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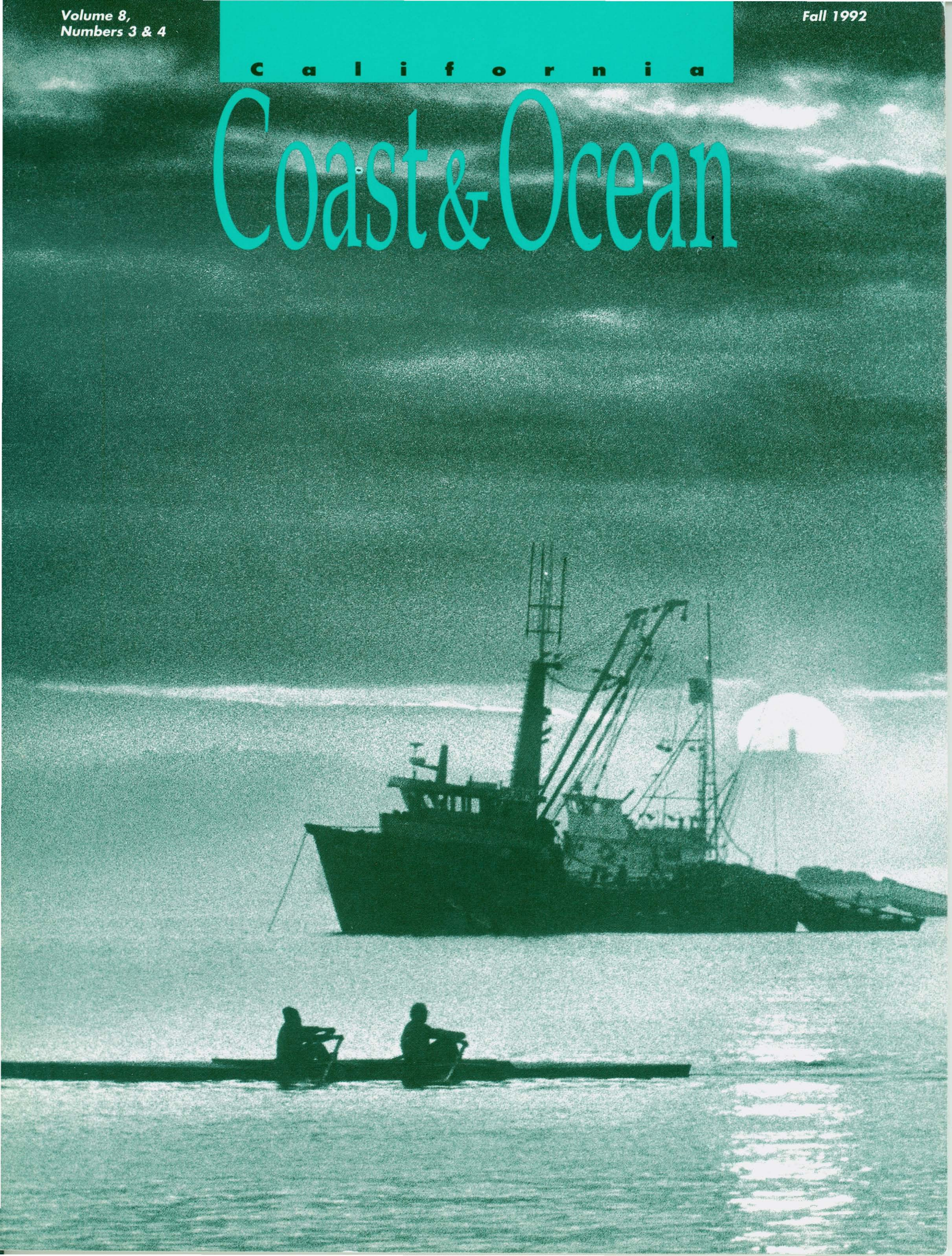
California

Coast & Ocean



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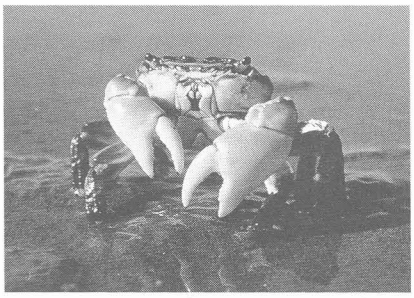

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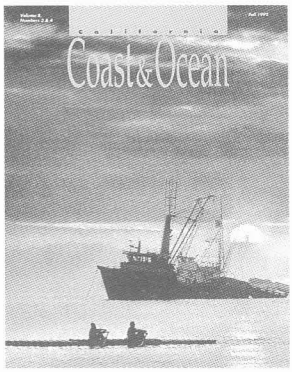


Cover: A fishing boat and a touring shell cross paths in the early morning waters of Richardson Bay. A tower of the Bay Bridge is visible against the rising sun. Photo by Scott Sommerdorf.

D.B. PLESCHNER

Abalone return to the deep, with a little help from some friends. Page 36.

From the Executive Office

by Peter Grenell

Winds of change now blowing through Washington, D.C., bring with them a fresh view and a will to positive action. As the federal government gears up for a new administration and a new Congress, let us hope that it will actively acknowledge California's national importance and provide greater assistance for coastal resource protection. Although competing claims of other states must be balanced and issues of "equity" considered, the unique importance of California's coast to the nation must not be ignored.

California's population continues to grow and roughly 80 percent of its 31 million people live along the coast. The state's most densely populated coastal areas include wetlands and estuaries that are among the most biologically productive, ecologically critical—and threatened—in the world. Immigration is concentrated in these same coastal areas. A recent study estimates that 25 percent of all legal immigrants settle in California; and an even higher percentage of illegal entrants. The pressure on coastal resources is intense, and likely to intensify even more. According to some estimates, 50 million people may live in California within 20 years.

The human and natural resources of California's coastal region are of great value to the entire nation. Yet in recent years California has not received a fair share of federal funding from sources like the Land and Water Conservation Fund, NOAA's Ocean and Coastal Resources Management (OCRM) funds, federal transportation funds, Environmental Protection Agency money, various funds from Department of the Interior programs, and others.

This neglect undermines a coastal program that has been established for 20 years and erodes cost-effective efforts to protect and enhance coastal resources for the future. It leads to competition for pennies that is not only unproductive but also diverts scarce human resources from cooperative work underway.

One small example illuminates the issue. One-third of the state's coastal program, that component consisting of Coastal Conservancy activities, is zero funded by federal OCRM for the second year in a row. This is the nonregulatory part of the overall program, which creates significant economic and employment benefits for the state while protecting and restoring threatened and degraded natural habitat, scenic areas, and public facilities. Last minute cuts in the state budget of the Coastal Commission, apparently resulting from the state's overall deficit situation, led to the Commission's assumption of federal OCRM funds previously allocated to the Conservancy. OCRM supported this move on the grounds that the Commission's regulatory activities came first. The amount in question? $369,000—two percent of the total budget for the three state agencies with principal responsibility for the coast: the Coastal Commission, Coastal Conservancy, and San Francisco Bay Conservation and Development Commission.

The human and natural resources of California's coastal region are of great value to the entire nation. Yet in recent years California has not received a fair share of federal funding.

How does this play out "on the ground?" In the Morro Bay watershed, for example, one of many Coastal Conservancy projects addresses critical problems of protecting the biological productivity of estuarine ecosystems, while restoring vanishing wetlands and improving local agricultural and range management practices. (See articles on pp. 8-24.) Years of work with the local community, as well as with several federal, state, and local agencies, has led the community to an understanding that its economic well-being and quality of life depend on effective stewardship of its superb natural resources. Whether the community can act on that understanding, however, depends largely on whether financial support from the state and federal government is available. Regrettably, Morro Bay was not included in the National Estuary Program, thus losing even the small amount of funds that could have flowed from this federal program. Morro Bay is just one of many California coastal locations where a carefully planned investment of public funds now would yield multiple dividends for generations.

Comprehensive watershed planning is underway for major coastal rivers, including the Santa Margarita, Santa Clara, Russian, and Garcia Rivers. The focus is mostly on fisheries restoration and enhancement, protection and enhancement of wildlife habitat, flood control, and recreation. With an infusion of federal funding, these planning efforts would translate much more rapidly into projects that create employment while protecting the nation's natural resources. These projects would also diminish the need for costly public expenditures for dredging in coastal estuaries by keeping sedimentation upstream.

For the good of the nation, the federal government must begin to acknowledge, by a major shift in its funding practices, California's importance to the nation, the recent impacts of both the recession and natural disasters on its economy, the dimensions of its population problems, and the irreplaceable value of its coastal resources.

Ebb and Flow

Recent Conservancy Actions

These and other State Coastal Conservancy projects moved forward between August and November 1992:

Santa Clara River Restoration

In August, the Conservancy authorized up to $100,000 each to the Ventura County Flood Control District and the Los Angeles County Flood Control District to prepare resource enhancement and management plans for the Santa Clara River. The Santa Clara is the largest and most significant river in southern California, and provides habitat for endangered species including the Least Bell's vireo, the California least tern, and the Unarmored threespine stickleback. The 1,200-square-mile coastal river system retains more natural qualities than any other in southern California, and has the highest potential for restoration. The Santa Clara also provides the greatest number of jobs in agriculture and sand/gravel production.

Ten agencies, ranging from federal to local, are joining to fund these comprehensive plans, to avoid future conflicts and restore degraded habitat. The project will document resources; describe and analyze hydrologic, geomorphic, and water quality conditions of the river and the effect of human activities on these conditions; identify the greatest problems facing the river, and formulate alternatives for addressing these problems. Specific implementation measures will be analyzed, including mitigation banks, acquisition of endangered species habitat, and creation of a joint powers river management authority. With this coordinated planning effort, the participating agencies hope to avoid piecemeal protection of sensitive lands as well as confrontations over proposed development.

Tijuana Estuary Tidal Restoration

Planning to restore degraded intertidal wetlands and channels at Tijuana Estuary in San Diego County has reached an important crossroads. In October, the Coastal Conservancy certified its environmental impact report for the tidal restoration program at a meeting at the Tijuana Estuary Visitor's Center and authorized $300,000 for construction plans for the Model Project, the first phase of implementation. Parallel action by the U.S. Fish and Wildlife Service under the National Environmental Policy Act is expected by December 30.

Sedimentation has resulted in a loss in tidal exchange with the ocean and has sharply reduced the self-maintaining tidal flushing that occurs in the estuary. The restoration program will recreate intertidal wetlands and at the same time increase tidal exchange. It balances the need for restoring wetland habitats and tidal function with the need to protect existing sensitive habitats. Important new work to control sediment at the source in the binational watershed is now being investigated.

Several endangered and threatened species thrive at Tijuana Estuary, among them the California least tern, Belding's savannah sparrow, and the Light-footed clapper rail. Their persistence here documents the importance of the area for wildlife.

The Conservancy and the U.S. Fish and Wildlife Service undertook restoration planning at the request of the ten-agency Reserve Management Authority. The two agencies are lead agencies in the joint state-federal environmental impact assessment (EIR/EIS) prepared by San Diego State University Foundation with Conservancy funding and coordination.

Santa Barbara Fishing Gear Storage Facility

MICK KRONMAN

This new commercial fishing gear storage facility near Santa Barbara's harbor opened in October. By providing affordable storage space, it will enable commercial fishermen to continue to operate out of Santa Barbara. The $100,000 project was authorized by the State Coastal Conservancy as part of the Local Marine Fisheries Impact Program.

The EIR/EIS constitutes the foundation document for assessing an ambitious 520-acre restoration program. Only the first increment of the program, the Model Project, is being prepared for construction now.

The restoration project will be carried out by the San Diego State University Foundation and the Pacific Estuarine Research Laboratory, under the direction of Dr. Gordon Shackleford and Dr. Joy Zedler. The Reserve Management Authority will oversee construction planning and the monitoring program.

Otay River Valley Enhancement

Also in October, the Coastal Conservancy approved Phases I and II of the Otay River Valley Enhancement Plan and authorized up to $1,468,000 to the city of San Diego for its partial implementation, including acquisition of appraised parcels within the valley, preparation of specific site improvement plans for the parcels acquired, and preparation of appraisals for additional priority parcels.

The Otay River Valley spans three jurisdictions (the cities of Chula Vista and San Diego and the county of San Diego) and has regional significance as an open space greenbelt corridor. The valley contains 16 significant habitat types and is home to several endangered and sensitive plant and animal species. Due to a lack of a comprehensive planning document for the river valley, mineral extraction, encroaching development, pollution, and uncontrolled public use continue to cause serious degradation of natural resources. In addition, the recreational needs of the South Bay community remain unmet.

The enhancement plan focuses on the natural resources of a five-mile area of the river valley between San Diego Bay and Otay Valley Road. It also addresses issues regarding cultural resources, recreational opportunities, land use and development opportunities and constraints, aesthetic concerns, educational and interpretive opportunities, economic and fiscal constraints, implementation requirements, and long-term management obligations.

Camp Three Island

Also in October, the Coastal Conservancy authorized up to $10,000 to the Sonoma Land Trust, in Sonoma County, to prepare an appraisal of the 1,448-acre diked historic bayland property known as Camp Three Island, on Sonoma Creek, south of Wingo and north of Skaggs Island. The Coastal Conservancy is cooperating with many public agencies to protect and restore wildlife habitat around San Pablo Bay. The staff of the U.S. Fish and Wildlife Service, which manages the San Francisco Bay National Wildlife Refuge, its satellite refuge in San Pablo Bay, and new refuge units that include the Marin Islands and Antioch, are seeking approval for adding several properties, including Camp Three Island, to the San Pablo Bay refuge.

Pillar Point Harbor Restoration

The Conservancy authorized the Pillar Point Harbor Urban Waterfront Restoration Plan in August and authorized up to $70,000 to the San Mateo County Harbor District for construction of the East Beach Pathway, and up to $50,000 for an engineering feasibility analysis of a proposal for expanding and improving Johnson Pier, the commercial fishing pier. Pillar Point Harbor is a regional visitor destination point, yet is isolated from the regional Half Moon Bay coastal trail. The northern link in the trail stops at the Pillar Point Harbor property line, where the east outer breakwater joins Surfers Beach. The proposed East Beach Pathway will complete this last link, making the harbor accessible to hikers and bikers on the six-mile trail.

The engineering feasibility analysis will identify in detail the necessary improvements and pier additions, and provide cost estimates for each proposed improvement. This information is essential for the District to plan construction work, and to develop a funding package.

Pacifica Acquisitions

Also in August, the Conservancy authorized up to $615,000 to the city of Pacifica in San Mateo County for acquisition of fee title to 148 shoreline acres and a purchase option for an additional 98 acres of the property known as San Pedro Point headland, an extremely prominent ridge along Highway 1. The agency also authorized $40,000 to the Pacifica Land Trust to prepare a coastal restoration plan for the 246-acre property, which is significant for its visual values and its forest and grassland vegetation, as well as for its recreational potential. The land to be acquired will link a series of parks that are readily accessible from nearby major urban population areas. The owners have agreed to sell on terms beneficial to the public. The sale price for the 148 acres to be acquired is $250,000 below the appraised value, and the sale price for the additional 98 acres would be $150,000 below the appraised value. The option for purchase of the second parcel extends to 1995.

Oceanside Ash Street Stairway

The city of Oceanside in San Diego County will build a wooden stairway within the Oceanside Strand redevelopment area with up to $60,000 authorized by the Conservancy in October. The site is at the end of Ash Street at Pacific Street.

The Conservancy and the city of Oceanside have worked since the 1970s to improve the Strand area for the community and visitors. The award-winning Oceanside Strand Restoration Plan, de-

veloped jointly by the city and the Conservancy, has been implemented, transforming the Strand from a degraded waterfront area with a truncated pier to an attraction visited by some three million people a year. The stairway will run between residential lots from Pacific to the Strand, and is the next-to-last planned access improvement in this area with heavy demand for beach access.

Carlsbad Agricultural Grant Programs

The Conservancy authorized up to $840,620 to the Palomar-Ramona-Julian Resource Conservation District in San Diego County in August to establish the Agricultural Support Grant Program and the Agricultural Research Grant Program. These programs will benefit long-term agriculture in the city of Carlsbad, where flowers and vegetables are the primary crops. They will be managed locally. Support for agriculture in Carlsbad is necessary because of problems resulting from residential development, high costs of water and other production inputs, and market competition from foreign sources.

Doran Marsh Barrier-Free Access

The Conservancy authorized up to $40,000 to the county of Sonoma in October for construction of a barrier-free trail on a dredge spoils site overlooking Bodega Bay, next to Doran Marsh. This site is ideal for bird watching and offers spectacular views of the entire bay. Materials dredged from Bodega Harbor are deposited into two settlement ponds, surrounded by levees. The trail will be built on top of the levees and will provide the first wheelchair access to Bodega Bay. The project will also include a new paved entrance road from Highway 1, a parking lot, a chemical toilet, and a walkway to the levee-top trail. Other improvements will include signs, two benches, and trash receptacles.

Marina Cove Barrier-Free Access

The city of San Buenaventura will install a portable ramp for barrier-free access at the Marina Cove Beach in the Ventura Harbor with up to $10,000 authorized by the Conservancy in October. Area. The ramp is designed primarily for wheelchair riders but will also be useful to elderly people, families with young children, and people launching kayaks, canoes, and windsurf boards. The ramp will be in place during the lifeguard season, April to October, beginning in spring 1993.

The park is directly across the street from the Channel Islands National Park Visitors' Center and was the city's safest swimming beach.

Urban Scene from the Window with a Camera

He nibbled winter scrabble, shrubs and grass
and then in the brambles he made a nest
and lay down. His antlers stood like bare trees.
He yawned and occasionally looked up toward me
where I stood, the glass open to cut the glare.
When I ventured into the yard,
he regarded me with sleepy calm.
I was the edgy one, in the warm-yet-cold sun,
in view of his antlers and strong, thick shoulders.
I remained close to the house where I could,
if need be, hide behind a door.
The neighborhood was quiet as a woodland.
Who would have heard me had I been charged?
No one at all, none beyond the unkempt yard,
the ragged alyssum and winter grass and wild
weedy fragrance.

—Nellie Hill

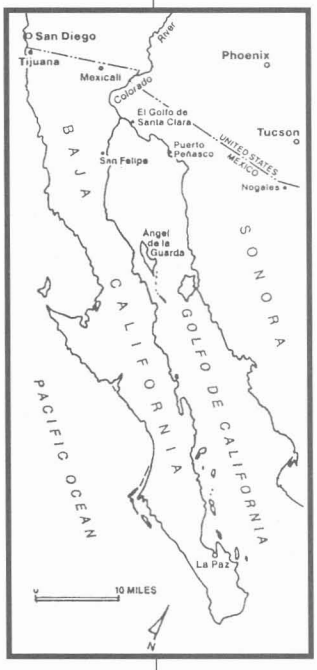
Nellie Hill lives in Berkeley.

Conference Log

Hope for the Most Endangered Cetacean

by Wesley Marx

The vaquita, or Gulf of California harbor porpoise—the most endangered of all cetaceans and one of the smallest—is rapidly emerging as a major conservation issue, thanks in part to scientists at the Instituto Tecnológico y de Estudios Superiores de Monterrey (ITESM) in Guaymas, Mexico. Their work in behalf of this species was the spark of a day-long conference held in San Diego last July under sponsorship of the University of California Consortium on Mexico and the United States (UC MEXUS).



Scientists did not even know this porpoise existed until 1955, when Kenneth Norris, professor of natural history at the University of California, Santa Cruz, found a skull he could not identify on an upper gulf beach. He and fellow scientist William McFarland subsequently determined the skull represented a new species and gave it the name of Gulf of California harbor porpoise. Local fishermen had long know it, as *vaquita* (little cow).

Flanked by desert, the upper gulf would seem a rather harsh environment for marine life. Its waters are shallow and turbid, with temperatures ranging from a winter low of 50° F to a summer high of 90° F, and 30-foot tides sweeping in as far as five miles on the sand flats. Yet life abounds in this sea of extremes. Schools of bottle-nosed dolphins cut through opaque waters and pelicans dive bomb schools of fish. While most seas depend on the vagaries of winds to turn over and recharge their nearshore waters, here the extreme tides perform this upwelling function daily. Because the upper Gulf is so productive, the vaquita does not have to range widely for the small fish that are its main prey. It may have the most limited distribution of any cetacean.

Scientists were anxious to observe the vaquita, but sightings were rare. Unlike bow-riding dolphins or leaping spinner porpoises, it does not rise far above the water surface. Indeed, Gulf fishermen have another name for this elusive porpoise: *duende* (spirit or goblin). Sometimes they pulled one up in the large-mesh gill nets used to catch the tasty totoaba, a large fish that is also unique to the Gulf. Lloyd Findley, then a marine researcher at the University of Arizona, and Robert Brownell Jr. of the U.S. Fish and Wildlife Service saw evidence of vaquitas killed by the nets in the 1960s.

In 1975, the distinguished Mexican scientist and conservationist Bernardo Villa helped to persuade the International Union for Conservation of Nature to list the vaquita in its Red Data Book of vulnerable species. That same year, Mexico banned totoaba fishing (but not use of the large-mesh totoaba net) so the depleted stock could recover, thereby hopefully also improving prospects for the vaquita. But the ban has been loosely enforced. Totoaba are served in local restaurants and smuggled into the lucrative U.S. market as "sea bass" fillets. More gill nets are being deployed to catch sharks, rays, and other market fads. The vaquita and totoaba are caught up in a fishery free-for-all.

Three faculty members at ITESM—Omar Vidal, Findley, and Alejandro Robles—have been working to reverse this industrious squeeze play. In 1985 these researchers, along with Brownell and Silvia Manzanilla, a marine mammologist now with Conservation International in Mexico City, performed the first scientific examination of fresh vaquita specimens at ITESM. Seven vaquitas had been killed in a net set during a totoaba research project, and an alert Robles had retrieved them and had them transported to Guaymas. The examination confirmed the vaquita's small size (about 105 pounds or a tenth of the weight of a bottle-nosed dolphin) and revealed another signature trait, a black ring around the eye, similar to the eye patch of a panda.

Subsequent work by ITESM researchers and Greg Silber, a former student of Norris who is now with the U.S. Marine Mammal Commission, confirmed the vaquita's precarious status. Silber estimates the population at 200 to 500 individuals. Vidal estimates that some seven percent of the population is lost to nets each year. At that rate, he says, the vaquita will be extinct "within ten years." To avert extinction, the ITESM researchers seek three major policy reforms: stricter enforcement of fishing regulations, a protected zone in the upper Gulf off-limits to nets and trawls, and economic alternatives for local fishermen.

Their efforts are beginning to pay off. In the Mexican press, the vaquita is emerging as a major symbol of the need for conservation. In February, President Carlos Salinas de Gortari of Mexico met with PRONATURA and other concerned environmental groups. A week later, Pesca, the Mexican fishery agency, banned use of large-mesh totoaba nets. The Mexican Navy now patrols the upper Gulf, ready to confiscate any poach-

ers' nets. A technical committee, chaired by Villa, has been formed to recommend other protective measures.

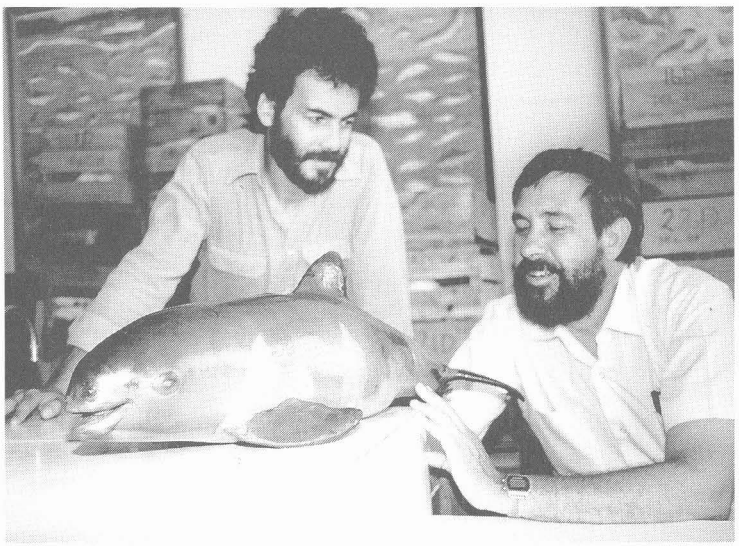
U.S. agencies are also responding. The National Marine Fisheries Service is trying to develop a simple test that will enable border inspectors to distinquish totoaba from other white fillets. Defenders of Wildlife has filed a petition with the Department of Commerce for a ban on all similar Mexican fillets to avoid mix-ups. Vidal and Robles, however, prefer a totoaba-specific test, so as not to deprive Mexican fishermen of the income from processing. The Department is expected to rule early next year.

Even if large mesh nets are kept out of the Gulf, both the vaquita and the totoaba will still be caught incidentally in smaller-mesh gill nets and shrimp trawls. At the UC MEXUS conference, Robles and Vidal stressed the need for a protected zone in the upper Gulf where both large and small nets would be excluded. Local fishermen were at first united in opposing such gear restrictions. However, research by Robles has shown that the current fishery, which takes place amid prime spawning and nursing grounds, depletes a whole range of commercial species. At the conference, two fishermen supported a protected zone. "If the gill net ban becomes broader, some fishermen might resent it," observed Heriberto Amaya-Solano of El Golfo de Santa Clara, who has been fishing in the upper Gulf since 1952. "But the problem already exists. There's no shrimp, no sharks, no rays. For me, it's clear a ban would be a benefit in the long term."

Amaya-Solano said economic alternatives had to be developed for the three upper Gulf fishing communities, San Felipe, El Golfo de Santa Clara, and Puerto Peñasco. Economist Roberto Sánchez of the Colegio de la Frontera Norte agreed: "In a country like Mexico, the conservation of nature cannot become another element of social inequality," he said. Sánchez and the ITESM researchers see three possible alternatives: ecotourism, aquaculture, and more selective fishing strategies. Hook and line fishing would still be permitted in the proposed protected zone. Vidal suggests that government provide access to such gear to local fishermen to help them make the transition and possibly work as guides for visiting sports anglers. Vidal would also like to see government support for ecotourism, including guided seabird and marine mammal watching.

Mexico has a direct economic interest in encouraging aquaculture. Its share of the global shrimp market shrinks as China, Ecuador, and other countries turn to farming rather than compete for depleted wild stocks. El Golfo de Santa Clara has one small shrimp farm. Robles is exploring with Sea World Inc. the possibility of a breeding program for the totoaba, similar to one Sea World scientists undertook with white sea bass to help restock the Southern California Bight. The ITESM researchers have been meeting with the Bureau of Applied Research in Anthropology at the University of Arizona to study other development options.

While fishing practices pose the most immediate danger to the vaquita and the upper Gulf, a major environmental change may also be at work. The Colorado River no longer transports sediment, nutrients, and fresh water to the delta below the border, and to the upper Gulf. The river has been diverted to farms and cities both north and south of the border. Once-extensive wetlands and riparian forests have receded in the delta. With a matching grant from the U.S. Fish and Wildlife Service, the Sonora Ecology Center, Hermosillo, is developing a plan to protect remnant wetlands that host the endangered Yuma clapper rail and desert pupfish. At the MEXUS conference, Mexico's Secretary of Fisheries, Guillermo Jimenez-Morales, noted that flow reductions "have limited the scope of the measures applied for the conservation and protection of the species."

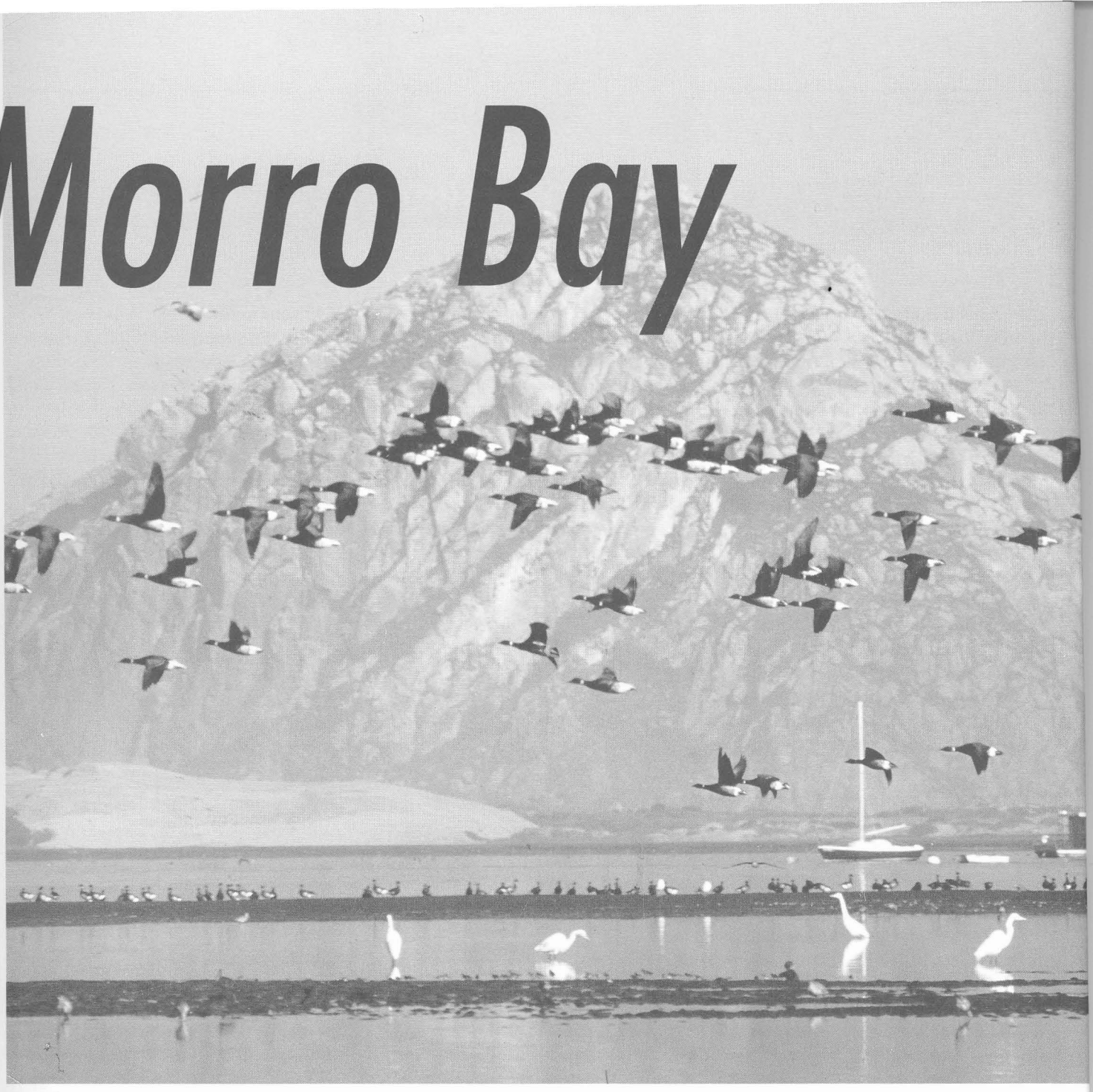


WESLEY MARX

Omar Vidal (left) and Lloyd Findley examine the perserved corpse of a vaquita. "This is the smallest of all cetaceans. It is also the most endangered," said Vidal.

Wesley Marx's latest book is The Frail Ocean: A Blueprint for Change in the 1990s and Beyond.

Morro Bay



ROLAND AND KAREN MUSCHENETZ

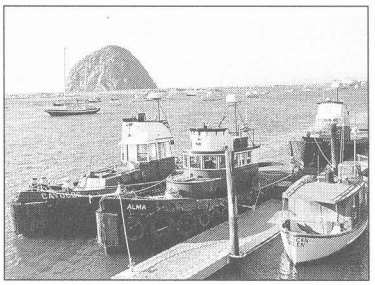
"Let us create a vision and challenge the institutions to accomplish it."

What does it take to move diverse interests in a community to unite and work together to protect an estuary?

Morro Bay has some answers.

By Steve Eabry

Mention Morro Bay on the central California coast and different pictures come to mind. For many people, it is Morro Rock, centerpiece of a scenic harbor village. To some, it is dinner in a favorite fish and chips restaurant, watching fishing boats and pleasure boats rocking gently at a misty dock. Morro Bay is the place where thousands of birds can be observed in the mud flats, great blue herons roost in the eucalpytus, and abalone and oysters are cultivated offshore. Until recently, however, few of the people who know Morro Bay were aware of it as an important estuary, inseparable from its watershed.



Carol Arnold

Now a larger sense of place has taken hold, thanks to a joint effort by a broad cross-section of the local community together with local, state, and federal government agencies. This effort lasted for more than five years and culminated in a plan for action to protect the natural resources of the bay and watershed. It brought public funding for innovative projects and made Morro Bay a model for effective citizen action as far away as the Great Lakes. This community now has a conservation ethic and a start toward a future that will allow for growth without sacrificing the assets that underlie both the local economy and its quality of life.

GOLDEN STATE AERIAL SURVEYS

Aerial view of Morro Bay and surrounding area, taken in January 1988. The peaks in the center foreground are the morros.

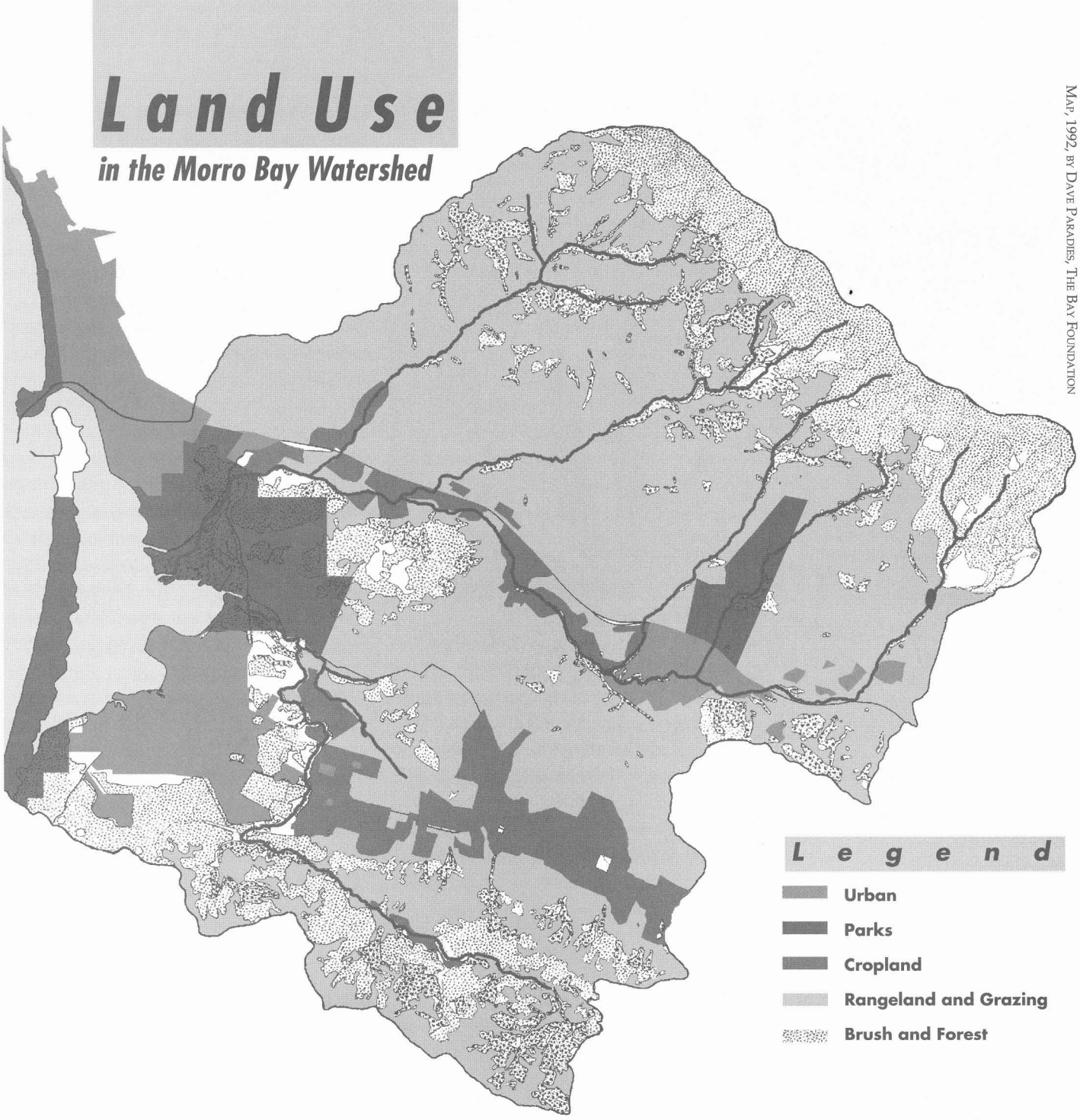
The 2,300-acre Morro Bay estuary is in San Luis Obispo County, midway between San Francisco and Los Angeles, at the western end of two coastal valleys. The city of Morro Bay (pop.10,000) snuggles against the only all-weather small craft commercial/recreational harbor within 100 miles in either direction. At the harbor entrance looms Morro Rock, a spectacular 587-foot-high stub of an ancient volcanic peak, the protected nesting place of a pair of American peregrine falcons. At the northern end of town stand the three stacks of the Morro Bay Pacific Gas and Electric generating plant.

Its remoteness from major population centers has until recently protected Morro Bay from the irresistible development pressures that have led to the loss or major alteration of the 27 other estuaries of significant size between here and Ensenada, Mexico. With the consequent loss of habitat, this bay's importance to wildlife has grown. Some 25 migrant and overwintering waterfowl and up to 24 species of shorebirds can be seen here. Brown pelicans hunt and rest along the beaches. The snowy plover nests and forages on the sand spit. Sea otters play offshore. At the south end of the bay, 17,000 people live in the residential community of Los Osos/Baywood Park, built on stabilized dunes. Adjacent to it, a patch of scrub is the last remnant habitat of the most endangered mammal in California: the Morro Bay kangaroo rat.

Morro Bay's 75-square-mile watershed is a broad basin shaped by two mountain ridges, the San Luis Range and the Santa Lucia Range. A series of 11 volcanic plugs, known as "morros," extends from Morro Rock to Cerro San Luis Obispo at the western boundary of the city of San Luis Obispo. It divides the watershed into two drainage basins, the Chorro and Los Osos valleys. The uplands and valleys are largely in agriculture (both dry and irrigated cropland and pasture) and state park land. Urbanization is clustered on the coast, and also inland at Camp San Luis, the California Men's Colony, and Cuesta College. Development pressures have accelerated lately—San Luis Obispo is now one of the fastest-growing counties in the state. But this bay's shoreline is still far less developed than most others on the California coast. A wide variety of indigenous life forms survives here.

Could the Bay Be Dying?

For some decades, however, people who



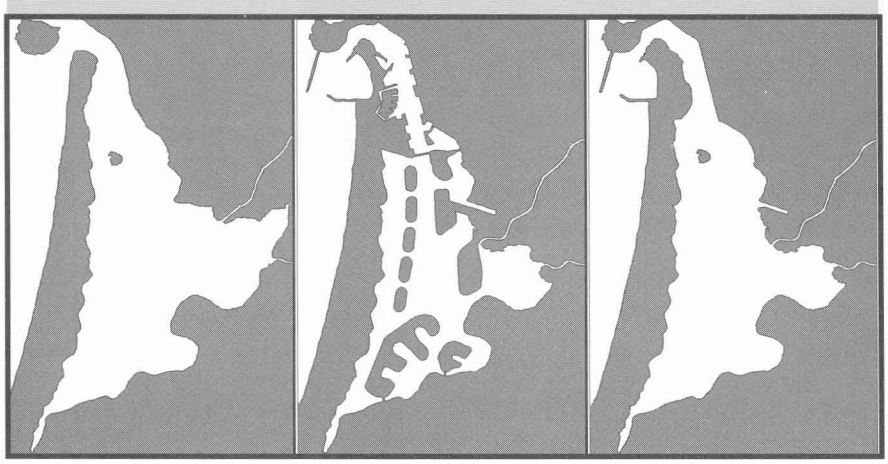
MAP, 1992, BY DAVE PARADIES, THE BAY FOUNDATION

live on the bay or visit it regularly have been noticing some alarming changes caused by rapid sedimentation. Some thought their bay was actually dying. They saw algal blooms. The southern end of the bay was filling in. Boats were getting stuck at low tide. A bridge that had been a perch for fishermen angling for steelhead in ten feet of water in the early 1960s was now so low you could barely crawl under it. In winter storms it tends to flood, closing the road that links Los Osos with Morro Bay and Highway 1. Although estuaries age naturally and most eventually turn to marshland and dunes, what would naturally have taken thousands of years was happening here at a much faster pace. Did the Morro Bay estuary have a future?

The question had been considered by government agencies as far back as 1966, when the state senate adopted Resolution 176, declaring the estuary to be of "utmost importance to the people of California." The resolution noted the estuary's abundant "fish, wildlife, recreational, and esthetic resources," and directed the Resources Agency

States of the Bay

In 1919, Morro Rock was an island, with harbor entrances to its north and south. The delta was about 200 acres. In 1960, the rock was linked to the mainland. Marinas, condo islands, and a major hotel on the sand spit were proposed. Now the harbor entrance has safety problems and needs frequent dredging. Sedimentation has expanded the delta to about 400 acres.



1919 1960 (proposed) 1992

DAVE PARADIES, THE BAY FOUNDATION

to conduct a study and prepare a plan for the preservation of those resources. In 1971 a planning task force of state and local agencies was formed under the direction of the county planning director to take on the senate's assignment. Three years later, the San Luis Obispo County and Cities Area Planning Coordinating Council allocated $100,000 ($20,000 from the county, $80,000 from the U.S. Department of Housing and Urban Development) for a Comprehensive Environmental Plan. A consultant was hired, and a wonderful plan was completed, noting that "the ecological balance of the bay depends heavily on the condition of the watershed" and recommending measures for maintaining that balance. It was published in 1975 and promptly forgotten.

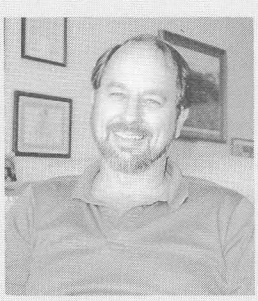
Ten years passed. Morro Bay continued to silt in. Don Parham, a retired engineer who lives on the south edge of the bay, saw through his living room windows that upland grasses were taking hold where mud flats had been, while areas that had been under water most of the time turned to mud flats at low tide and stayed exposed for ever longer periods of time. Marine biologist Bud Laurent, patrolling in a kayak as marine resource manager for the Department of Fish and Game, documented the process with photographs. At the going rate, the bay would soon disappear.

Worried comments about the "dying bay" came to the attention of Carol Arnold, who was working on the completion of a State Coastal Conservancy project to restore a 26-acre site to a wetland and wooded park on the south side of the bay. The Conservancy had been involved here since 1979, when resident protests stopped the Morro Pali-

Voices

PHOTOS: RASA GUSTAITIS

Bud Laurent
Chairman, San Luis Obispo County Board of Supervisors



"The 1975 document was wonderful, especially given its time. It was not used for fear of political sensitivities: fear that it would not have support of the agriculturalists. It did not have the support to make the political institutions clasp it to its bosom. There was no effort to use that document as a springboard for participation and inclusion. That happened later. Now we have real support, I think, for this document. . . .

The task force is held together by our goodwill and concern, since all participation by government and citizens groups is voluntary. Nothing we've done bears any authority. We are largely a discussion and information group. But that has been very valuable in helping other agencies and in looking for grants. . . . The Coastal Conservancy has been the most important player in this scenario, with its interests and contacts with other agencies. The money Carol Arnold was able to get for the initial study by Phil Williams and Associates, the purchase of Chorro Flats—those things are very important to keep up the group's enthusiasm. Most of us understand that this is an incremental, evolutionary process.

The county being the coordinator—the hub of the wheel—has been important. We have planning authority but not fining authority that would be perceived as a threat to landowners or dischargers. We are probably as neutral and safe a coordinating body as could be found. And Steve Eabry has enhanced that with his particular set of strengths. He has provided the glue for the Morro Bay Task Force."

sades Co. from building a hotel on 26 acres of Monterey pine woods and marsh in the south bay. Eventually, the developer had agreed to limit construction to two houses on one acre, donating the rest to the Coastal Conservancy, which then undertook to restore the marsh, build trails and other public access facilities, and turn it over to the Morro Coast Audubon Society, which now manages the Sweet Springs Preserve. This project turned out to be the start of a long involvement for the Conservancy on Morro Bay.

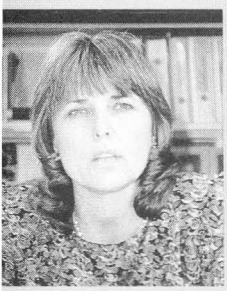
Arnold talked to people in the community and heard of the old watershed study. She found a copy, reviewed it, then called Dan Ray at the California Coastal Commission and found that he also was aware of the sedimentation problem and of the old plan. Arnold and Ray then agreed to organize a workshop of agencies with responsibilities on the bay, to discuss this and other issues. The county agreed to facilitate the meeting, held in June 1986. Participants agreed that erosion and sedimentation were issues of critical concern.

The Conservancy then took the lead in responding by allocating $100,000 to the Coastal San Luis Resource Conservation District (RCD) for a Morro Bay watershed enhancement plan, including a hydrologic study of the bay. The plan, prepared by the U.S. Soil Conservation Service and Philip Williams and Associates, confirmed the problem, assessed its dimensions, and proposed remedies. Hydrologist Jeffrey Haltiner undertook bathymetric surveys of the bay bottom, compared his results with old (1800s) maps, and quantified the decrease of water depth during that time. The Soil Conservation Service identified actions that would reduce sedimentation, focusing on actions to keep sediment upstream. The enhancement plan identified a flat place about a mile upstream on Chorro Creek, where sediment used to spread out under willows. The creek had been channelized, preventing flood waters from spreading out over the floodplain and speeding the flow of sediment-laden water toward the bay. The watershed plan also recommended erosion control work throughout the watershed.

The RCD and the Soil Conservation Service did not leave the planning to experts alone. They organized landowners into a committee and worked with them, as well as with others in the community, thereby building a foundation of citizen interest, understanding, and support. They showed that somebody cared and something could be done.

ROLAND AND KAREN MUSCHENETZ

In 1962 people fished for steelhead from this bridge in 10 feet of water.

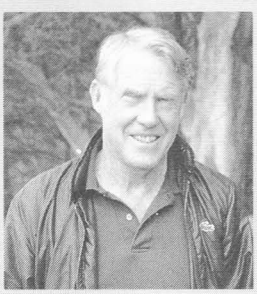


Pat Beck
County planner

"This is the last year for 959 money [Coastal Resources & Energy Assistance Program]—money cities and counties got because we had offshore [oil] projects either proposed or approved that had potential for impacting our county. Our hope was that the National Estuary program would provide federal dollars, with the city making its contribution. We're experiencing cutbacks now, not just because of state cutbacks but because revenues associated with development are down. But I'm a fatalist in that I believe things come in due time."

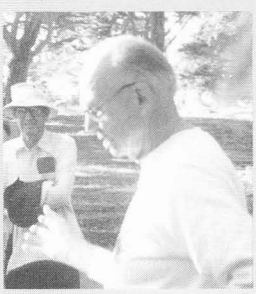
Bill Newman
President, Friends of the Estuary

"We've got a community consensus that we need a management plan, that we want to keep the bay in good shape. The hotel business needs a healthy bay. Commercial fishermen do. Everyone is participating, there is not much opposition. We'll get the job done."



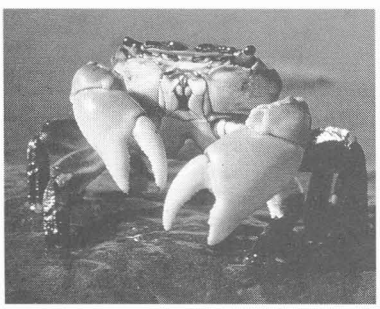
Don Parham
Founding President, Friends of the Estuary

"We've pretty much decided to go ahead and write a management plan of our own. Money's a lot tighter now than it was before—that's something we will just have to work with. If we can get the agencies to continue with their in-kind help, we can get a lot done."



ROLAND AND KAREN MUSCHENETZ

ROLAND AND KAREN MUSCHENETZ



(Upper) Godwits feed in the shallow pools left by the receding tide at sunset. (Lower) Low tide brings out crabs in search of food on the mud flats.

The June workshop reinforced the need for a continuing task force to address estuarine and watershed issues. Pat Beck, the county planner, proposed that the county take the lead in the coordination effort. The board of supervisors approved this plan in 1987, with a part-time position, funded with Coastal Resources and Energy Assistance Program monies. I was hired to coordinate the Morro Bay Inter-Agency Task Force.

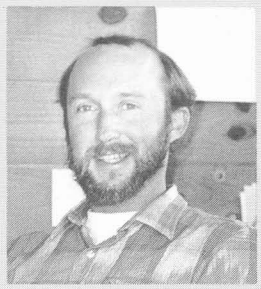
Learning From the Past

As I addressed myself to my job, one question demanded consideration: What went wrong the first time? The 1975 watershed management plan had fallen into oblivion, as, surely, so many good reports had in government offices throughout the country. Why? To prevent a similar fate for this new effort, it was important to find out.

Many people in government were reluctant to talk about it. From the few who would, or who remembered, I concluded that there were two closely related reasons. First, no one "owned" the 1975 plan. It was prepared by a consultant, not even a local firm, and while it was very good, no local agency had a feel for its contents and no reason to implement it. Second, the project director had shown contempt for the public. She had stated publicly that it was "unfortunate" that lay people were getting involved with the review of a final draft, questioning whether they had the expertise to understand the long, technical report. Her view was that critiquing the plan should be left to experts, and that citizen involvement would only make the plan a political football. With this attitude, the experts had the plan all to themselves and they shelved it. The plan was not even adopted by the agency that had paid for it. This was a good lesson for these planners' successors to take to heart.

I quickly realized that my efforts to bring together the various agencies and interest groups could not succeed without full public involvement. In September 1989, a public meeting was held at which the new Morro Bay Task Force was formally launched, including public agencies and all commercial, industrial, and public interest groups with concern for the bay and its watershed. We adopted a mission statement: "Let us create a vision and challenge the institutions to

Voices



Scott Robbins
Project leader, U.S. Soil Conservation Service, Morro Bay Watershed Enhancement Project

C&O: *What brought you to Morro Bay?*
SR: I was hired to open an office here to implement the enhancement plan funded by the Coastal Conservancy and to lead the enhancement project. The plan has three phases: first, land treatment, working with ranchers, farmers, and other landowners in the watershed, trying to convince them to use soil conservation practices on their land; second, the Chorro Flats project [to restore a marsh as sediment trap for Chorro Creek]; third, some kind of sediment trapping wetland for Los Osos Creek [the second creek emptying into the bay]. We're in the middle of the second phase now.

C&O: *Is it unusual for the Soil Conservation Service to be doing this kind of watershed management work?*
SR: The watershed approach was emphasized in the 1930s and 1940s but a lot of time we've been guilty of band-aid work—fixing a gully here, a stream bank there, without looking at the whole watershed. Now we're finally realizing that you can't keep doing that forever. You have to treat the management that created the problem. We've had education programs on that, and we work with 4-H—a lot of what we do is for future generations. If we don't teach young people sound practices, they'll make the same mistakes we do.

C&O: *What's the relationship between your agency and resource conservation districts?*
SR: The best way to explain it is to go back to the beginning. In the 1930s, during the Dust Bowl, the federal government saw a need for the Soil Conservation Service, to give farmers technical advice on conservation. Franklin Delano Roosevelt thought: how will farmers take to a bunch of college educated people coming in to tell them how to farm? So in every county they set up a group of farmers, locally elected mostly, to advise the Soil Conservation Service and work with us. Over the years we have become partners.

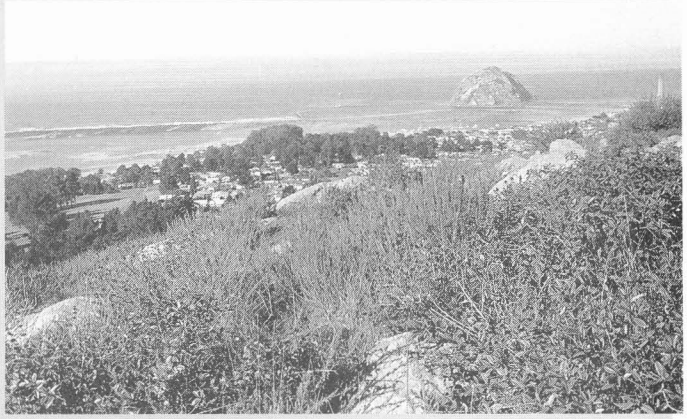
C&O: *Similar to the relationship between the Coastal Conservancy and RCDs and nonprofit land trusts. What can you offer?*
SR: Financial and technical assistance. We have the $400,000 from the Coastal Conservancy to the RCD. And because we had the enhancement plan and the task force, we have been able to get funding also from the U.S. Department of Agriculture and the Regional Water Quality Control Board. Once you have a plan and a solution identified, it's much easier to get this type of funding.

C&O: *What erosion control project here stands out for you?*
SR: The biggest and best we'll probably do here is the demonstration project on John Maino's property. We're trying to demonstrate to local ranchers how a guy can use time-control grazing to improve ground cover on the ranch, improve production of cattle, and improve wildlife. This management philosophy can turn ranchers into ecologists and turn environmentalists on to the fact that ranching can improve the land rather than being destructive.

C&O: *Does the farmer gain or lose economically?*
SR: He gains because he'll probably have a longer green feed period, and a lot of times he can have more animals on the land than he can on a continual grazing system.

C&O: *You are also working to stabilize stream banks, and on smaller erosion control projects. Why do farmers not solve these problems before they get bad?*
SR: They need technical assistance. They know they have a problem but maybe don't know what's best to do. And they need financial assistance. They may want to take care of it, but have to spend money on seed and have to put it off.

C&O: *So the creek is damaged, the land erodes, and that may affect his ability to stay in farming?*
SR: That's right. Soil is the farmer's basic resource. If he loses its productivity, he is taking it out of his bank account.
We're also working on the estuary. We helped the county stabilize a landfill on Los Osos [creek]. The county had just finished closing it off when we had the "March Miracle" [storms after a dry winter]. We estimate 80,000 tons [of soil] were lost—there were huge gullies—and most of that went into the bay. We gave the county technical advice to prevent it happening again. Last year we had seven inches of rain in a week, and the thing worked pretty darn good.



CAROL ARNOLD

Protection of the upper watershed keeps sediment out of the bay.

C&O: *Do you expect ranching to stay in the area?*
SR: Yes, it's really the highest and best use of these hillsides.

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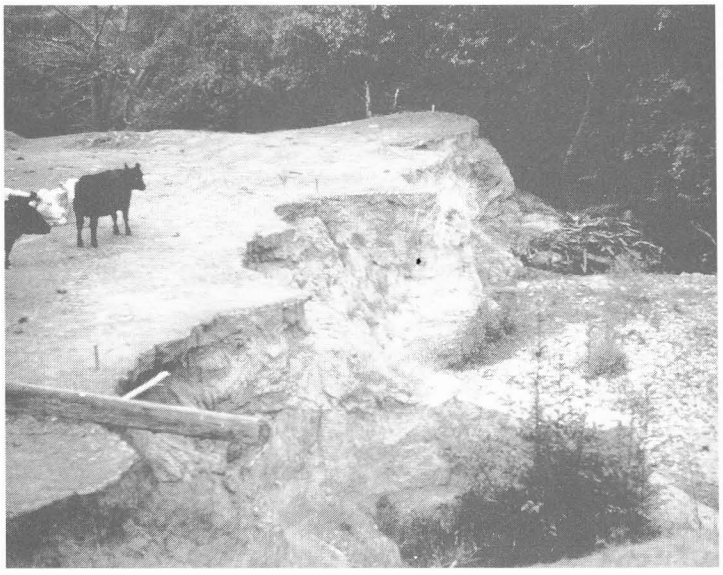
CAROL ARNOLD



LAUREL MARCUS

(Left) Vast amounts of soil washed into the bay from a newly covered landfill during March rains. (Right) Without erosion controls, cows can cause major damage to streams.

accomplish it."

At 8 A.M. the next morning I had a phone call from Jean Cartwright, who was active in many social and environmental organizations. "You know what you need?" she started out, and told me: "We have all these environmental groups with some interest in the bay, but none focused just on the bay and the watershed." Within a week she had joined with Don Parham and Eileen Bowen, who also is active in the Audubon Society and the Natural History Association, to launch the Friends of the Estuary. The organizational meeting drew 120 people—a very high turnout for this area—and it was for, rather than against, something. With Parham as president, the group's membership swelled to 2,000 within the year. The Friends pursued the Morro Bay cause in Sacramento and in Washington.

The task force met quarterly and supported the growing number of initiatives, from the RCD, the Friends, and others concerned with the bay. All its work was voluntary. It had no formal authority. For it to be effective, its members had to keep up a high level of interest, see some results, and appreciate the common cause within their many perspectives. My job was to make sure these requirements were met and to keep the information flowing. The county was very supportive. Pat Beck allowed me a level of flexibility rare within government. She showed me that one of the best things government can do is to facilitate what the community wants. The Coastal Conservancy played a vital role, with step-by-step commitments of technical assistance and funds that encouraged morale by demonstrating progress. Upon completion of the enhancement plan in 1989, the Conservancy provided $410,000 to the Coastal San Luis Obispo Resource Conservation District to begin implementation of erosion control work.

Two pioneering projects were launched by the RCD with Conservancy funds and cost-sharing by landowners: an experiment in "cell grazing" designed to reduce erosion, restore native vegetation, and allow cattle ranchers to make more effective use of rangeland; and the purchase of land at the site pinpointed by the enhancement plan on Chorro Creek for restoration as wetland that would trap sediment. (See sidebar.)

According to Bud Laurent, now chairman of the county board of supervisors, "the Coastal Conservancy has been the most important player in this scenario, with its interests and contacts with other agencies." Conservancy projects served as catalysts for leveraging funds and commitment from other agencies. The RCD, working closely with the Conservancy and the task force, sought these funds energetically and effectively.

With the hydrologic study and the enhancement plan in hand, the RCD was able to convince the U.S. Department of Agriculture to designate the watershed a Hydrologic Unit Area. In 1991, the USDA provided

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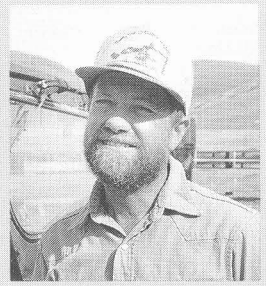
Voices



John Maino, a family rancher, runs beef cattle on 1,850 acres of hills off Route 1, between Morro Bay and San Luis Obispo. He grew up on a dairy ranch, was graduated from California Polytechnic State University and Colorado State University, in animal science, and is the first family member to live on this ranch, most of which was bought by his grandfather in 1916. He is experimenting with time-control grazing (also called cell grazing) in a $100,000 project funded largely by the State Coastal Conservancy through the Coastal San Luis Resource Conservation District. Instead of ranging throughout the grazing lands, under this system the cattle are confined by fences to smaller areas, and periodically moved. Strategically placed watering troughs also serve to redirect their movements.

CAROL ARNOLD

New water tank for time-control grazing system.

JM: I became interested in time-control grazing a number of years ago, at a seminar by a wildlife biologist named Alan Savory. He popularized this concept in this country. Traditionally, on California annual rangeland it was thought that the way to go was continuous grazing at a moderate rate. After I went to that seminar I decided to try cell grazing, and I started to see some changes and real advantages. Some of the riparian areas saw rest they had not seen before. Grasses started to grow and cover the sides. There was a decrease in trailing, and we started to see some perennial plants greening up more, as well as other types of vegetation. Usually with shrubs, maybe they'd green up and the cattle would nip them right away. With time-control grazing the cattle wouldn't be there for six or eight months, maybe.

California was perennial rangeland until the Spaniards came and introduced annual grasses that were very aggressive. Maybe we're trying, to a degree, also to increase perennial grasses. If they green up before the rains, they have a longer growing period, so we can capture solar energy for a longer period of time. And that's what we really have to harvest and sell. So the energy conversion can be much greater, and yet we can increase the number of perennial plants that are out there.

Another thing: the watering areas used to be cattle refuse areas. All the manure was deposited right there. But in this system, they will deposit nutrients all through the paddock rather than just by the water trough, so the nitrogen will spread out.

C&O: *But the perennial grasses were not grazed before the Spaniards came, at least not by domestic animals.*

JM: There were grazing herds of elk. One of the things Savory had seen in Africa was animals coming into an area and pretty much denuding everything around. Then they leave and don't come back for, maybe, a year. Grazing pressure was always there, but not continuously. Overgrazing is a function of time, not of numbers.

C&O: *Seems like you'd also end up with more volume in plants.*

JM: That's a good point. First growth comes from the root stores because the plant can't capture solar energy. As it comes up, growth accelerates on solar energy. Then the plant matures and growth levels off. So you want to keep animals in that steep growth curve. Oh yes, you can hopefully get more productivity.

C&O: *Is there research on this method?*

JM: I wish there was. I don't think there are enough of these grazing cells around yet . . . I think a lot of times the universities are not as out there as they should be. Also, these systems are expensive to put in.

C&O: *Depends on what you count. What if you count the costs of ranchland erosion downstream?*

JM: Yes, some water quality questions come in, and the question of who should pay for this. Our land is zoned agricultural, and we have made a commitment to agriculture, so we have given up, to a degree, what might be highest and best use of the land—houses, golf courses. Society wants us to do that, and so I think society needs to help out a bit. We need to keep our land in production, and I think grazing is the most ecologically sound production you can get on these hills. To me the ruminant has a tremendous advantage [over vegetables, for instance] in that it harvests solar energy and natural rainfall in forms we can't utilize, and it converts that solar energy into useful meat products and maybe byproducts. Managed properly, the grazing animal can have tremendous value. If managed improperly, it no doubt can abuse the land.

If this works out, maybe we will establish that we not only help the quality of the rangeland but also can increase our

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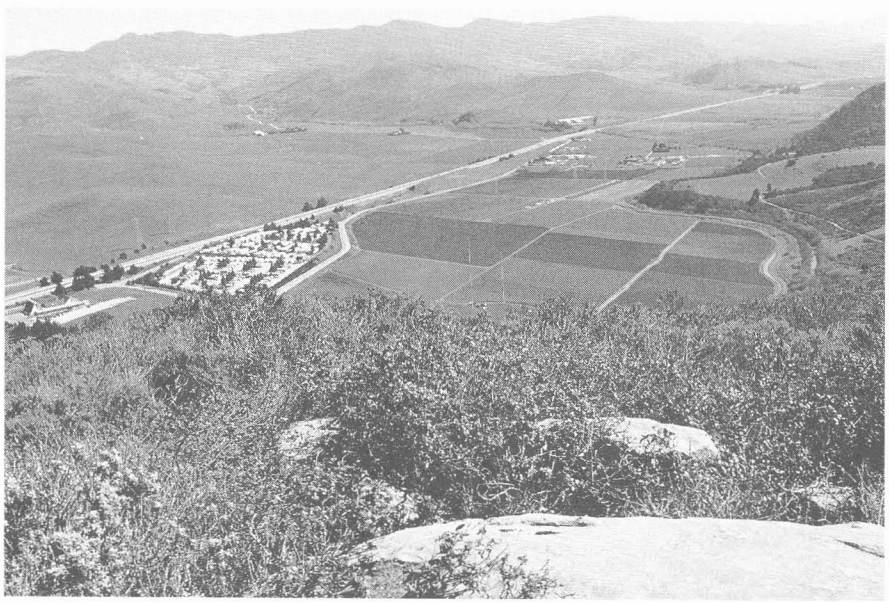
Chorro Flats

To prevent sediment from clogging a body of water, you must either keep the soil on the land or trap sediment upstream. The Morro Bay Watershed Enhancement Plan recommends both methods, and the State Coastal Conservancy is working with both.

To reduce erosion on ranch and farm lands, the Conservancy has provided $400,000 to the Coastal San Luis Resource Conservation District, enabling it to undertake several demonstration projects. Most of the Conservancy's effort and funding, however, have gone toward trapping sediment upstream. The focus for this work is a 127-acre property about a mile upstream on Chorro Creek.

This land, now called Chorro Flats, was once known as Chorro *ciénaga* (swamp). Here, under willows and riparian vegetation, the creek's floodwaters spread, slowed down, and released sediment. In the 1950s the creek was diked and confined to a narrow channel along the southern edge of the property. This allowed adjacent land to be used for irrigated vegetable crops in rich, stream-deposited soils. But the sediment coming downstream no longer spread on the land, it remained suspended in floodwaters, traveling down to the bay floor.



CAROL ARNOLD

Chorro Creek, at the right, will be freed from its channel so its flood waters can spread over the flats, holding back some of the sediment that now flows into the bay. View is from Black Hill, looking east.

The Conservancy analyzed this property and saw a prime opportunity to restore the former "swamp" to its prior state as sediment trap and recreate riparian wetlands, while also preserving agriculture on part of the site. After two years of negotiation with the landowner, an agreement was reached whereby the Conservancy would provide funds to the Coastal San Luis Resource Conservation District (RCD) to acquire and restore the site.

As the cost of purchase, $1,300,000, would require other funds besides those available to the Conservancy, the agency applied for and received over $800,000 from Proposition 111 funds. These are monies accrued from gasoline taxes and administered by the California Department of Transportation.

The RCD is preparing a plan to restore the property by constructing a sediment basin, replanting willow and other riparian plants, and retaining a portion of the site for agriculture that will use practices sensitive to the site's natural resources. Some public access will be provided, with interpretive signs to educate visitors about the important wetlands of Morro Bay and the value of agriculture in the watershed.

Combined with the erosion control work in the watershed, the restoration of the Chorro Flats property is expected to achieve a reduction in sedimentation of about 47 percent, enough to extend the life of Morro Bay by many years.

—Carol Arnold

DAVID MIDDLECAMP, *THE TELEGRAM-TRIBUNE*

The Chorro Delta of Morro Bay, looking southwest from Black Hill, over marshes.

Continued from page 16.

funds for education and technical and financial assistance in that unit to three of its agencies: $60,000 a year for five years to the USDA Cooperative Extension for adult education and the 4-H watershed environmental education program; $100,000 a year for five years for cost-sharing assistance on conservation practices from the USDA Agricultural Stabilization and Conservation Service; $140,000 a year for five years for technical assistance by the Soil Conservation Service.

In 1991, the Environmental Protection Agency provided $163,000 to the RCD through the Central Coast Regional Water Quality Control Board to hire a soil conservationist to provide technical assistance to landowners and overall leadership to the enhancement project. The RCD used these funds, together with the USDA funds, to establish and expand a Soil Conservation Service field office in Morro Bay.

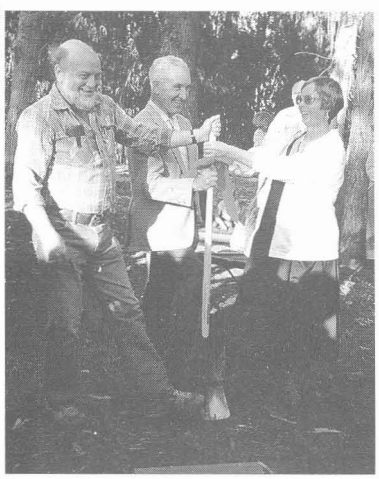
In December 1991, The Coastal Conservancy and CalTrans provided $1.35 million to the RCD to purchase the Chorro Flats parcel, for enhancement to trap sediment on Chorro Creek, thereby also reducing floods at the bridge on South Bay Blvd. (See sidebar.)

In 1992, the work done thus far persuaded the federal Environmental Protection Agency to award a grant to the Regional Water Quality Control Board ($100,000 a year for ten years) for a paired watershed study to monitor the effectiveness of instituting best management practices. California Polytechnic State University, San Luis Obispo, will do the research. The board dedicates one full-time biologist position to Morro Bay watershed activities—the first biologist in an all-engineering office.

One success built on another. The Coastal Commission chose the Morro Bay Watershed as a pilot project for analyzing existing management of nonpoint source pollution, such as sedimentation. This will eventually become a statewide effort. The Wildlife Conservation Board allocated $47,300 in 1992 to the RCD for erosion control and steelhead habitat enhancement on Chorro Creek. And Camp San Luis, a National Guard facility, just recently contracted with the Soil Con-

servation Service for the development of a management plan for its 6,000 acres. Working cooperatively through the task force, the community was able to bring in resources that it could not have tapped otherwise and to undertake projects that had never been done before—this despite the growing shortage of funds at all levels of government.

As these projects advanced, the community's interest in the bay grew. But it was apparent to me that most people still did not understand the dynamics of the estuarine system and the watershed, what was important about wetlands, how the harbor end of the bay related to the back bay, how stream flow and runoff were linked to the fact that pleasure boats could not get out of the state park marina during low tide. I asked a number of people and groups whether there was interest in holding a conference on these and other topics to raise the general public's awareness. Many thought it was a good idea, and we began to plan.



EILEEN BOWEN

(From left) Phil Persons, Al Switzer and Carol Arnold at the groundbreaking ceremonies for the Sweet Springs Reserve.

We gave ourselves one and a half years and formed a steering committee that represented a spectrum of bay users: government agencies, the hotel association, Pacific Gas and Electric, commercial fishermen, private consultants, the Harbor Festival, and all local environmental groups. When someone suggested that it was a waste to do so much preparation for one event, we decided to offer a column about the estuary to the local newspapers, to get people interested in the issues and to start looking forward to the conference, to be held in 1991.

The "State of the Bay" column ran in three local newspapers every two weeks for a year and a half. It was an all-volunteer effort. Forty local experts wrote on 60 topics, including natural history, geology, culture, and policy. When the "State of the Bay" conference was held in October 1991, with solid media support and leadership by the Friends, 1,400 people came out for its nine days of educational activities. At a two-day teachers' workshop, 120 teachers learned to use the bay as a laboratory and to bring estuarine principles into the classroom.

Anatomy of a Nomination

Meanwhile, the Friends of the Estuary and the Bay Foundation pursued their related but separate missions. As of 1992, the foundation had completed a study of freshwater inflows and urban runoff, funded with $35,000 from the county, and had established an estuarine research library in conjunction with Cuesta College and Pacific Gas and Electric. It is now completing a computer bibliography of estuarine materials applicable to the bay and also a major watershed modeling project that will allow an understanding of the bay's ecosystem.

The Friends, meanwhile, worked to win inclusion for the bay in the Environmental Protection Agency's National Estuary Program (NEP), thereby continuing the work begun by the task force with a new infusion of resources. The NEP is a planning program designed to involve the entire ecosystem. Its goal is to bring together all federal, state, and local governments, affected industry, and citizen organizations and to create, by building consensus, a comprehensive conservation and management plan to protect, enhance, and restore the entire ecosystem. To be selected for the program required a nomination by the governor and selection by the EPA administrator. There are 17 national estuaries, two in California: San Francisco Bay and Delta, and Santa Monica Bay.

The Friends of the Estuary and others were lobbying for such a nomination by Governor Deukmeijian but made no progress until fall of 1989, when Don Parham suggested that we needed a nomination package, and that we should prepare one ourselves. The Friends invited 14 local experts to a meeting. All agreed to work on the task and all met the deadline: two weeks. With a little bit of editing, it was on its way to Sacramento within a month. The late Assemblyman Eric Seastrand introduced Concurrent Resolution No. 118, which affirmed the importance of Morro Bay and called for the nomination. The legislature passed it on June 29, 1990. Governor Deukmeijian agreed to make the EPA nomination, but it was an election year and other priorities took hold. Governor Wilson took the step in May 1991, with support from both senators, the two

Continued on page 23.

Endangered Kangaroo Rat Cornered

The innocuous Morro Bay kangaroo rat, which looks like a small gerbil, is "probably the most critically endangered mammal in California," according to the Department of Fish and Game. None have been seen in the wild since 1986, when biologists counted 50 on a 200-acre parcel of coastal scrubland by some spacious homes in Los Osos, overlooking south Morro Bay.

How many—if any—K-rats survive on this property is unknown because its owner, Morro Palisades Co., refuses to permit federal and state biologists access to it. "If the agencies want to protect the rats, they can buy the land from us," said Al Switzer, a partner in the firm. The catch is, however, that without knowing there are rats on the parcel, the agencies cannot make a strong case for a purchase that could cost between $5 and $10 million. Some K-rat advocates charge that Morro Palisades Co. is singlehandedly dooming this mammal to extinction, for the longer protection for it is delayed, the grimmer its prospects. Switzer said he has "no sympathy for the rats. Right now, horses, bikes, cats, and walkers cross the property. I definitely feel the rats are harmed by this, and the only way they will be protected is if the agencies buy the property. But don't ask us to protect the rat to our detriment. We're being denied the use of our own property."

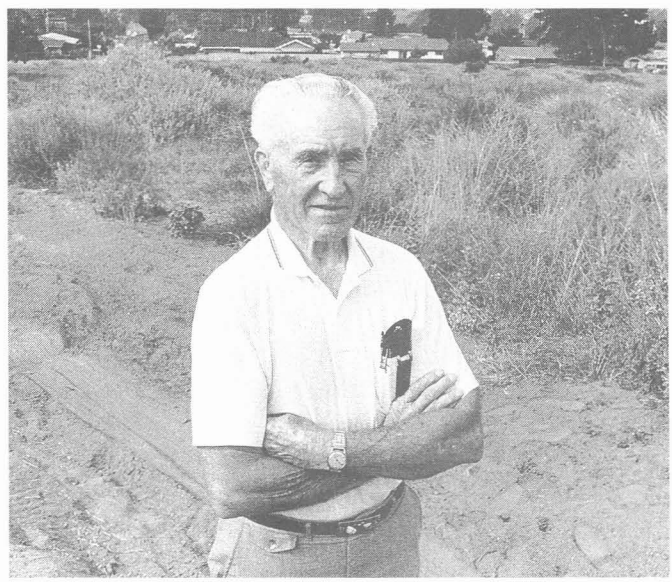
Switzer's firm hopes to build houses with bay views on the parcel. Because the land is officially endangered species habitat, however, he needs a permit from Fish and Wildlife. To consider a permit application, Fish and Wildlife needs to see a habitat conservation plan that specifies how the K-rat would be preserved. In 1986, the Coastal Conservancy authorized $24,750 to San Luis Obispo County to prepare such a plan. Its goal was to set aside critical habitat areas and to designate where development could occur. The plan remains incomplete today. One major reason: no access to the habitat.

Whether this 200-acre site can still serve as K-rat habitat is an open question. "You're not only dealing with the sprawl of Los Osos, but the variable pattern of habitat required by the K-rat," notes David Sears, district superintendent of the State Department of Parks and Recreation. "K-rats prefer low vegetation that lets them see each other and hopefully breed. " Naturally occurring fires used to provide this habitat. But fires are incompatible with housing developments.

Under Sears' supervision, since 1984 about 100 acres of land in the nearby Montaña de Oro State Park have been subjected to controlled burns and revegetation to create habitat for K-rats, in hopes some will be transplanted there one day. If any rats still exist on the Morro Palisades Co. parcel, they are now are isolated on their 200-acre island, with no corridors available to encourage them to move on their own.

Lack of access to the only known K-rat habitat has also been a major obstacle to efforts to build a successful captive breeding program. A recovery plan prepared in 1982 for the Fish and Wildlife Service by Aryan Roest, professor emeritus at California Polytechnic University, calls for rats to be captured on private land, bred in captivity, and then released to public lands with suitable habitat where they can be protected and monitored. Roest managed to breed some in the 1980s, though "getting these rats to mate is very labor-intensive and difficult because the female

THE TELEGRAM-TRIBUNE



DAVID MIDDLECAMP, THE TELEGRAM-TRIBUNE

(Upper) The Morro Bay Kangaroo Rat is California's most endangered species. (Lower) Al Switzer, partner in Morro Bay Palisades Co., which owns the last known habitat of the K-rat, refuses to allow biologists on the property to ascertain how many are left.

CAROL ARNOLD

CAROL ARNOLD

(Left) K-rats in captivity for breeding. (Right) K-rat preferred habitat.

can kill the male," he said. Only one of the offspring survives, at the National Zoo in Washington, and it is too old to reproduce.

The only known place where K-rats might be found for captive breeding, or for translocation, is the Morro Palisades property. By now, however, it may be too late to try, even if the property owner were suddenly to grant access. "We'd have to do a risk assessment before moving the species. We can't hammer the final nail in the coffin," comments Naomi Mitchell, wildlife biologist at Fish and Wildlife.

Is this the end, then, for the Morro Bay kangaroo rat?

The Fish and Wildlife Service recently assembled a recovery team of kangaroo rat experts to consider what to do. Attempting to purchase the 200-acre habitat parcel might still be an option. No single agency can come up with the total purchase cost. The Wildlife Conservation Board (the real estate arm of Fish and Game) said it is willing to pay part, if Fish and Wildlife also contributes. That agency is awaiting recommendations from the recovery team.

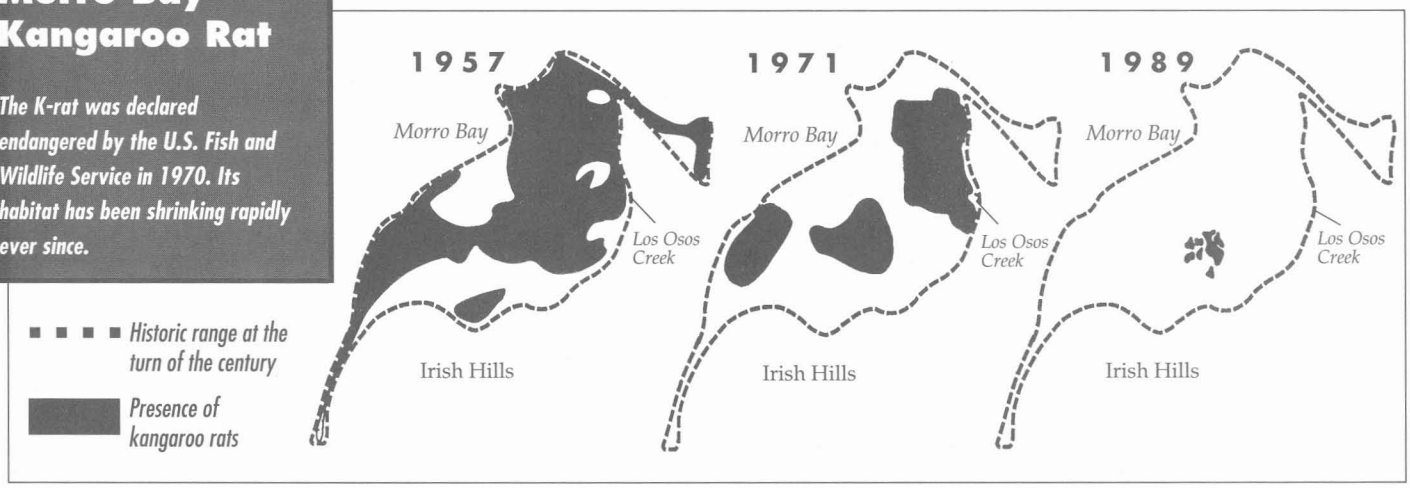
"Even if Fish and Wildlife decides to contribute [money toward the purchase], it would take about three or four years to accomplish the acquisition and require an appropriation from Congress," says Mitchell. Would that not be a costly gamble? she was asked. "Of course it's expensive," she responded. "They don't call it 'Bayview' for nothing—but there's no verbiage in the Endangered Species Act that says a species is too far gone to make it worthwhile."

Meanwhile, Bud Laurent, chairman of the County Board of Supervisors, estimates that the human population of Los Osos will double to about 28,000 by 2010.

—Regina McGrath

Distribution of the Morro Bay Kangaroo Rat

The K-rat was declared endangered by the U.S. Fish and Wildlife Service in 1970. Its habitat has been shrinking rapidly ever since.



MAPS BY ROGER GAMBS, BIOLOGICAL SCIENCES DEPARTMENT, CAL POLY, SAN LUIS OBISPO

Continued from page 20.

congressmen representing the watershed, and many others, including the California Coastal Operators Group, representing the oil industry—an ally not easy to win. The package he sent to Washington was essentially the one our volunteers had put together a year and a half earlier. Only administrative sections had been modified.

Now our efforts shifted to Washington. If the EPA administrator chose us as an estuary of national significance, he would convene a management conference. This conference is a four-to-five-year planning process to develop a management plan for the bay and its watershed. It would enable work to continue when other funding sources dried up. California resource agencies, including the Coastal Conservancy, were badly hit when voters rejected the 1990 Parks and Wildlife bond issue (Prop. 149), a principal funding source. (No such initiative was on this November ballot.) We were one of ten estuaries vying to be among the three chosen. On October 26, 1992, the disappointing news came: The estuaries selected were Tillamook Bay, Oregon; San Juan Harbor, Puerto Rico, and Corpus Christi, Texas. We were not.

This was crushing—but we knew, all along, that we were going for a long shot and lacked the political clout of some other states in this election year. The failure to win that golden ring does not cancel what we had gained. The task force had brought together a team that knows it can accomplish a great deal. The structure that has been put into place will remain, and many programs will continue. The RCD's and Conservancy's Morro Bay watershed program and the task force are being used as a model elsewhere. In 1990, representatives of the Morro Bay Task Force were invited to Saginaw Bay, Michigan, to help leaders from the Great Lakes identify ways to strengthen community involvement in lakeshore and watershed projects.

In a support letter for our nomination to EPA Administrator William K. Reilly, former Coastal Commission staffer Dan Ray, now with the McKnight Foundation in Minnesota, wrote: "I am convinced that further

Voices *Continued from page 17.*

stock. Maybe there comes the payoff to the rancher. This is not a life style where you get rich, it's one that people have to be committed to and enjoy. Most of it is a multigenerational thing, where it's a part of you. I think people in this care deeply for the land, but at the same time you have to pay the bills. If it doesn't rain for the next three years this system is not going to help, of course.

C&O: *Have you been involved with the watershed planning for Morro Bay?*
JM: I was on the landowners' advisory committee. When I first heard about it, I was mainly interested in knowing what sort of regulations are in store for us now in the coastal zone. But I learned there would be funds for practices in the watershed, real money, not just a few thousand dollars for plugging up a gully, which in my mind is just treating the symptom. So I started looking around for ways to get involved and realizing that it was nonregulatory—I looked for ghosts in the closet and didn't see that many—I talked with the rest of my family and with Scott [Robbins] of the Soil Conservation Service. He knew I was interested in time-control grazing. So it was just being at the right place at the right time. Maybe we can change our ways of managing so we don't need the band-aids.

C&O: *How do you expect to see this community ten years from now?*
JM: I would like to see agriculture held in esteem. A lot of people coming here, they're escaping an urban environment they couldn't stand, and then it's "Katie, bar the door." I understand that. But a lot of them look at agriculture as open space and it's not open space. They don't care if you make a living. That's probably mainly being uneducated. Some people see cattle as degrading the environment, but these hills are not suitable for farming. That's what caused the erosion here: a third of the ranch was farmed. I think we are the best stewards of the land, but we need some understanding and help from the community. ❐

Voices *Continued from page 15.*

C&O: *"Highest and best use" means the use that makes the most money off land, doesn't it?*
SR: You could probably make a lot more money if you put hotels and condos on these hillsides, but ranching is the most appropriate use. People here like the open atmosphere. They don't want to drive from here to San Luis and see houses and stores all the way.

C&O: *People usually don't like that, but it happens.*
SR: It's very fragile. Every time you have an election for the county board of supervisors it could go one way or another. If the wind starts blowing for the developers, you may have a general plan and a land use element but it still comes down to five people sitting on the board of supervisors.

C&O: *But you have a better chance now, with the community so involved with the watershed planning?*

SR: Oh yes, much better. ❐

CAROL ARNOLD

San Luis Obispo County is one of the fastest growing counties in the state.

development of the Morro Bay program will reveal many new lessons we can draw on—lessons much more applicable in most midwestern waters than those gained in the large, urbanized, grossly contaminated and damnably complex estuaries now over-represented in the National Estuary Program." This year, the Morro Bay program is being used as a model by nonprofit organizations seeking to strengthen management of key reaches of the upper Mississippi River.

What we envision for Morro Bay may take time, and we have to expect some setbacks. After all, what we are doing now on the watershed began way back. We are now coming together to develop a management plan without the National Estuary Program. It could be said that we were continuing what the 1975 watershed plan had outlined. There is a much higher level of awareness and concern among citizens, about the health of the estuary as well as an understanding of its relevance to their quality of life and economic well-being. The community now knows that it is responsible for what happens in the Morro Bay watershed, and that it can make wonderful things happen. The proof: it already has.

In a recent column in Morro Bay's *Sun Bulletin*, Anne Ashley Quinn, a local resident, pointed out that waiting for someone in Washington to declare our bay a place of significance was a bit like ignoring the evidence of our own eyes (as in *The Emperor's New Clothes*): "Stand in Sweet Springs as the rising sun transforms the bay from black to silver. A night heron stands immobile, a dawn sentry, while little willets industriously sweep the tawny grasses for food. It is a sacred place. We all need to work to save Morro Bay. But our waiting for a government decree is a little like the officials admiring the emperor's new clothes in the Hans Christian Andersen tale. . . . We do not need a governmental proclamation to declare Morro Bay a sanctuary . . . . We can protect our own resources and let the government catch up when they can. To us, it is already a sanctuary and there is none like it in the world." ❐

Steve Eabry is coordinator of the Morro Bay Task Force. He describes his job as a "pot-stirrer."

The Moral of the Story.

1. Involve the public. Be flexible in your goals, to accommodate special interests and talents in the community.
2. The government's role is to find out what the community wants and help obtain it.
3. One successful project will engender another.
4. Good work is not lost, even if it takes time to come to fruition. The first watershed plan contained key elements it took ten years to implement.

How Do You Weigh an Elephant Seal?

How do you get an accurate weight on a 4,600-pound bull elephant seal during mating season without getting run over in the process? Chip Deutsch put a lot of thought into this when researching his PhD thesis on weight loss by elephant seals during mating season at the Año Nuevo rookeries in San Mateo County. He came up with a sure-fire way to entice a bull onto a scale.

Deutsch and his colleagues made a fiberglass model of a female elephant seal and placed it next to a bar scale similar to one used to weigh cattle but made of aircraft-strength aluminum.To reach the model, the seal would have to crawl over the scale. The scientists began to play tape recorded calls of a female seal being mounted by a male. "The recordings attracted male seals from about 100 yards away. They all moved toward the sound because if a male seal discovers another seal of inferior rank mounting a female, he will step in and take over," explains Deutsch.

What happened when the bull discovered the object of his desire was made of fiberglass? "Sometimes he'd just fall asleep. Other times he'd try to mount it anyway," says Deutsch. "We only really got into trouble when we tried to intimidate them onto the scale by playing recordings of their own threat vocalizations or waving a tarp at them. A few would turn on us and charge when they knew we were just bluffing . . .They'd crush the snow fence we used to corral them," he said.

Using the model, Deutsch managed to get 93 weights on 54 males. From the time the bulls arrive at Año Nuevo from the waters off Alaska and British Columbia in December, until March, when they leave, they neither eat nor drink. They live off their fat reserves, despite the fact that they expend considerable energy in fighting to establish a mating hierarchy. "The largest bull we encountered weighed 4,600 pounds. It probably weighed 5,000 pounds when it arrived," Deutsch says. "On average, adult males lose one-third of their weight during mating."

From the point of view of the females, this is probably a good thing. Cows generally weigh about 1,100 pounds, between one-third and one-sixth the weight of the bulls. After she arrives in late January, a cow gives birth and then about three weeks thereafter, mates. The female fasts during the four weeks she is on land.

But food and drink are clearly all the seals are abstaining from. The rookery at Año Nuevo has about 1,600 females and 300 males while the nearby rookery on Año Nuevo Island has about 700 females and about 200 males. ❐

A young male crosses the scale to approach the female model. He doesn't seem to notice the sound speakers, at right.

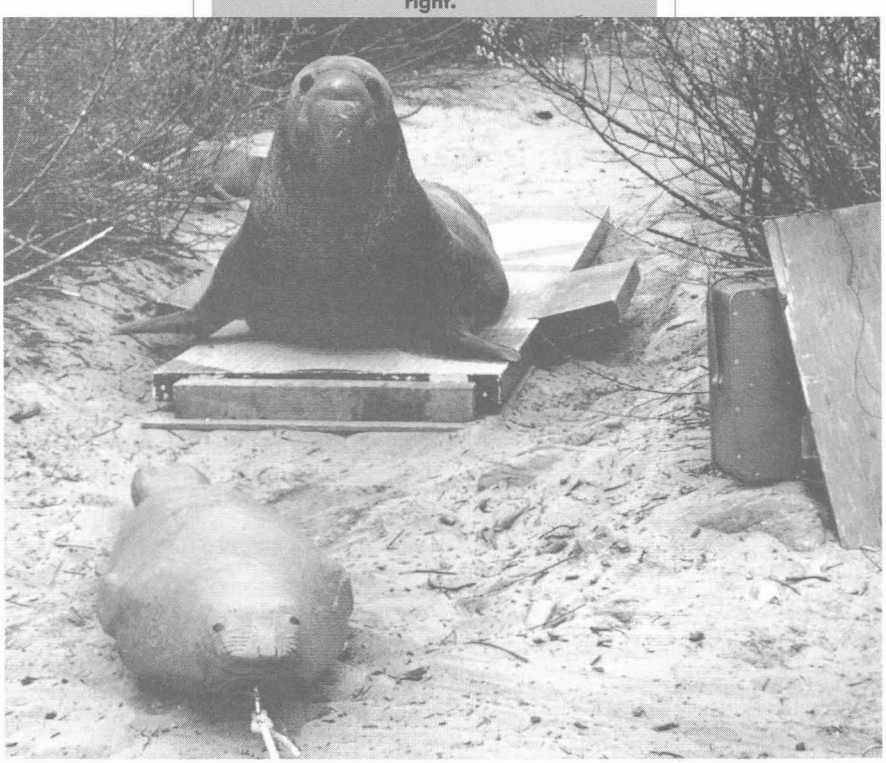
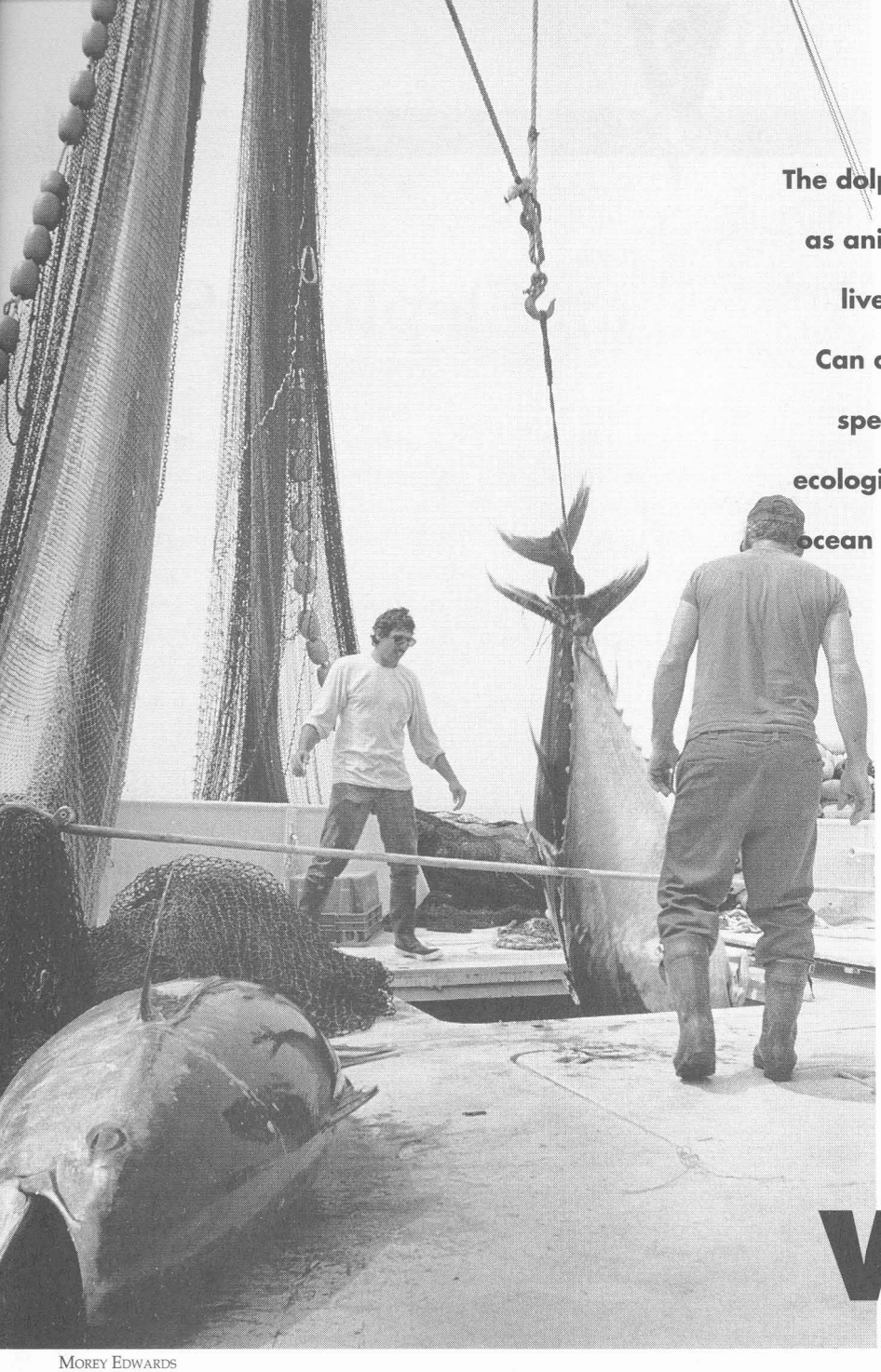
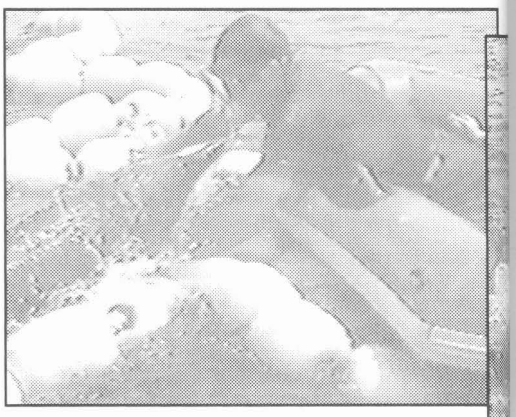


Photo courtesy of Chip Deutsch

The dolphin-tuna controversy is usually cast as animal rights versus the right to earn a livelihood, but it raises other questions. Can a campaign on behalf of a particular species cause side effects that outweigh ecological gains? And, can the U.S. protect ocean wildlife without global cooperation?



MOREY EDWARDS

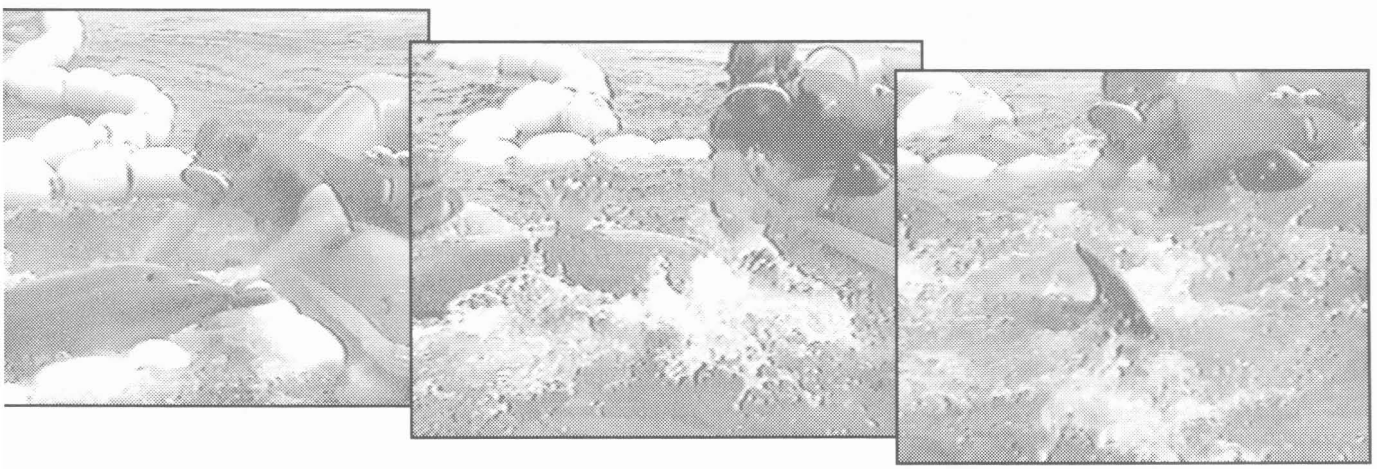


When Sam LaBudde, a biologist with the Earth Island Institute, secretly filmed scores of dolphins being killed in the nets of a Panamanian tuna boat in 1988, he forged a powerful weapon in the campaign for dolphin-safe tuna, which has arguably saved thousands of dolphins' lives. Now, however, as dolphin advocates press on toward their goal of eliminating all dolphin kills, the unintended consequences may prove costly not only to U.S. and other fishermen but also to other marine life.

LaBudde's film put into high gear a boycott of tuna caught by purse-seine nets, which sometimes enmesh dolphins in the process of capturing the fish. It summoned broad public attention to a problem that had

The Trouble with Tuna

by Mick Kronman

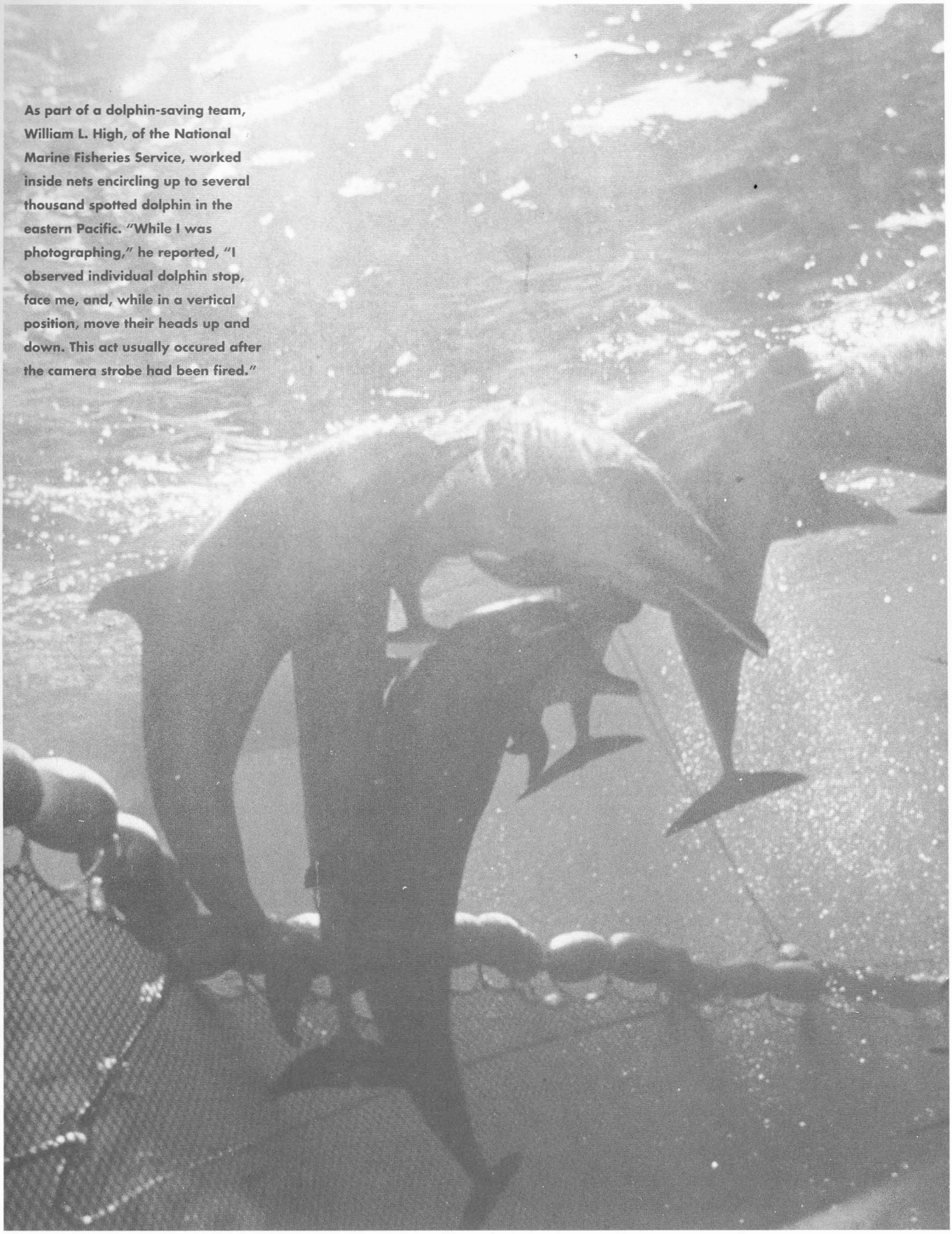


Courtesy American Tunaboat Association

for years troubled tuna fishermen as well as scientists, environmentalists, and animal rights advocates: commercial fishing for mature yellowfin tuna in the eastern tropical Pacific is impossible without incidentally killing dolphins.

In the eastern tropical Pacific, a 7.5-million-square-mile zone stretching from California to Chile and out to Hawaii, this prized fish swims with dolphins for reasons scientists have yet to understand. Fishermen locate tuna by spotting dolphins. They cast the nets around them to capture the tuna swimming beneath. As they pull the nets closed at the bottom, like giant inverted umbrellas, and then draw them in, dolphins sometimes become entangled in the tough nylon webbing and drown. Enormous progress has been made in reducing this unintended bycatch, but even with skilled use of all existing dolphin-protection measures, no way has been found to eliminate dolphin kills altogether while setting on them for mature yellowfin tuna. The solution of dolphin advocates is to outlaw this practice. But no efficient method has been developed for hunting this fish without setting on dolphins.

The LaBudde film brought scenes of dolphin slaughter into American living rooms, sowing seeds of deep enmity between environmentalists and fishermen. The disaster it documented has been called "an anomaly" by a leading authority, James Joseph, direc-



As part of a dolphin-saving team, William L. High, of the National Marine Fisheries Service, worked inside nets encircling up to several thousand spotted dolphin in the eastern Pacific. "While I was photographing," he reported, "I observed individual dolphin stop, face me, and, while in a vertical position, move their heads up and down. This act usually occured after the camera strobe had been fired."

William L. High, National Marine Fisheries Service

tor of the Inter-American Tropical Tuna Commission (IATTC). For fishermen it was evidence that dolphin advocates suffer tunnel vision, failing to appreciate their predicament and their efforts to rescue dolphins they accidentally catch. For environmentalists the film was proof that fishermen are callous and greedy.

The dolphin/tuna problem began in the late 1950s, when the U.S. fleet jump-started the modern age of tuna fishing by switching from small pole-and-line boats to larger purse-seiners. Instead of hooking tuna one at a time, fishermen caught several tons per "set" by encircling schools of dolphins to capture the tuna swimming below them. Tuna fishing expanded rapidly. By 1978, the number of U.S. tuna boats tripled and the carrying capacity of each quadrupled, with 150 purse-seiners prowling the eastern tropical Pacific, each with a capacity of about 1,000 tons. According to researchers at the Southwest Fisheries Research Center in La Jolla, up to 500,000 dolphins a year perished through the early 1970s—a ghastly bycatch by any measure.

To fishermen, extracting masses of sea mammals—dead or alive—from the nets was not only heartbreaking, it was time-consuming and difficult. To reduce the slaughter, they developed dolphin-protection equipment and avoidance/release techniques. The principal ones are the Medina panel (named for the skipper who invented it) and the backdown procedure. The Medina panel is a strip of fine-mesh webbing sewn into a purse-seine net near its top, or corkline, to prevent dolphins from snagging their beaks and drowning. In the backdown procedure, a skipper puts his vessel in reverse gear after the net is set and tugs on the net until one end dips slightly below the surface, allowing dolphins to escape. Encircled tuna, meanwhile, swim deeper in the net and are unlikely to get away. Fishermen often jump into the net during this procedure, with the tuna, dolphins and God-knows-what-else, to shepherd individual mammals over the corkline. It's dangerous work that can result in injury, or, in the case of a seaman bitten by a shark in 1980, death.

The use and improvement of these safeguards was encouraged by the National Marine Mammal Protection Act of 1972, passed after scientists, environmentalists, and animal rights advocates besieged Congress to reduce or stop dolphin kills. It set broad goals for reducing dolphin takes to "insignificant levels approaching zero." Incidental mortality decreased for the U.S. fleet but the number of total dolphin kills kept rising. "Just when American tunamen began pioneering ways to avoid or release dolphins, Mexico and Venezuela entered the eastern Pacific fishery with inexperienced captains and crews," explained Martín Hall, chief scientist for the IATTC, which had been created in 1950 to study yellowfin tuna stocks and recommend appropriate measures to maintain them.

COURTESY *NATIONAL FISHERMAN*

In subsequent years, responsibility for monitoring tuna boats was assigned to the IATTC. On-board observers from the Commission, the National Marine Fisheries Service, or other nations' programs covered a growing percentage of the international fleet, reaching 100 percent in 1992. As scientists learned more about the tuna/dolphin relationship, further legal controls were put into place. An annual dolphin kill quota of 20,500 was established for the U.S. fleet, as well as kills-per-set quotas.

The 1988 amendments to the Marine Mammal Protection Act required nations wishing to export eastern Pacific yellowfin tuna to the United States to participate in the IATTC observer program and follow specified dolphin protection techniques used by the U.S. fleet. Tuna embargoes were mandated against countries whose fleets unduly exceeded U.S. skippers' dolphin mortality rates, and for countries identified as intermediaries for dolphin-unsafe tuna imports to this country. Embargoes have since been

imposed on more than 20 countries and in November 1992 were in effect against seven, including Mexico, Venezuela, France, and Japan.

Dolphin advocates, however, pressed for outlawing the practice of setting on dolphins altogether, together with aggressive research and development of alternative fishing methods. "This fishing method is inherently flawed, " said Greenpeace legislative director Gerry Leape. "It's the only fishing method we've seen where you deliberately target one species to get another. No matter how careful the captains are—and some are very good—you can't control the weather. The wind may come up and collapse the net, causing hundreds of dolphin kills."

During the backdown procedure, fishermen often jump into the net with the tuna, dolphins and God-knows-what-else, to shepherd individual mammals over the corkline. It's dangerous work that can result in injury, or, in the case of a seaman bitten by a shark in 1980, death.

In 1981, Congress allocated funds to the National Marine Fisheries Service (NMFS) for research into alternate methods of fishing. The result was an improvement in the nets, but no alternative. Congress also requested the National Research Council to identify methods that would reduce or eliminate the kills. The Council appointed a study committee, which in February 1992 issued its report, *Dolphins and the Tuna Industry*. It concluded that no practical technology exists to totally eliminate dolphin deaths in the process of fishing for mature yellowfin tuna in the eastern Pacific. To reduce kills, the report recommends:

- Better training for skippers. Most dolphin deaths are caused by a small percentage of the captains. Records indicate that fewer dolphins die when experienced tuna skippers set the net.
- Testing various net modifications and fishing techniques.
- Researching the use of fish attracting devices (FADs), specially designed arrays that float at sea and attract bait fish and pelagic species such as tuna.
- Studying the night behavior of tuna and dolphins. If it is found, for instance, that tuna do not swim with dolphins at night, as has been suggested, night fishing might be recommended.
- Conducting 5-7 years' research before taking any measures as drastic as a moratorium on purse-seining in the eastern Pacific.

In 1988, David Phillips, executive director of Earth Island Institute, an international environmental organization, launched a "dolphin-safe tuna" campaign, seeking to accomplish what federal and state agencies had not been able to: eliminate all incidental kills. The method: urge consumers to boycott tuna caught by purse-seines set on dolphins and thereby end this practice by destroying the market.

By Earth Island's definition—one that dolphin-safe canners eventually adopted—if any dolphins are encircled during a trip by a purse-seiner—regardless of how many sets were dolphin-free and whether the dolphins died or were released—the entire load is dolphin-unsafe. The catch must be certified as dolphin-safe by an on-board observer from the NMFS, the IATTC, or the government whose flag is flown aboard ship. All uncertified tuna transshipped, brokered, labeled or canned is considered dolphin-unsafe.

Earth Island Institute also began a monitoring program to ensure that tuna described as dolphin-safe was not somehow "laundered" before it hit the market. Begun in Thailand—which processes more canned tuna than any other nation in the world—the program was later expanded to other tuna canning centers, including the Philippines. Earth Island staff inspectors check procurement and shipping records to trace tuna from the time it is caught to its arrival at the cannery.

After the LaBudde film was broadcast, "dolphin-safe" tuna became a cause for lunchbox packers across the nation and in Europe. Many dolphin fans view these cetaceans as kindred spirits. An Earth Island leaflet describes them as "communicative, highly evolved and one of only a few wild creatures known to save human lives."

Some scientists believe that some dolphins' communication skills and high brain-to-body ratio indicate an intelligence superior to that of most species, putting them "in the respected company of chimpanzees and elephants," according to Kenneth S. Norris, a retired professor of natural history at the University of California, Santa Cruz, who

has studied cetaceans for 42 years. He wrote in a recent issue of *National Geographic* that some dolphins' memory is similar to that of humans, that they can follow complicated directions, and can develop relationships with humans.

Other scientists, including Australian researchers M.M. Bryden and Peter Corkeron, find "no clear supporting evidence" on intelligence. "One problem in assessing their intelligence is that we have only the human perspective," they note in a 1988 book, *Whales, Dolphins, and Porpoises* (Facts on File, Inc., New York). Still others point out that the very concept of intelligence is a human one and contend that dolphins, along with other ocean mammals, need special protection because, unlike fish, they reproduce slowly. Some populations of the species (including those of spotted and spinner dolphins) have diminished severely, they claim.

Fishermen tend to scoff at Earth Island's goal of stopping all dolphin deaths in seines. The manager of one tuna seiner complains that their philosophy "'Disneyfies' the environment to a point where man has no place in it. This is not a battle between ugly fishermen and cute dolphins. It's an issue of resource management, solving a problem so we can reap the value of tuna (about 5 million cases per year from the eastern Pacific) while reducing dolphin mortalities to the lowest technologically feasible level. We need to lower bycatch just like in any fishery, whether it's dolphins, turtles, unmarketable fish or whatever. But to demand nothing short of zero-kill is ludicrous."

In April 1990, StarKist, Bumble Bee, and Van Camp Seafood—the three largest U.S. tuna canners—announced they would henceforth buy only tuna certified as dolphin-safe. The announcement brought a consumer response that has seen dolphin-safe markets spread throughout the United States, Europe, and Australia. Tuna on the "dolphin-unsafe" market dropped in price with decreasing demand, dragging down the price for all tuna. In addition, good fishing conditions and healthy stocks in the western Pacific contributed to ever greater harvests, and, consequently, lower prices.

"When we went dolphin-safe in 1990, we figured monitoring and regulatory costs might add two cents to a can of tuna, and a two-tiered price system for dolphin-safe and dolphin-unsafe tuna might emerge," said StarKist spokesman Erik Bloemendaal. "But excellent fishing in the western Pacific, aided by a shift of U.S. boats to that region, has kept retail prices equal to or lower than prices two years ago."

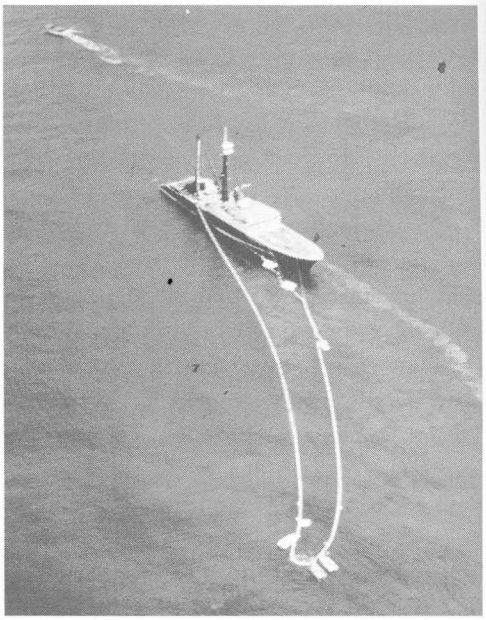
What was good for consumers, however, was bad for fishermen. Prices they received have plummeted 22 percent since 1990, to their lowest level in 15 years. Bill Gillis of the American Tuna Sales Association said premium yellowfin (20 pounds and up, found almost exclusively in the eastern Pacific in association with dolphins) currently earns $750 a ton, compared to $1,200 in 1987.

After the "Big Three" decision, about 90 purse-seiners from 11 nations continued to locate schools of 30-50-pound yellowfin by setting nets around dolphins in the eastern tropical Pacific, according to the IATTC, but total reported dolphin kills in 1991 were 27,000—80 percent lower than in 1986, thanks

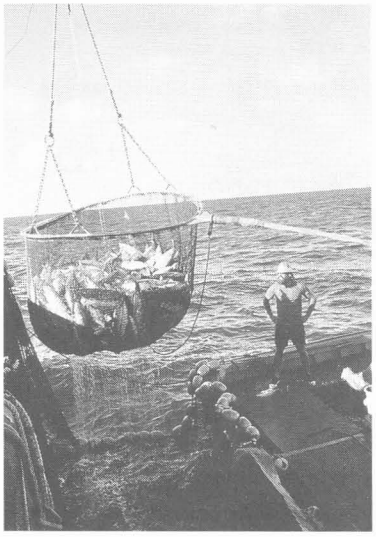
PHOTOS: PORT OF SAN DIEGO

(Upper) Catching tuna the old-fashioned way—by hook and line. Some environmentalists think fishermen should return to this method for the controversial yellowfin tuna. (Lower) Tuna canneries once provided employment in San Diego and San Pedro.

William L High, National Marine Fisheries Service



Courtesy Inter-American Tropical Tuna Commission



William L High, National Marine Fisheries Service

(Upper left) The extended net covers a lot of ocean; (upper right) the net narrows during backdown procedure. (Lower) Hauling in the tuna.

to IATTC workshops for captains, technical improvements, and embargo threats, as well as the dolphin-safe tuna campaign. At a Senate hearing July 23, 1992, David Cohen, Deputy Secretary of State for Oceans and Fisheries, said that other countries fishing the eastern Pacific had adopted dolphin protection measures similar to those used by U.S. fishermen and that the 1988 Amendments had achieved a 75 percent reduction in total dolphin mortalities in just three years. Mexico led the foreign fleet with a drop in its kill-per-set rate from 8.2 in 1988 to 2.9 in 1991.

The U.S. presence in these waters dropped from 29 boats in 1990 to six in 1992, with only three still setting on dolphins. Some of the fleet was sold to foreign owners during hard times in the 1980s, while most of the 55 boats still in U.S. ownership (all based in San Diego) moved to the western Pacific in quest of dolphin-safe tuna. In the first nine months of 1992, the reported U.S. fleet dolphin toll was 361.

Tuna industry leaders credit fishermen for the improving dolphin mortality statistics, pointing out that kills per set—a measure of improved technological efficiency and skipper competence—have dropped from more than 15 to 1.8 for the eastern Pacific's international fleet since 1986. Dolphin advocates, however, saw evidence that their campaign to end purse seining for tuna was closer to its goal. "Markets are drying up [for tuna not certified as dolphin-safe]," said Earth Island's Phillips. Ecuador and Panama have banned the practice of setting on dolphins. There is no doubt that the dolphin-safe movement is responsible for the reduced mortalities. There's only one goal left—bringing it to zero."

To harvest dolphin-free tuna, fishermen had two choices: target younger yellowfin that do not swim with dolphins in the eastern Pacific, or move to the western Pacific, where no strong dolphin/tuna association has been shown. Both choices pose serious drawbacks. To fish in the western Pacific not only means being away from home for four months compared to two, it requires that captains retrofit their boats, at the cost of about $1 million per boat, for larger nets, new hydraulics and new engines to catch smaller fish that swim deeper. Some tunamen can't afford the makeover, and some can't afford to fish for the lower-priced skipjack.

In addition, the ratio of the lower-valued skipjack to yellowfin is three to one, inverse to that in the eastern Pacific. To fish for immature yellowfin (known as log fish or school fish because they tend to congregate beneath floating logs or debris), "to me . . . is immoral," said Frank Alverson, spokesman for the Fishermen's Coalition, a San Diego-based advocacy group. "It forces us to kill undersized fish and ruin the fishery, all in

the name of the environment."

If all seiners working the eastern Pacific hunted the smaller fish, yellowfin stocks in the region would plummet 50 percent in three years, IATTC director James Joseph, said at a federal tuna/dolphin workshop in November 1991. "The maximum yield of yellowfin in the ETP, where recruitment is up 30 percent since the 1970s and stocks are abundant, can be taken only if harvesting is delayed until the fish are 35-75 pounds, when they're most often found with dolphins."

In the process of capturing the smaller yellowfin, fishermen also find themselves bringing in a troubling bycatch—not dolphins but other species. "One seiner fishing dolphin-safe in the eastern Pacific recently had to throw away 600 tons of nonmarketable species to fill its 1,200-ton hold with tuna," said Teresa Platt, who manages her family's eastern Pacific fishing operations. "That includes black skipjack, mackerel, bullet tuna, sharks, turtles and billfish such as marlin. Is this an appropriate way to fish? To us, it's an environmental and financial nightmare." There's no minimum size limit on tuna. Many dolphin-safe skippers looking to make ends meet still harvest the small fish, earning a mere $175/ton.

Setting on younger yellowfin may also mean hostile encounters with foreign governments. "To catch tuna that don't associate with dolphin, it would be nice to fish within other nations' 200-mile limit, especially in Mexico, where the nearshore fish are most plentiful," said Teresa Platt. "But among all nations fishing the eastern Pacific, only Costa Rica offers a license for taking tuna within its EEZ [Exclusive Economic Zone]. It's only good for 90 days, and it costs $20,000 a pop—a bit pricey at best." If U.S. fishing boats creep closer to other nations' shores without the required license, they invite vessel seizures. (The United States offers no license for taking tuna inside its EEZ. In fact, few foreign-only operations of any type are allowed—a result of the "Americanization" of U.S. fisheries over the past 15 years.)

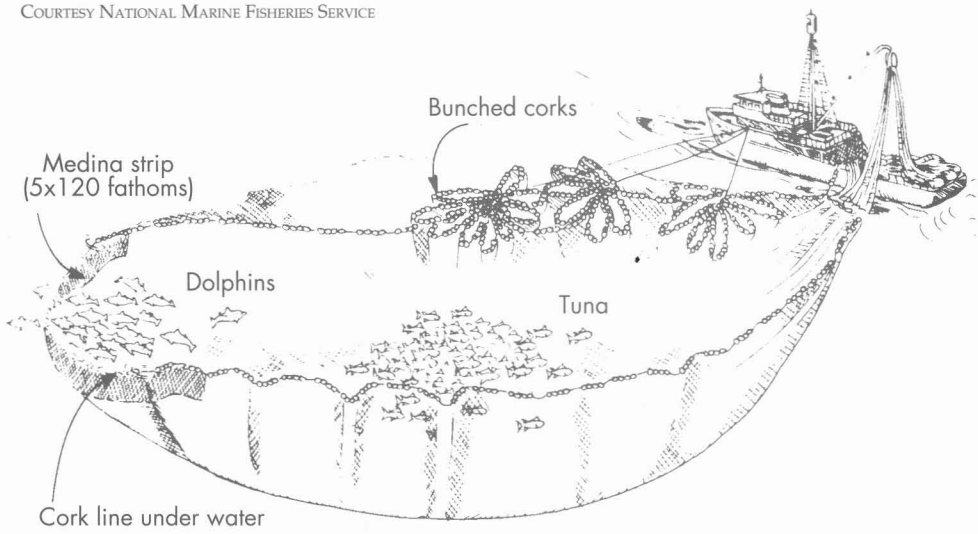
The solution, according to Earth Island's Phillips, is for U.S. boats to relocate to the skipjack-rich western Pacific, where six vacancies still exist in a recently renegotiated treaty between the United States and 17 island nations. Under the pact, up to 51 U.S. tuna boats pay about $100,000 per season to fish within the countries' 200-mile EEZs. The National Marine Fisheries Service reports that tuna stocks in the western Pacific (especially skipjack) are healthy, and catches have been excellent in recent years.

"Why fish on dolphins when there's already a worldwide market glut, prices are down and adequate tuna supplies can be found in dolphin-safe waters?" Phillips argues. He believes a handful of tuna boats can still survive in the eastern Pacific by fishing dolphin-safe on younger yellowfin and by returning to the old hook-and-line method. The rest, he said, can relocate.

The "WesPac's" future may not be cloudless, however, as the current 194-boat international fleet—including boats from Japan, Taiwan, and Korea—continues to grow, notes Dave Burney, spokesman for the the U.S. Tuna Foundation, which negotiates treaties for U.S. vessels. "Many of the island nations are considering limiting access to their fishing grounds, especially since Asian countries are sending tuna boats down there as fast as they can build them."

Dolphin-safe policies have already led to international tensions. Last year, a panel of the General Agreement on Tariffs and Trade

COURTESY NATIONAL MARINE FISHERIES SERVICE



In the backdown procedure, a skipper puts his vessel in reverse gear after the net is set and tugs on the net until one end dips slightly below the surface, allowing dolphins to escape. Encircled tuna, meanwhile, swim deeper in the net and are unlikely to get away.

"One seiner fishing dolphin-safe in the eastern Pacific recently had to throw away 600 tons of nonmarketable species to fill its 1,200-ton hold with tuna," said Teresa Platt, who manages her family's eastern Pacific fishing operations. "That includes black skipjack, mackerel, bullet tuna, sharks, turtles and billfish such as marlin. Is this an appropriate way to fish? To us, it's an environmental and financial nightmare."

(GATT—a pact that binds 109 nations to a set of international trade rules) called the embargo imposed under the Marine Mammal Protection Act on nations that do not abide by U.S. dolphin-kill standards illegal, claiming one country may not foist environmental laws upon other nations operating outside its jurisdiction, harvesting nonendangered animals.

Mexico, the country that brought the GATT grievance, could have pushed the United States to lift the embargo and amend the Marine Mammal Protection Act, but it tabled its protest, possibly, some sources claim, to use as leverage in North American Free Trade Agreement negotiations.

Joined by several environmental groups, Earth Island charged in its newsletter, *Dolphin Alert*, that the GATT ruling places free trade above marine mammal conservation and represents "a dangerous threat to international environmental protection efforts." For the IATTC and others, however, solutions range from negotiation, technical assistance, and education to U.S. imposed embargoes and other punitive measures.

Still more international discord can be expected in the wake of the passage of the International Dolphin Conservation Act (HR 5419) approved by a 389-15 vote of the House of Representatives and by consensus of the Senate just before it adjourned. It was signed by President Bush October 27.

This measure could deal a heavy economic blow to some tuna fishing nations, especially Mexico, which operates more than half the vessels now yanking tuna from the eastern Pacific. The bill establishes a five-year moratorium on the practice of setting on dolphins as of March 1, 1994. On that date, the U.S. quota for dolphin kills drops to zero, under penalty of vessel seizure, fines, and imprisonment. Importing "dolphin-unsafe" tuna becomes illegal. Provisions binding other nations to dolphin-safe fishing go into effect only if these nations agree to abide by the moratorium. If a nation does so, any current embargo against it is immediately lifted. But after five years, an embargo can be reimposed if a ship in its fleet sets on dolphins and kills even one. Such an embargo would first affect yellowfin tuna products but, if corrective measures are not taken promptly, could be extended to other fish products.

For Mexico and Venezuela, the two major fishing nations concerned, the incentive for agreeing to such a severe measure would be the lifting of the embargo now in force against them. After five years, their fishermen would have a choice of either finding a way to fish "dolphin-safe" in the eastern Pacific, forgo fishing there, or give up the U.S. market and fish for "dolphin-unsafe" markets. The bill offers no direct relief to displaced tuna fishermen, but provides $4 million per year for research into dolphin-safe fishing practices, ranging from new net designs to more work with FADs.

"Our vessels and, I believe, the international fleet will not be able to fish under these conditions," said Dick Atchison of the American Tunaboat Association. "Pushing for zero mortality is like telling the trucking industry to eliminate highway fatalities."

In an alternative effort to resolve the dolphin/tuna problem, the IATTC in June forged a first-ever multilateral agreement to further reduce dolphin deaths among all tuna seiners prowling the eastern Pacific. Replacing a hodge-podge of national programs among countries fishing the region, the so-called "La Jolla Agreement" is the scientific body's first move into hands-on regulation and compliance monitoring.

"This is one of the most comprehensive agreements ever concluded on the conservation of marine resources exploited on the high seas by many nations," said the IATTC's Joseph.

The pact calls on those nations to reduce dolphin deaths by a series of annual limits that progress from 19,500 in 1993 to fewer than 5,000 in 1999. The limits, Joseph explained, will be reached by placing dolphin mortality quotas on individual vessels.

The IATTC plan echoes the findings of the National Research Council (NRC) study by seeking to reduce dolphin deaths by technological improvements and education. It features continuation of workshops that teach state-of-the-art dolphin avoidance/release techniques. Scientists and skippers review ways to avoid net collapses, equip-

ment malfunctions and improper vessel maneuvers, all of which can increase dolphin kills. "We've completed 17 workshops since 1989, and nearly every skipper in the international fleet has attended," says Hall, of the IATTC. "Some have been several times." The United States has committed $1.2 million in fiscal year 1993 for tuna/dolphin reasearch, including $584,000 to the IATTC program. Mexico has allocated $1 million for research, and Venezuela committed $500,000 to the IATTC program.

"Pressure from environmentalists has clearly driven this process," Hall said. "It has motivated skippers to learn the available techniques and tools for reducing dolphin deaths." As a result, he said, on-board observers report that 99.8 percent of all dolphins encircled by U.S. boats in 1991 were released unharmed, and mortalities among the foreign fleet have slumped to 2.5 per set—on a par with U.S. fishermen. "This means the IATTC program is beginning to pay off significantly."

Mexico and Venezuela endorse the IATTC plan. "Our government has always preferred a multilateral agreement over an all-out moratorium like HR 5419," says Felipe Charat, vice president of the Mexican National Fisheries Association. But Earth Island's Phillips sees the plan as an attempt "to undermine an international push for a complete moratorium on mortalities. In fact, it's really no solution at all," he said. "It perpetuates the killing of dolphins well into the next century."

Others, including Greenpeace's Gerry Leape, worry that a moratorium without a parallel effort to develop alternative fishing methods might create a vacuum that another nation, unconcerned about dolphin protection, might fill, opting to fish for "dolphin-unsafe" markets. Phillips discounts this worry, saying that market is vanishing. Leape also worries that promising efforts to regulate purse-seining on a global scale might be undermined by the limited focus of the measure. He pointed out that the eastern Pacific is already "observed more extensively than any other fishing area in the world." Because there is no on-board monitoring in the western Pacific, the extent of dolphin and other mammal kills in seines is not known, he said.

COURTESY NATIONAL FISHERMAN

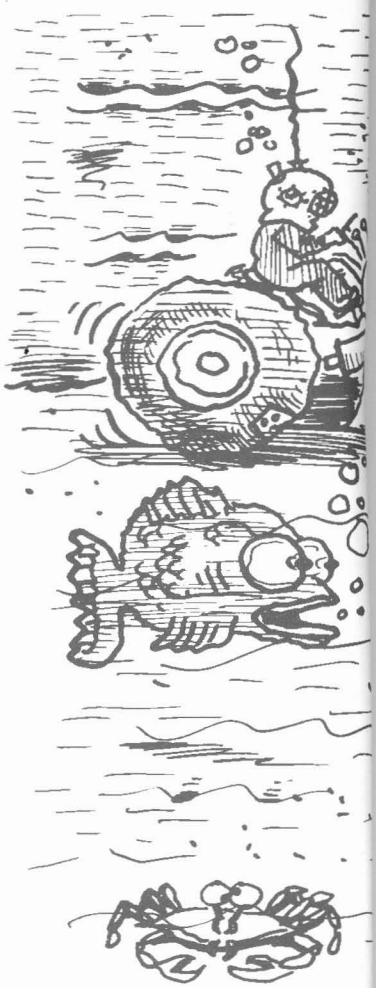
The *Ocean Pearl's* fish-spotting helicopter lands aboard the new tuna superseiner during christening ceremonies at the Campbell Industries shipyard in San Diego in 1982.

Which approach reigns supreme—that embodied in HR 5419 or in the IATTC pact—will become clear in the months ahead. A complete moratorium could close the door on a near-century of tuna fishing in the eastern tropical Pacific, at least for now. Under the IATTC plan, tunamen might return to the grounds they call home to catch premium yellowfin while continuing to reduce dolphin deaths, accepting that some kills will be the inevitable consequence of this fishery. If, as everyone hopes, a method is someday developed to fish successfully without setting on dolphins, everybody will be greatly relieved. ❐

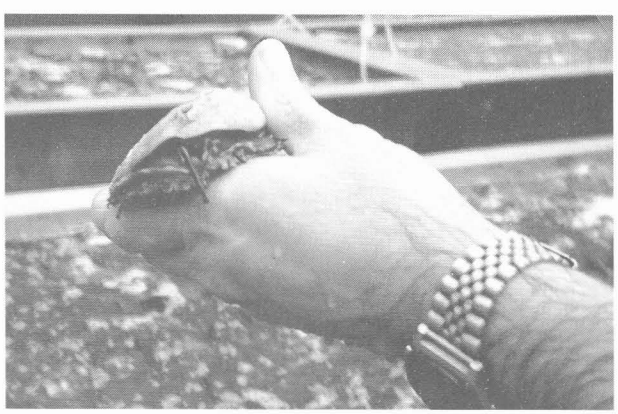
Mick Kronman is a field editor for National Fisherman *magazine and a fisheries consultant based in Santa Barbara. He is a former commercial fisherman.*

aquaculture

California's Abalone Farmers Take The Plunge



California is the only state in the nation with the potential to become a major cultivator and exporter of abalone.



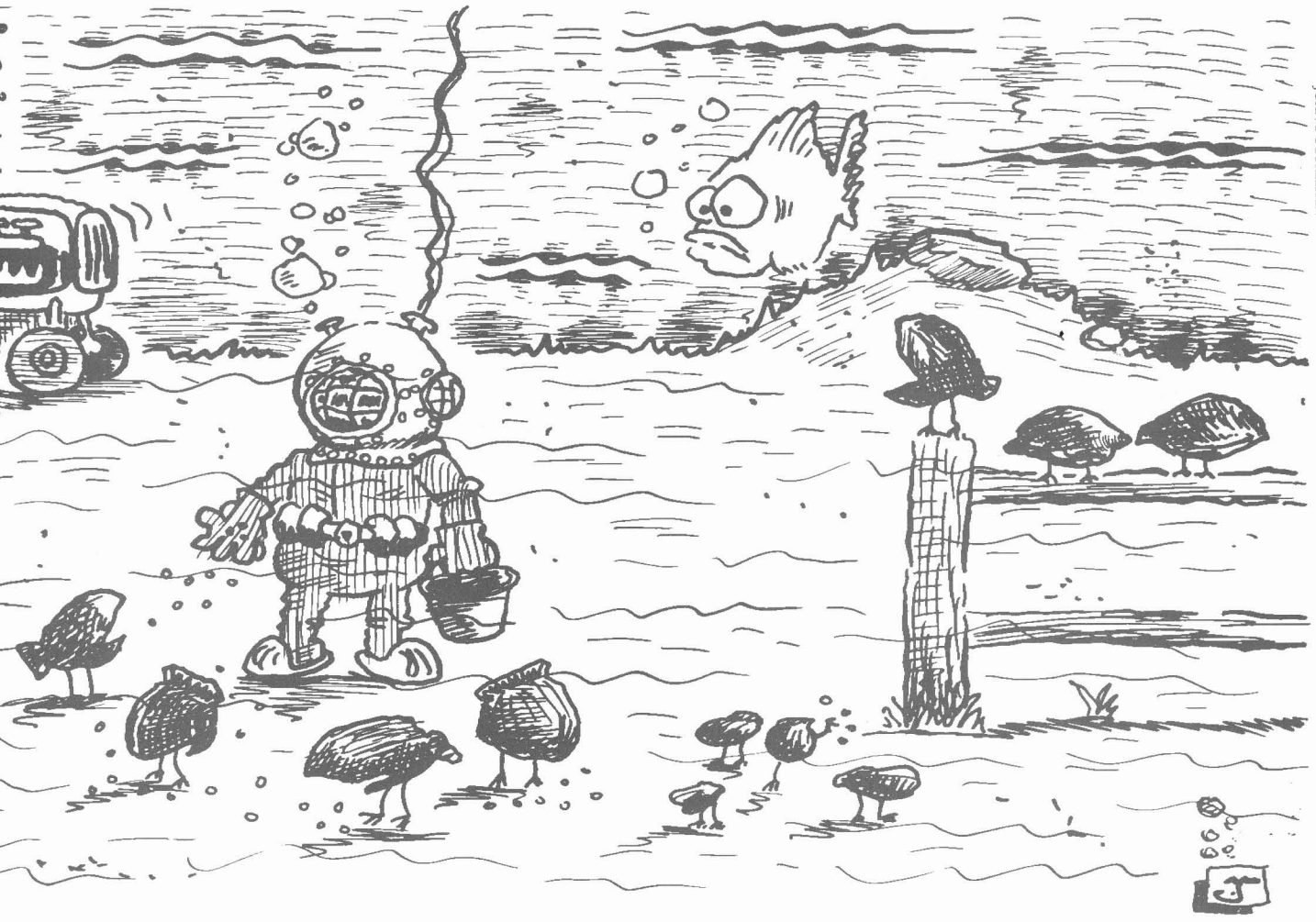
REGINA MCGRATH

by Regina McGrath

When it comes to raising dairy cattle, artichokes, or brussel sprouts on California's coast, plenty of people can advise you how to get started. Not so for abalone: there is not much experience to draw from. The history of abalone farming in California goes back only to the late 1960s. Now, however, this tasty mollusk with the beautiful shell promises to become one of state's most lucrative mariculture species, largely because it brings premium prices in Japan.

"Japanese wholesalers are willing to pay $18 per pound—$2 to $5 per pound more than U.S. domestic prices—on top of that they pay for shipping," said Peter Scrivani, president of Pacific Mariculture Inc. in Santa Cruz. "Japanese consumers are paying $75 to $100 per pound for live abalone."

Japan buys live wild abalone from China, Australia, Taiwan, and Korea. Only California sells cultured as well as wild abalone to Japan. But as the standard of living has risen in Taiwan and Korea, more of their crop has been consumed domestically, according to



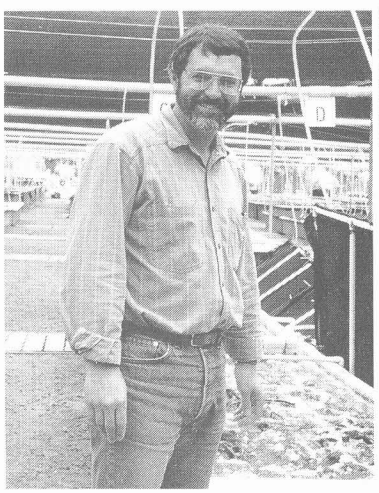
JOHN POGORELSKIN

John McMullen, president of Ab Lab Aquaculture Industries In Oxnard. For this reason, and the fact that abalone is now being grown in large enough quantities to attract the Japanese, the price of California abalone in Japan jumped by 50 cents a kilo over the past six months, McMullen said.

California's abalone aquaculture industry is still "in transition from research and development to commercial production," said Bob Hulbrock, aquaculture coordinator for the State Department of Fish and Game, who sees "much potential for developing a vital industry. Right now, our major aquaculture products, in terms of both volume and value, are oysters, catfish, and trout," he said. "Abalone could become a major species, particularly because of the price it commands."

There are currently three major producers and maybe a dozen smaller operations in the state, he said. Abalone Farm Inc., in Cayucos, San Luis Obispo County, is the oldest (founded 1968) and biggest, with 7 million abalone under cultivation. Pacific Mariculture and Ab Lab each have over a million. No farms currently exist in Oregon and Washington, and there is one experimental farm in Hawaii, according to Ken Chew, director of the Western Regional Aquaculture Center in Seattle. Growers in these states probably will never equal California's output, either because the water is too cold or there is not enough kelp available to feed the abalone, say growers here. Chew agrees, adding that California growers have already worked out a lot of the technological problems. Because abalone are cultivated on private land, not on state tidelands, as oysters are, production statistics do not have to be reported to the Department of Fish and Game. But it is safe to say that the three major California growers, together, are raising about 10 million abalone.

At least half of the output of the big three farmers is being exported to Japan. California is still a small player in the Japanese market compared with China and Australia, but last year the Japanese ate more live abalone from California than from Taiwan



REGINA MCGRATH

Pete Scrivani, president of Pacific Mariculture (above), which grew this red abalone (opposite page). It is about four weeks away from market size.

Abalone Help Restore Wetland

The State Coastal Conservancy strives to find ways to enhance the coast while benefiting coastal industry and agriculture. In the case of a wetland in Oxnard in Ventura County, restoration literally depends on an abalone farm.

With $65,000 from the Conservancy and a matching sum from the city of Oxnard, a restoration plan will be created for the 125-acre South Ormond beach wetlands area, a severely degraded coastal wetland with restricted public access. It contains at least two known endangered plant species and potential nesting sites for the endangered least tern, snowy plover, and Belding's savannah sparrow.

Streams and creeks that used to nourish the wetland with fresh water were diverted into drainage ditches when the Oxnard plain was turned into farms. The wetlands were further isolated when the airfield at Point Mugu Naval Air Station was constructed. Now they receive fresh water only when it rains, and the area is sometimes flooded by the ocean during extreme high tides. The restoration plan will call for Ab Lab Aquaculture Industries, situated next to the wetland, to discharge its effluent directly onto the wetland, owned by Southern California Edison. John McMullen, president of Ab Lab, is looking forward to the arrangement. "It will cut my electricity consumption by about 25 percent," he said, adding, "I've lived here all my life, and I remember when all this area was wetlands." How much fresh water will be needed and where it will come from have yet to be determined.

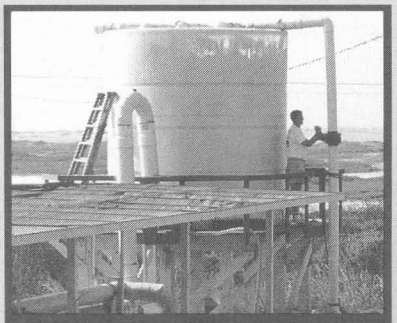


Photo Courtesy Ab Lab

Oxnard's Ab Lab is adjacent to the South Ormond beach wetland.

At 46, McMullen is one of the old men of abalone farming, having been in the business for 18 years. Currently, Ab Lab has about 1.8 million abalone under cultivation. The abalone don't produce much waste, so the wetland will be getting a constant supply of oceanic water, he noted. In Chile, where he is involved in a joint venture, there is a plan to use wastewater from an abalone farm to raise finfish.

In 1990, McMullen purposely sited a new abalone farm next to the Southern California Edison Ormond Beach Generating Facility so he could get his seawater from SoCal's intake pipe rather than build his own intake, which he says would have cost millions of dollars. SoCal draws its seawater through a pipe that extends a quarter mile into the ocean. McMullen says that for this reason he has had very few water quality problems. The abalone farm also discharges through the generating plant. SoCal charges him for the use of the pipes, leases him the 15 acres Ab Lab occupies, and will share in some of the farm's profits once these reach a certain level.

McMullen is currently raising red abalone, green abalone, and a hybrid of red and green. Half of his output is destined for Japan. "The green are more tolerant of warmer water and occur naturally in southern California and Baja," he explains, "but the red are better feeders, so we're trying to blend them." McMullen says there is "great potential" for using heated water from SoCal's plant as a medium to speed up the growth of green abalone and hybrids.

He anticipates that his business will benefit when people start visiting the wetland. He is considering opening his farm for public tours and may sell his abalone to walk-in customers, possibly one day a week. "The wetland stands a good chance of being used properly once it's restored," says McMullen. "Right now we still have motorcyclists tearing it up and dogs everywhere." The restoration is expected to be completed in 1993.

and Korea combined, according to a Japan Export Trade Organization report. In 1991, Abalone Farm alone shipped about 35 metric tons or about 350,000 live abalone to Asia, says president Frank Oakes. He expects to ship 60 metric tons overseas this year. "Our product is much more in demand in Japan than the abalone from Korea or Taiwan because our species grow bigger," he said.

Breaking Ground

Before any profits—yen or dollars—can start rolling in, however, much planning, a hefty investment, and years of work are required. The startup of Pacific Mariculture provides a glimpse of what is involved.

Scrivani, who has a PhD in algology (the study of algae), decided to go into the "ab" business (as it's known in the trade) in the course of a study on the commercial potential of various marine animals. He started a pilot abalone farm at Long Marine Laboratories, University of California, Santa Cruz, in 1986, experimenting with tank configurations and abalone density. At the same time he began his search for a site suitable for a commercial-size operation.

He found it a few miles north of Santa Cruz, west of Highway 1, on Sand Hill Bluff at the edge of a brussel sprout farm. It had the essential characteristics: an available source of clean sea water, nearby kelp beds, electricity, an accessible labor pool, and it was near an international airport. "Abalone farms are a good adjunct to conventional coastal farms," said Scrivani. "We lease land that the brussel sprout farmer can't use because of the salt spray." A huge shell midden next to the farm indicates that Native Americans probably used the windy bluff to dry abalone long before anyone ever thought of farming them here.

To get to Scrivani's farm, you drive toward the ocean on a narrow dirt road through acres of dark green brussel sprouts, until you see a 400,000-gallon holding tank, which signals the entrance to the farm, about 30 feet from the bluff's edge. Strings of brown pelicans fly overhead, and a stiff saltwater wind ruffles the black mesh that covers row after row of bubbling tanks. A few small prefabricated brown buildings house a hatchery and office space for Scrivani, his staff biologist, and 11 other employees.

It took two years to get all the necessary permits from the county, state, and federal agencies, including an aquaculture license from Fish and Game. Then Scrivani bought some red abalone seed stock—the world's largest abalone—from McMullen and waited. It takes almost three years for the abalone to grow to 100 grams or 3.5 to 4.0 inches in diameter—the size preferred by the Japanese for holiday feasts.

REGINA MCGRATH

Scrivani checks on kelp supply in tank full of young abalone.

When they leave the hatchery, the abalone are only 0.25 to 0.50 inches in diameter, and they eat diatoms. After about three months, they are large enough to be moved to another tank and are fed kelp. Scrivani estimates his farm consumes 20,000 pounds per week of kelp—about 100 pounds of kelp per week per tank, with about 100 tanks. He

Abalone Sanctuaries

With the help of a grant from UNESCO's Man In the Biosphere Program, research marine biologist Gary Davis and his colleagues at Channel Islands National Park are studying the possibility of creating "zones of replenishment" as a method for rebuilding the state's depleted wild abalone stocks. California's abalone harvest peaked in 1957, when over 5 million pounds were caught, reports the Department of Fish and Game. The harvest today is about half a million pounds annually, and in some areas, particularly in southern California, abalone have disappeared altogether, mainly because of overfishing.

The traditional management tools employed by Fish and Game to sustain the abalone population are increasing the size of the abalone that can be caught and shortening the abalone season. But these measures have not prevented the abalone stock from diminishing.

Davis believes the abalone could recover if they are given more opportunity to spawn. Abalone can live to be 30 to 35 years old. The current management strategy allows them to be caught when they are about ten years old, and since they mature at about four to five years, this gives them about five years to spawn, says Davis. If they were allowed to live longer, they would obviously produce more young, particularly in light of the fact that mortality of abalone larvae is 99 percent.

The zones of replenishment would be areas where abalone could live for 25 or more years without risk of capture by commercial and recreational fishermen. The young would presumably migrate outside of the zone, making more abalone available for harvest. Creating replenishment zones could also be useful for other long-lived species, such as lobsters, rock fish, black sea bass, white sea bass, lingcod, and angel sharks, says Davis, who points out that the zones have worked well for fisheries in Japan, Australia, New Zealand, South Africa, the Philippines, and the Caribbean. Representatives from some of these countries shared their expertise at last year's annual meeting of the American Fisheries Society.

Davis will spend the last of his $50,000 grant designing studies to determine what the optimum size of a zone should be, how close together zones should be, and what fish species benefit the most from protection. If he gets more funding, he plans to conduct the abalone studies in areas that already are closed to harvesting since "the resource base is so eroded in California that there is very little left for commercial or recreational fishing as it is."

It was only in the twentieth century that limits were placed on abalone harvesting as more Californians rushed to buy the tasty dense white steak-like meat. Long before Europeans came to North America, Native Americans were harvesting abalone for food and made tools and jewelry from their shells. In the mid-nineteenth century the Chinese, primarily railroad workers, began harvesting them commercially. For some time, the hunting of sea otters almost to extinction helped the abalone population to sustain itself. Now the sea otter population has grown to the point where some fishermen accuse them of eating up more than their share of the abalone. Perhaps the zones of replenishment will provide enough abalone to keep both man and beast happy.

leases a nearby kelp bed from the Department of Fish and Game and hires people to harvest kelp by hand from boats. "Kelp is a renewable resource and one of the fastest-growing plants. We only harvest the top three or four feet of the canopy," said Scrivani.

Kelp and clean sea water are the basic resources abalone require to grow. Scrivani pumps water up 60 feet from a sea cave below the farm, and pipes it another 20 feet to the holding tank. The water circulates throughout the tanks and is discharged via gravity back to the ocean, as clean as when it came in, except for a small amount of abalone excreta.

His highest cost is labor, including the biologist who supervises spawning. The other employees feed the abalone, maintain the pumps and other equipment, and market the crop.

Abalone is a hardy intertidal species and not difficult to raise because it is not subject to viruses and is not cannibalistic, said Scrivani. However, like all farms, his operation is subject to the whims of nature. "The ambient water temperature around here is 13° to 15° C. During the last El Niño, in 1982-83, it rose to 17° C. This depresses the abalone's ability to spawn and can even kill off kelp in southern California." Abalone larvae are also very sensitive to any kind of chemical pollution in the sea water. (Because of this sensitivity, they are used to monitor large-volume municipal dischargers throughout the state.) An oil spill could mean disaster.

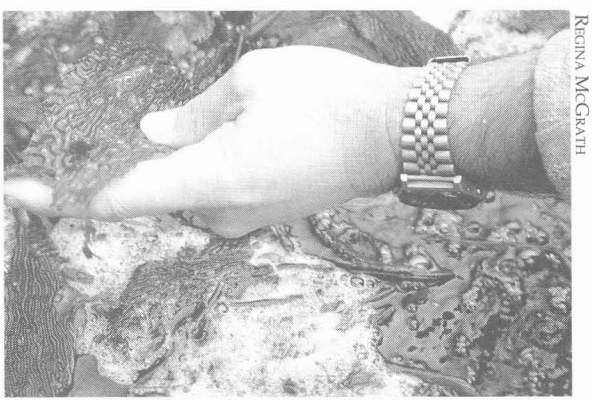
Because of his concern about water quality, Scrivani sits on the board of Save Our Shores, a nonprofit organization concerned with coastal protection and opposed to offshore oil development.

The establishment of the Monterey Bay National Marine Sanctuary has enhanced the economic outlook for both Scrivani, whose farm is within its boundaries, and for Oakes, whose Abalone Farm is on Point Estero, just south of the sanctuary's boundary. "Now we can be sure that the sea water will remain pristine and no oil drilling or tanker traffic will endanger our hatchery," said Scrivani. Oakes commented: "In the last few years we've seen a noticeable decline in our water quality and have had to do more rigorous water treatment. Having that sanctuary means that no large point sources of pollution are going to flow down toward us with the California Current."

Catching Up

The United States lags behind many other countries in its support for aquaculture (see *Coast & Ocean*, Summer, 1992, p. 13). Regarding abalone, it has not even gone so far as gathering statistics on the industry. A reporter seeking figures on the size of the industry from the U.S. Department of Agriculture was told that the only figures the Department had came from the United Nations Food and Agriculture Organization in Rome (and these turned out to be riddled with inconsistencies.) Meryl Broussard, principal aquaculture scientist with U.S.D.A., said that a task force is being formed that will include his agency, the Department of the Census, and the Department of Commerce. They will try to agree on a unified set of statistics and a reporting system, so that at least there will be some better data on abalone. Unlike governments elsewhere, the U.S. and California governments offer little technical or economic assistance to encourage development of this promising, environmentally sound, coastal industry.

"Money—not kelp—is the biggest constraint to expanding this industry," said Oakes.



REGINA MCGRATH

California is the only state in the nation with the potential to become a major cultivator and exporter of abalone. Kelp is abundant and water temperatures in central and southern California are right for growing red abalone—the largest and most marketable species. Although abalone are also found off the Oregon and Washington coasts, they take much longer to reach market size because the water is colder. Hawaii's surface water is too warm to grow either abalone or kelp, so growers there have the added expense of pumping up colder water from the depths. Scrivani said he has customers in Hawaii because a Hawaiian abalone farm

Sowing Seed In The Sea

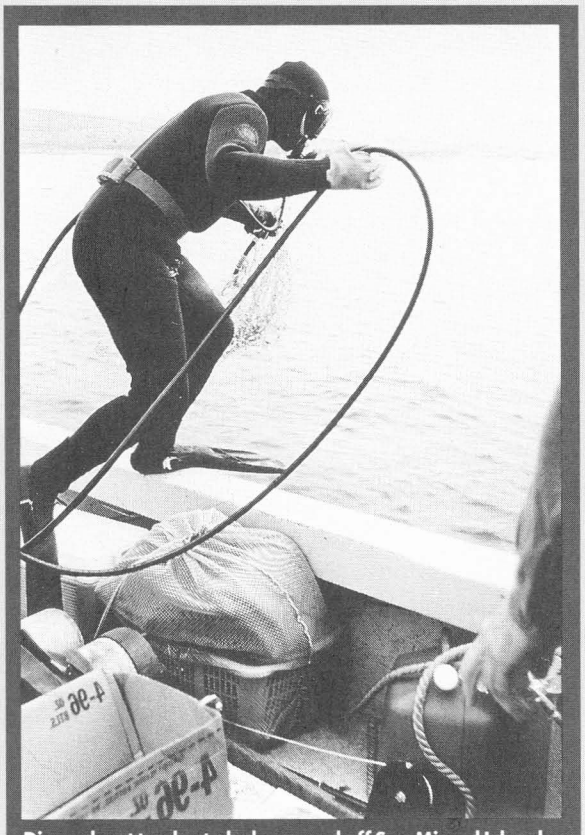
Commercial divers have been planting abalone seedlings in the wild for years, but their efforts have been informal, and without much scientific foundation. Now they are embarking on efforts to research the effectiveness of replenishment methods with newly available tax funds.

"I know intuitively that we're successful in replenishing some of the resource," said Randy Brannock, a commercial abalone diver living on Catalina Island, who said the California Abalone Association, a 130-member group representing commercial divers, has planted hundreds of thousands of abalone seeds around the Channel Islands while harvesting abalone over the last 20 years. "Now we need to get more scientific. Our next push is to plant several million larvae at a time and do some follow-up research on how many actually make it to adulthood."

The project will be sponsored by the association, with funds from a tax established in 1989 by legislation sponsored by the association for research on this diminishing resource. The tax requires divers to pay about $5 for every dozen abalone they sell—about four to five percent of their income, said association president John Colgate. The seedlings to be used will be purchased from abalone farmers, who will also advise on planting methods. Before the advent of commercial hatcheries, the association used seedlings from a lab it established on Stearns Wharf in Santa Barbara.

Abalone growers are glad to help the divers. Roy Gordon, president of Bodega Farms, in Marin County, was delighted when some North Coast divers bought some of his seedlings recently. "We have a whole generation here in California that has grown up without ever tasting abalone because it is scarce, said. "In five to six years, that may change." Commercial divers in New Zealand, Australia, and Japan have been replanting abalone as they harvest for years, he said. He has been raising 3 million seedlings since last January for sale at home and abroad.

In an earlier effort—a program set up by Abalone Farm, in Cayucos, and paid for by



Diver about to plant abalone seed off San Miguel Island.

D.B. Pleschner

Atlantic Richfield Oil Co.—commercial divers were given about 120,000 seedlings for replenishing wild stocks in central California. "I was an abalone sportdiver in high school and college, and decided I should be putting some of it back," says Frank Oakes, president of Abalone Farm. Recently, adult abalone from this outplanting have been found on San Miguel Island in the Channel Islands.

The decline of wild abalone has been blamed on overharvesting, ocean pollution, the resurgence of the sea otter population, management practices, and on a withering foot syndrome that is causing black abalone from Mexico to Point Conception to die, according to Pete Haaker, marine biologist with the Department of Fish and Game. He said similar symptoms have been observed in red and green abalone as well. Brannock is sure that red and green abalone are dying from the syndrome.

To enhance survival prospects for planted seedlings, the association plans to test different designs for a shelter that serves as a kind of half-way house between tank and open ocean. "We lower the structure one or two weeks before the larvae are ready to settle so it becomes part of the seascape, then we release the abalone into the structure. This way the abalone is still protected from predators," explained Brannock. "Then we open the doors, let the abalone crawl out, and reel in the structure to be used again."

failed after kelp proved too expensive to raise. Abalone don't grow in the Atlantic Ocean or the Gulf Coast.

Hulbrock believes that the expansion of abalone mariculture in California is limited primarily by its reliance on kelp, but Oakes believes the main constraint is financial. So far, the kelp supply appears to be keeping up with demand, not only from abalone farmers but also from the much larger industry that produces an additive used in many products, from ice cream to cosmetics. However, to prepare for future contingencies, Abalone Farm and Ab Lab are cooperating in experiments to produce a synthetic kelp substitute. "We feed a kelp substitute—partially made from kelp itself—to abalone that are six to eight months old," says Oakes. "If we could wean the larger abalone to this substitute, it would give the industry a lot more flexibility." So far, research has been trial and error, with growers sharing information. "If we get this worked out, it will help abalone farmers just getting started who can't locate near a kelp bed, and it will help during the winter months, when kelp takes a beating from the storms," Oakes said.

"Money—not kelp—is the biggest constraint to expanding this industry," said Oakes. He estimates it takes about $5 million to start up a large fully integrated abalone farm (hatchery, nursery and grow-out facility), partly because it takes at least three years before the first crop can be harvested. He said some Japanese investors have shown an interest in investing in abalone farms here. However, "We, personally, haven't made much of this opportunity, probably because of our pride," said Oakes. "Everyone in my company takes a lot of pride in the fact that we can sell a superior product to the Japanese at a better price than Japan's own abalone farms can, even though they've been growing abalone for generations." ❐

Regina McGrath is associate editor of Coast & Ocean.

The Canyons of San Diego

Some Grand, Some Not

by Jim King

Setting up for a landing at San Diego's Lindbergh Field, planes descend far out over the city's eastern suburbs, then head west before gliding down between the eucalyptus of Balboa Park and the downtown highrises. Before the eyes of the descending passengers who choose to peer out the aircraft windows, a panorama unfolds. It spans the hills of Baja California to the south to the rugged interior of Mount Palomar and the Cuyamacas to the north, with the city, a working harbor, bay and ocean shorelines extending between them. Much of California's coast has this juxtaposition of mountains and sea. But a studied look at the terrain reveals more. San Diego has a distinctive landscape of mesa and canyon and valley. Once you land and enter this landscape, traveling by freeway or surface street, you lose sight of this topography except now and then, when suddenly the horizon narrows and cliff sides close in.

The canyons and valleys are an important feature of this metropolis of some 2.5 million people, expected to grow to 3.1 million by 2010. Some of the canyons—those that have not been thoroughly plundered—preserve qualities now nearly lost in the fast-moving city. They are places offering quiet and solitude, even surprise glimpses of wildlife.

In the North Park District, in the heart of the city, I recently sat alongside a canyon rim, musing on how ordinary it is in San Diego to enjoy the chatter of a hundred songbirds and the calming rustle of eucalyptus in some wild place just beyond the backyard. Refreshed by heavy winter rains, this neighborhood canyon was a sanctuary carpeted with nasturtiums and vinca, too steep for any but the birds and their crafty predators—a cool, green oasis for human eyes. How nice. If only my apartment in the north came with its own canyon.

San Diego's canyon and mesa topography extends from the old city neighborhoods around the bay to the far-flung suburban communities to the north, south, and east. Throughout this roughly 2,000-square-mile region, the coastal plain is cut by a

network of drainages. ("Canyon" and "valley" are the terms used, somewhat interchangeably, to describe them, though "valley" generally connotes a sizable stream corridor and a gentler slope.)

The larger valleys are oriented east to west, with smaller ones flowing into them. Among the largest are the San Diego River and Sweetwater River valleys in the central part of the area, the Otay River Valley to the south, and Tecolote Canyon, San Clemente Canyon, Los Peñasquitos Canyon, and the San Dieguito River Valley to the north. Those smack in the middle of the city are, in many ways, the most enchanting: the canyons of Balboa Park, Hillcrest, North Park, and Golden Hill. Neighboring residents are well-acquainted with the many lesser-known vales, like Spruce Street Canyon and Florida Canyon, which give distinction and interest to their inner-city surroundings.

Some Canyon History

Having canyons winding their way through the center of town can cause considerable inconvenience. It wasn't until 1911 that the First Avenue Bridge was constructed over the main stem of the Spruce Street Canyon, allowing a clear shot into downtown from nearby uptown neighborhoods. In 1912, the Spruce Street suspension footbridge was constructed to allow residents of a secluded hillside district better access to neighbors, from whom they were separated by a narrow finger of the canyon. Generations of uptown teens have cherished this hidden place, sometimes to the chagrin of residents unnerved already by the natural sway of the suspension bridge.

Imagine the delight people found in these canyons one hundred or five hundred years ago, when they offered the only retreat from the dry and dusty world above. Yet as San Diego began the urban evolution we witness today, other values took precedence. Rail lines and roadways began to replace the trails of indigenous people.

Early in this century, such canyons were recognized as impediments to the town's circulation, requiring the construction of bridges in some cases, earth moving and grading in others. On the eastern fringe of San Diego, in Mission Gorge, 18th century Spanish settlers built a dam. Its ruins still pond the ephemeral waters of the San Diego River. The site now invites quiet contemplation of humans' relationship to their landscape.

In recent years, widespread concerted effort has begun to preserve canyon areas as open space. Mission Gorge, Tecolote Canyon, the Otay River Valley, and the San Dieguito River Valley have been the subject of multipurpose park, open space, recreation, and resource preservation initiatives. Significant investment will be required to restore a semblance of the natural environments that once existed here, but the process has begun, and tangible rewards for the public are guaranteed.

JIM KING

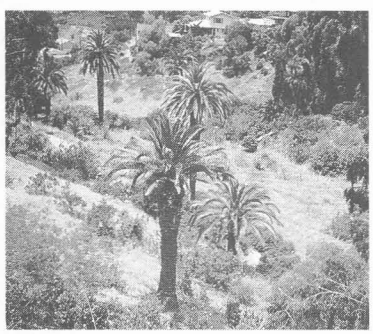
This suspended footbridge connects neighbors of Spruce Street Canyon.

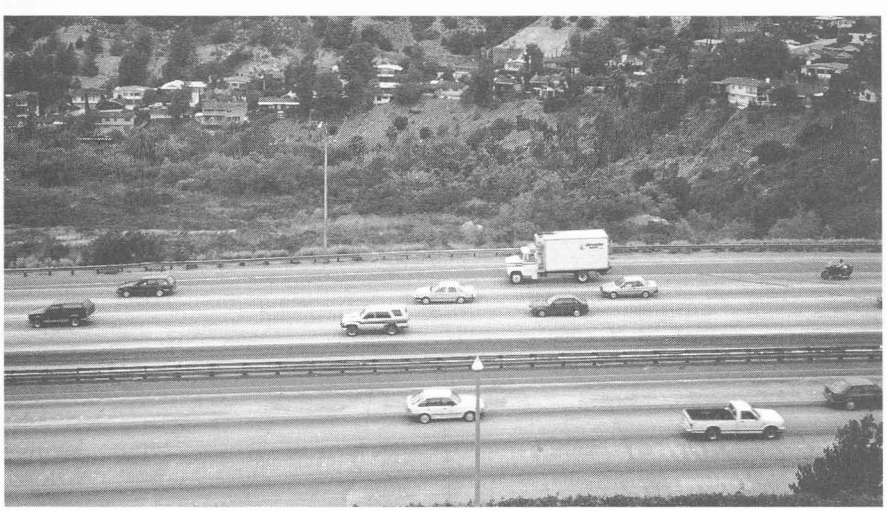
Nothing much can be done to restore those canyons and valleys that have been heavily developed, with highways, offices, hotels, commercial buildings. Rose Canyon, between La Jolla and Clairemont Mesa, is traversed by Santa Fe Railroad's main North-South line and I-5. I-15 runs through Murphy Canyon, between Clairemont Mesa and Serra Mesa. Light industry and office parks cram its sides. Scores of other canyons, large and

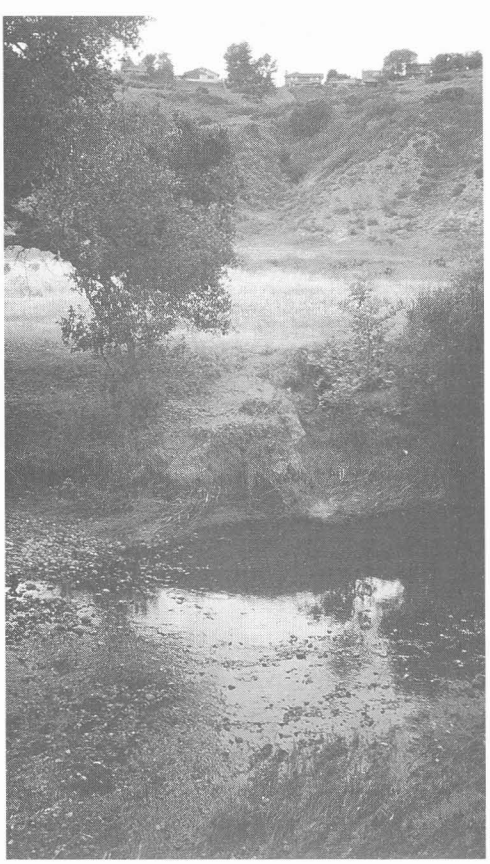
small, have been developed for all manner of uses, including highways, landfills, sewer and power lines, golf courses, and recreation centers. Canyon sites are favored for important components of the city's new sewage processing infrastructure. As land values have skyrocketed, canyon areas near the center of the city have been given a second look as locations for many types of development, and many projects have gained approval.

The high cost of site preparation required to make irregular canyon terrain buildable gave these areas a margin of protection for a long time. Their development becomes economically feasible as centrally located coastal land becomes more dear. While the city's general plan and growth management plan acknowledge the values of canyon areas in terms of open space, recreation, and wildlife, forceful arguments have been made in favor of infilling as a means of economic stimulation and economic development.

PHOTOS: JIM KING







(Upper) Palms and eucalyptus have naturalized in Spruce Street Canyon. (Lower) Some canyons have been used as transportation corridors and residential areas. (Right) Tecolote Creek.

Dead-end for Wildlife

Very disturbing analyses in recent years have indicated San Diego's development pattern is ruinous to the region's wildlife. A morning walk along even the smallest remnant canyon might be rewarded with the song of a mourning dove or a glimpse of a raccoon or skunk. But these are only the urban survivors. Few species are so fortunate as to adapt to the human-altered landscape.

In some of the larger tracts of open land, as can be found in Mission Gorge or in the Otay River Valley, a coyote or soaring raptor might be sighted, giving solace to naturalists. But the much larger community of species once common in these places has been strikingly diminished and is in great distress.

A landmark analysis of the status of chaparral-requiring birds at 37 San Diego canyon sites was performed in the mid-1980s by Michael Soulé and fellow researchers of the University of Michigan. This work, *Reconstructed Dynamics of Rapid Extinctions of Chaparral-Requiring Birds in Urban Habitat Islands, (Conservation Biology*, Vol. 2, No. 1, 1988, pages 75-92), carefully documented the plight of certain avian species in San Diego's fragmented urban canyons and, by inference, revealed the plight of many other species as well. The canyons and valleys have been dissected and splintered and, by and large, no longer function as wildlife corridors connecting to the wildlands beyond the urban fringe. Rather, they are habitat islands, in many cases islands for extinction, where only the most adaptable species survive—the raccoons and doves common to downtowns everywhere as well as some

species of hawks.

Soulé's work indicated that space and population size determine the viability of many isolated groups once their habitat is separated from larger tracts by urban developments. Evidence suggests that elimination of larger predators, such as coyotes, foxes and mountain lions, results in an increase in smaller predators (mesopredators) such as raccoons, skunks, and feral cats. These prolific predators, in turn, lead to the loss of vulnerable prey species, particularly ground-nesting birds such as the California gnat catcher, the Great roadrunner, California quail, and the California thrasher. Within a few decades of isolation, these species were extirpated from the canyons.

A windshield survey of the vegetation of San Diego area canyons might give a clue to what the wildlife is facing. You might be hard pressed to find a native plant in some of the smaller isolated downtown canyons, where eucalyptus and date palms have naturalized. Where native vegetation remains, sage would be expected on the south-facing slopes, chaparral on the north. Sycamore and willow riparian communities would be expected in the larger canyon bottoms. These biological indicators are often askew after development encroaches and the surrounding landscape is altered. Renegade irrigation and street runoff dribbles down from canyon rims. Myriad escaped garden plants attempt to dominate. Your aunt from Chicago marvels at the proliferation of geraniums and nasturtiums, pretty good evidence that wildlife is in trouble.

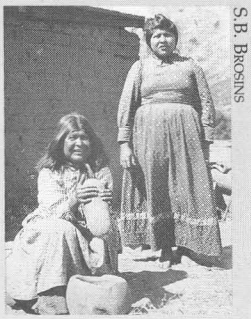
Planning Critical

Throughout California, the urbanization process continues. San Diego had a good shot at being a modern utopia. Several things went wrong. Having been blessed with a diverse topography and rich biota, might it not have preserved the canyons and valleys with habitat corridors that connected to the mountain wildlands? Hindsight says it would have been simple. But that thinking postdates the destructive development that now makes that grand vision impossible.

But people should think in these terms now. Good planning is possible and, in fact,

San Diego, Then and Now

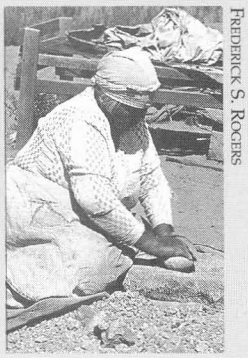
San Diego was probably a more wooded place, and warmer, when the earliest human inhabitants arrived about 10,000 years ago. They were Stone Age hunters, following herds of large and edible animals—mammoths, bison, and saber-toothed tigers—across the bridge of land from Asia to Alaska, and down the coast. Apart from some crude stone tools, they left few relics of their existence. As one of their key sites was along what the Spanish called the San Dieguito River, they are sometimes referred to as the San Dieguito culture.



S.B. Brosins

Next on the scene were the La Jollans, who settled near coastal lagoons where fish and shellfish were plentiful. Though archaeologists once assumed they had succeeded the San Dieguito people, more recent discoveries show they may have lived here at about the same time. Whether they were part of the same culture or another one is still open to question.

The last group of "Indians"—Columbus' misnomer that blankets all the original inhabitants of the New World—came westward from the Colorado River Valley about 1,200 years ago. They knew how to use bows and arrows, make pottery, and gather a wide variety of plants for food, including acorns, which they laboriously ground into meal. They were still here when the Spanish came, changed their lives, obliterated their culture, and named them Diegueños after the mission built to oversee their conversion. Those north of the San Diego River called themselves Ipai; south of the river were the Tipai, or Kumeyaay.



Frederick S. Rogers

The generations of Indians who lived in the area pretty much took their natural surroundings as they found them. . . . Today, most of the things we take for granted here come from somewhere else. The water that turns a near-desert into a place of green lawns and tropical flowers is nearly 90 percent imported, from the Colorado River and Northern California. Oranges, originally Asian, were brought from Spain via Mexico. Avocados are Central American; eucalyptus trees, Australian. Our three main natural habitats—chaparral, wetlands, and streamside—have been invaded by "foreigners," who have made themselves at home, even as the rest of us nonnative San Diegans have done.

Excerpted with permission from Walking San Diego, *by Lonnie Burstein Hewitt and Barbara Coffin Moore, The Mountaineers, Seattle, Wash.*

Photos courtesy of the San Diego Museum of Man.

RON KUKULKA

Florida Canyon, with Coronado Bridge in the background, and Veterans Hospital at right.

is critical, if the decimation of species is to be stopped, and urban people are to have the link to the natural landscape that their spirits demand. It is essential to prevent the fragmentation of habitats where it has not yet occurred, and to maintain habitat corridors between adequate blocks of habitat to enable species to disperse. Some important initiatives have been launched in San Diego to turn things around to the extent that this is possible. The work underway now in the Otay River Valley, San Dieguieto Valley, and the Tijuana River Valley offers hope. The possibilities are limited, however, and it's important that planning precede extinction listings in the less-developed reaches of the state.

San Diego's canyons are more important than ever. They are oases in the gray concrete modern city. Rustling leaves, the quiet, the aroma of earth and grasses—even today, the canyons provide opportunities to encounter some of the basic elements of the natural world. ❐

Jim King often travels in San Diego County as project manager for the State Coastal Conservancy.

Citizens in the Canyons

Community college students and those in adult education programs are invited to learn about San Diego's canyons through a series of presentations developed by the San Diego Association of Governments in 1988. The program, called "Canyons," is designed to be given in seven sessions, each of which is accompanied by a slide presentation. It explores the canyons' natural and human history, the forces that work to change them, the uses to which they are put, and what can and is being done to preserve them and/or regulate their development. Teachers interested in obtaining a copy (cost is $4.00, slides are loaned) should write to SANDAG, 401 B St., Suite 800, San Diego, CA 92101, or call (619) 595-5300.

Editor's note: Information on visiting the canyons of San Diego can be found in *Walking San Diego*, by Lonnie Burstein Hewitt and Barbara Coffin Moore, The Mountaineers, Seattle, WA: 1989. $10.95. To order, call 1-800-553-4453. (See review in *C&O*, Fall 1990, Page 46.)

Tecolote

Befriend Your Local Canyon

CHAD SLATTERY

Tecolote Canyon.

When Shirley Miller, president of the Friends of Tecolote Canyon, returns from a year in London, she knows she will find the canyon she loves much the way she left it, despite major new building projects elsewhere in San Diego. "It's a beautiful canyon," she said. "Tecolote Creek has water year-round because of runoff from people's yards. Along the banks there are oaks and sycamores, hundreds of years old. We have almost 100 species of birds, including the endangered Least Bell's vireo, and mammals from the coyote on down. At night you hear the coyote songs from one end of the canyon to another. A red-tailed hawk nests 200 yards from my house."

It could have been different. In 1970, a four-lane highway, condominiums, and apartment houses were planned for Tecolote Canyon. "This is a six-mile-long, skinny canyon, with a perimeter of about 27 miles, said Eloise Battle, chairperson of the Tecolote Citizens Advisory Committee. "It serves several communities. There are about 45 identified entrances."

Alerted to the development plans by a teacher from the San Diego Museum of Natural History whose class on native plants she had taken, Battle joined neighbors who were concerned about preserving their canyon views. In 1971 they organized as Citizens to Save Open Space (Citizens SOS). Over 66 percent of the property owners around the canyon agreed to be assessed by the city to raise money for buying canyon land for a park. This agreement was formalized as San Diego's Park Procedural Ordinance, and it set the precedent for other groups seeking to protect their local canyons. "Eloise Battle and her group were very instrumental in the formation of the Park Procedural Ordinance, and Tecolote Canyon Park was the first big open space park in the the city created because of it," says Don Prisby, community development specialist with San Diego's Park and Recreation Department.

About 2,000 properties were assessed: those on the canyon's rim at $775 each (payable in installments over ten years), those across the street at $175. Property owners were later reimbursed with bond funds from San Diego's Proposition C, passed in 1978 to preserve open space. More than 700 acres were acquired, then over 200 more, creating a city park of 915 acres, "almost as big as Balboa Park [1,400 acres]," said Miller. The neighbors' assessments covered about 25 percent of the cost, with the rest coming from the San Diego City Council's Environmental Growth Fund, financed by a small surcharge on utility bills. Tecolote Canyon Natural Park was dedicated in 1977.

With its main goal achieved, the SOS group reorganized and in 1981 became a nonprofit corporation, Friends of Tecolote Canyon. "Each rainy season we go down for two or three weeks to plant and do some cleanup," said Miller. "About a dozen of us are active members, but for the planting some 30-40 people come." The Friends also keep a lookout for any further threats to their natural park.

Meanwhile, a welcome development is about to begin in the canyon: In February, ground is expected be broken for an interpretive center, to be funded mostly by a grant from State Department of Parks and Recreation Regional Competive Grant Program to the San Diego Park and Recreation Department. "The Sierra Club and the San Diego Museum of Natural History already lead hikes here," said Battle. "We are hoping to get a city ranger and volunteers too."

Thus, because the people who lived around it fought to protect it, everyone can now enjoy the canyon. Says Battle: "Believe me, none of this ever would have happened if there hadn't been hundreds and hundreds of people wanting it." —*C&O*

Friends of Tecolote Canyon can be contacted by writing to Eloise Battle at 5635 Tamres Dr., San Diego, CA 92111

Groups working to protect other canyons in San Diego include:

• Friends of the San Dieguito River Valley—Formed in 1985 to restore and preserve the resources of the valley; currently concerned with stopping hillside erosion caused by mountain bikes in Crest Canyon. Works to stop development on valley's edges, remove nonnative plants, and buy property. About 350 members. P.O. Box 973, Del Mar, CA 92014-0973.

• Friends of Los Peñasquitos Canyon Preserve—Works to restore riparian and marsh habitat and vernal pools. Seeks to restore the creek to its original course. Weeds out nonnative plants, such as tamarisk, and plants coast live oaks.; is developing a management plan for endangered species and working to create wildlife corridors among canyons. About 250 members. P.O. Box 26523, San Diego, CA 92196, or phone (619) 484-3219.

The San Diego chapter of the Sierra Club (619) 299-1741 or the San Diego Association of Governments (619) 595-5342 may know of other canyon protection groups.

Yes In My Back Yard

Bats Are Not Rats

by Christine Scott

Yes, bats! Our only flying mammal, and the most misunderstood. One of nature's best designed pest controls, a single *Myotis yumanensis* (a small bat native to coastal and inland California) can easily consume 600 mosquitoes in one hour—something no can of insecticide can do. Bats have been devouring night-flying insects by the thousands of pounds for 55 million years.

We in California have an estimated 23 species of bats. Our bat populations are declining, however, at an unconscionable rate. The Department of Fish and Game has designated two species as "species of special concern," and eight more species await listing. Loss of habitat is the most severe threat to bats' survival, followed by our long-time and widespread use of pesticides, and people's unreasonable fears.

Upon finding a bat in the house, most people will immediately move to destroy it. They are aided by "pest control" people, who, for a very steep price, will remove bats for you. More harm is done than good—not only to the bats, but to your bank account.

There is no reason to get rid of bats. They are moving into people's attics to roost because the trees they used to roost in are disappearing. But they do not make nests, chew electrical wiring or cause any structural damage to buildings. The excreta of most species does not smell, unless the colony becomes very large. If the bats absolutely need to leave (e.g., a new roof is being put on), their exit can be accomplished inexpensively and safely. You have to plug up their entrance hole, *after* ensuring that they have all left to find food—otherwise you will trap one in your attic. Since bats have only one baby a year, it is critical not to exclude them during nursery season, mid-May through September.

You could also provide an alternative safe roosting place so they can go about their jobs as insect controllers. To do this, you want to set up a bat box in the warmest part of the yard, out of the wind. Although they are mammals, bats do not have a constant body temperature, so they look for protected spots where they can huddle together for warmth. Locating the box near water helps. It should be placed at least ten feet off the ground. If you buy a box, try to get a large one and caulk the seams. A 1 x 1.5 foot box could hold 100 bats, but giving them a 3 x 3 foot box is better. Bat boxes are like bird boxes, but instead of a floor, they have vertical slots through which the bats can enter. Don't paint the box! This will make it too slick for the bats to hold on.

The pallid bat *(Antrozous pallidus)* is helpful to drought-stricken oaks because it eats the beetles that feed on them.

CHRISTINE SCOTT

Dispelling Some Myths

Perhaps too much late-night reading of Bram Stoker's *Dracula* has given people some misconceptions about bats that need to be cleared up if we are to succeed in saving them.

Out of nearly 1,000 species of bats, only three are vampire bats, and they can be found only in South America and up into Mexico—not in Transylvania or California. They mainly attack livestock.

Fear of rabies also makes people's blood run cold. It is estimated that less than one-tenth of one percent of the entire wild population contracts rabies. These are not the kinds of numbers that should terrify people. Bats do not get furious rabies and seek out other animals to bite. They instead become paralyzed and die. Never pick up a bat off the ground, and you will never have to worry about rabies.

There are no blind bats, they all see quite well, but only in black and white. Bats have evolved to forage at night with little or no light, doing the same job as diurnal birds. They depend on echolocation, using an exquisite combination of very high-frequency sound waves, unique ear shapes, and nose-leaves as receptors. Bats are excellent navigators. The old story of bats becoming entangled in people's hair is quite untrue. It may have emerged from the fact that mosquitoes gather around people as they are strolling in the evening, and the bats are simply making the most of this condensed food source. Bats can actually detect an object as fine as a human hair.

Bats' make up the order *Chiroptera*, meaning "hand wing," whose closest relations are primates. They have a very elaborate social structure, including maternity colonies where all the females gather to raise their young.

Even knowing all this, some people will remain frightened or repelled by bats. But not you, perhaps. You may be among those who will recognize yourself lucky when you see a bat in the yard.

Christine Scott is a founding member of the California Bat Conservation Fund, a non-profit group organized this fall to help preserve our native bats. If you need advice or are interested in having her visit a classroom with her bats, call her at (415) 456-6598, or write P.O. Box 1502, Ross, CA 94957.

Book Reviews

Lakes, Rivers, Wetlands

Restoration of Aquatic Ecosystems: Science, Technology, and Public Policy, *by the Committee on Restoration of Aquatic Ecosystems: Science, Technology, and Public Policy, National Research Council, National Academy Press, Washington, D.C.: 1992, $39.95, 552 pp*

The National Research Council is a branch of the National Academy of Sciences, one of the foremost scientific organizations in the United States. The purpose of the council is to advise the public and the federal government on scientific issues and to recommend actions to improve public policy using the best technological information available. When the academy chooses an issue for evaluation, it selects the best scientists in the field and requests their deliberation and recommendations. This book is the result of such an investigation and represents the thinking of its 15 members. It is an excellent compilation of our current understanding and experience in aquatic ecosystem restoration. For the reader desiring technical information and references to the scientific literature, this text is highly recommended. It is not intended for the lay public, except those persons interested in public policy.

The book deals with three major ecosystems: lakes, rivers, and wetlands. The initial chapters review the current status of these aquatic systems and present the basis for the committee's overriding recommendation for a national program in aquatic ecosystem restoration. The facts presented include that 53 percent of the "presettlement" wetlands of United States (excluding Alaska) have been filled; that 40 percent of the perennial streams are adversely affected by turbidity; and that 2.6 million acres of the nation's lakes are impaired by siltation, pollution, and eutrophication. Although the committee found that progress was being made in the ability to restore these systems, it found little to cheer about as the social and environmental stresses on aquatic systems are increasing.

The most interesting and useful chapters in the book are those devoted to individual ecosystems. Each chapter provides an overview of the problem, the history of degradation and public policy to correct the problem, and a technical appraisal of the various restoration methods used. The chapter on lakes is exceptionally well done and reviews acidification, eutrophication, and contamination by toxic substances. It also provides a complete review of various lake restoration methods, using case histories to illustrate the effectiveness or limitations of each technique. The chapter on rivers and streams provides only a brief background on stream dynamics and flow but does provide a good explanation of the various factors contributing to the degradation of streams. There is a substantial evaluation of various instream habitat enhancement structures; however, there are no illustrations, and the reader would have to consult other sources to find out what is being discussed.

The chapter on wetlands is not as well organized as the other chapters, perhaps due to the diversity of habitats reviewed or the greater complexity of federal and state regulations. It provides only a brief description of the impacts to wetlands and the techniques used to restore degraded habitats. The examples used are largely drawn from coastal wetlands, many in California. The authors strongly criticize restoration as part of governmental mitigation policy, leaving the reader with the impression that all wetland restoration is ineffective. By limiting its focus to mitigation, the chapter does not present the broad range of experience by federal, state, and nonprofit agencies in successful wetland habitat restoration. On the other hand, many of the recommendations in the chapter are extremely important elements of a successful restoration plan and implementation effort.

The committee concludes that a National Restoration Strategy needs to be adopted with a 20-year restoration goal of 10 million acres of wetlands, 400,000 miles of streams and rivers, and 1 million acres of lakes. No costs are provided for this program. Without concerted legislative attention, this goal will be difficult to achieve. However, recommendations are made to improve existing programs and to improve restoration technology, and these are certainly feasible within current fiscal and legislative constraints.

To order, write to National Academy Press, 2001 Wisconsin Ave. N.W., Harris Building, Room 384, Washington, D.C. 20418 (enclose $39.95 plus $3.00 shipping charge), or phone (800) 624-6242.

Reviewed by Michael Josselyn, professor of biology, Romberg Tiburon Centers, San Francisco State University.

Rolling Along: Park Guides

Easy Access to National Parks: The Sierra Club Guide for People with Disabilities, Also Useful for Seniors and Families with Young Children, *by Wendy Roth and Michael Tompane. Sierra Club Books, San Francisco, CA: 1992. $16.00, 352 pp*

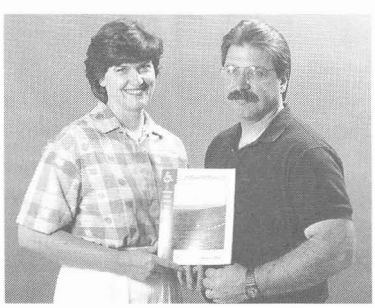
California Parks Access: A Complete Guide to the State and National Parks for Visitors with Limited Mobility, *by Linda and Allen Mitchell, Cougar Pass Publishing, Escondido, CA: 1992. $19.95, 320 pp*

Special efforts have been underway for some time now to expand access to public facilities for people who use wheelchairs or are otherwise mobility-impaired, as well as for people with vi-

sual and hearing impairments. Many of those efforts are due to the 1992 Americans with Disabilities Act, but others have grown out of the disability rights and independent living movements. These two new guidebooks are welcome additions to the growing literature that invites people of all abilities to venture out to enjoy their state and national parks.

Wendy Roth, a television producer and writer who uses an electric wheelchair, and Michael Tompane, a film and video editor and photographer, spent over a year researching *Easy Access to National Parks*, traveling 32,000 miles through 41 states, evaluating 41 national parks and interviewing park visitors, rangers, and access coordinators. They have detailed comprehensive excursions to 18 great parks, selected as exceptional for their accessibility, regional significance, and natural beauty. They range from Carlsbad Caverns, to Yosemite National Park, to the Florida Everglades.

Three sections comprise this well-written and easy-to-use guide. The first section, "Easy Access Essentials," includes a section on the genesis and process of the book; "Best Visits," gives a detailed look at the 18 featured parks; and "At a Glance" summarizes information on national parks in geographical order. Sixteen maps, a 16-page color insert, and 12 black and white photographs assist the reader in planning a trip.



Wendy Roth, Michael Tompane.

This book is useful to many others besides wheelchair users. Besides the 44 million people with long-term disabilities in this country, there are many others who are temporarily impaired because of various injuries. In addition, Roth points out, "Our travels reveal that people with disabilities have needs like those of families with young children, seniors, and those who want gentle, low-effort hiking outdoors." As a wheelchair user, I enjoyed the book because of the knowledge I gained of the opportunities available for independence while viewing these wonders. It also evoked memories of my own explorations of several of the same parks.

To order, write to Sierra Club Store Orders, 730 Polk St. San Francisco, CA 94109 (enclose $16.00, plus sales tax and $3.00 for shipping and handling).

California Parks Access is an excellent reference book for anyone who wants to plan a visit to the state's many natural beauties. The six chapters are arranged geographically, from the North Coast to inland southern California. Each park summary begins with a thumbnail sketch of the area and its historical significance, followed by a description of access at the park.

The authors include details such as traveling distances on trails, surface textures, and restroom locations. Special programs for wheelchair users are noted. Phone numbers and addresses are provided for readers who want more information. The appendices are interesting and helpful, particularly the "Access Summary," an easy-to-use matrix with an alphabetical list of all the parks described in the book, detailing campgrounds, restrooms, showers, lodging, trails, stores, and more.

Both books define two degrees of accessibility: "accessible" as determined by state and federal regulations, and "moderately accessible," meaning usable. "Difficult" or "inaccessible" means there are no accessible features. In both books, these degrees of difficulty are used in describing major sites, trails, campgrounds, and restrooms.

I like both books and would recommend them to anyone who enjoys the outdoors as well as for acquisitions by public and private libraries. I only hope that both will be updated in years to come; for, as I know from my experiences with officials of the Tahoe National Forest, major efforts are now underway to make our national and state parks more accessible to the traveler with a disability.

To order, write to Cougar Pass Publishing, P.O. Box 463060, Escondido, CA 92046-3060 (enclose $3.50 for shipping and handling and $1.50 sales tax) or call (800) 735-3805.

Reviewed by Sam Dardick, executive director of the Foundation of Resources for Equality and Employment for the Disabled, Grass Valley, CA.

KARRIE LIN CARLSON

Hiking Northern California

The Best Day Hikes of the California Northwest, *by Art Bernstein, Mountain N'Air Books, La Crescenta, CA: 1992. $13.50, 224 pp*

This is a very personal account of 94 day hikes in the California Northwest, between Marin County and the Oregon border and west of Highway I-5 (except the four hikes at Mt. Shasta). The book concentrates on hikes between two and ten miles long in the northern mountains (Trinity, Marble, Siskiyou, Yolla Bolly) with the rest spread out along the coastline and in the coastal ranges.

In describing criteria for his choice of hikes, the author acknowledges time and physical constraints, personal preference,

and a desire to present a cross-section of hikes in the region. The text reveals other criteria, such as the author's dislike of trails following creeks and of those lacking some outstanding feature. The hikes are directed toward specific goals, such as summits or lake basins.

Details listed include trail length one way, water availability, access road quality, best season, trail difficulty, elevation gain, trail uses (almost all exclude motorized vehicles or are for hikers only), ownership, and a phone number.

This book is not a detailed trail guide and lacks the formality of many hiking books. The author attempts to "capture the essence of each place," with "observations on natural history and enough information to get you there and back without major mishaps." The informative narration on a particular topic of natural history is sometimes spread out over several chapters covering the same area, such as the explanation of the geology of Point Reyes. The maps are rudimentary. Don't try to use the book as a trail guide; get a good map of the area.

Driving to the trail head is also covered because it's "part of the experience" and can be "crucial to understanding the trail's natural history." In the car culture of California, it's unfortunate but true that driving has, by necessity, become part of the outdoor experience.

I've hiked 28 of the 94 hikes, mostly on the Marin, Sonoma, and Mendocino coastline and in the coastal hills. Of some 27 hikes in the coastal zone, ten are described as coastal trails. Of the trails I've been on, I can attest that the descriptions are accurate, though I found that in some places the author's impressions diverged from my own experience.

The book should give the reader a sense of wanting to do the hike, or not. I'll never make it to all the trails, but I'm moved to head north, with this book and a map in my day pack, seeking new and little-known places to explore.

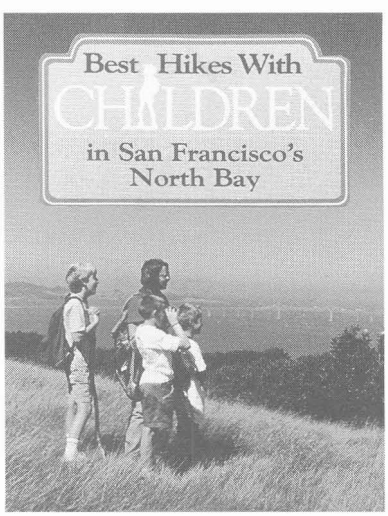
To order, write to Mountain N'Air Books, P.O. Box 12540, La Crescenta, CA 91224, or call (800) 446-9696.

Reviewed by Richard Nichols, statewide coordinator for Coastwalk, an all-volunteer nonprofit organization dedicated to completing the continuous California Coastal Trail and protecting the coastal environment.

With Kids

Best Hikes With Children: San Francisco's North Bay, *by Bill McMillon with Kevin McMillon. The Mountaineers, Seattle, WA: 1992. $12.95, 224 pp*

If your family is like mine and routinely repeats the same well-known hikes week after week, then *Best Hikes With Children: San Francisco's North Bay* is for you. Ninety trails throughout Marin and Sonoma counties are described, including useful information such as trail difficulty, distance, elevation gain, hiking time, time of year to go, and map. The authors provide suggestions for finding frogs and birds and wildflowers along many of the trails, and mention good vista and resting stops.



Most of my family's favorite hikes are in this book, accurately described. An unfortunate oversight was made, however, on hike No. 10, the Benstein/Cataract Trail Loop. The guide routes hikers back to their cars before they have visited the best stretch of the Cataract Trail, between Laurel Dell and Alpine Lake on Mount Tamalpais. During the rainy season, wonderful waterfalls cascade over large rocks along this stretch. Parking is also very limited given the heavy usage at many trailheads on Mount Tamalpais, such as hike No. 11, the Phoenix Lake Trail. If the parking lot is full, the nearest parking is about one-half mile down the road.

The authors highlight cautions along trails, such as poison oak, slippery bluff edges, and steep sections. They also provide interesting environmental and historical tidbits. Many trails described are open to equestrians and/or mountain bicycles. The only omission I spotted in reviewing the list of trails is the extensive system of Marin County Parks and Open Space District lands, which is underrepresented. I particularly like the network of trails in Indian Valley and Indian Tree in Novato.

Many families who live in the North Bay do so because of the proximity to so much public open space. This book enables them to get out and enjoy the beauty and diversity that is available.

To order, call (800) 553-4453, or mail $12.95, plus $2.00 for shipping to The Mountaineers, 1011 S.W. Klickitat Way, Suite 107, Seattle, WA 98134. *Best Hikes With Children: San Francisco's South Bay,* by the same authors, is also available (same price).

Reviewed by Terri Nevins, project manager with the Coastal Conservancy's site reservation program and a longtime resident of Marin County.

From Other Shores

MEXICO

Egg Patrol: Rebuilding the Sea Turtle Population

by Marc Beyeler

Under September's full moon, half a dozen men and women stand quietly on the beach of a small village near Puerto Vallarta, watching a sea turtle drag herself up onto the sand. Using her back flippers, she scoops out a cylindrical pit, then starts laying her eggs. After she has finished hauling her 100 pounds back into the ocean, the watchers uncover her eggs and move them to a nearby hatchery on the beach.

Now in its third year, the San Francisco sea turtle project successfully collected and hatched about 5,000 sea turtle eggs during the two months of September and October 1992. With a human population of about 1,500, the village of San Francisco, an hour's drive northwest of Puerto Vallarta on the Pacific Coast of Mexico, faces a beach where several of the seven or eight species of sea turtles (experts disagree) lay their eggs. They include the East Pacific Green, Olive Ridley, and Leatherback. Fifteen years ago, an estimated 5,000 sea turtles laid eggs on the beaches near San Francisco. Now, not even 100 appear. The drastic decline is attributed to egg poaching and to overfishing of adult sea turtles for their meat, shells, and skin. During the six weeks of incubation, eggs are also vulnerable to natural predators, such as ghost crabs, skunks, and raccoons, despite the mother turtle's efforts to hide them in the sand.

To find the eggs before predators and poachers do, local volunteers who live in San Francisco—both Mexicans and resident Americans—patrol six beaches during the three-month egg-laying period. They then replant the eggs in the sand of a 6 x 10 meter bamboo and chicken wire hatchery, on the same beach, out of range of the pounding surf. When the baby turtles break out of their eggs 45 to 50 days later, the volunteers carry them to the ocean.

"Hatchery programs are often the only alternative because the nesting habitat is so badly damaged and poaching is so severe that if you leave the nests alone, the eggs will be lost," says Deborah Crouse, director of the species recovery program for the nonprofit Center for Marine Conservation, in Washington, D.C. She points out, however, that there are a lot of risks involved. By putting the eggs in one place, the volunteers risk losing them all if a storm, predator, poacher or bacterial infection strikes. If eggs are moved to a site that is even a few degrees cooler than the one where they were laid, all the hatchlings will be male.

All species of sea turtles in U.S. waters are federally listed as threatened or endangered. The United States, Mexico, and over 100 other nations have signed of the Convention on International Trade in Endangered Species (CITES), which calls for trade sanctions against any country found to be trading endangered species or their products. All sea turtles are listed as threatened or endangered by CITES. Worldwide, it is estimated that the sea turtle population is less than one-tenth the size it was 50 years ago.

Mexico is home to more species of nesting turtles than any other country, and is the most important country for turtle nesting in the world. Most sea turtles in U.S. waters live in the Gulf of Mexico or the southeastern Atlantic, since waters off the Pacific Coast are too

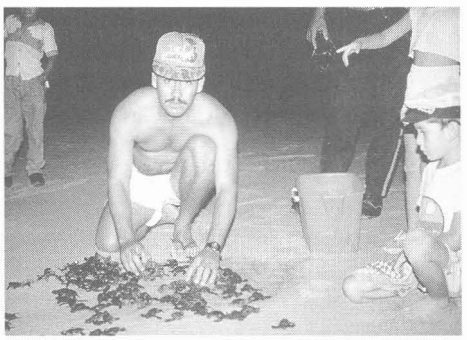
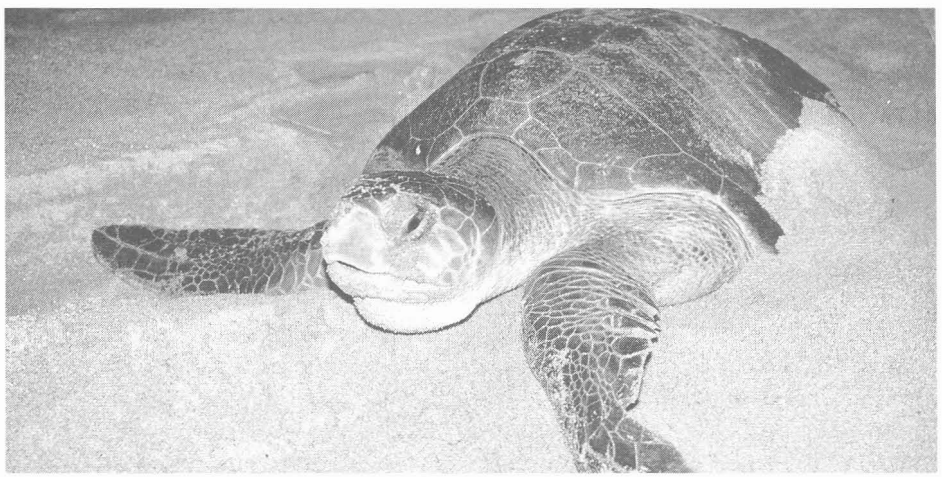
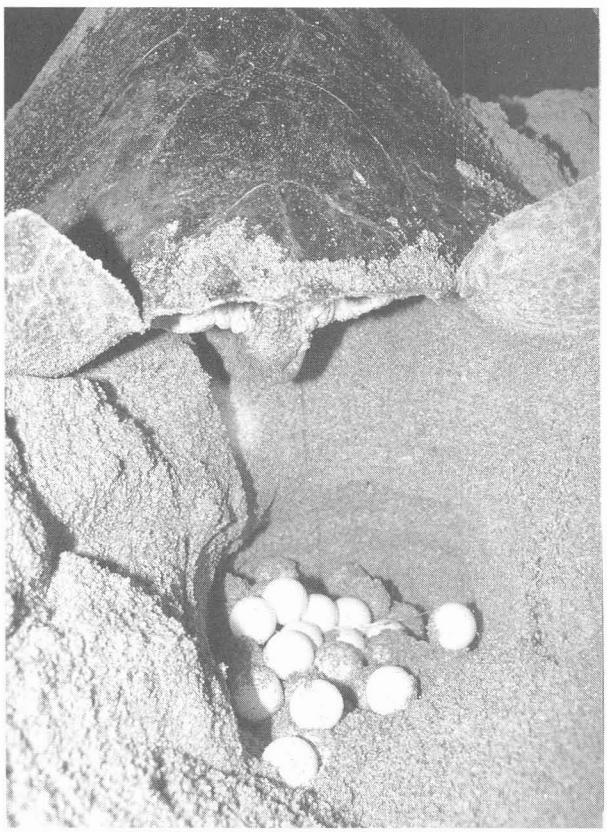


PHOTO: MARC BEYELER



Upper: Volunteers watched as baby sea turtles emerged from their shells. Lower: Small Green Pacific sea turtle.

cold for nesting. Although there is no trade in turtle shell or meat in the United States, each year, according to Crouse, as many as 55,000 sea turtles may die in shrimp trawl nets in U.S. waters, mainly in the southeastern Atlantic. The Center for Marine Conservation supports a proposal put forth in April by the National Marine Fisheries Service to require turtle excluder devices on all shrimp trawl nets in U.S. waters at all times.



JESSE HENDRY

Turtle laying eggs on a beach near San Francisco, Nayarit.

Sea turtles can live for 100 years, and their reproductive rate is low. Most reach sexual maturity at 20 to 30 years. About 100 eggs are laid in each nest (a total of 400 to 600 eggs every two to three years), and less than one percent will make it to adulthood. With the help of the volunteers, the San Francisco turtle population could double in a decade.

The project is one of a growing number of community-based efforts to protect sea turtles in Mexico and Central America. Local volunteers view sea turtle restoration as an important conservation and environmental issue, but they also feel their cause will bring the economic benefits of ecotourism to their community, as the turtle population grows and more people come to view them. The forest and beaches of San Francisco already attract tourists.

Turtle restoration in Mexico is supported by a 1990 decree signed by President Carlos Salinas de Gortari that outlaws the killing of adult sea turtles and the selling or buying of turtle eggs. The decree also established the National Program for the Protection, Preservation and Investigation of Sea Turtles and includes language promoting sustainable economic alternatives to turtle fishermen, a few of whom are now volunteers in the sea turtle project. However, economic assistance to provide retraining or capital to turtle fishermen has yet to materialize.

The programs to protect the sea turtles in Mexico and elsewhere are often funded by environmental groups from abroad. More information is available from:

- EarthWatch, 680 Mt. Auburn St., Box 403, Watertown, MA 02272; phone: (617) 926-8200.
- Foundation for Field Research, P.O. Box 2010, Alpine, CA 92001; phone: (619) 445-9264.
- Earth Island Institute, Sea Turtle Restoration Project coordinates volunteer expeditions to Mexico, Costa Rica, and Nicaragua. Write to 300 Broadway, Suite 28, San Francisco, CA 94133; phone (800) 859-SAVE.
- Center for Marine Conservation provides fact sheets and other educational materials on sea turtles. Write to 1725 DeSalles St. NW, Suite 500, Washington, D.C., 20036.
- *Marine Turtle Newsletter* c/o Scott Eckert, Hubbs-Sea World Research Institute, 1700 South Shores Rd., San Diego, CA 92109; phone: (619) 226-3872.

Marc Beyeler, manager of the Conservancy's Urban Waterfronts Program, visited San Francisco, Nayarit, in September, and patrolled for eggs with local volunteers.

Shell Not Enough Protection

Sea turtles spend their entire lives at sea, except when the females come ashore to lay their eggs. If they manage to reach the ocean, hatchlings may become prey to sharks, bluefish, and sea gulls. Those that survive are believed to congregate for the first several years of their life in areas where ocean currents come together. Later they move to protected bays and estuaries. In most species, the turtles are 20 to 30 years old before they begin breeding.

In addition to shrimp trawls and dredges, loss of nesting habitat is largely responsible for the drastic decline in the turtle population. Seawalls, condominiums, and hotels alter valuable nesting areas. Not only does coastal development discourage females from coming ashore to nest, but artificial lighting often attracts the newly emerged hatchlings, and they head away from—instead of toward—the sea.

In 1990, the first refuge in the United States specifically for sea turtle nesting was established. The Archie Carr National Wildlife Refuge is on the east-central coast of Florida.

Source: The Center for Marine Conservation.

Letters

More Help with Natives

Editor:

Regarding your "Yes In My Back Yard" column, I have two additions to make to your sources for native plants and advice. The Los Angeles/Santa Monica Mountains Chapter of the California Native Plant Society has published a list of recommended native species to be used in the Santa Monica Mountains. For a copy ($5.00), write to Betsey Landis, California Native Plant Society, 3908 Mandeville Canyon, Los Angeles, CA 90049, or call (310) 472-0624. Also, a new native plant nursery has opened in Malibu. Write to Matilija Nursery, 6007 Trancas Canyon Road, Malibu, CA 90265, or phone Bob Sussman at (310) 457-3381.

Jo Kitz
California Native Plant Society

The nonprofit California Native Plant Society has 29 chapters and 8,000 members statewide. For information, call (916) 447-2677.

Editor:

The California Conservation Corps Napa Native Plant Nursery is stocked with many of the native plants your readers may need for environmental plantings. These plants are being grown as a benefit to California's environment and for such purposes as erosion control, revegetation projects, streambank stabilization, wildlife habitat improvement, and beautification of state highways. This is the time to begin planning for next year's needs as well.

This nursery was established to:

1. Make various species of California native plants available to public agencies and public-minded organizations at reasonable prices.

2. Offer young people in the Conservation Corps the opportunity for an academic and vocational experience that will give them the propagation and management skills necessary for employment in the field.

CCC crews also gather site-specific seeds and cuttings for propagation at our nursery and install any large amount of plant material obtained from the nursery. For a list of species and prices, or for more information, call (707) 253-7783. Or write to us at CCC, P.O. Box 7199, Napa, CA 94558.

Chris Sauer and Mike Forte
California Conservation Corps
Native Plant Nursery

Outdoors in Orange County

Editor:

Re: *"Who Will Mind Our Riches?* (Summer 1992), there are major environmental education self-supportive efforts being made in Orange County and elsewhere that can easily be replicated statewide.

Last year, some 47,000 elementary age students participated in the Outdoor Science School and Environmental Field Study program, both operated by the Orange County Department of Education on a financially self-supportive basis. These programs are enthusiastically supported by teachers, administrators, school boards, parents, and community leaders.

The resident Outdoor Science School, at five picturesque sites in the San Bernardino National Forest, provides fifth and sixth graders with "senses-on" study opportunities to explore, observe, investigate, and become actively involved as learners of botany, zoology, geology, meteorology, astronomy, and ecological relationships. Recreational and cooperative learning activities round out the typical five-day, four-night program, which provides 30-35 hours of direct science instruction. Since 1974, some 185,000 students have participated; 16,700 this year.

Some 30,000 students took part in the Environmental Field Study program, which provides third to sixth graders with one-day (about five hours) or two-day (about ten hours) "senses-on" study opportunities at six natural historical sites. Half-day programs (about three hours) are available for third graders. A Traveling Naturalist takes a bit of nature and ecology into primary grade classrooms.

The instructional activities of both programs articulate closely with the California Science Framework, Environmental Education guidelines, and elementary school science textbooks. The newly formed nonprofit Orange County Outdoor Science Foundation provides financial support for needy and deserving students. It has raised $45,000 and is embarking on a major fund-raising campaign to ensure that every student, regardless of financial circumstances, can be involved.

Orange County is not alone. According to a recent California Outdoor School Administrator survey, 60 public Outdoor Science School programs serve some 150,000 fifth and sixth grade students statewide.

John F. Dean, Ed.D., County Superintendent of Schools

Dan Leinbach, Principal, Outdoor Science School

Pam Johnson, Manager, Environmental Field Study Program

Nathaniel Lamm, Administrator, Academic Events and Environmental Education

Editor's note: The average cost per student to attend an outdoor school is $200.

Mystery Photo

About how much of California's coast is publicly owned? A correct guess wins you a free subscription to your favorite magazine, *Coast & Ocean*.

NELIA FOREST

Last issue's mystery solved:

JOHN INASE

Editor:

Your mystery photo in the summer 1992 issue is not as easy as it may seem. Your beast is one of the rock-boring clams in the family *Pholadidae* (the Piddocks), of which there are at least 12 species in California. I suspect your clam is a "Flat-Tip Piddock," also known as *Pentitella penita* (Conrad, 1837). [Yes, says John Inase, who provided the photo—*Ed.*]

With regard to how these clams bore into rocks, I would like to shamelessly promote my forthcoming book, *Bivalvia of the Northeastern Pacific Ocean* (by Eugene Coan, Paul Scott, and Frank Bernard), by including the following excerpt:

"The family *Pholadidae* is highly modified for the mechanical abrasion of a burrow in solid substrates (possibly assisted by chemical secretions) and burrowing in clay, mud, shale, shell, and plant remains. There are also cases of penetration of lead sheathing, plastics, and PVC, causing failure of submerged electric cables. The shell, rather than being merely a container for the soft parts, is modified to apply mechanical force to the substrate. The hinge is no longer concerned with alignment of the valves, but has become a fulcrum for the valves, which have a circular rasping movement and are applied to the substrate by the sucker-like foot."

Paul H. Scott,
Associate Curator
Department of Invertebrate Zoology,
Santa Barbara Museum
of Natural History

The Romberg Tiburon Centers
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