benefit from additional encouragement and academic support are targeted. Reserve used: Sedgwick Reserve

UC SANTA CRUZ

Art/Photography

ART 132. Color in Photography
Concentration on making photographic works in color. Students produce a portfolio of color photographs, read historical and theoretical works, and study photographs and other art works. Individualized projects may include work with color transparencies, color xerox, computer-generated imagery, or mixed media.

ART 133A-B. Senior Studio in Photography
Intensive studio experience, with emphasis on development of individual projects that will lead to required senior exhibition. Reserve used: Landels-Hill Big Creek Reserve

ART 134. Special Topics in Photography
Special studies in photography, concentrating on specific subject matter or media. Topics may include documentary photography, landscape, alternative processes, or mixed media.

Reserve used: Landels-Hill Big Creek Reserve
College Eight

C8 42A. Student-Directed Seminar: Ecopsychology and Social Change
Interdisciplinary course that combines the fields of ecology, psychology, sociological theory, and environmental theory. Examination of the reciprocal relationship between humanity and the Earth, along with methods of creating social change through uniting social justice movements with environmental movements.
Reserve used: Landels-Hill Big Creek Reserve

Earth Sciences

ES 109L. Elements of Field Geology Laboratory
Basic tools and techniques used in geologic fieldwork. Preparation, analysis, and interpretation of geologic maps. Topics include topographic maps, Brunton compass, rock identification and description, structure sections, and landslide recognition.
Reserves used: Año Nuevo Island Reserve, Landels-Hill Big Creek Reserve

Ecology and Evolutionary Biology / Division of Physical and Biological Sciences

EEB 75. Scientific Diving Certification
Prerequisite for BIOE 161L, Kelp Forest Ecology Laboratory, and all research diving performed under the auspices of UCSC or other academic institutions. Coursework includes lectures and scuba diving. Topics include subtidal sampling techniques, navigation, low-visibility diving, search and recovery, rescues, small-boat use, oxygen administration for divers, technical blue-water deep-diving, physics, and physiology.
Reserve used: Landels-Hill Big Creek Reserve, Kenneth S. Norris Rancho Marino Reserve

EEB 120. Marine Botany
Introduction to the biology of marine algae, fungi, and angiosperms with regard to form and function. Major boreal, temperate, and tropical marine plant communities.
(Formerly, Biology 170.)
Reserve used: Landels-Hill Big Creek Reserve

137L. Ichthyology Laboratory
Introduction to the biology of jawless, cartilaginous, and bony fishes — their classification, evolution, form, physiology, and ecology.
Reserve used: Landels-Hill Big Creek Reserve, Kenneth S. Norris Rancho Marino Reserve

139L. Biology of Marine Mammals Laboratory
Basic marine mammal taxonomy, anatomy, and field methods, with emphasis on local field identification and understanding of local species.
Reserve used: Año Nuevo Island Reserve

Highlighted course, page 14:

EEB 141. Ecological Field Methods (formerly Field Methods for the Study of Animal Biology)
Field-oriented course in the study of animal ecology and behavior. Combines overview of methodologies and approaches to field research with practical field studies.
Reserves Used: Año Nuevo Island Reserve, Landels-Hill Big Creek Reserve, Younger Lagoon Reserve

143. Herpetology
Lectures introduce students to evolution, development, physiology, behavior, ecology, and life history of reptiles and amphibians. Materials integrate with conceptual and theoretical issues of ecology, evolution, physiology, and behavior.
Reserve used: Angelo Coast Range Reserve

143L. Field Methods in Herpetological Research
Introduction to natural history, censusing techniques, physiological ecology, and behavioral analysis of reptiles and amphibians. Techniques for analyzing behavior and physiology.
Reserve used: Hastings Natural History Reservation

EEB 145. Plant Ecology
Exploration of the ecology of plant form, function, distribution, abundance, and diversity. Topics include plant adaptations to environmental conditions, life history variation, competition, reproductive ecology, herbivory, and patterns of diversity.
(Formerly, Biology 169.)
Reserve used: Landels-Hill Big Creek Reserve

152. Community Ecology
Develops the major themes of community biology: structure, trophic dynamics, succession, complex interactions among species, herbivory, evolution, and coevolution. Case histories of well-studied marine and terrestrial systems.
Reserve used: Fort Ord Natural Reserve

160. Marine Ecology
Paradigms and designs in marine ecology. Review of the paradigms that have shaped our understanding of marine ecology; analysis and discussion of experiments with these paradigms.
Reserve used: Younger Lagoon Reserve

160L. Marine Ecology Laboratory
Supervised individual research projects in experimental marine biology. Students carry out a complete research project, including: (1) the formation of hypotheses; (2) the design and implementation of experiments; (3) collection, analysis, and interpretation of data; and (4) write-up of an oral presentation.
Reserve used: Younger Lagoon Reserve

162A. Marine Ecology Field Quarter
Total immersion in marine ecology. Paradigms and designs in marine ecology. Review of paradigms that have shaped our understanding of marine ecology; analysis and discussion of experiments with these paradigms.
Reserve used: Younger Lagoon Reserve

EEB 165. Marine Conservation Biology
In-depth comparison of the biology and conservation of marine versus terrestrial ecosystems. Examination of marine biodiversity loss resulting from overexploitation, habitat loss, species introduction, and pollution, with particular emphasis on the resulting trophic cascades, biodiversity losses, and climate change.
(Formerly Biology 163.)
Reserve used: Younger Lagoon Reserve

BIOE 165A-B-C-D. Field Ecology of Baja California Supercourse
Intensive, on-site learning experience in terrestrial field biology that covers: (A) ecology of plant form, function, distribution, abundance, and diversity; (B) field methods in animal biology; (C) field methods in plant ecology; and (D) independent field research, in which students, under the supervision of course instructors, develop research proposals, carry out fieldwork, analyze data, and prepare final research papers and oral presentations.
Reserves used: Año Nuevo Island Reserve, Landels-Hill Big Creek Reserve

168. Systematic Botany of Flowering Plants
Examination of the taxonomy and evolution of flowering plants. Special topics include phylogenetics and cladistics, plant species concepts, and modern methods of systematic research.
Reserve used: Landels-Hill Big Creek Reserve
**UC SANTA CRUZ continued**

**EEB 281N. Topics in Marine Vertebrate Ecology**
Seminar on the ecology of marine vertebrates. Topics vary from the factors that explain the distribution of marine predators to island biogeography and the ecosystem effects of introduced vertebrates on islands.
*Reserve used:* Landels-Hill Big Creek Reserve

**Environmental Studies**

**ENVS 104A. Introduction to Environmental Field Methods**
Basic field skills, including habitat description, behavior observation, specimen collection techniques, mapping and map interpretation, vegetation analysis, population sampling, microclimate measurement, soil and water sampling. Emphasis on use of scientific method; experimental design, data handling, statistical analysis and presentation; basic field methodologies.
*Reserve used:* Fort Ord Natural Reserve

**ENVS 106A. Natural History of Birds**
Evolution, taxonomy, physiology, behavior, ecology, and management of birds. Birds observed in habitats that include bay, marsh, meadow, forest.
*Reserve used:* Younger Lagoon Reserve

**Highlighted course, page 15:**

**ENVS 107A-B-C. Natural History Field Quarter**
A 15-unit field course that uses California wildlands to develop skills of natural history observation and interpretation. Students gain the ability to identify plants, animals, vegetation types, and landscapes, as well as address the complex issues of preservation and management of these resources.
*Reserves used:* Angelo Coast Range Reserve, Hastings Natural History Reservation, Landels-Hill Big Creek Reserve, Santa Cruz Island Reserve, Sweeney Granite Mountains Desert Research Center

**ENVS 131L. Insect Ecology Laboratory**
Field and laboratory exercises designed to test hypotheses or demonstrate principles in such areas as behavior, mutualism theory, community ecology, and agricultural ecology. Experimental design, analysis, and interpretation of data emphasized, along with observational skills.
*Reserve used:* Landels-Hill Big Creek Reserve

**ENVS 152. Science and Land-Use Decisions**
Technical and policy dimensions of major land-use decisions assessed through a detailed case study (reuse of Fort Ord). Technical review will stress geological constraints; policy review will stress the CEQA process.
*Reserve used:* Fort Ord Natural Reserve

**ENVS 160. Restoration Ecology**
Multidisciplinary overview of restoring degraded ecosystems. Among the topics addressed are linkages between ecological principals and restoration, planning and implementing restoration projects, evaluating restoration success, and case studies of restoration of specific ecosystem types.
*Reserve used:* Younger Lagoon Reserve

**ENVS 162. Plant Physiological Ecology**
Introduction to the theory of plant interactions with the physical environment. Emphasis on influence of abiotic stresses on the recruitment, survival, growth, productivity, and reproduction of plants.
*Reserves used:* Sierra Nevada Aquatic Research Laboratory (SNARL) – Valentine Eastern Sierra Reserve, Younger Lagoon Reserve

**ENVS 165. Freshwater Issues and Policy**
Concepts, vocabulary, and skills necessary to the analysis of freshwater issues are introduced from hydrology, ecology, law, economics, engineering, and other disciplines. Skills are then applied to case studies involving local, state, and international freshwater conflicts and crises.
*Reserve used:* Landels-Hill Big Creek Reserve

**ENVS 167. Freshwater and Wetland Ecology**
Physical and biological patterns and processes in freshwater and wetland systems, with primary focus on Central Coast systems from headwaters to coastal marshes.
*Reserve used:* Landels-Hill Big Creek Reserve

**ENVS 183. Environmental Studies Internship**
A supervised off-campus learning experience related to environmental problem solving. Students may work with government agencies, private organizations, citizen action groups, or in specialized apprenticeships on an individual or team basis. Internship intended for Environmental Studies majors.
*Reserve used:* Younger Lagoon Reserve

**ENVS 196A. Senior Seminar: Management of Protected Lands**
Through selected readings, students explore natural reserve and biodiversity management. Completion of an individual/team project related to the natural reserves administered by UC Santa Cruz is required. Project focus may be on reserve planning and policy, ecological diversity, design and management, or program development.
*Reserves used:* Fort Ord Natural Reserve, Landels-Hill Big Creek Reserve, Younger Lagoon Reserve

**Ocean Sciences**

**OCEA 158. Biology and Conservation of Marine Birds and Animals**
Designed for Ocean Sciences and Biology majors, and interested non-majors with an understanding of basic marine ecology. Systematics, adaptations, ecology, behavior, and conservation of seabirds and marine mammals. Monterey Bay area faunas and issues emphasized.
*Reserve used:* Año Nuevo Island Reserve

**Physical Education, Recreation, and Sports**

**OPERS 5R. Aquatics: Basic Scuba Diving**
Coeducational course divided into three parts: lecture, pool lab, and open-water experience. Four open-water training dives offered. Emphasis on training for open-water scuba diving using the beach as a base of operation. Sections geared toward the successful completion of NAUI Scuba Diver Certification.
*Reserve used:* Younger Lagoon Reserve

**Science Communication**

**SCIC 201C. The Science Essay**
Survey of science and nature essayists. Purpose, content, form, and style considered. Writing assignments include film and book reviews, as well as original essays on current issues in science, technology, and society.
*Reserve used:* Landels-Hill Big Creek Reserve
APPENDIX B:

UC Courses Hosted by UC Natural Reserves
Presented by Reserve

ANGELO COAST RANGE RESERVE

UC BERKELEY

Environmental Science, Policy, and Management
140. General Entomology
147. Field Entomology

Integrative Biology
1B. General Biology
175. Herpetology
175L. Herpetology Laboratory

UC DAVIS

Environmental Science and Policy
123. Introduction to Field and Laboratory Methods in Ecology

UC SANTA CRUZ

Ecology and Evolutionary Biology
143. Herpetology

Environmental Studies
107A-B-C. Natural History Field Quarter

AÑO NUEVO ISLAND RESERVE

UC SANTA CRUZ

Earth Sciences
109L. Elements of Field Geology Laboratory

Ecology and Evolutionary Biology
139L. Biology of Marine Mammals Laboratory
141. Ecological Field Methods (formerly Field Methods for the Study of Animal Biology)
165A-B-C-D. Field Ecology of Baja California Supercourse

Ocean Sciences
158. Biology and Conservation of Marine Birds and Animals

BODEGA MARINE RESERVE

UC BERKELEY

Integrative Biology
103. Invertebrate Biology
157L. Ecosystems of California
C158. Biology and Geomorphology of Tropical Islands

Physical Education
47. Introduction to Scuba Diving

UC DAVIS

Atmospheric Sciences
290. Graduate Seminar

Biological Sciences
1B. Introductory Biology
1C. Introductory Biology
122. Population Biology and Ecology
122P. Population Biology and Ecology / Advanced Laboratory
124. Coastal Marine Research
199. Special Study in Biological Sciences

Center for Population Biology
225. Terrestrial Field Ecology

Ecology – A Graduate Group
214. Marine Ecology: Concepts and Practice

Environmental Science and Policy
121. Population Ecology
124. Marine and Coastal Field Ecology
125A. Terrestrial Field Ecology
150A. Physical and Chemical Oceanography
152. Coastal Oceanography

Environmental Toxicology
127. Environmental Stress and Development in Marine Organisms
230.4. Experimental Approaches to Problems in Coastal Toxicology

Evolution and Ecology
112. Biology of Invertebrates
114. Experimental Invertebrate Biology
115. Marine Ecology
211. Workshop in Applied Phylogenetics

Geology
109. Earth History: Sediments and Strata

Neurobiology, Physiology, and Behavior
141. Physiological Adaptation of Marine Organisms
141P. Physiological Adaptation of Marine Organisms / Advanced Laboratory Topics

Physical Education
29. Basic Scuba
128A-B. Research Diving Techniques

Plant Biology
118. Introductory Phycology and Bryology

Plant Pathology
135. Field Identification of Mushrooms

Wildlife, Fish, and Conservation Biology
102. Field Studies in Fish Biology
102L. Field Studies in Fish Biology: Laboratory
120. Biology and Conservation of Fishes

UC LOS ANGELES

Ecology and Evolutionary Biology
106. Experimental Marine Invertebrate Biology
123. Marine Ecology
164. Field Biology of Marine Fishes
165. Ecological Physiology of Marine Vertebrates
COAL OIL POINT NATURAL RESERVE

UC SANTA BARBARA

Anthropology
181. Methods and Techniques of Field Archaeology

College of Creative Studies
(Art) 101. Landscape Painting with an Artist and a Naturalist

Ecology, Evolution, and Marine Biology
112. Invertebrate Zoology
113L. Ecology and Evolution of Terrestrial Vertebrates: Laboratory and Fieldwork in Vertebrate Biology
116. Invertebrate Zoology: Higher Invertebrates
120AL-BL. Field and Laboratory Studies in Ecology
128. Ecological Constraints to Ecosystem Restoration
133. Biodiversity and Conservation Biology
140L. General Plant Ecology Laboratory
142BL. Chemical and Physical Methods of Aquatic Environments

Environmental Studies Program
1. Introduction to Environmental Studies
193SP (in the 193AA-ZZ series). Special Topics in Environmental Studies: Shoreline Preservation

Interdisciplinary Humanities Center
91. Interdisciplinary Issues in Aquatic Sciences and Policy

EAGLE LAKE BIOLOGICAL FIELD STATION

UC DAVIS

Environmental Science and Policy
123. Introduction to Field and Laboratory Methods in Ecology

Land, Air, and Water Resources
105. Field Studies of Soil Resources in California Ecosystems

EMERSON OAKS RESERVE

UC RIVERSIDE

Botany and Plant Sciences
31. Spring Wildflowers
133. Taxonomy of Flowering Plants

FORT ORD NATURAL RESERVE

UC SANTA CRUZ

Ecology and Evolutionary Biology
152. Community Ecology

Environmental Studies
104A. Introduction to Environmental Field Methods
152. Science and Land-Use Decisions
196A. Senior Seminar: Management of Protected Lands

HASTINGS NATURAL HISTORY RESERVATION

UC BERKELEY

Environmental Science, Policy, and Management
100. Environmental Problem Solving
147. Field Entomology

Integrative Biology
157L. Ecosystems of California
257A. Current Topics in Behavioral Physiology: Animal Behavior
UC SANTA CRUZ

Ecology and Evolutionary Biology
143L. Field Methods in Herpetological Research

Environmental Studies
107A-B-C. Natural History Field Quarter

JAMES SAN JACINTO MOUNTAINS RESERVE

UC IRVINE

Earth System Science
218. Terrestrial and Marine Ecology

UC LOS ANGELES

Geography
163. Field Analysis in Biogeography

UC RIVERSIDE

Biology
163. Evolutionary Ecology of Terrestrial Vertebrates
166. Conservation Ecology

Botany and Plant Sciences
31. Spring Wildflowers
146. Plant Ecology

Extension
406. A Field Study of Birds

JEPSON PRAIRIE RESERVE

UC BERKELEY

Integrative Biology
157L. Ecosystems of California

UC DAVIS

Animal Science
16LA. Raptor Migration and Population Fluctuations

Ecology – A Graduate Group

Entomology
116. Biology of Aquatic Insects

Environmental Science and Policy
123. Introduction to Field and Laboratory Methods in Ecology

Geography Graduate Group
298. Group Study

Land, Air, and Water Resources
105. Field Studies of Soil Resources in California Ecosystems

Landscape Architecture
50. Site Ecology

Plant Biology
117. Plant Pathology
147. Survey of Plant Communities of California

Wildlife, Fish, and Conservation Biology
155. Habitat Conservation and Restoration
156. Plant Geography

KENDALL-FROST MISSION BAY MARSH RESERVE

UC SAN DIEGO

Scripps Institution of Oceanography
295L. Introduction to Marine Biodiversity and Conservation

LANDELS-HILL BIG CREEK RESERVE

UC LOS ANGELES

General Education Cluster
70CW. (Earth and Space Sciences) Life in the Cosmos Seminar

UC SANTA CRUZ

Art/Photography
132. Color in Photography
133A-B. Senior Studio in Photography
134. Special Topics in Photography

College Eight
42A. Student-Directed Seminar: Ecopsychology and Social Change

Ecology and Evolutionary Biology
75. Scientific Diving Certification
120. Marine Botany (formerly Biology 170)
137L. Ichthyology Laboratory
141. Ecological Field Methods
(formerly Field Methods for the Study of Animal Biology)
145. Plant Ecology (formerly Biology 169)
165A-B-C-D. Field Ecology of Baja California SuperCourse
168. Systematic Botany of Flowering Plants
281N. Topics in Marine Vertebrate Ecology

Earth Sciences
109L. Field Geology Laboratory

Environmental Studies
107A-B-C. Natural History Field Quarter
131L. Insect Ecology Laboratory
165. Freshwater Issues and Policy
167. Freshwater and Wetland Ecology
196A. Senior Seminar: Management of Protected Lands

Science Communication
201C. The Science Essay

McLAUGHLIN NATURAL RESERVE

UC BERKELEY

Integrative Biology
157L. Ecosystems of California

UC DAVIS

English
180. Fieldwork in Nature and Culture

Freshman Seminar — Environmental Science and Policy
2. Plant Ecology of the Northern California Coast Range

Population Biology – A Graduate Group
298. Monte Carlo Seminar

Wildlife, Fish, and Conservation Biology
100. Field Methods in Wildlife, Fish, and Conservation Biology
110L. Laboratory in Biology and Conservation of Wild Mammals
MOTTE RIMROCK RESERVE
UC RIVERSIDE

Biology
163. Evolutionary Ecology of Terrestrial Vertebrates

KENNETH S. NORRIS RANCHO MARINO RESERVE
UC LOS ANGELES

Ecology and Evolutionary Biology
106. Experimental Marine Invertebrate Biology

UC SANTA BARBARA

Ecology, Evolution, and Marine Biology
106. Biology of Fishes
112. Invertebrate Zoology
116. Invertebrate Zoology: Higher Invertebrates
138. Ethology and Behavioral Ecology

Ecology and Evolutionary Biology
75. Scientific Diving Certification
137L. Ichthyology Laboratory

QUAIL RIDGE RESERVE
UC DAVIS

Ecology – A Graduate Group

English
180. Fieldwork in Nature and Culture

Entomology
156L. Biology of Parasitism Laboratory

Environmental Science and Policy
98. Directed Group Study
123. Introduction to Field and Laboratory Methods in Ecology

Plant Biology
102. California Floristics

Wildlife, Fish, and Conservation Biology
10. Wildlife Ecology and Conservation
100. Field Methods in Wildlife, Fish, and Conservation Biology
110L. Laboratory in Biology and Conservation of Wild Mammals
111. Biology and Conservation of Wild Birds
111L. Laboratory in Biology and Conservation of Wild Birds

SAGEHEN CREEK FIELD STATION
UC BERKELEY

Environmental Science, Policy, and Management
101A. Sierra Nevada Ecology

Integrative Biology
157L. Ecosystems of California

UC DAVIS

Ecology – A Graduate Group
200A-B. Principles and Application of Ecological Theory

English
180. Fieldwork in Nature and Culture

Entomology
109. Field Taxonomy and Ecology

Plant Biology
145. Sierra Nevada Flora

Teaching Resources Center
398. Seminar on College Teaching

UC LOS ANGELES

Civil and Environmental Engineering
194. Hydrology

SAN JOAQUIN FRESHWATER MARSH RESERVE
UC IRVINE

Earth System Science
114. Earth System Science Laboratory and Field Methods
134. Fundamentals of GIS for Environmental Sciences
218. Terrestrial and Marine Ecology

Ecology and Evolutionary Biology
9E. Horticultural Science
9K. Global-Change Biology
175. Restoration Ecology
179. Limnology and Freshwater Biology
E179L. Field Freshwater Ecology
(formerly Limnology and Freshwater Biology Laboratory)
E182. Mediterranean Ecosystems: Biodiversity and Conservation
184. Entomology
189. Environmental Ethics
E190. Conservation, Ecology, and Evolutionary Biology
191A-B. Senior Seminar on Global Sustainability I, II
199. Independent Study in Biological Sciences Research: Wetland Ecology
199. Independent Study in Biological Sciences Research: Restoration Ecology

SANTA CRUZ ISLAND RESERVE
UC LOS ANGELES

Ecology and Evolutionary Biology
124. Field Ecology: Island Biogeography

General Education Cluster
1. The Global Environment: A Multidisciplinary Perspective

Geography
163. Field Analysis in Biogeography

UC SANTA BARBARA

Anthropology
181. Methods and Techniques of Field Archaeology

Ecology, Evolution, and Marine Biology
170. Biology/Ecology of the Marine-Land Interface

Environmental Studies Program
111. The California Channel Islands (Summer Session)

Geography
194. Field Studies in Geography
199. Independent Studies: Internship

UC SANTA CRUZ

Environmental Studies
107A-B-C. Natural History Field Quarter
Appendix B • 37

SCRIPPS COASTAL RESERVE

UC SAN DIEGO

Ecology, Behavior, and Evolution
102. Introductory Ecology – Organisms and Habitat
131. Marine Invertebrate Ecology Laboratory

Physics
2BL. Physics Laboratory: Mechanics and Electrostatics

Scrpps Institution of Oceanography
10. The Earth
15. Natural Disasters
87. Freshman Seminar: The Physics of Surfing
100. Introduction to Field Methods

SEDGWICK RESERVE

UC DAVIS

Environmental Science and Policy
123. Introduction to Field and Laboratory Methods in Ecology

Land, Air, and Water Resources
105. Field Studies of Soil Resources in California Ecosystems

UC SANTA BARBARA

Anthropology
162. Prehistoric Food Production
181. Methods and Techniques of Field Archaeology

Bren School of Environmental Science and Management
201. Ecology of Managed Ecosystems (formerly Ecological Principles)
212. Biological Community Survey and Analysis
215. Landscape Ecology
235. Watershed Analysis

College of Creative Studies
(Art) 101. Landscape Painting with an Artist and a Naturalist (Biology) 101. Models and Experiments

Ecology, Evolution, and Marine Biology
140L. General Plant Ecology Laboratory
141. Physiological Plant Ecology
166. Field Approaches to Terrestrial Plant and Ecosystem Sciences

Environmental Studies Program
119. Ecology and Management of California Wildlands

Geography
277. Spatial Environmental Modeling (Graduate Field Spectrometry)

Gevirtz Graduate School of Education
(teacher Education Program)
390. Curriculum and Instructional Procedures and Materials Used in the Teaching of Science
390M. Procedures for Teaching Science: Secondary

Summer Institute in Mathematics and Science
2005. Summer Institute in Mathematics and Science

SIERRA NEVADA AQUATIC RESEARCH LABORATORY (SNARL) — VALENTINE EASTERN SIERRA RESERVE

UC BERKELEY

Earth and Planetary Science
217. Fluvial Geomorphology

Integrative Biology
157L. Ecosystems of California

UC DAVIS

English
180. Fieldwork in Nature and Culture

UC LOS ANGELES

Earth and Space Sciences
103A. Igneous Petrology

Ecology and Evolutionary Biology
132. Field Behavioral Ecology

Geography
159D. Problems in Geography
163. Field Analysis in Biogeography
163. Glacier Environments of California’s High Sierra

UC RIVERSIDE

Environmental Sciences
176. Acquisition and Analysis of Environmental Data

UC SANTA CRUZ

Bren School of Environmental Science and Management
236. The Mountain Snowpack

Earth Science
118. Summer Field Geology

Environmental Studies
162. Plant Physiological Ecology

STEBBINS COLD CANYON RESERVE

UC BERKELEY

Environmental Science, Policy, and Management
140. General Entomology

UC DAVIS

Biological Sciences
10. General Biology

Ecology – A Graduate Group

English
180. Fieldwork in Nature and Culture

Entomology
104. Behavioral Ecology of Insects
107. California Insect Diversity
116. Biology of Aquatic Insects
156. Biology of Parasitism

Environmental Science and Policy
123. Introduction to Field and Laboratory Methods in Ecology

Plant Biology
102. California Floristics
118. Introductory Phycology and Bryology

Plant Biology – A Graduate Group
224. Water in Physiology and Ecology of Plants
Plant Pathology
224. Advanced Mycology

Wildlife, Fish, and Conservation Biology
10. Wildlife Ecology and Conservation
100. Field Methods in Wildlife, Fish, and Conservation Biology
155. Habitat Conservation and Restoration

STUNT RANCH
SANTA MONICA MOUNTAINS RESERVE

UC LOS ANGELES

Ecology and Evolutionary Biology
114B. Field Ornithology
122. Ecology
154. California Ecosystems
265. Special Topics in Plant Ecology: Mediterranean-Climate Ecosystems

General Education Cluster
M1A. The Global Environment

Geography
100. Principles of Geomorphology
100A. Principles of Geomorphology: Field and Laboratory
101. Coastal Geomorphology
101A. Coastal Geomorphology: Field and Laboratory

Physics and Astronomy
3. (Nature of the Universe:) Astronomical Observation

SWEENEY GRANITE MOUNTAINS
DESSERT RESEARCH CENTER

UC BERKELEY

Integrative Biology
1B. General Biology
175. Herpetology

UC DAVIS

Art Studio
110. Photography I (or: Graduate Seminar in Art)

UC LOS ANGELES

Ecology and Evolutionary Biology
132. Field Behavioral Ecology
134B. Field Physiological Ecology of Desert Animals
(Field Biology Quarter)

UC RIVERSIDE

Biology
163. Evolutionary Ecology of Terrestrial Vertebrates

Earth Sciences
100. Introductory Petrology

UC SANTA BARBARA

Ecology, Evolution, and Marine Biology
141. Physiological Plant Ecology
166. Field Approaches to Terrestrial Plant and Ecosystem Sciences
166FT. Terrestrial Plant and Ecosystem Ecology: Weekend Mini-Course

Environmental Studies Program
114B. Soil Genesis and Classification

UC SANTA CRUZ

Art/Photography
133A-B. Senior Studio in Photography

Environmental Studies
107A-B-C. Natural History Field Quarter

VALENTINE CAMP — VALENTINE EASTERN SIERRA RESERVE

UC DAVIS

English
180. Fieldwork in Nature and Culture

YOUNGER LAGOON RESERVE

UC SANTA BARBARA

Ecology and Evolutionary Biology
141. Ecological Field Methods
(formerly Field Methods for the Study of Animal Biology)
160. Marine Ecology
160L. Marine Ecology Laboratory
162A. Marine Ecology Field Quarter
165. Marine Conservation Biology

Environmental Studies
106A. Natural History of Birds
160. Restoration Ecology
162. Plant Physiological Ecology
183. Environmental Studies Internship
196A. Senior Seminar: Management of Protected Lands

Physical Education, Recreation, and Sports
5R. Aquatics: Basic Scuba Diving

Editor’s Note: No UC classes were reported as having visited these NRS reserves during the 2005-06 academic year: Blue Oak Ranch, Box Springs, Chickering American River, Dawson Los Monos Canyon, Elliott Chaparral, and Jenny Pygmy Forest.
Background Resources

- [http://www.worldwatch.org/node/5984](http://www.worldwatch.org/node/5984)

- [http://www.lulu.com/content/1687426](http://www.lulu.com/content/1687426)

Brief Reviews of the State of the Earth’s Natural Resources

- [http://www.journals.uchicago.edu/toc/an/2003/162/1](http://www.journals.uchicago.edu/toc/an/2003/162/1)
- [http://www.journals.uchicago.edu/doi/full/10.1086/376572](http://www.journals.uchicago.edu/doi/full/10.1086/376572)


- [http://www.worldwatch.org/node/5983](http://www.worldwatch.org/node/5983)


National Academy of Sciences and National Research Council Publications

- [http://www.nap.edu/catalog/10750.html](http://www.nap.edu/catalog/10750.html)

- [http://www.nap.edu/catalog/9975.html](http://www.nap.edu/catalog/9975.html)

Earth Observation Networks

National Ecological Laboratory Network (NEON)  [http://www.neoninc.org/](http://www.neoninc.org/)
Ocean Observatories Initiative (OOI)  [http://www.oceanleadership.org/ocean_observing/](http://www.oceanleadership.org/ocean_observing/)
The mission of the UC Natural Reserve System is “to contribute to the understanding and wise management of the Earth and its natural systems by supporting university-level teaching, research, and public service at protected natural areas throughout California.” Field study is an important dimension of many disciplines, and, for over 40 years, the NRS has supported university-level teaching in a wide variety of disciplines that require field sites.

The NRS is often described as “a classroom without walls” or “a library of ecosystems.” Such descriptions recognize that, in order to study the environment, one must go out into it and learn through direct observation and measurement. Those who’ve experienced university instructional programs conducted in the field will attest: such programs promote learning that cannot be readily achieved in the classroom. In the words of NRS founder Mildred E. Mathias:

The Natural Reserve System is an educational innovation born out of necessity. How can anyone begin to understand the dynamics of ecosystems without actually experiencing them?