UCSC Research Park

UCSC's Endangered Campus Lands

R&D Proposal Prompts A Closer Look

Remove an absolute minimum of trees, shrubs, and branches . . . consider the basic mood of the place . . . Build many trails, reveal many places where a student or a teacher or an administrator could sit in a quiet hour with only nests and the dead twigs intruding upon his solitude. There are few places on earth where such a phenomenon might occur—other than in national parks and remote wildernesses. To have this opportunity on a campus of a great university is a priceless event.

—Ansel Adams, thoughts on the University of California, Santa Cruz

On the northern outskirts of UCSC's central campus lies a vast stretch of undeveloped land, over 500 acres of forest and woodland known simply as the "upper campus." Much of the land is covered by a tapestry of oak and evergreen trees, marked by open grasslands and dense patches of chaparral. A large stand of redwoods dominates its northern boundary.

There are no buildings on the upper campus, and no paved roads. Although a series of trails connects the area with the central core of classrooms and office buildings below, the upper campus remains isolated and removed. Some students are unaware that it belongs to the university, and many have never visited the area.

Near the southern edge of this tract of land, on a hillside directly above the central campus, lies the 108-acre site of the university's proposed Research and Development (R&D) Center. Much of the site is covered by a dense understory of brush. In some places, though, the vegetation has been burned or cut away to establish a fuel break—a clearing which prevents wildfires from reaching the lower campus.

Although no buildings have ever been constructed on the site, several large-scale development projects have been proposed for the area. In the early 1960's, university planners envisioned UCSC as a sprawling campus with 25 colleges and nearly 28,000 students. According to Louis Fackler, Director of UCSC's Office of Campus Facilities, the site was to be developed into a massive complex of buildings to accommodate several research institutes planned for the campus.

"But the whole demographic picture changed," says Fackler, "and the original plan was modified to reflect the smaller size of the campus." In 1978, the area was designated as a "natural resource area." Says Fackler, "This only meant that the university didn't have any immediate use for the land, not that they would never build on it."

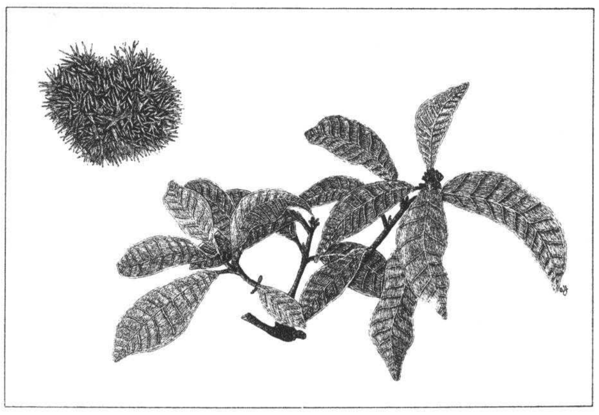
Last May, UCSC's Chancellor Robert Sinsheimer decided that the university could use the land. According to the center's project description, the site was selected over five others because it was the most ecologically disturbed, did not disrupt ocean views, and would cost the least to build on.

The decision, however, raised concern among those who feared that the development of an industrial complex like the R&D Center would alter the natural setting of the campus and would pose serious threats to the environment.

"We're just beginning to discover what some of the impacts might be," says Larry Pageler, a member of the project's Environmental Assessment Group. The group, headed by Environmental Studies Associate Professor Jim Pepper, is currently preparing an environmental impact report for the center, to be published next summer.

"So far," says Pageler, "we've been able to steer the project's architects away from the really sensitive areas on the site and have suggested that they be excluded from future development."

Some of these "sensitive" areas support unusual plant life. "There are a lot of species that you just



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The giant chinquapin tree is a northern forest plant that reaches its southern limit in Santa Cruz.

don't expect here," says Roy Buck, a consultant who recently completed an extensive plant survey of the area. Some of the grasses and sedges, says Buck, typically grow in marshes and wetlands. Others, like the giant chinquapin tree, range as far north as Washington, but are found nowhere south of UCSC. The site also includes mysterious stands of "dwarfed" redwoods that appear to be saplings but are among the oldest redwoods on campus.

The area's vegetation provides a rich habitat for a diversity of animals, including deer, several species of owls, and even an occasional bobcat. In fact, more than 40 species of mammals and over 80 species of birds live on or near the site, says former UCSC faculty member Roger Luckenbach, who surveyed the area last winter. Nearly all of the bird species breed there and three are listed on the Audubon Society's "Blue List"—a catalog of species whose numbers have declined in recent years.

Besides disrupting plant and animal life, developing the upper campus site for industrial activity could also harm the water system that originates there. The site is located above a major aquifer that supplies water to nearly all the springs and streams on the lower campus.

"I'm worried that toxic solvents used by electronics firms at the center could make their way into the water supply," says UCSC environmental studies professor Robert Curry, who has studied the hydrology of the area. Curry says his concern stems from the recent reports of similar ground-water contamination in nearby Santa Clara Valley. He believes the potential for widespread contamination in Santa Cruz could be just as serious.

"Unlike the Santa Clara Valley, where the contaminated water remains in the valley," he says, "the water from UCSC flows downhill into other areas." According to Curry, the water flows into underground streams that eventually emerge in parks and residential areas located in the city below.

The potential for contamination could be lessened, says Curry, "by isolating wastewater in separate pipes and transporting it away from the site." He warns, however, that the center must also be designed so that rain water at the site can be recycled back into the aquifer. Curry suggests paving parking lots with permeable materials and situating storm drains so that water can continue to soak into the ground.

For many, the potential impacts of the R&D Center represent a much larger problem concerning the overall development of the campus. How can the university continue to grow and still preserve its significant natural resources?

"No university can lock up its lands forever," says UCSC environmental studies professor Ken Norris, "but the lands must be managed under a comprehensive plan that treats the campus as a whole." Norris fears that without such a plan, the lands will dwindle away as various interest groups lay claim to them. He feels that some of UCSC's natural areas should be set aside for research and teaching, while it's still possible. "There is an opportunity here for the support of natural area teaching and research that far transcends anything I know of at any other university in the U.S.," he says.

A team of researchers assembled by Norris is currently conducting field studies to identify those areas on campus which could prove valuable to future research. According to Norris, the team's goal is to preserve representative samples of all the habitats on campus, including those which support rare or unusual species.

He feels such research is the first step toward protecting the campus's significant natural resources. Says Norris, "Unless we take some action to preserve some of the important things on this campus, they will disappear."

—Ava Ferguson

Pacific giant salamanders (Dicamptodon ensatus) *can reach a foot in length and weigh up to three pounds. They breed in wet areas on the UCSC campus.*

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Regulating Radiation in the Lab

Stamped on the doors to 27 UCSC labs are bright, magenta-and-yellow logos that read, "Caution: Radiation Area." Behind these doors, researchers wearing aprons and gloves reach around lead or Plexiglas shields to handle their test tubes and beakers. Labels identifying radiation zones adorn refrigerators, work benches and shields, and contaminated trash goes only in a special container.

In these labs, researchers handle minute amounts of radioactive materials as routinely as they use microscopes or test tubes. Like most contemporary life-science research labs, UCSC labs use radioisotopes—radioactive forms of chemical elements—to map gene sequences along chromosomes, analyze hormone and antibody activity, study the structures of various molecules, and trace the use of substances by organisms. Radioisotopes are invaluable to researchers because of the special properties of radioactivity.

Most elements exist in a variety of chemically identical atomic forms. These "isotopes" differ only in the unique numbers of neutrons in their nuclei. Like kernels of unpopped corn, most isotopes remain internally stable unless energy is added from the outside. Radioisotopes, though, have unstable nuclei: they are radioactive.

Atoms of radioactive materials constantly expel particles and energy. This release is spontaneous and irreversible, much like the popping of corn. Once "decayed," the atoms are always more stable, and eventually no longer radioactive.

Scientists using special instruments can detect this energy release in even the minutest quantities of a radioactive substance. Yet in other respects, radioisotopes are indistinguishable from nonradioactive elements to living organisms. Therefore, scientists can use radioisotopes as "tags" or "labels" to follow physiological processes without altering the organisms they study.

For example, a researcher may ask which parts of a plant use a certain nutrient. The researcher feeds the plant the "labeled" nutrient and the nonradioactive one, so it absorbs both through its roots. At set times, the researcher tests different parts of the plant for radioactivity, thereby tracing the nutrient's path.

But the same properties that make radioisotopes invaluable as research tools also make them hazardous to life. If the energy and particles expelled by decaying radioisotopes strike living cells, the damage can be tremendous.

In the early 1900's, for example, factories hired young women to apply luminous radium-containing paint to watch and clock faces. Many of these workers died of cancer: they had ingested traces of the radioactive radium by moistening their paint brushes with their lips.

Overexposure to radiation can injure the skin, shorten lifespans, and damage genes. Since genes instruct cellular activities, including reproduction, alterations can cause drastic effects, such as birth defects and cancer. Proper use and disposal of radioactive materials was not strictly governed until the late 1930's and early '40's, when Federal and local governments began establishing guidelines.

To promote public health and safety, current Federal and State regulations are strict. At UCSC, each radioisotope user must submit a special request including proof of handling skills with the campus Radiation Safety Committee. If the Committee approves the request, the researcher must adhere to certain restrictions, such as a ceiling on the amount allowed at any one time, where the radioisotopes can be used, and how they should be handled.

A radioisotope emits one or some combination of three types of radiation: alpha particles, beta particles, or gamma rays. Since most alpha particles travel less than a centimeter in air and cannot penetrate the skin, they are only hazardous if swallowed or absorbed through a cut in the skin. The more powerful gamma rays can travel long distances at the speed of light, and penetrate and destroy tissue. Most of the UCSC labs use beta-emitters, which are the least dangerous, said Bob Hall, Senior Technologist at the campus Environmental Health and Safety Office (EHSO).

Hall and his assistant, Steve LeBoeuf, keep careful records of the amount of radioactive wastes received and the contaminated wastes generated by each lab. Hall checks each new package for leaks before delivering it to a lab.

The Radiation Safety Office (RSO) requires spot checks of the radiation labs four times a year. Hall monitors the labs with a portable survey meter, a hand-held instrument such as a Geiger counter, that detects and measures most radiation. He then wipes benches and other heavily used lab areas with separate filter papers. The wipe tests are necessary because not all radiation registers on the survey meters. A more sensitive instrument, a scintillation counter, analyzes the filter paper samples.

Radiation doses accumulate over a lifetime. Everyone experiences a constant low level of exposure to radiation from natural sources in the ground, air, water and even food, but workers in labs that use radioisotopes receive far greater exposure.

UCSC lab workers wear film badges to monitor the amount of radiation they receive. The film on these badges blackens in response to radiation exposure when it is developed. The university sends the badges every three months to a private company, which reads them and maintains lifetime exposure records for each individual.

An employee whose measured exposure approached the legal allowance in a given period would be temporarily "pulled out of the radiation lab," said Hall, but this has never yet happened at UCSC. "The labs here are extremely safety-conscious," said Hall. "My goal is for people to have only one-tenth of the allowed exposure."

Since many of the labs' wastes will be radioactive for quite some time, great care is taken with disposal. Hall picks up all the contaminated trash from the labs, again making careful records. He packages solid and liquid wastes in separate 55-gallon drums, which are temporarily stored in locked metal lockers outside. A radiation broker collects about eight drums from UCSC every three months. Eventually the broker delivers the wastes to a special storage site for burial.

Radioisotopes from research labs are classified as "low-level" radioactive waste—as compared to the "high-level" products of nuclear reactor facilities. California currently ships most of its low-level wastes—from hospitals, industries and research labs—to Hanford, Washington. But a 1980 Federal Low-Level Waste Policy Act is forcing California to reassess its present waste disposal methods. The act allows public sites to close their doors to other states. California may face a closed door in Washington in January, 1986.

California is reviewing two alternatives for its low-level waste disposal: it can petition to join a "compact," and share a site with other states, or it can maintain an independent site, as Texas has decided to do.

Within a compact, several states share a disposal site; the member generating the most wastes is the first host. After thirty years, the responsibility rotates to the next heaviest waste generator in the compact, and a new site is established within that state. When most states across the country formed compacts in response to the 1980 act, California did not join.

For California to enter a compact now, its membership must be approved by each member state's legislature. "California generates 80 to 90 percent of the low-level waste west of the Rockies," said John Hickman, a Health Physicist in California's Department of Health Services. "It's about 200,000 cubic feet a year."

Regardless of whether California tries to join a compact or to go it alone, it will have to find a suitable site for disposal within its borders. Possible regions for the site are being considered and the state recently contracted UC Irvine to study ways of minimizing low-level waste production. Research labs may face new regulations within the next few years, as California wrestles with the question of what to do with its low-level wastes.

—Karen Watson

Sam Sees with Sound

Dolphins do it. Bats do it. And now even research physicists do it. What they all do is "see" with sound waves. Using a device called the Scanning Acoustic Microscope, or SAM, researchers are seeing sights that are invisible to normal light microscopes: images of plant and animal cells, without the use of stains; pictures of invisible flaws in silicon circuits; and images of invisible inhomogeneities in certain alloys. All of these images are visible because the researchers use sound waves instead of light waves.

Sound waves affect matter differently from light waves. While light affects the electrons in matter, the alternating regions of compression and rarefaction of sound waves affect the matter's elasticity—its ability to regain its original shape after it has been distorted by an external pressure. So while an object may be opaque or completely transparent to light, it may have differences in elasticity that allow SAM to make a "picture" of its structure.

The idea of using sound waves for magnification was first suggested back in 1949 by Soviet physicist S. I. Sokolov. He proposed that sound waves travelling through water could be used for magnification. The frequency of the waves would have to be very high, around a billion cycles per second, for the microscope to have the resolution of a light microscope. Unfortunately, he was not able to build the microscope. The technology needed to realize this idea became available only recently, in the early 1970's. Then Calvin Quate, a professor of electrical engineering and applied physics at Stanford University, began developing the Scanning Acoustic Microscope.

SAM is based on the principle that the intensity of the sound reflected from an object is related to the elasticity of the object. The less elastic an object is, the more intense the reflected sound waves will be, just as a hard wall will reflect sound better than a soft curtain. When measured on a microscopic scale, most objects reveal slightly varying elasticities, because of slight differences in the molecular structure of the object. By measuring these slight differences, SAM can form an image of an object.

The basis of SAM is the acoustic lens, which consists of a two-millimeter-long sapphire rod with a piezoelectric (pronounced pe-a-zo-e-lek-trik) crystal attached to one end and a hemispherical indentation on the other end. The indentation acts as a lens, focusing the waves into a single point on the object. The indentation is very small, about 40 micrometers in diameter (about 1/25 the size of the period on this page).

The piezoelectric crystal is a special material which produces an electric charge if pressure is applied to it. The pressure changes the distance between some oppositely charged atoms in the crystal. This causes a slight charge imbalance with the other atoms of the crystal, which manifests itself as a charge on the crystal.

This effect can be very dramatic. For instance, if a three-inch piece of barium titanate is struck with a small hammer, a 300-volt charge will appear on the crystal. The crystal also works in reverse: if an electric current is applied to it, the crystal expands, causing pressure in the surroundings.

Professor Quate uses the piezoelectric crystal both to produce the sound wave and to record the reflected wave. By applying a high frequency alternating current to the piezoelectric crystal (a simple matter with electrical equipment), he gets the crystal to produce a high frequency sound wave in the sapphire. This wave then travels to an adjacent water medium, after being focused by the indentation. The wave then strikes the object being viewed at a single point. The part of the wave reflected by the object is then transported back through the water and the sapphire to the piezoelectric crystal.

The crystal then does its other trick, and converts the pressure impulses of the sound wave into electrical signals. The signals are then amplified and recorded for viewing on a television screen. A light