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NRS Turns Twenty

The NRS celebrates its Twentieth Anniversary in 1985. In these past two decades, the System has evolved from 7 original sites to 26 reserves that together contain a broad cross-section of California's natural habitats. We've added on-site personnel, facilities, and equipment to many of the sites, and we now have an extensive bibliography of reserve-based research.

To commemorate the past 20 years of growth, the NRS is planning a year-long celebration punctuated by several events, new programs, and publications. These include:

•"In Celebration of Nature"—A fall lecture series jointly sponsored by the NRS and UC Extension, to be held at UC Los Angeles and UC Berkeley. Speakers are being chosen from an international pool of field scientists, environmental planners, writers, and wildlife artists. *Transect* subscribers will receive a special lecture-series mailing early in 1985.

•Twentiethth Anniversary Report—A 4-color, 20-page booklet describing the purpose and history of the NRS, and highlighting various teaching, research, and public service projects based on NRS reserves. The report will feature color photographs by Galen Rowell, a professional photographer known for his wilderness images. Over the past seven months, Galen has visited six reserves, capturing more than 4000 photos of students, teachers, and researchers in action. A limited number of copies of the report will be available upon request.

•Computerized Bibliography—See News and Notes article.

•Special Events—Including guided tours of selected reserves and dinners honoring donors and friends.

—Sarah Steinberg
NRS Editor



Galen Rowell ©1984

UC Berkeley zoologist, Dr. Wayne Sousa, has studied Bodega Head's rocky intertidal community for five years. His research on the recovery of this community from natural disturbance, such as storm surf, has just been published in the December 1984 issue of *Ecology*. For a related paper published in 1981, Dr. Sousa received the prestigious George Mercer award from the Ecological Society of America. The award is given annually for the best research paper in the field of ecology by a young scientist. In early November, Dr. Sousa's Bodega study site was heavily coated with oil from the ruptured tanker S.S. Puerto Rican.

Oil Spill Hits Bodega Marine Reserve

A storm-driven oil slick hit the Bodega Marine Reserve before dawn on Saturday, November 10. By the next morning, most of the surge channels and intertidal habitats along the Reserve's mile of rocky outer shoreline had been coated with oil the consistency of chocolate mousse. Heavy wave action from several Arctic storms had emulsified the oil with seawater, giving it a thick foamy texture.

The slick formed when the oil tanker Puerto Rican sank with 1.4 million gallons of cargo 15 miles southwest of the Golden Gate. An unexplained explosion ripped the tanker in two on October 31, but the 2.8 million-gallon bow section remained afloat.

Portions of South Farallon Island and Point Reyes National Seashore had been hit earlier in the week, but Bodega appeared to be the most severely affected of the three sites. The impacts were not limited to the rocky shoreline.

Storm surge carried portions of the slick into Bodega Harbor east of Bodega Head.

The Reserve includes 90 acres of leased tidal mudflats and saltmarsh fringe just inside the Harbor entrance. Approximately 160 acres of mudflat habitat in the Harbor were covered by a thin film of oil.

Traces of oil were also detected in the Marine Lab's seawater system, but no immediate damage to the system or to research organisms was detected.

Although the long-term impacts are as yet unknown, some of the short-term impacts were severe. In the first two days, over 700 oiled birds had been collected by volunteers and lab researchers from nearby beaches and shoreline. Half of the birds were dead. The remainder were shipped 35 miles south to the International Bird Rescue Center at Fort Cronkite where they were cleaned and fed.

The vast majority of the oiled birds were pelagic and nearshore diving species. Surf scoters, white winged scoters, common murre, and American coots were the most

Continued on page 6

SNARL and Año Nuevo Island Receive NSF Facilities Grants

Sierra Nevada Aquatic Research Laboratory

The Sierra Nevada Aquatic Research Laboratory (SNARL), a component of the Valentine Eastern Sierra Reserve, recently received a \$95,000 two-year grant from the National Science Foundation's Biological Research Resources Program.

The grant will be applied to the construction of \$165,000 in facilities improvements at SNARL to double user housing and laboratory space. At present, SNARL can accommodate 11 to 15 people for long periods and up to 27 people for short periods. The Reserve's housing and lab space have been used to capacity—both summer and winter—the past five years, and many users have had to be turned away.



Mount Morrison and the Convict Creek moraine loom over the Sierra Nevada Aquatic Research Laboratory (SNARL) near Mammoth Lakes, California. Convict Creek flows through the lab complex at the bottom of the photo.

Existing facilities include five user-residences, totalling 3200 square feet, two attached garages, a 2800-square-foot lab building with four labs, four offices, a library, a darkroom, and a double garage with shop, a 1250-square-foot fish house with a flow-through stream water system, a 400-square-foot woodshop, a small radiation lab, a small storage shed, streamflow control structures and observation ponds with towers. A four-wheel drive truck, a snowmobile, and several boats, together with a wide assortment of analytical lab equipment and synoptic collections, are also available for research and teaching use.

Año Nuevo Island Reserve

The Año Nuevo Island Reserve has just received a \$38,000 one-year grant from the Marine Laboratory subprogram of NSF's Biological Research Resources Program. The Reserve is administered by the Center for Marine Studies (CMS) at the UC Santa Cruz Campus, and CMS is an emerging center for marine mammal research on the west coast. The grant will be used to upgrade facilities and equipment as part of a \$66,000 package of facilities improvements and vehicle purchases for the Reserve.

Existing facilities consist of three former U.S. coast guard lighthouse structures: a shop and foghorn building, a fuel storage blockhouse, and a lighthouse keeper's residence. The residence is dilapidated and unused—California sea lions have been the sole tenants since its abandonment by the Coast Guard in 1948. The other two structures are currently used by researchers for housing and lab space. The blockhouse provides kitchen, dining, and workspace. The foghorn building provides sleeping accommodations for ten.

The grant will provide \$25,000 for a new roof, windows, siding repair, and paint job for the foghorn building. Another \$8,000 will pay for a four-kilowatt electric generator and sophisticated recording weather instrumentation. The grant will also provide

\$5,000 to construct animal care and handling facilities at CMS's Long Marine Lab, 19 miles south of the Reserve.

The NSF grant is being matched by approximately \$3000 in labor by CMS personnel and \$25,000 from the University-wide NRS Office in Berkeley. The NRS contribution, to be spread over three years, will fund interior renovation of lab and kitchen space, construction of new observation blinds and fenced runways, and purchase of a raft, outboard motor, and four-wheel drive truck. These improvements will significantly enhance the usability of the reserve by researchers, some of whom spend up to two months at a stretch on the Island.

To date, research has focused on the Island's diverse pinniped population. Año Nuevo Island features the largest population of northern elephant seals north of the Channel Islands—approximately 3000 individuals, including some 1200 pups born each winter. The southern-most breeding colony of Steller's sea lions also occurs on the Island, producing 600 pups annually. Approximately 150 resident harbor seals produce 40 pups each spring, and more than 8000 California sea lions haul out on the Island each fall. In addition, sea otters use the surrounding waters, and Alaska fur

Continued, next page

The proposed new facilities consist of four components. The largest and most important component is a combination dormitory and semi-private housing unit to accommodate large research groups or several smaller groups. It will consist of five small bunkrooms accommodating up to four persons each, two restrooms with showers, a large dining room and work/study area, and a kitchen to support cooking by more than one group.

The second component is a lab addition built around a walk-in freezer/cold room. Cold room specifications are designed to support experiments in snow physics, as well as experiments in brine shrimp hatching and lake sediment/solute interactions associated with Mono Lake research conducted at SNARL. The third component adds heat and water utilities to the existing radiation lab. And the fourth component adds a short stretch of stream channel between the final stream-diversion structure and the bypass channel. This new channel segment will allow multiple stream research projects to be conducted simultaneously for the first time. The improvements are

scheduled to be operational by late fall of 1985.

These improvements should significantly enhance research productivity at SNARL. Since 1977, eleven masters theses and one doctoral dissertation have been completed based on work done at SNARL, and six doctoral dissertations are now in progress.

Approximately \$70,000 in University cost sharing was required by the NSF facilities development grant. These funds came from the Valentine Reserve Endowment, the Santa Barbara campus Office of Research Development, and the University-wide Office of the Natural Reserve System. In addition, two firms from the nearby town of Mammoth Lakes contributed design services worth approximately \$15,000 as part of the cost sharing package. Alan O'Connor and Associates contributed architectural and structural engineering services and Triad Engineering contributed civil engineering services. These donations are most appreciated!

—Jeff Kennedy
NRS Environmental Planner

Año Nuevo Grant, *cont'd.*

seals occasionally visit the Island. Only one other site in the lower 48 states—San Miguel Island off southern California—has as many pinniped species as Año Nuevo Island.

Research at Año Nuevo spans a wide range of biological disciplines: behavior, ecology, evolution, genetics, physiology, parasitology, and anatomy. Over 108 research publications, six technical reports, three doctoral dissertations, and two masters theses have resulted from research conducted there.

Most of the early work has focused on behavior, reproductive success, and long-term population studies, primarily of elephant seals. Researchers have since completed 17 consecutive years of breeding season observations on the Island.

More recently, research has begun to focus on physiological ecology. Northern elephant seals fast for several months during the breeding season. Research on fat metabolism and respiratory water balance during fasting may shed light, not only on the ecology of this fascinating species, but on a variety of human medical problems, including weight control, as well.

Another physiological study investigates sleep apnea in elephant seals. Sleep apnea is the temporary cessation of breathing during sleep. A pilot study found that an increase in respiratory carbon dioxide during sleep could stimulate the resumption of breathing during sleep apnea. Since Sudden Infant Death Syndrome (SIDS) in humans may result from insensitivity to carbon dioxide during sleep apnea, re-



This aerial view shows eight-acre Año Nuevo Island and the former Coast Guard facilities now being renovated with NSF funding. The foghorn building is on the left, and the blockhouse is in the middle of the photo. The lightkeeper's house in the foreground is no longer used.

searchers hope that their study of blood gases in pinnipeds may provide a clue to the treatment of SIDS in humans.

These are just two of many research projects now in progress that will benefit from the Reserve's facilities and equipment improvements.

Scientific research is just the latest chapter in Año Nuevo's long and colorful history. The Island and its wildlife were first noted by Francisco de Gali in 1584. It was subsequently named Punta de Año Nuevo when it was sighted by Sebastian Vizcaino in January, 1603. More recently, the Coast Guard established a manned lighthouse on the Island in 1872, but the buildings were abandoned in 1948 when the lighthouse was automated.

The California Department of Parks and Recreation subsequently purchased the Island and adjacent mainland in 1958 and dedicated the land as a State Reserve. Although the mainland is open to the public for ranger-led tours, the Island has been closed to the public since 1967. The Island's wildlife are highly sensitive to human disturbance. Since 1968, the University of California has managed all scientific use of the Island pursuant to a use and management agreement with the Parks Department. The Island has been a component of the NRS since 1968.

—Jeff Kennedy
NRS Environmental Planner



Steve Davenport/Center for Marine Studies

Año Nuevo Island supports five species of pinnipeds—the most diverse population in the lower 48 states with the exception of California's San Miguel Island.



Steve Davenport/Center for Marine Studies

Once decimated by hunting, California's northern elephant seal population has made a remarkable recovery. Año Nuevo's population annually produces some 1200 pups, such as the newly-weaned pups seen here.

Mosquito Research at San Joaquin Freshwater Marsh

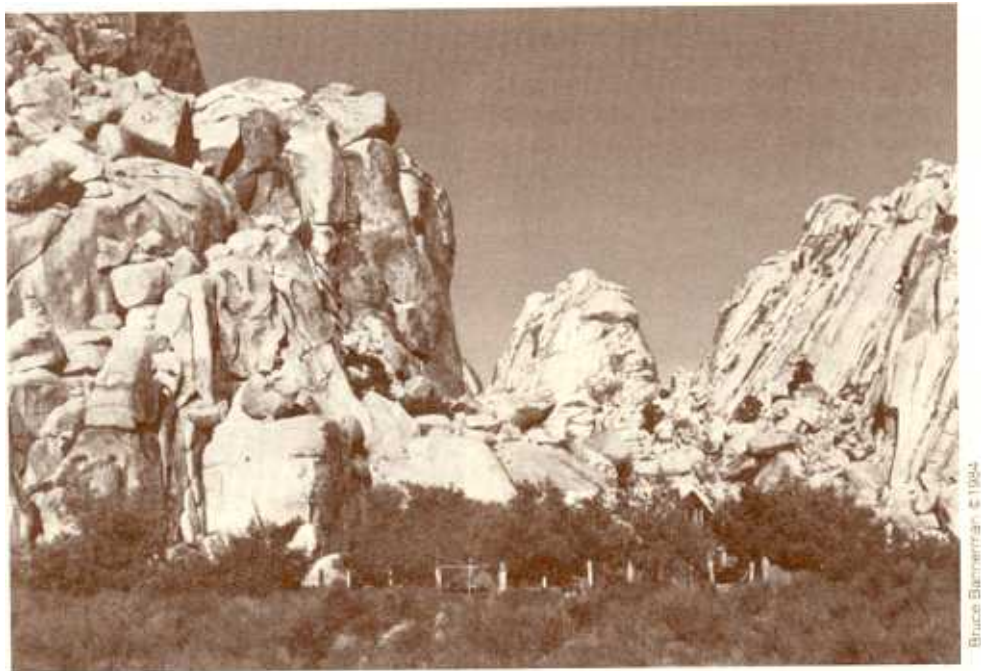
Anyone who's needed a liberal dose of insect repellent to enjoy a summer outing can appreciate society's urge to control mosquitos. Aside from their sheer annoyance, mosquitos carry encephalitis and other viruses that endanger human health. Unfortunately, traditional mosquito control methods emphasize the use of chemicals with undesirable environmental side effects.

Modern research is now beginning to develop integrated pest-management (IPM) techniques that emphasize manipulation of environmental variables and use of natural predators and parasites to control insect pests without the use of chemicals. Five UC Irvine investigators have recently received an \$11,500 grant for IPM research from the University of California's Cooperative Extension Mosquito Research Program. Their project is a three-year study to develop IPM techniques for mosquito control in marshes and wetlands.

The study is a multi-disciplinary project of the UC Irvine Departments of Ecology & Evolutionary Biology and Developmental & Cell Biology, the Orange County Vector Control District (OCVCD), and the UC Natural Reserve System. The goal is to develop mosquito control techniques that are compatible with environmental management objectives for natural wetlands. These objectives include endangered species preservation, migratory waterfowl habitat management, and habitat preservation for teaching and research use.



San Joaquin Freshwater Marsh Reserve features multiple ponds and water control structures that allow researchers to manipulate environmental factors affecting mosquitos.



The Granite Cove addition to the Granite Mountains Reserve features ranch buildings (behind the trees in the photo) that will serve as the Reserve's new field headquarters. The addition is made possible, in part, by a \$50,000 donation from Grace Becker Vamos. See article page 5.

Project investigators chose the San Joaquin Freshwater Marsh Reserve as the ideal site for their project for several reasons. It is immediately adjacent to the Irvine campus where sophisticated laboratories and support facilities are available. It has a decade's worth of baseline data on mosquito populations collected by the OCVCD. And its dikes, culverts, and multiple water sources allow experimental manipulation of environmental parameters, such as vegetation, water quality, and flow.

This last capability is a significant feature of the project. The marsh receives water from five separate sources: direct precipitation, surface runoff, shallow wells, deep wells, and tertiary-treated wastewater from an adjacent sewage treatment plant. Each source provides water of varying quality and salinity. These multiple sources allow researchers to manipulate the quantity and quality of the water to predetermined specifications. This capability, together with the ability to manipulate vegetation and mosquito predators in separately diked ponds, provides researchers with a powerful investigative tool to study inter-relationships between water quality, vegetation, mosquito populations, and aquatic food webs.

When complete, this study will provide data needed to design model marsh management strategies and compatible mosquito control techniques that minimize negative impacts on freshwater wetland ecosystems.

—**Jeff Kennedy**
NRS Environmental Planner

News and Notes

Vamos Donation. Grace Becker Vamos recently contributed \$50,000, the largest cash gift the NRS has received from an individual donor to date. Of this generous unrestricted gift, \$40,000 will go towards acquiring a 310-acre parcel known as Granite Cove, the field headquarters site for the Granite Mountains Reserve in the northern Mojave Desert. The remaining \$10,000 will be used to produce the Twentieth Anniversary Report.

Mrs. Vamos is the aunt of Madeline Becker Drake, Administrative Assistant in the University-wide NRS office. She decided to make her contribution after reading an article describing the NRS in the June, 1983 issue of *California Monthly*, the magazine of the California Alumni Association at Berkeley.

Thank you, Grace!

Reserve Brochures. A brochure on the San Joaquin Freshwater Marsh Reserve is now available. Designed for prospective Reserve users, this eight-page publication by NRS Editor Sarah Gustafson describes the natural resources of the site, summarizes management and research projects in progress, and provides information on Reserve facilities and regulations.



Cover illustration of a redwing blackbird for the San Joaquin Freshwater Marsh brochure.

Pygmy Forest Management Plan. A comprehensive resource inventory and management plan has recently been developed for the Pygmy Forest Reserve by Berkeley graduate student Christine Reid and Associate Professor of Forestry and Resource Management, Dr. Joe McBride. The Berkeley campus administers this reserve, which is located near Van Damme State Park, two miles southeast of the town of Mendocino, on the northern California coast.

The Reserve features a highly restricted endemic flora dominated by stunted individuals of Mendocino cypress and Bolander pine. The understory consists of a few species of manzanitas and sedges, and an unusual carpet of lichens.

The low diversity and stunted growth forms are a product of the half-million-year-old podsol soils that have formed on a series of five marine terraces in the region. These heavily-leached soils are low in nutrients and as acidic as vinegar. A shallow claypan further stresses plants by blocking root development. It also floods roots and lichens in standing water during the five-month rainy season.

Only a few species have adapted to survive in this harsh environment. Studies of the interactions between soils, vegetation, and climate in the pygmy forest ecosystem are providing important insight into the joint development of soils, vegetation, and the animal life they support. The research focuses on the mutual feedback relationships between these ecosystem elements.

The purpose of the new management plan is to preserve the integrity of the Reserve's pygmy forest ecosystem for research use. The fragile nature of the lichen cover and the small size of the Reserve do not permit extensive use by classes. Nearby pygmy forest sites are available for such use, however.

The plan addresses management issues associated with septic tank impacts on groundwater quality, impacts from adjacent development, offroad vehicles, use levels and user impacts. The plan also addresses needed facilities improvements associated with parking, circulation, and off-site housing for reserve users. In addition, the plan stresses the need for research on the fire ecology of the pygmy forest ecosystem, as well as the need for a program to inform the local community about the values and sensitivities of this unique and fragile system.

Continued on page 8

NRS Reserves Support a Broad User Community

A prominent factor in the vitality and productivity of NRS reserves is their availability to users outside of the nine-campus UC system. The 1983-1984 Annual Report of the Philip L. Boyd Deep Canyon Desert Research Center near Palm Desert, California, graphically documents how broad-based the user community of NRS reserves can be.

More than seventy researchers and hundreds of students engaged in a record 31,183 user-hours of research and instruction at Deep Canyon. Reserve users came from 7 UC campuses, 4 California State University campuses, 22 other colleges and universities, and 20 museums, laboratories, government agencies, and private organizations. Sixty-four percent of the user-hours came from UC campuses, and thirty-six percent came from non-UC-affiliated institutions. The non-UC institutions are listed below.

California State Universities at Fullerton, San Diego, Pomona, and Bakersfield. Cornell University. University of Maryland. Universitat Bremen, Germany. Cambridge University, England. University of Michigan, Dearborn. Northeastern University, Boston. University of Wisconsin, Madison. Vanderbilt University, Tennessee. McMaster University, Canada. Virginia Polytechnic Institute and State University. Pomona College. University of Redlands. Oregon State University. CSIRO, Australia. Stanford University. Weizmann Institute, Israel. Utah State Uni-

versity. Colorado State University. Ohio State University. Albion College, Michigan. Max Planck Institute, Germany. University of Southern California.

Other institutions are as follows. California Academy of Sciences. Los Angeles County Museum. Palm Springs Desert Museum. Argonne National Laboratory. San Francisco VA Medical Hospital. Los Alamos National Laboratory. National Science Foundation. American Society of Plant Physiologists. Anglia Television, England. Living Desert Reserve. Channel 10 Cable TV, Coachella Valley. U.S. Fish & Wildlife Service. California Department of Fish & Game. Riverside County Flood Control District. Sierra Club. Coachella Valley Water District. Riverside County Planning Department. California Department of Forestry. The Nature Conservancy. U.S. Geological Survey.

Such rich diversity of users fosters a highly productive teaching and research environment. Twenty-one theses and published research papers were listed for Deep Canyon's 1983-84 annual report, alone. Resident Reserve Director, Dr. Al Muth, and his wife Vic have done a superb job of providing administrative and support services for such a broad-based user community. They represent just two of fifteen resident personnel who administer the most-heavily-used NRS Reserves. We couldn't do the job we do without them!

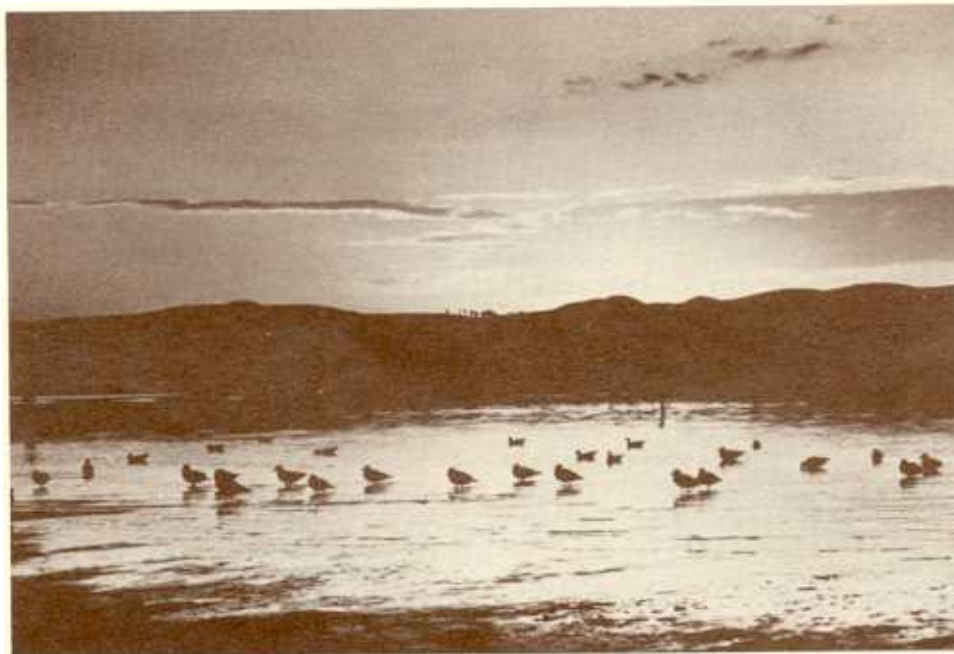
Oil Spill, cont'd from p. 1

severely affected, followed by western, eared, and horned grebes, and common loons. Isolated individuals of another ten species were also rescued.

More difficult to assess is the spill's long- and short-term impacts on intertidal flora and fauna. A series of back-to-back storms the following week scoured most of the emulsified oil from intertidal rocks. The storms left an oily foam in the surf zone as the only sign of the spill's presence. Although some long-term transect data exist for selected rocky intertidal species, accurate quantitative impact assessment will be complicated by natural losses due to wave scour. (Scouring of intertidal plants and animals is a normal result of the first winter storms). Impact assessment in the harbor mudflat community may be easier due to its greater protection from wave scour.

The tanker's multiple cargoes further complicate impact assessment. At least three grades of oil were on-board: paraffin, a light-weight lubricating oil, and a heavier-grade oil. Mechanical mixing by wave action, together with evaporation of volatiles and sinking of heavier fractions constantly changed the chemical composition of the slick. The exact composition of the Bodega slick is not yet known.

From a research perspective, the impacts of the spill may already be significant. The Bodega Marine Reserve is a national baseline monitoring and inter-calibration site for the U.S. Mussel Watch Program. Mussel Watch uses bio-assays of the mussels, *Mytilus californianus* and *M. edulus*, to



Galen Rowell © 1984

Marbled godwits forage for invertebrates in the Bodega Harbor mudflats at dawn. Two months after this photo was taken, the mudflats were covered with a film of oil from the tanker S.S. Puerto Rican.

monitor coastal water pollution. Mussels of this genus are found on both the Pacific and Atlantic coasts, providing a nationwide standard for coastal pollution monitoring.

Because they are filter feeders, these mussels sample a large volume of seawater and plankton each day. Since hydrocarbon pollutants are lipid-soluble, they accumulate in the mussel's fatty tissues where they are concentrated at levels several orders of magnitude above ambient levels in the surrounding seawater. The mussels thus act as bio-accumulators—living amplifiers of aquatic pollutants. Analysis of mussel tissue lipid extract using gas chromatog-

raphy gives a highly accurate assay of even low-level pollutants.

Researchers at the Bodega Marine Lab were principal collaborators in the development of the Mussel Watch Program, and Bodega was chosen as a national inter-calibration site because of its lack of disturbance. The effect of the oil spill on Bodega's status as an inter-calibration site is not yet known.

Bodega is also an undisturbed control in an international research project studying shorebird migration between North and South America. The project, headed by Dr. Pete Myers of the Academy of Natural Sciences in Philadelphia, has compiled over ten years of population and migratory data for Bodega's sanderling population. The project is funded by grants from the National Science Foundation and the World Wildlife Fund. The spill's impact on the control population is also unknown.

University representatives and agents of the oil and tanker companies involved are designing a sampling and monitoring program to assess the spill's impacts. Fortunately, both the ship owner and the cargo owner are American companies, so negotiations will not be complicated by international law.

Woodward-Clyde, a San Francisco Bay Area engineering firm, is representing the oil and tanker companies in the design of the sampling and monitoring program. In turn, Woodward-Clyde has retained the Bodega Marine Lab to assist in program design and to collect and analyze the samples. Lab researchers are the acknowledged experts on the marine biology of the region affected by the spill.



Galen Rowell © 1984

Bodega Marine Lab manager, Paul Siri, injects a small test sample into one of the lab's gas chromatographs. The lab shown here will be used to analyze extracts of sediment and tissue samples for oil pollutants.

The sampling program, which began November 18, covers 27 sampling sites from the Farallon Islands north to Point Arena. Samples will consist of sediment cores on soft substrates and selected invertebrates on both soft and rocky substrates. Samples will be taken from both high and low tide levels at each site with four or more replicate samples for each tide level. Sand and mussel samples will also be taken from the intake lines and filters of the Marine Lab's seawater system.

Once collected, each sample will be frozen and stored for subsequent analysis. Researchers will tally species presence and abundance for each sample. They will then use gas chromatography/fluorescence ionization to analyze sediment extracts and selected tissue samples for pollutants. For samples requiring more detailed analysis, a gas chromatograph/mass spectrometer will be used. These tests will allow researchers to determine the exact hydrocarbons present in the slick and their relative concentrations.



This aerial view shows the bow of the oil tanker S.S. Puerto Rican being towed into San Francisco Bay for cargo pump-out.

Other components of the impact assessment program include dragline sampling of Dungeness crabs and bottom fish in the Farallon Gulf off Point Reyes and benthic invertebrate sampling in the Bodega Harbor mudflats. Berkeley graduate students Greg Ruiz and Rich Everett have several years of site-specific baseline data on invertebrate populations in the mudflats. Follow-up studies of Bodega sanderling and marbled godwit populations are also planned, as are studies of small crabs and saltmarsh plants.

A program of this magnitude is expensive. An entire lab will be dedicated to storage and analysis of samples for at least the next three months. Three staff have been hired to implement the program. Bodega research ecologist, Dr. Peter Connors, will head the sampling team and Bodega research specialist and marine chemist Brock deLappe will head the analysis team. The first phase of the program, involving just the initial collection of field samples, is estimated to cost \$26,000.

Summer Program at the James Reserve

Before the James San Jacinto Mountains Reserve became part of the NRS, its benefactors—Harry and Grace James—operated a summer camp on the property as part of their Trailfinders School for Boys. The camp stressed learning from the natural world.

This past summer, the James Reserve carried on the tradition of the Trailfinders by hosting a summer internship program for local high school juniors and seniors. The program provided an opportunity for students to get a feel for actual research by participating in on-going field research projects.

This reserve-generated program was funded with a \$15,000 grant from the Wildwoode Children's Center, a private, non-profit organization based in Palm Springs. The Center supports extramural activities for gifted and talented junior high and high school students.

In addition to covering room and board for all participants at the Reserve's Trailfinders Lodge, the grant provided salaries for a full-time cook and a full-time program coordinator. The grant also paid for rental of three microcomputers and video equipment.

Twenty science-oriented students from ten Riverside County high schools attended the program from the beginning of July through the middle of August. The students were divided into three groups that alternated every two weeks between the James Reserve and the USC Marine Science Center on Catalina Island, where Ann Hamilton led the marine studies end of the program.

Because there were only ten students on the Reserve at a time, each had an almost one-to-one relationship with the nine research biologists who guided the program. In addition to attending seminars given by the scientists, the students went on expeditions to Anza-Borrego Desert State Park, a condor-observation site on Mount Piños, and bat colonies in the San Jacinto Mountains, among other places.

The major thrust of the program was to provide students with the opportunity to learn about field science first-hand by assisting the biologists with their research. The projects covered such areas as plant genetics and taxonomy, pollination ecology, entomology, bird ecology, bat ecology, archaeology, and computer programming.

By the end of the summer, the students learned to identify plants to the species level and insects to the family level. They studied bluebird skins in the Reserve's synoptic collections, used mist nets to trap bats, and participated in an archaeological dig. The group also added considerably to the Reserve's synoptic collections. To quantify all the information they collected, the students helped design and implement software for the Reserve's growing data base management system.

A similar program will be offered next summer. Feel free to contact me for more information.

Dr. Mike Hamilton
Resident Director
James San Jacinto Mountains Reserve
P. O. Box 1781
Idyllwild, California 92349
(714) 659-3811.

Trial analyses of selected samples will then be used to design two subsequent phases. These will involve more detailed and comprehensive sample analysis, as well as implementation of the assessment programs mentioned previously.

Impacts on genotypic variation in local barnacles will also be studied as part of the assessment program. Existing oil spill literature indicate a reduction in genotypic variation in some species of barnacles following oil spills. Such alterations in the genetic composition of a population can have serious implications for the population's ability to adapt to future environmental stresses. Bodega researcher Dr. Dennis Hedgecock has over 2000 electrophoretic gels documenting pre-spill genotypic variation in local barnacle populations, providing a baseline for post-spill follow-up studies. Phase II and III studies are estimated to cost \$200,000.

Once the initial impact has been as-

essed, a follow-up sampling program will be designed to monitor recovery. Negotiations covering mitigation measures and payment for damages await the results of the initial sampling program.

—Jeff Kennedy
NRS Environmental Planner

Postscript, 11/30/84. In the two weeks since this article was first written, a second oil slick from the sunken stern of the tanker S.S. Puerto Rican has just reached Bodega Head. Although the first slick is now known to have been primarily a light lubricating oil, the second slick consists of a heavy, sticky bunker oil. Over half of the Bodega sanderling population now shows evidence of oiled feathers. The California Department of Fish and Game is monitoring the slick's movement by air. Future leaks from the sunken stern are a distinct possibility.

Computerized NRS Bibliography. On the eve of our twentieth anniversary, efforts are well underway to develop a computerized bibliography and database of all theses and published research based on work supported by NRS Reserves.

To date bibliographic citations have been compiled from Reserve annual reports and files in the University-wide NRS office. These data are now being entered on a Hewlett Packard 150B Touchscreen™ Personal Computer with a 15 megabyte Winchester Drive. Microrim's R:BASE™ Series 4000 Relational Database Management System is the software being used. This software—developed by NASA for the space shuttle program—will allow customized keyword searches of the database. The first draft of the bibliography is expected to be completed by late February. A companion bibliography of regional resource inventory and management citations pertaining to NRS Reserves will follow.

A preliminary survey of the citations compiled to date indicates that over 1000 research publications, 100 technical reports, 122 doctoral dissertations, and 76 masters theses have resulted from work supported by NRS reserves.

OBFS Annual Meeting. This year's annual meeting of the Organization of Biological Field Stations (OBFS) was held in September at Canada's Bamfield Marine Station on the Pacific rim of Vancouver Island, British Columbia. OBFS is an organization of North America's biological field station directors—see OBFS article in the Fall 1983 *Transect* 2(1):3.

Six NRS personnel attended the meeting representing the following sites: Bodega Marine Lab and Reserve, Valentine Eastern

tran' sect (trăn' sêkt), n. 1. Field Science. A line along which physical and biological data are collected. 2. **Tech. Slang.** A cross-sectional slice of the environment under study.

In a broad sense, the Natural Reserve System, is also a transect. It encompasses a representative cross-section of California's natural diversity in a system of natural areas and field stations specifically reserved for teaching and research use. Recognizing this, we have chosen to call our newsletter the *Transect*. For a free subscription—two issues per year—write or phone the systemwide NRS office (415/644-4211; ATSS 532-4211).

Sierra Reserve/Sierra Nevada Aquatic Research Lab, Santa Cruz Island Reserve, Año Nuevo Island Reserve, Big Creek Reserve, and the University-wide NRS Office. Representatives from Berkeley's Sagehen Creek Research Station and Stanford's Jasper Ridge Reserve also attended.

The OBFS meetings provide invaluable opportunities for field station directors to share ideas and techniques for solving administrative and management problems. They also afford the opportunity to observe the operation of another field station in action.

The Bamfield Marine Station is administered by a consortium of five western Canadian universities. It features extensive lab, housing, dining, boat, and dock facilities, and is one of only four University-administered Canadian field stations with an annual operating budget in excess of \$1,000,000 Canadian.

The first edition of a computerized NRS mailing list has just been completed. The list encompasses over 2600 interested faculty, students, staff, agency personnel, friends, and donors. The absence of a computerized list in the past has hampered the timely distribution of the *Transect*. With this issue we hope to be in a position to provide better service to our readers.

If you are a new subscriber to the *Transect*, we would appreciate information on your status as faculty, staff, student, or just plain friend of the NRS. If you're faculty, we'd like some indication of your research interests, and if you're a student, some indication of your year, department affiliation, degree program and area of interest. This information will help us to better understand you, our readers, and your information needs.

Any comments or suggestions concerning the *Transect* are most welcome and should be sent to:

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Erratum

Citation and copyright information were inadvertently omitted from the reprint of the *BioScience* editorial, "An Ecology of the Landscape," in the last issue of the *Transect* Volume 2, No. 2.

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