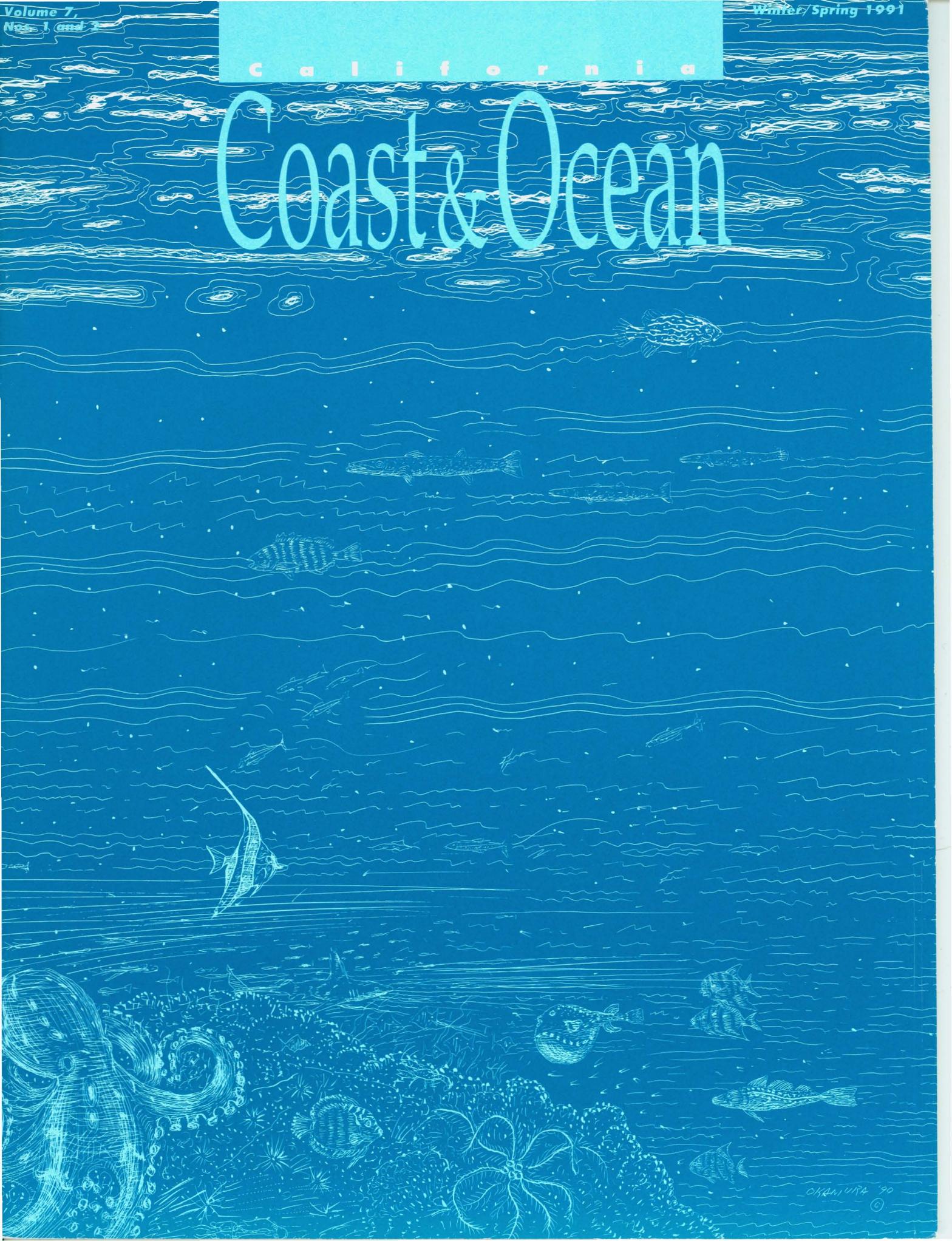


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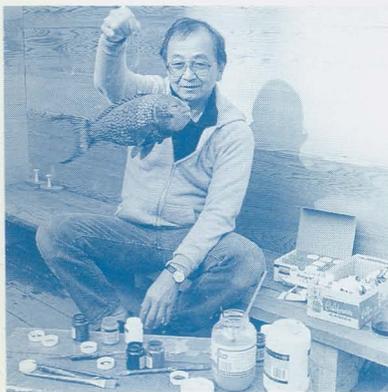


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About the cover: Arthur Okamura's work has often centered on the rich life zones where land meets ocean. He has explored the northern California coast in watercolors, oils, silkscreen printing, clay, and other media. For this special issue of *Coast & Ocean*, he used scratchboard to delve below the surface, into a vibrant underwater seascape.

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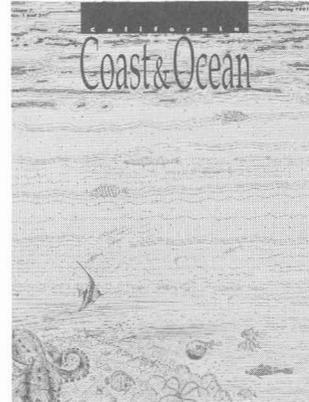
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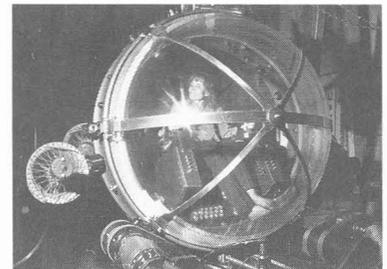
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**Aqua
Incognita:**
We don't know
enough about the
oceans to treat
them as we do.
See page 7

Dolphins by Dan Hubig

From the Executive Office

by Peter Grenell

The time has come to consider some new directions in ocean resource management and governance. Failure to do so now could doom us to repeating mistakes made during the settlement of our western lands—and worse. The old approaches to land development and resource exploitation, and their underlying values, are clearly inappropriate to the fluid unbounded ocean world, and to our fragile global interdependence.

As new technology opens the deep seas to ever greater exploitation, it creates an urgent need to establish basic rules to protect the common good. We need to articulate public rights in relation to private entrepreneurship rights, to understand the consequences of our inclination to “use” natural resources that otherwise go to “waste,” revise a decision-making system that is based mainly on short-term gain, and come to terms with our historical compulsion to use new technology regardless of the damage it inflicts on the common resource base.

As Sylvia Earle points out in her interview in this issue of *Coast & Ocean*, “The benefits we are already deriving [from the ocean] are priceless. Most people think of the value of ocean resources in terms of what they take out—fish or minerals. But there are other, priceless values, such as a hospitable climate, breathable air, a generally healthy earth ecosystem. We must protect that system.”

The notion of “balancing” conservation and growth is obsolete. We do not have a choice between the two. Rather, we must find ways to tap ocean resources without further damaging our hydrospheric life support system. To do so we must move more cautiously in the use of nonrenewable resources. This will require changes in what technology and

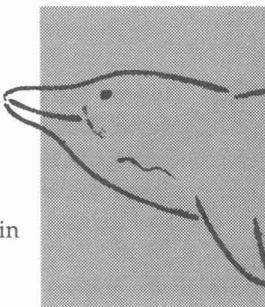
investment decisions are made, how we make them, and in the incentive system that underlies these decisions. Our knowledge of ocean and marine processes and resources is still rudimentary at best. To develop the technological, management, and governance systems we need, we must have more information than we now possess.

These thoughts suggest the need to move conservatively when planning new ocean resource exploitation, such as sea bed mining, energy exploration, or harvesting of “underused” fisheries. We must maintain flexibility and adopt a wide scope for action. A tough regulatory “bill of rights” alone would not solve all the problems we will face.

Almost two decades of experience here in California with perhaps the world’s most stringent system of coastal development controls—as successful as it has been—clearly show that a broader approach is needed. The public sector must work with the private sector to resolve critical issues and come up with this approach.

Global problems are location-specific and must be addressed locally and regionally. Thus there is reason and scope for coordinated state and local action. To be effective, we must view ocean resource problems in a spatial context, from inland to the shoreline, and outward through the nearshore area to beyond the outer continental shelf. After all, it has been estimated that at least 40 percent of ocean pollution originates on land.

Much attention has been given to the coast, that extremely sensitive, ever-changing, amazingly complex edge that is full of risk and opportunity. This



special issue of *Coast & Ocean* now focuses on the ocean environment that meets our shoreline from Crescent City to Imperial Beach. In these pages Robert Knecht, co-director of the Center for the Study of Marine Policy, Graduate College of Marine Studies, University of Delaware, discusses the opportunities to shape a new federal and state ocean policy inherent in President Reagan’s 1988 proclamation of the 200-mile Exclusive Economic Zone, the 12-mile territorial sea, and also in the state’s three-mile jurisdiction. Paul Siri of the University of California’s Bodega Marine Laboratory considers whether U.S. fisheries would benefit from the draft Law of the Sea. Sylvia Earle, National Oceanic and Atmospheric Administration chief scientist, speaks of new options for exploring the ocean realms, and marine scientist Gregory Silber describes the sea otter translocation project as a case history that demonstrates how difficult it is to manage ocean wildlife without essential knowledge. Regina McGrath demonstrates how hard it is to get a coherent picture of what we are discharging into the ocean. Gary Sharp, visiting scientist at NOAA’s Center for Ocean Analysis and Prediction in Monterey, shows that science now has the capability of making major breakthroughs in knowledge by establishing a common research framework. All this and more we offer in hopes of helping to direct public attention to the 70 percent of the planet surface that lies under salt water, particularly as it touches the California coast.

From now on, *Coast & Ocean* will offer regular coverage of ocean issues. At a time of domestic and foreign crises, the need to plan for the management of environmental resources, including ocean resources, is not a “soft” issue but a vital concern. We will soon enter a new global era of resource wars unless we design a strategy for peaceful and equitable management and governance now. □

Ebb and Flow

RECENT CONSERVANCY ACTIONS

Napa Watershed Restoration

Both wildlife and vineyards should benefit from innovative new programs being undertaken by the State Coastal Conservancy and the Napa County Resource Conservation District in the 4,500-acre Huichica Creek watershed in southwestern Napa County.

During the past decade, much of this watershed has been converted from range and dairyland to vineyards at a cost as high as \$30,000 an acre. In the process, water has been increasingly diverted for irrigation. With streamside vegetation all but gone in places because of prior grazing, habitat was severely damaged for fish, the endangered California freshwater shrimp (*Syncaris pacifica*), and other aquatic life.

In the marshes downstream, which include some of the few remaining waterfowl nesting areas in San Francisco Bay, lack of fresh water has led to the death of most ducklings during the past several years. Both in the creek and the marshes, aquatic life is further endangered by pesticide runoff from the vineyards.

Environmental degradation in the watershed has also had negative impacts on viticulture. Conversion of huge areas of grassland and oak woodland to monocultures made vines susceptible to infestations of leaf hoppers, requiring large doses of strong pesticides. Landowners recognize consumer and resource agency pressures to reduce pesticides, and concerns about the effects of pesticides on the endangered shrimp.

In December, the Coastal Conservancy took steps on two fronts toward resolving these problems. First, the Conservancy authorized up to \$75,000 to the Napa County RCD to prepare a resource enhancement plan for the

watershed, focusing on water quantity, water quality, and soil erosion, as well as on enhancement and revegetation of the creek channel and watershed lands. The plan will include:

- Low-water irrigation trials on an eight-acre vineyard set aside by Robert Mondavi Winery, which is also providing \$22,000 and extensive in-kind services.



Vineyard, with cover crop, in Huichica Creek watershed. Photo: Soil Conservation Service.

- Trials of integrated pest management strategies, including planting native vegetation, on an 18-acre vineyard set aside by Buena Vista Winery.

- A test of the use of cover crops to protect bare soil from winter rains and reduce sedimentation into the creek and marsh, conducted on a seven-acre vineyard set aside by Sterling Vineyards.

In a second effort to resolve problems in the Huichica Creek watershed, the Conservancy authorized up to \$345,000 to the Napa County RCD to help the district, together with the Wildlife Conservation Board (WCB), acquire 19 acres of the Cabral Ranch, about three miles south of Highway 12/121. The RCD will use the agriculturally zoned upland to develop a commercially sized vineyard that will demonstrate how landowners can develop highly productive quality vineyards in a manner that

protects the watershed. The WCB will acquire the remaining acreage, south of the creek, for inclusion in the Department of Fish and Game Napa Marsh complex. The WCB will contribute \$735,000 toward the total \$1,080,000 acquisition cost of the ranch.

Viticulturists are highly motivated to find alternative pest control measures, partly because of pressures from consumers and resource agencies. They are also concerned about the costs of chemical pest control and the continued resistance of pests. They are reluctant to commit money and resources to make the transition, however, without seeing that proposed alternatives are economically viable and effective. To eliminate conventional pesticide use, they need to know an array of alternatives, including biological and viticultural approaches, organic chemicals, or synthetic chemical alternatives. Effective practices are specific to crop, pest, and area, requiring an integrated approach of many methods. No long-term research data exist to demonstrate how environmentally sensitive methods perform under different climatic and economic cycles.

The RCD will use about 14 acres of the Cabral Ranch for a demonstration project, funded by equipment suppliers, viticulturists, and the University of California, Davis, Sustainable Agricultural Research Education Program. The goal is to show growers throughout northern California the methods that are least costly, most effective, and most protective of the watershed. Once the demonstration vineyards are productive, the RCD anticipates that the value of the harvest will pay for ongoing management costs.

Marsh Park on Napa River

John F. Kennedy Park Marsh was once part of an extensive and diverse wetland system along the Napa River. At



Año Nuevo Van

The State Coastal Conservancy contributed \$10,000, and Chevron Corp. provided \$20,000 to buy and outfit this van. It will shuttle wheelchair riders from the parking lot at Año Nuevo State Reserve to a boardwalk, so they can view the elephant seals. Photo by Gary Strachan.

the river mouth and at Fagan Slough, saltwater marshes were bordered by seasonal wetlands, riparian areas, and freshwater marshes. Much of this wetland has been destroyed here, as elsewhere on San Francisco Bay, by diking, dredging, and filling. A little of what has been lost will, however, be restored at Kennedy Park. The Coastal Conservancy approved an enhancement plan for the marsh in December and authorized up to \$200,000 to the city of Napa for its implementation. The aim is to restore habitat diversity to diked historic wetlands along the Napa River and fulfill a regional need for interpretive public access to these important brackish and freshwater areas. The Napa Parks and Recreation Department, which owns and operates Kennedy Park, will monitor the project and will manage the wetlands with technical assistance from the Department of Fish and Game.

San Dieguito Acquisition

With \$2 million from the Conservancy, approved in October, the San Dieguito River Valley Regional Open Space Park Joint Powers Authority (JPA) is pursuing purchase of a key piece of

land for the proposed 43-mile-long regional park to flank the river from its headwaters in the Volcan Mountains to the ocean at Del Mar. The 90-acre property (known as "HorseWorld") straddles the river just across Interstate 5 from the Del Mar fairgrounds. It lies within the eastern extension of the historic lagoon and marsh system that once encompassed about 1,000 acres but now consists of only a few hundred acres south of the fairgrounds. The JPA intends to restore the wildlife habitat on the property and link it to a park trail system when other properties in the area have been assembled.

The Conservancy also approved a conceptual plan prepared by its staff for about 800 acres of river valley east of Interstate 5, as well as another \$100,000 to the JPA to prepare designs to carry out portions of it. The plan outlines, among other things, natural resource values and measures that might be taken to improve each of the disturbed habitat types—stream, riparian, salt and brackish marsh, freshwater pond and marsh, grassland, coastal sage scrub, and eucalyptus grove. It also describes steps that need to be taken to implement the improvements.

Tecalote Shores

The city of San Diego will construct a barrier-free playground at Tecalote Shores in Mission Bay Park with the help of up to \$170,000 authorized by the Conservancy in October as part of its coastwide effort to increase access for physically challenged people. This will be one of the largest barrier-free playgrounds in the country, featuring a large integrated play structure accessible to people of all abilities.

Marathon Property, Hayward

The East Bay Regional Park District will acquire the 132-acre Marathon Property, one of the last undeveloped and unprotected seasonal wetlands on the Hayward shoreline, with the help of up to \$1.1 million authorized by the Conservancy in December. The total acquisition cost is \$6.1 million. Disbursement of Conservancy funds is contingent on securing funding from four other public agencies: U.S. Fish and Wildlife Service, \$2 million; State Lands Commission, \$500,000; Wildlife Conservation Board, \$1 million; the park district, \$1.5 million. The district will manage this land for public access and resource enhancement jointly with the U.S. Fish and Wildlife Service and the California Department of Fish and Game.

This property, which includes an intact wetland-upland transition zone, is a natural extension of the park district's adjacent 115-acre Hayward Seasonal Marsh. The district will build a spur trail to connect with the Hayward shoreline and the Bay Trail.

Blohm Ranch, Monterey County

Up to \$2.2 million was authorized in December to The Nature Conservancy to acquire the 343-acre Blohm Ranch, including marsh acreage, at the head of Elkhorn Slough, in a major step toward implementing the Elkhorn Slough

Wetland Management Plan. Steep erosive slopes, now in strawberry production, will be restored to native chaparral. This will protect the wetlands below, as well as the long-term viability of a ranch that has been damaged by drainage from the steep eroding slopes on the Blohm property. Public access will be provided on one of the most scenic properties on Elkhorn Slough as part of the project. The local farming community is among the project's supporters.

Marina Vernal Ponds

The city of Marina will prepare a resource enhancement plan for seven vernal ponds in the city with \$25,000 authorized by the Conservancy in December in its effort to enhance and manage the region's wetland resources in a comprehensive manner.

Ventura Pier Restoration

Final engineering for the restoration of the Ventura Pier began after the Conservancy succeeded in putting together a funding package of \$3.5 million in public funds, including funds provided by the Legislature, the Department of Parks and Recreation, the Wildlife Conservation Board, and \$500,000 in fully reimbursable Conservancy money, approved last October.

Ventura River Estuary

With up to \$50,000 in Conservancy funds, the city of San Buenaventura will prepare a resource enhancement plan for the Ventura River Estuary, where diverse coastal ecosystems are in close proximity. The river mouth suffers from years of neglect, including reduced water quality and waste discharges upstream, upstream water diversions, urban runoff, fragmentation by an interstate freeway and rail line. The city and the California Department of Parks and Recreation have committed matching funds toward

preparation of the plan and will participate in its implementation.

Martinez Waterfront Restoration

As part of its effort to increase public access to the San Francisco Bay and nearby shorelines, the Coastal Conservancy has authorized up to \$10,000 to the city of Martinez for a waterfront restoration feasibility analysis and cost estimates for public improvements. The city has committed \$30,000 for engineering and planning studies to improve the Martinez Waterfront.

Escondido Beach

The Conservancy authorized an Interagency Agreement with the California Coastal Commission in December to accept and use \$300,000 of the Commission's in lieu fee account for operations and maintenance of Malibu accessways, and authorized \$50,000 to the nonprofit Surfrider Foundation to operate and maintain a coastal accessway at 27400 Pacific Coastal Highway, Escondido Beach, Malibu, for at least ten years. Escondido Beach is one of the few wide sandy beaches in Malibu where historic access has been eliminated by development. This is one of three accessways to be reopened to the public in this area.

Arroyo Grande Valley

In response to concerns about the continued viability of active farming in San Luis Obispo County's Arroyo Grande Valley, Conservancy staff met several times with local government officials and farmers. A consensus emerged that this valley represents in microcosm some major issues that confront coastal agriculture where prime soils are farmed immediately adjacent to urban areas. Local officials agreed on the need for policies to support farming and

lessen urban-farm conflicts.

To assist the city of Arroyo Grande and the county of San Luis Obispo formulate such policies with expert assistance, the Conservancy authorized \$25,000 to the city of Arroyo Grande in December to prepare a Coordinated Agricultural Support Program for the Valley. The analyses developed as part of this program will enable the Conservancy to tailor potential future projects to the special needs of this farming community. The county and city will contribute about \$15,000 in staff time and materials toward the effort.

Bracut Marsh

Also in December, the Conservancy authorized up to \$67,500 to the Redwood Community Action Agency for site improvements on 13 acres north of Eureka on the eastern shore of Arcata Bay. This site, known as the Bracut Marsh, had been acquired by the Conservancy and restored in 1982 as salt marsh and natural upland habitat to mitigate the development of several wetland remnants, less than one acre each, in Eureka's industrial area. In lieu fees paid by developers of the remnant marshes reimbursed most of the Conservancy's expenditures. Since then, several problems limiting the biological and ecological productivity of the marsh and uplands have developed. Redwood Community Action will complete improvements begun two years ago. In the first phase, invasive plants were eradicated, the upland area was planted and fenced, and data were collected to determine the feasibility of dredging unsuitable fill and improving tidal flow. The second phase includes earthwork to maximize the site's ecological and biological resource value and significantly improve the project's demonstration value as a feasible approach to wetland mitigation.

Sea Otter Relocation Controversy

Continued from page 20.

day), and there is no guarantee that they will not head south again, for whatever reasons propelled them in the first place. Benz did say, however, that "we have never caught an animal here that had been caught before." Sneaking up on an otter under water, putting it into a trap, hauling it into a boat, then a van, then releasing it within its assigned territory can take six or eight hours and is not pleasing to the otter. To the people who have to do it, it feels unprofessional and just a way to avoid the real problem. "We have to face the facts," said Jack Ames. "They're down there because they have been excluded from their range."

A Question of Values

So what are the alternatives? If otters continue to increase in numbers and are not permitted to expand their habitat, they will have to be managed by either putting some in captivity or killing some.

Ames said he could personally accept killing some animals and using the products, as Native Americans used to do. However, "many are appalled at that idea," so it is politically unacceptable. Shall sea otters be allowed to expand into their historic range? Ames believes that without a northern boundary to match the one in the south, such expansion is "just a matter of time," and that we may well see otters repopulating their historic range along the entire California coast. This may mean that those who make their livelihood diving for abalone or sea urchins, and digging for mussels and clams may need to find other ways to support themselves and their families. Mariculture may be an option to some. Some mariculture projects are already underway, with bottom leases in coastal waters. In making a transition, the shellfish industry may need help, as the sea otter has required human help in getting reestablished. Sports fishermen

would still be able to find abalone, but that may be a more difficult challenge.

Ames points out that "the presence or absence of otters in a system makes a tremendous difference to what's in the system—more so than with almost any animal I'm aware of. It is likely, though not proven, that otters in an area might increase the extent of kelp and other algae, and thereby create habitat for certain fin fish." Of course, a proliferation of humans who like to watch otters can be expected along the coast, feeding the tourist industry, which is assuming ever greater economic importance in the state.

The questions raised by the otter translocation controversy go far beyond how to divide shellfishing grounds. As with fishing and other human ocean activities, the sea otters' future depends on our ability to keep the water environment healthy. On that there is general agreement. Human population pressures will put increasing stress on the ocean and its natural systems. Oil (both drilling and transportation) will be one of the major issues. Friends of the Sea Otter, a strong backer of the translocation project initially, believes that it should be carried through its full five-year term, despite the high otter mortality, because of the knowledge that is expected to emerge. Such knowledge is essential to the continuing struggle to protect the otter against oil spills and other human-generated hazards. The organization is now working to get oil tanker lanes moved farther offshore, to make sure that preparations to deal with oil spills are in place, and is also looking into the effects of pesticides on sea otter mortality. In a larger sense, the well-being of the California sea otter population can be seen as an index of the quality of our environmental stewardship. □

Gregory Silber, whose doctorate in marine biology at the University of California, Santa Cruz, dealt with the ecology of whales and dolphins, is the scientific and executive director of Friends of the Sea Otter. Rasa Gustaitis is editor of Coast & Ocean.



**Don
Coppock**

Don Coppock, manager of the Coastal Conservancy's agriculture program and a staff member for over ten years, died on February 12 at the age of 36 from an AIDS-related illness. He was a passionate advocate for the conservation and continuing public use of California's coastal resources. His largest project and primary focus since 1985 was Cascade Ranch, north of Santa Cruz. He also helped organize over 30 other projects involving coastal agriculture, public access to the coast, and hiking trails.

Don Coppock exercised leadership in the field of resource conservation statewide, nationally, and internationally, serving on the board of the Santa Monica Mountains Conservancy, and working with many other land trusts and conservation organizations in this country and Great Britain.

Born in Sacramento, raised in San Mateo, and graduated from Reed College in 1977, he obtained a diploma in urban design and regional planning from the University of Edinburgh, Scotland, in 1980, and a master's degree in city planning from the University of California, Berkeley, in 1982.

The family has asked that donations in the memory of Don Coppock be made to Project Open Hand, 2720 17th Street, San Francisco, CA 94110 or to the Shanti Project, 525 Howard Street, San Francisco, CA 94105.

Aqua Incognita

The
Wild
Wet
West

Off the western coast of North America, between Alaska and southern California, a rich wild zone extends some 200 miles into the ocean, unique in the variety of life it supports. As the California Current, pushed south by winds, moves and mixes the waters, surface water is swept out to sea and cold nutrient-laden water wells up along the edge of the continental shelf, feeding meadows of plant life that are food to a vast array of creatures, from tiny shrimp to fish and ocean birds. And they, of course, are food to the larger animals, including the sea lions and sea otters we like to watch, and the great whales that pass by.

Some natural scientists refer to this zone as the Nearshore Pacific. Government officials, corporate executives, and many others think of it as the U.S. Exclusive Economic Zone. By any name, it is inseparably part of the Pacific Ocean, just as the California Current is inseparably part of the great system of gyres that moves water throughout the oceans, and the oceans are one watery world, inextricably connected with the indivisible atmosphere. Any lines humankind draws will only have meaning if we recognize that biospheric reality.

Now that the United States has claimed a 200-mile EEZ, how and in whose interest shall it be governed and managed? What role shall California play? With pressures on ocean systems growing much faster than our knowledge about them, how shall we assure that we not destroy what cannot be reclaimed? Shall we permit the nearshore waters to continue to be used as a wastewater dump without, at the same time, finding out the impact on marine ecosystems? As we run out of landfill space, shall we pour sewage sludge into the ocean abyss, as some scientists recently proposed—even after we have found life forms there nobody has even imagined possible? How shall we resolve competing claims to ocean resources that are bound to become more intense? In the pages to follow, we raise some urgent questions we must consider now, while we still have a chance to choose.

The American Ocean

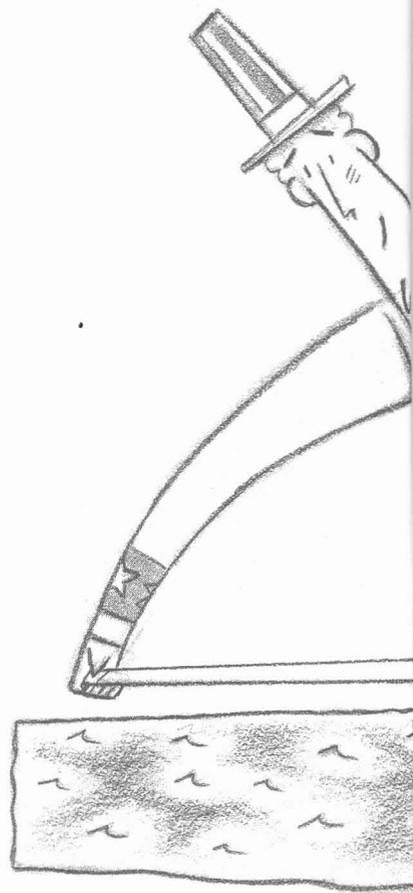


A Shared Responsibility

by Robert W. Knecht and Biliانا Cicin-Sain

No comprehensive goals have been spelled out for this vast area—one-and-a-half times the land mass of the United States. Without explicit goals and priorities, effective governance is impossible. Also, no coherent management scheme exists.

Drawings by Dan Hubig

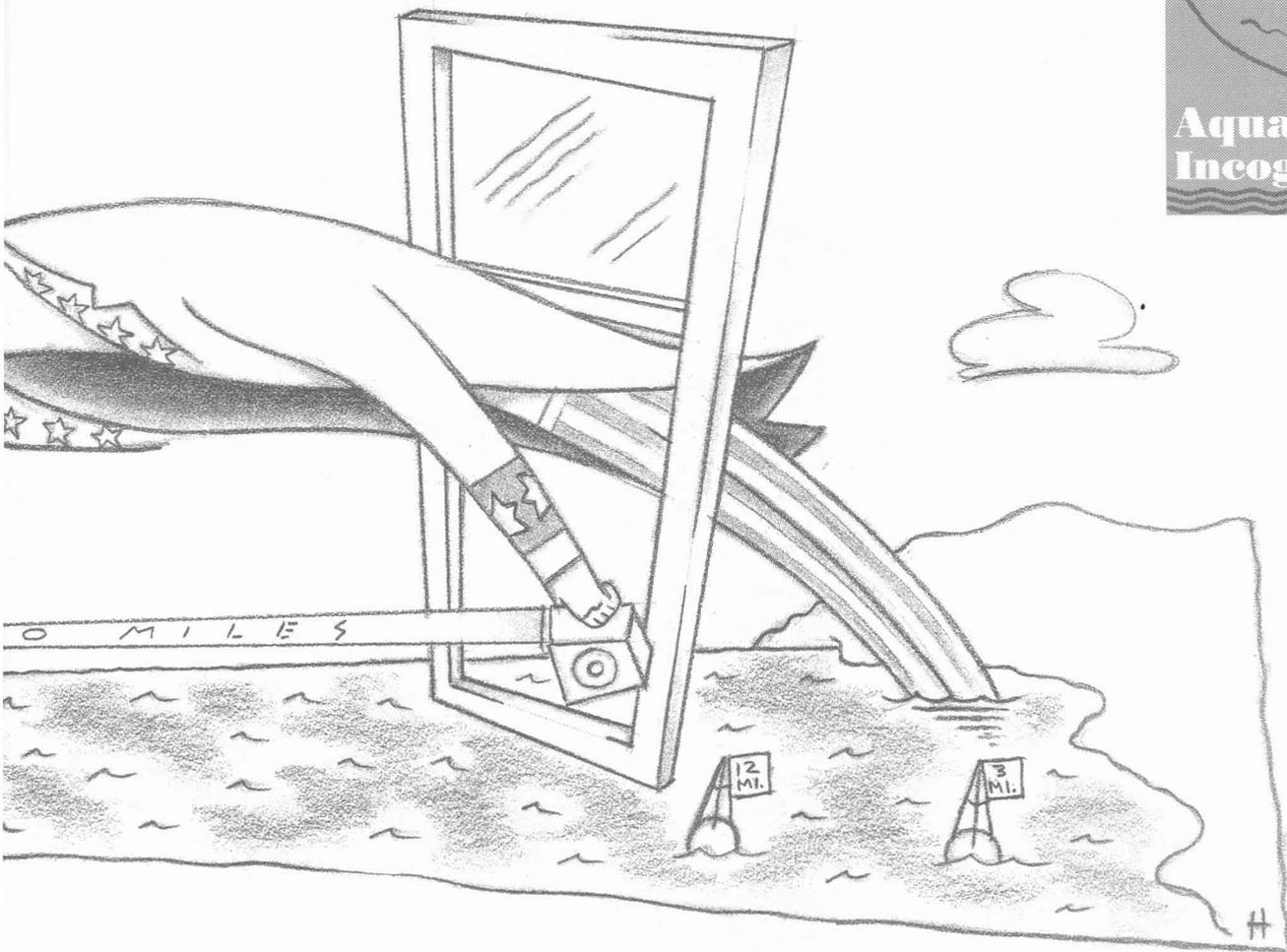


The 1990s are likely to offer a much needed “window of opportunity” to improve how we govern our oceans. In California, a new administration has entered office with at least two significant ocean studies underway: the State Lands Commission is examining the off-shore resource base, and the Ocean Resources Task Force, mandated by the California Ocean Resources Management Act of 1990, has been charged with reviewing policy and formulating recommendations for ocean management.

In Washington, the ocean and environmental leadership appointed by President Bush is beginning to address, in concert with Congress, the important ocean policy issues facing the nation.

Worldwide, there is increased action on many fronts as environmental groups, international organizations, and individual nations prepare for the June 1992 United Nations Conference on the Environment and Development to be held in Rio de Janeiro on the twentieth anniversary of the first U.N. Conference on the Human Environment, which took place in Stockholm.

The goal of this article is to provide an up-



to-date overview of issues surrounding the “governance” of the American Ocean. The term “governance” in this context means the assembly of arrangements, both regulatory and nonregulatory, that a government uses to protect and enhance the public interest and natural resources in coastal and ocean space. The “American Ocean”^{*} is comprised of coastal waters and ocean extending 200 miles from the U.S. shoreline. It includes internal waters such as San Francisco Bay, Puget Sound, and Chesapeake Bay; the three-mile zone of state jurisdiction, the 12-mile U.S. territorial sea; and the 200-mile Exclusive Economic Zone (EEZ) within which the nation has control over essentially all resources and economic uses.

No comprehensive goals have been spelled out for this vast area—one-and-a-half times the land mass of the United States. Without explicit goals and priorities, effective governance is impossible. Also, no coherent management scheme exists.

We will (1) assess present ocean governance; (2) show that a “window of opportunity” for change now exists; (3) propose goals and concepts that ought to be built into a new

stewardship-oriented scheme for governance; and (4) indicate how such a scheme might be established.

What is Wrong: Current Problems

Current ocean governance is a jumble of jurisdictions that has little relation to ocean dynamics, and of single-purpose laws and management programs that often conflict.

Three separate jurisdictional bands divide offshore water and ocean areas. Local governments generally control inland waters and the immediate shoreline; states have authority from the shoreline to the three-mile limit, and the federal government has jurisdiction from the three-mile limit to 200 miles.

This division complicates the planning and management of virtually all ocean activities, which usually take place across designated boundaries. It often causes benefits and costs

★ ★ ★

**Authors’ note: The term “American Ocean” was coined by Biliana Cicin-Sain in connection with a June 1989 conference on “Values and the American Ocean” held in Santa Barbara, Calif.*

Overlapping Jurisdictions off the California Coast



This cross section shows the various legal jurisdictions off the shore of California. The definitions of the continental shelf and the Coastal Zone Management Act are at issue. The Exclusive Economic Zone is defined from the baseline of the territorial sea out to 200 miles, in accord with article 57 of the 1982 Law of the Sea Convention. Source: Secretary of Environmental Affairs, California Ocean Resources Management Program.

of ocean resource exploitation to fall unevenly on different jurisdictions.

Within federal and state waters, different resource and use activities typically fall under the aegis of different agencies that operate within different legislative frameworks. One federal statute and agency governs fisheries management, a different statute and agency manages offshore oil development, yet a third handles water quality and related matters. And, of course, federal laws and agencies differ from state laws and agencies governing fisheries, minerals, and the like within state jurisdiction. This single-purpose approach means that:

- Few opportunities exist for examining the implications of decisions in one ocean sector (such as oil development) on other ocean sectors (such as fisheries). Although most laws require that the consequences of a proposed action on other ocean uses be examined, the reviews take place within a specialized context

that tends to be biased toward a particular outcome, either development or protection, depending on the particular agency conducting the review.

- Few, if any, opportunities exist for long-range planning to protect, enhance, and use ocean resources in particular areas or regions, such as the Santa Barbara Channel, since no government agency is responsible for an ocean region as a whole.

- Few, if any, opportunities exist for the interested public to debate overall priorities and goals for a particular resource or region or to contribute to trade-off decisions among different uses or activities proposed by user groups.

- Disagreements and conflicts among different users and different government agencies are difficult to solve through public means because no agency or other authoritative source has jurisdiction over such conflicts.

The controversy over the federal outer con-

Continental shelf oil and gas program is a case in point. Federal authorities and oil companies were concerned with developing the oil, while states and coastal communities were alarmed at the side effects: probable damage to fisheries, the tourist industry, and coastal resources. Protests grew to the point where President Bush was persuaded to shut down virtually all activity in the program except for that underway in the Gulf of Mexico. This controversy might have been averted had there been adequate consultation between the Secretary of the Interior and the affected state and local governments, and had the offshore oil and gas program been viewed as one element in a larger, more comprehensive national energy strategy (yet to be developed) that includes encouragement of alternative energy sources such as solar, and a strong emphasis on energy conservation.

Jurisdictional discord and single-purpose thinking are not the only defects in current ocean governance, however. Our understanding of ocean processes is rudimentary. Attempts to predict the impacts of various uses—mining, dumping, fishing—are often necessarily primitive. Thus, any rational government scheme must acknowledge the dynamic, fluid, and mobile nature of the oceans, their complex and interdependent ecosystems, and our present ignorance of many details of these realms.

Why This Is a Time of Opportunity

When President Reagan proclaimed the new 200-mile Exclusive Economic Zone in March 1983, he opened a window of opportunity to establish a sounder ocean governance scheme. He opened that window wider in December 1988, when he extended the U.S. territorial sea from three to 12 miles in width, thus quadrupling the offshore zone under almost total jurisdiction of the United States. Taken together, the extension of U.S. claims over ocean resources to 200 miles and the broadening of the territorial sea represent major changes in the ocean jurisdiction of our nation and, as such, call for a thorough re-examination of ocean governance.

President Reagan's proclamations were generally consistent with the provisions of the 1982 Law of the Sea Convention. Indeed, most of the world's coastal nations have also now established such broader ocean zones.

Within the huge area of the EEZ, the United

States has control over virtually all resources and economic uses. Furthermore, for the first time, a uniform set of legal rights ("sovereign rights") exists over all of the resources in the zone. In the past the United States had a variety of different types of rights over different resources and uses, depending upon the nature of the particular piece of U.S. legislation that established those rights. The geographic reach of a particular set of rights varied, depending upon the terms of the legislation involved. So, for example, the United States had "exclusive fishery management authority" in the 200-mile fishery conservation zone, "jurisdiction and control" over the resources of the continental shelf, and "jurisdiction over the taking and/or importation" of marine mammals.

Stewardship Responsibilities

Implicit in the notion of "sovereign rights" over resources, we believe, is a higher level of government responsibility than existed before such rights were claimed, when U.S. authority over various resources was more limited. We believe that the EEZ concept of sovereign rights necessarily has associated with it an enhanced role of public stewardship for the renewable, common property resources found in the ocean.

Because a higher level of governmental authority now exists over the area encompassed by a common economic zone boundary, there is a clear opportunity for new ocean governance arrangements. An EEZ-oriented management framework would allow for the replacement of single-purpose programs with better integrated programs that view particular uses or activities within the framework of ocean stewardship. It conceivably would allow for joint federal-state management, thus reducing the problem of multiple jurisdictions. Also, an EEZ-based management scheme could readily lend itself to experimentation with a regional approach to ocean resources governance not unlike the regional structure now used to manage fisheries.

University of Michigan political scientist John Kingdon has explored how "windows of opportunity" develop in national policy making. In his model, a "window of opportunity" opens for brief periods when significant problems are recognized within a propitious political climate. In such moments policy proposals that happen to be ready have a good chance of gaining a place on the national agenda. Based on Kingdon's model, elsewhere

Implicit in the notion of "sovereign rights" over resources, we believe, is a higher level of government responsibility than existed before such rights were claimed.

we have shown that windows of opportunity in ocean policy opened in the early 1960s for science-related legislation, and in the late 1960s and early 1970s for coastal and ocean environmental legislation. Now it seems possible, even likely, that a window of opportunity could open in the next few years for ocean policy change.

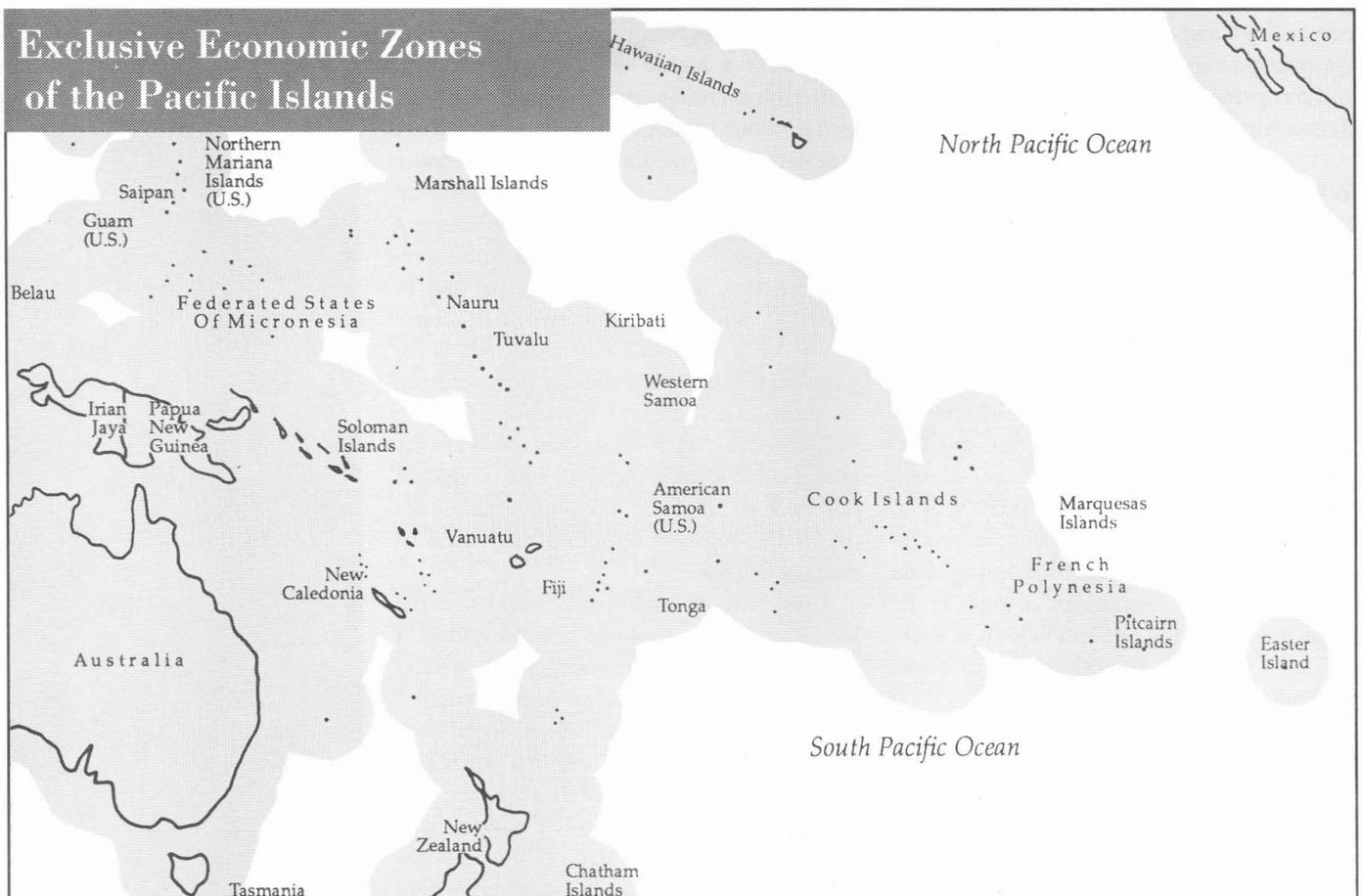
The problems have certainly become evident. Medical wastes and other noxious debris wash onto East Coast beaches; fish and marine mammal die-offs increase in frequency off our coasts; coastal water quality and associated shellfish bed closings continue to be a major problem; highly vocal conflict continues over offshore oil drilling; and important fishery stocks continue to decline in many areas. Meanwhile, George Bush has brought into office a number of well-recognized and experienced environment and ocean administrators and has sought to become known as the "Environmental President." This, coupled with continued high congressional interest in the coasts and the oceans, has created a political climate that is now, we believe, once again open for major policy change.

An indication of this political readiness and

the associated receptivity to new policy and governance arrangements can be seen in the November 1990 legislation reauthorizing the 1972 Coastal Zone Management Act (CZMA) that, among other things, addresses the vexing problem of coastal water quality in a new way. The new approach requires an unprecedented level of cooperation between two formerly independent programs: state coastal zone management programs developed and implemented under the CZMA and state nonpoint source pollution management programs being implemented under Section 319 of the Clean Water Act.

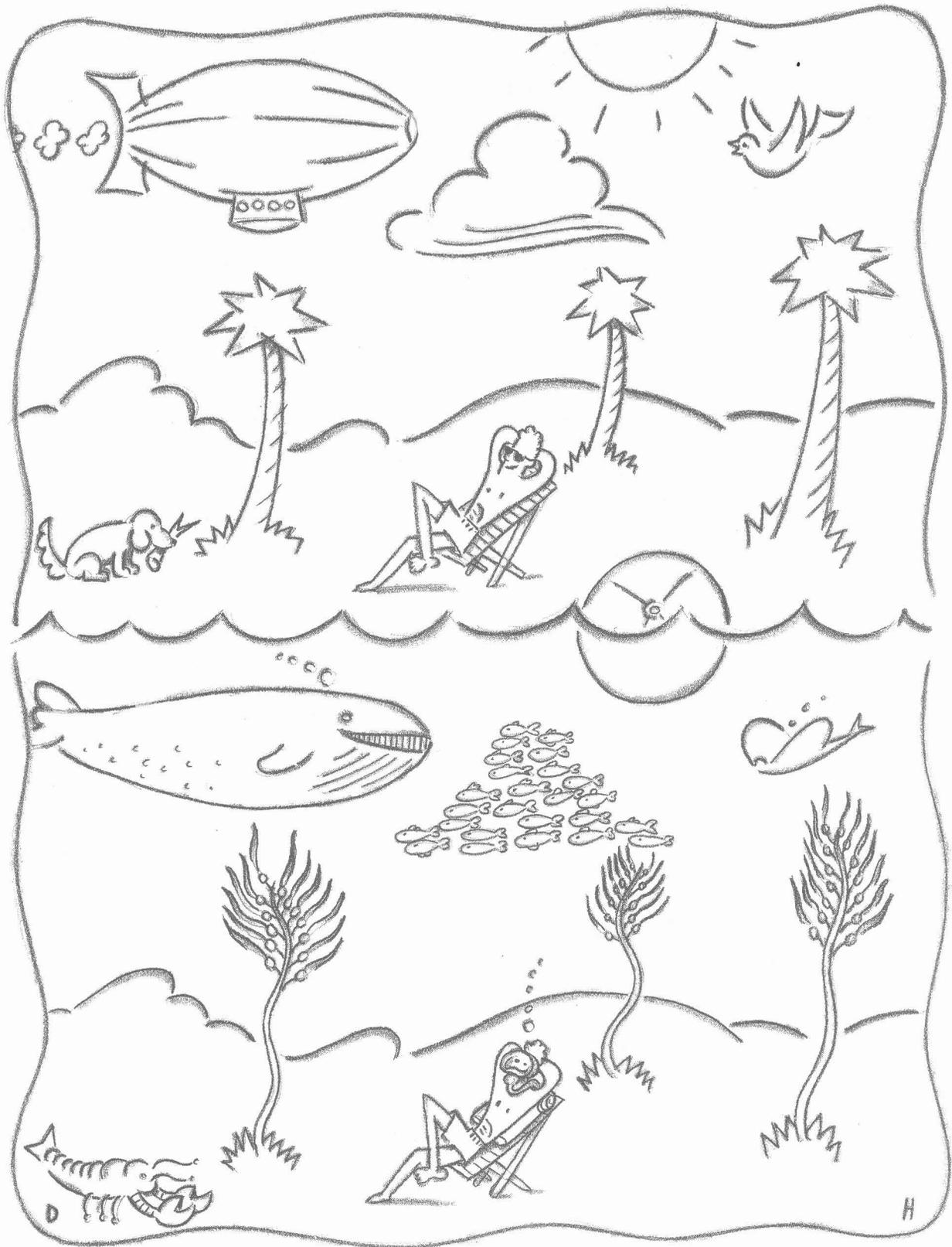
In California, meanwhile, the passage of the California Ocean Resources Management Act of 1990, together with the election of a new governor pledged to address ocean and environmental problems, has clearly created a climate for possible change. Barring preoccupation with the state budget deficit and assuming some level of cooperation between the governor and the legislature, some new ocean initiatives could be launched.

A nation surrounded by one of the largest and richest assemblies of ocean resources in the world surely needs a clearly articulated

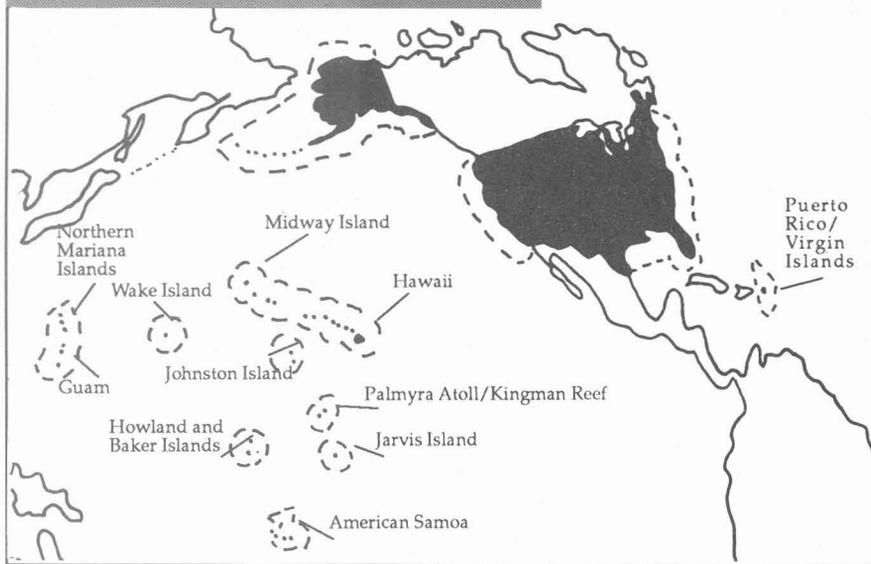


Source: The Pacific Basin Development Council

Any rational government scheme must acknowledge the dynamic, fluid, and mobile nature of the oceans, their complex and interdependent ecosystems, and our present ignorance of many details of these realms.



Exclusive Economic Zone of the United States



ocean policy with respect to the conservation and use of those resources if conflict and waste are to be prevented and the long-term public interest is to be protected. Yet, to a remarkable degree, we have avoided setting overall governance goals or priorities with regard to ocean resources and uses. Our present approach implies that we can somehow achieve maximum public good from our fisheries resources, maximum protection of marine mammals and bird life, and maximum improvements in coastal water quality by implementing the separate pieces of legislation governing each of these and other activities without regard to the interconnections between them or the impacts that one activity has on another.

Elements of Effective Governance

We believe that the national government has a responsibility, as part of its public trust duties, to manage and conserve both renewable and non renewable ocean resources for the benefit of both present and future generations of Americans. Coastal states have a similar duty. Safeguarding the resource base should be a fundamental objective in any scheme for ocean governance. It should be basic to any ocean use decisions. Acceptance of this principle would dictate that as part of any ocean development program, unique or especially sensitive or valuable ocean regions should be identified and placed aside for protection over the long term.

Beyond acceptance of this basic principle,

an improved, second-generation ocean governance system, in our judgment, must meet certain tests.

- It should be both equitable and efficient. To be equitable, it should include the affected coastal states as full partners in all federal ocean decisions that affect their economic or environmental interest. To be judged efficient, it must be stable and lead to predictable outcomes. Development and environmental interests and the public as a whole are better served when the policies to be followed, as well as the decision-making processes themselves, are fully understood in advance and lead to outcomes in reasonable time periods.

- It should have both federal and coastal state components. At the federal level, there should be a visible and authoritative mechanism to insure that federal agencies align their coastal and ocean activities and policies to be consistent with the nation's expressed ocean goals. The coastal states, in return for acting as responsible partners with the national government in ocean resources governance, should continue to receive the federal support needed to build their ocean capabilities.

- It should be orderly—that is, potential conflicts should be identified early and equitable solutions developed by means of processes that protect and enhance the public order.

- It should encourage and facilitate planning for important ocean areas as a means of avoiding later conflict and delay.

Avenues Toward Change

Several routes exist at both the federal and the state level for developing these concepts further and beginning to incorporate them into a new legislative framework. First, in the last several years the U.S. House of Representatives has several times considered legislation to create a blue ribbon national ocean policy commission, of the type chaired by Julius Stratton in the late 1960s, empowered to re-examine the entire framework for ocean governance in the United States and to recommend changes. Such legislation could be proposed again this year.

Second, legislation has been introduced recently in Congress to create a regime for hard minerals exploration and exploitation in the EEZ. Such legislation could be broadened to include the EEZ generally, with a more explicit ocean governance reform component.

A third route involves the recently expanded territorial sea. Congress is likely to undertake studies of the policy implications of this expansion and the possible need to re-examine state and federal ocean jurisdictions in this regard. Such studies conceivably could lead to legislation reforming the U.S. ocean governance system.

Alternatively, coastal states could take the lead in experimenting with new and more enlightened approaches to ocean governance. In a noteworthy example, Oregon, over the last two-and-one-half years, has been developing an ocean resources management program for resources (and activities) within what the state has unilaterally defined as its "ocean stewardship zone." This zone, generally coincident with the Oregon continental shelf, extends from 30 to 70 miles offshore and embraces ocean activities and resources of maximum economic and environmental interest to the state. Other states and territories are also beginning to consider ocean initiatives of this type.

Special Opportunities for California

With one of the most extensive and valuable coastal areas in the nation, California has both special advantages and special responsibilities with regard to ocean governance. The state Coastal Zone Management program is seen nationally (and internationally) as one of the strongest and most effective programs. It is, of course, also one of the oldest and, in spite of concerted efforts to the contrary, one of the most durable. Operating alongside the California Coastal Commission is the truly innovative companion State Coastal Conservancy, with a remarkably broad and versatile set of tools to complement the regulatory devices available to the CZM program to further advance the public benefits of California's coastal resources.

Yet there are serious problems in the California coastal zone. Biologically productive marine areas continue to be lost to development. Growing ports need to modernize and expand, but that expansion usually entails the filling or dredging of wetland areas. Finding appropriate offsetting wetland areas to restore as a way of compensating for losses such as these is a major challenge. Tensions continue to run high in California's fisheries sector as conflicts between recreational and commercial fishermen continue. The recent gill net initiative is symp-



Few, if any, opportunities exist for the interested public to debate overall priorities and goals, or to contribute to trade-off decisions among different uses.

omatic of the intensity of this problem.

Understandably, the major emphasis in California's coastal management effort to date has been on the immediate shoreline where the problems and pressures have been most acute. However, increasing interest in offshore resources will require more attention for planning and management of ocean areas. Furthermore, the state will need to be fully prepared when the federal government proposes

Clearly, California's substantial interests in its offshore ocean areas extend far beyond the existing three-mile limit and probably also well beyond the 12-mile limit. California needs to examine this issue carefully and to determine where its long-term interests lie.

resumption of outer continental shelf oil and gas development off California shores. Similarly, interest in the placer minerals in the nearshore areas of northern California and southern Oregon is likely soon to lead to proposals for exploration and exploitation. Proposals now exist to create a number of marine sanctuaries, including one in Monterey Bay, and to consider the entire north coast as some sort of a marine protected zone. In this regard as well, the state government will have to play a leadership role if rational and effective protection programs are ultimately to be put in place.

One additional issue facing the state needs to be discussed. As mentioned above, in late 1988, President Reagan broadened the U.S. territorial sea from three to 12 miles. Although Mr. Reagan's proclamation itself did nothing to change the existing ocean jurisdiction of the state, it did create the possibility that, with suitable federal legislation, state ocean governance could be extended to cover the additional nine miles of territorial sea. Clearly, California's substantial interests (economic, environmental, social, etc.) in its offshore ocean areas extend far beyond the existing three-mile limit and probably also well beyond the 12-mile limit. California needs to examine this issue carefully and to determine where its long-term interests lie. If the state were to decide to join other coastal states, such as Hawaii and Alaska, in pursuing an increased state role out to the new 12-mile limit, it could bring important political power to the debate.

An International "Window of Opportunity"

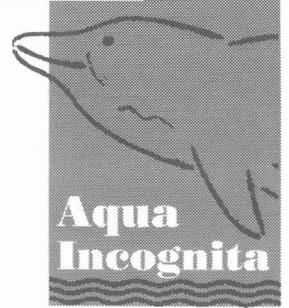
Remarkably, a "window of opportunity" also exists internationally in connection with the preparations now underway for the June 1992 United Nations Conference on the Environment and Development to be held in Rio de Janeiro. Twenty years earlier, in 1972, the first U.N. Conference on the Human Environment set off much of the subsequent international environmental action. The Rio gathering could be equally important. It may consider international conventions dealing with global climate change, international coastal management and sea level rise, land-based sources of marine pollution, and protection of genetic diversity. Californians can influence the preparatory process for this conference by contacting the active federal agencies (Department of State,

Environmental Protection Agency, National Oceanic and Atmospheric Administration), as well as by associating themselves with the work of national and local environmental organizations such as Greenpeace, the Sierra Club, and the Natural Resources Defense Council.

Summary

Increasing pressures on state and national coastal zones have revealed the inadequacies and weaknesses of the present ocean governance system. Based on fragmented jurisdictions and single-purpose management approaches, the present system fails to provide effectively for early conflict identification and resolution, fails to encourage and facilitate long-term planning for important ocean areas, does not adequately balance and accommodate valid local and state concerns and interests, and does not reflect an awareness of governmental stewardship responsibilities. While the detailed mechanics and structure of an improved second-generation governance scheme are not yet discernible, the attributes that such a scheme should possess can be described. Favorable political climates exist nationally and internationally for considering major policy changes in ocean governance. An even clearer "window of opportunity" is developing in California, the coastal state perhaps best equipped intellectually and organizationally to deal with the ocean governance challenge. The time is right for California to re-assert itself as the national leader in this field. □

Professors Robert W. Knecht and Biliانا Cicin-Sain are Co-Directors, Center for the Study of Marine Policy, Graduate College of Marine Studies, University of Delaware, and Senior Researchers, Marine Science Institute, University of California, Santa Barbara. Portions of this article are based on an earlier paper entitled "National Ocean Policies: A Window of Opportunity," co-authored by Robert W. Knecht, Biliانا Cicin-Sain, and Jack H. Archer and published in the journal Ocean Development and International Law (Volume 19, pages 113-142), 1988.



Disaster Insurance for a Favorite Species

**by Gregory Silber
and Rasa Gustaitis**

In 1987 the U.S. Fish and Wildlife Service, with the help of state agencies, began a controversial five-year project to establish a new colony of sea otters off San Nicolas Island, 200 miles from California's central coast. The results thus far have been discouraging. Of 139 otters moved, only 14 were still at the island in March 1991. Some biologists remained hopeful, however, because four pups had recently been weaned to independence.

"It hasn't gone as well as we hoped, but we knew it wasn't going to be easy," said Galen Rathbun, project leader for California sea otter research at Fish and Wildlife. Scientifically this was a pioneering effort in many ways. Also, he said, "as often happens, politics got involved."

Controversy surrounded the translocation project from its inception. Shellfishermen



RICHARD BUCICH

opposed it, seeing otters as unfair government-protected competition and fearing that this expansion of their territory was a step toward claiming the entire coast for otters, at fishing industry expense. Other people questioned whether the effort merited millions of dollars and hundreds of man-hours. Still others argued that otters were sufficiently established already, or felt that they should be permitted to expand their range without drastic human intervention. As the discouraging results came in during the

program's first three years, many people were also disturbed by the death or disappearance of large numbers of translocated otters.

Last August, the California Fish and Game Commission, which sets policy for the Department of Fish and Game, voted



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unanimously to cease supporting the project. Subsequently, the California Coastal Commission asked Fish and Wildlife not to take any more otters until the population now on the island proves itself stable. Fish and Wildlife, however, encouraged by the progress of pups born at the island, plans to move 18 more otters to the island this year, having decided that the potential gains of so doing outweighed the drawbacks with respect to the overall recovery of the species. Besides strengthening the island colony, biologists hope to learn basic facts about sea otters that could be invaluable in further efforts to protect the species against oil spills and other man-made hazards.

The translocation project raises many questions regarding management of natural systems, with implications far beyond this particular controversy. How aggressively should we intervene to preserve threatened populations? At what cost should rescue efforts be made? Should we weigh the damage done to the species, or resource, by past human activities? Shall a species be protected if the price is drastic reduction, or even elimination, of an established human economic or recreational activity? Are some species with charisma being favored over others with less

popular appeal? Does sentimentality about some animals get in the way of sound biology? How does advocacy for a single species fit with the wider interest of comprehensive resource management?

Such questions will continue to grow more urgent as human population and other pressures impact ever more heavily on the ocean and the life forms that inhabit it, making conflicts more frequent and the need to find ways to resolve them more dire. The California sea otter translocation project offers an opportunity to reflect upon these issues.

Back from the Brink

Before the 1700s, sea otters ranged from Baja California to Alaska, throughout the Aleutian archipelago, and across the Pacific Rim to Siberia and Japan. An estimated 20,000 inhabited the California coastal waters, the population staying in balance with the habitat with the help of predators: Indian hunters, grizzly bears, killer whales, great white sharks, and bald eagles who went after the pups. Then a shipwrecked Russian expedition discovered the otters' luxurious fur, hunting for pelts began, and by the 1900s, the species was nearly extinct.

In 1911, when the International Fur Seal Treaty accorded protection to sea otters, only 13 small colonies were left within their historic range. By 1920, the only sea otters south of Alaska were a small colony off Point Sur. In 1941, a state law established a sea otter reserve between the Carmel River and Cambria. Further federal protection came with the Marine Mammal Protection Act in 1972. In 1977 the California sea otter was listed as "threatened" with extinction under the Endangered Species Act. It is now also a "fully protected mammal" under California law. The mandate for protecting the species is held jointly by state and federal agencies.

There are now about 140,000 sea otters off the Alaskan coast and about 1,600 off California, mostly between Año Nuevo Point in San Mateo County and the Santa Maria River mouth in Santa Barbara County. Slight declines in the California population were observed in the 1980s. They have been attributed in part to widespread use of gill nets and to water pollution, though the cause is not firmly established. Recent legislation is limiting gill net use. A voter initiative bans them as of January 1, 1994 within three miles of the coast

from Point Conception to the Mexican border, and within one mile of any of the Channel Islands. State law has banned gill net fishing at specific water depths in the sea otters' principal range off central California.

Trying for Some Insurance

By far the most serious threat to California sea otters now is that of oil spills. These sea mammals, unlike whales and pinnipeds, have no blubber. They stay warm within their multilayered fur, which they constantly clean and maintain. If just 20 percent of the coat is oiled, it loses its insulating properties and the otter is likely to die of hypothermia. At least a thousand died in 1989 as a result of the big spill in Alaska's Prince William Sound. If a spill of that magnitude hit the California coast, it might cover the entire sea otter range and destroy the entire otter population.

Therefore, in 1981, Fish and Wildlife drew up a Southern Sea Otter Recovery Plan, calling for the establishment of separate breeding populations outside the existing range but within the historic range. The plan stated that "translocation of sea otters appears to be the most effective and reasonable management action." San Nicolas Island, managed by the Navy as part of the Pacific Missile Test Center, was chosen as the translocation site because it was the least developed of the Channel Islands, had an adequate food supply, and supported the smallest commercial fisheries among the Channel Islands. Within five years beginning in 1987, up to 250 sea otters were to be relocated to San Nicolas, with no more than 70 transferred in any one year.

As of early March 1991, a total of 139 otters had been captured, implanted with radio transmitters, and flown to the island. Of these, 36 returned to the places where they had been captured, 77 could not be traced, and 12 were known to have died as a result of the move or because of other human-related causes.

"The big picture looked really bad, with only about 15 otters there after three years. But there's a good side: They are still there, and some pups are now on their own," said Jack Ames, research marine biologist with Fish and Game, who was disappointed when his agency withdrew from the project "when it was just starting to look like it was going to work."

Though he and other biologists had expected better results by now, they are also still hopeful because of experiences among some of the five

previous otter translocation projects, farther north. Between 1965 and 1972, a total of 708 Alaskan otters were moved to new locations either in Alaska, or in Washington and Oregon. Those moved to southeastern Alaska and British Columbia have developed into well-established populations, with 1,000 and 70 individuals, respectively. Attempts to establish otters in the Pribilof Islands and off the Oregon coast, however, have failed, and all the introduced otters died. In another effort, however, the result followed a pattern that could apply to the California project. After 59 Alaskan otters were moved to the Washington coast between 1969 and 1970, their group diminished to 13 individuals but then expanded to more than 200.

What happened to the otters that vanished from San Nicolas Island? Despite their protected status, dead sea otters occasionally are found with gunshot wounds. The only remaining nonhuman predators are the great white sharks, which kill an estimated 10 to 15 percent of California sea otters, and killer whales. Was San Nicolas an appropriate habitat? The island is used for tracking and testing missiles, but Rathbun said military activities were not thought to have been a major disturbing factor, judging from the fact that the island has the second largest pinniped population along the state's coast. Food is in ample supply. Like much else about the sea otter, the reasons why many transplanted animals vanished remains a mystery.

Which Predator Shall Prevail?

From the beginning of the translocation project, there have been opponents, the most passionate among them being commercial shellfishermen. Some shellfisheries became established after shellfish proliferated in the wake of the otters' slaughter. In one sense, the fishermen came to occupy the niche vacated by the otters. Now, with the otters' return, they feared that their livelihood would be sacrificed for the sake of the animals.

Otters eat huge amounts of shellfish—up to a third of their body weight daily—burning calories at two to three times the rate of similar-size land mammals. They eat 50 different species of tidal and subtidal creatures, most of which are not commercially valuable, but also abalone, lobster, mussels, clams, and sea urchins. Most commercial shellfisheries cannot now profitably coexist with large sea otter

Even people who have only seen photographs of the furry faces and bright eyes are likely to concur with Lawrence Durrell, who found them to be "quite the most enchanting animals" he had ever seen. But hundreds of marine species have been depleted and endangered by human resource abuse. Is charm a good reason to put so much attention on one species? For biologists, sea otters have many other important characteristics.

populations. This might perhaps not be the case had humans not depleted abalone and other stocks in the recent past.

"Three billion pounds of seafood are destroyed each day by 200,000 animals between Alaska and California," claims Jon Holcomb, of Fort Bragg, a commercial urchin diver and member of the Sea Urchin Advisory Committee to the director of the state Department of Fish and Game. "That doesn't mean it eats everything it kills. I've found lobsters with the gut eaten, tail intact. In California, 200 miles of coast are occupied by the sea otter."

Holcomb estimates that the state's commercial shellfishermen number 2,500 at most, including 125 abalone divers, a varying number of crab fishermen, 750 spiny lobster fishermen, and about 600 sea urchin divers.

Sea urchins may be the state's largest fishery economically, and the largest export fishery harvest, almost all going to Japan. In 1989, landings totaled 2.8 million pounds and the price paid to sea urchin fishermen totaled \$21 million. Chinook salmon, the next-largest fishery, brought in \$13.5 million that same year. No quota on urchin landings has been set. "We want to restrict the take, enhance the resource by planting, farm it in the long run and manage it," Holcomb said. The fishermen recently adopted a self-imposed tax on their catch and agreed to a small size limit.

Richard Williams of Save Our Shellfish, an urchin diver who lives on the Mendocino County coast and has been in the fishing industry for 17 years, fears that "the government will start shutting down fisheries to assure there is a food resource for otters to spread into."

He and Holcomb said they feel rather hopeless because of the power of the otters' "cuddly quotient." Holcomb said the otters have a powerful single-interest lobby: "Margaret Owings [founder of Friends of the Sea Otter, a nonprofit organization with 4,700 members worldwide] has friends with clout all the way to Washington D.C." In addition, the fishermen keep running into "a bunch of people dressed up like trees and bushes." The whole issue, he said, is "almost like the Middle East conflict, with extremists on all sides."

The Cuddly Quotient

Nobody who has watched California sea otters lolling on their backs wrapped in kelp fronds, all four paws in the air, is likely to argue

that they lack charisma. Even people who have only seen photographs of the furry faces and bright eyes are likely to concur with Lawrence Durrell, who found them to be "quite the most enchanting animals" he had ever seen. But hundreds of marine species have been depleted and endangered by human resource abuse. Is charm a good reason to put so much attention on one species?

For biologists, sea otters have many other important characteristics, though Fish and Game biologist Jack Ames does acknowledge that "there's no doubt that they're fuzzy and cute." These are highly specialized, intelligent, uniquely adapted creatures, with a strong capacity for learning. Each has its own distinct personality, food preferences, tool-using habits, and parenting style. Otters are also highly significant to the coastal ecosystem.

Much about sea otters remains unknown—how they hear, see and smell, what their life span is. Biologists were surprised by their "strong homing instinct," said Carl Benz, Sea Otter Recovery Program coordinator at Fish and Wildlife, after so many otters swam back 200 miles to the places where they had been caught. Tom Williams, a Monterey veterinarian who has studied otter biology for 22 years, once remarked: "What we know about the sea otter would fill a pretty good-sized book. What we don't know would fill a heckuva big building."

Whether sea otters should be protected even at the cost of severe limits, or even abolition, of commercial shellfishing along parts or all of the coast is a matter of values. However, in devising the translocation program, Fish and Wildlife compromised by establishing an "otter-free zone" south of Point Conception. Any sea otter found in this zone—which comprises all of southern California—is to be captured by nonlethal means and taken away as long as there are sea otters on San Nicolas Island, according to Rathbun. Whether there was also agreement to draw a northern boundary is in dispute. Benz said no. Some Fish and Game sources said it was part of the deal. Shellfishermen insist there was to be such a boundary, and that the government has betrayed them by not drawing one.

As you cannot very well put a fence across the California ocean, the otter-free zone has had its problems. Otters are not always easy to capture, (in one instance, four men had to make 24 attempts on one otter within a single

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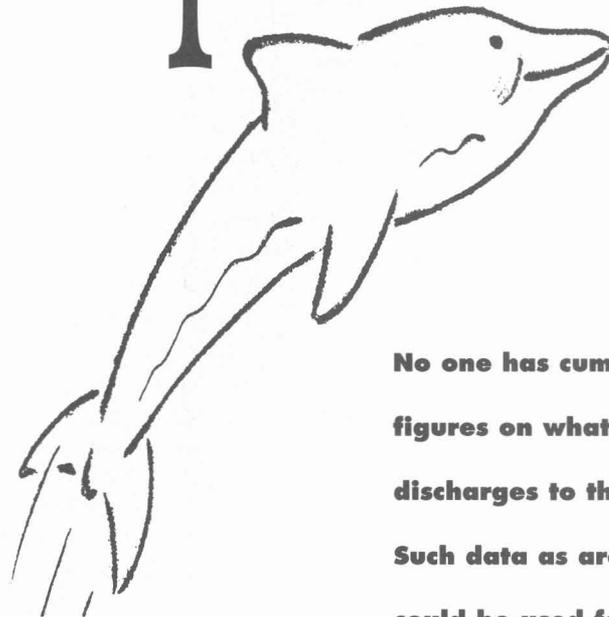
by Regina McGrath

In this age of instant computer access, when any grocery clerk can verify a customer's bank balance with a single phone call, Californians may be surprised to learn that no public agency knows the total volume of various toxins and pollutants being discharged through outfall pipes into coastal waters; that no map of these outfalls exists; and that regulatory agencies rely on the dischargers to do most of the monitoring.

Each day, more than 16,165 million gallons of treated wastewater flow into the Pacific Ocean from 332 dischargers, some of whom have more than one outfall pipe or service dozens or even hundreds of industries. For each of these dischargers, a state regional water quality control board has issued a permit. But to find out how much lead, or mercury, or cadmium, PCB, or some other contaminant is in the water at the end of the pipe—or exactly where those outfall pipes lie—you would have to do an enormous amount of research.

If you visit the offices of each of the nine regional water quality control boards, pull the permits from the files, and make your own calculations, you might be able to figure out the total volume of these toxins permitted, and come close to finding out what the dischargers told the government they released each month. "All that kind of data is available—it's just scattered," said Eugene Bromley, environmental engineer at the Environmental Protection Agency's Region 9. You will have to take the dischargers at their word, though, for the accuracy of this information—as the regulatory agencies now do. Although the Internal Revenue Service does not take the taxpayer's word on what he earned, demanding W-2 forms and other evidence, the regional water quality boards have neither the staff nor the funds for more than token monitoring.

Ocean as Dispose-all



No one has cumulative figures on what California discharges to the ocean. Such data as are gathered could be used far more effectively to protect marine life.

HOT SPOTS THE FARALLONES NATIONAL MARINE SANCTUARY

On the crags looming out of the Gulf of the Farallones, thousands of ocean birds nest—the largest concentration of seabirds in the continental United States. Along the shore and in nearby waters, 19 species of whales and porpoises lounge and swim. Underneath the waters, in the canyons and gullies swept by various currents, lie at least 47,500 55-gallon steel drums, some filled with radioactive waste. A few of these drums are only 298 feet underwater, only 30 miles from San Francisco. And an unknown number are leaking.

Anyone who braves the rough waters outside the Golden Gate to visit this unique wildlife refuge can see why it has been declared a national marine sanctuary and a UNESCO biosphere reserve. Harder to understand, from today's perspective, is that for 24 years, as late as 1970, federal agencies and private firms used it as a disposal site for radioactive materials.

Neither the exact location nor the contents of all the drums are known, said Ed Ueber, director of the sanctuary. When dumping started in 1946, disposal of nuclear wastes was essentially unregulated. Some of the barrels contain residues of the Manhattan Project, which developed the atomic bomb. Others may contain medical wastes of unknown toxicity. Among those who used the Farallones as a dump were the Atomic Energy Commission, the U.S. Naval Radiation Laboratory, Chevron Research, Nuclear Engineering Co., and Ocean Transport Co., according to Congressional hearings in 1980. Few records were kept.

What is known is that there has been plutonium leakage. In 1977 the Environmental Protection Agency recovered one drum and found that one percent of its surface was perforated and that sediment under it was contaminated by plutonium. Other drums were found crushed in the middle because of air pockets inside.

Nobody knows the degree of hazard. To find out if the drums are leaking, one

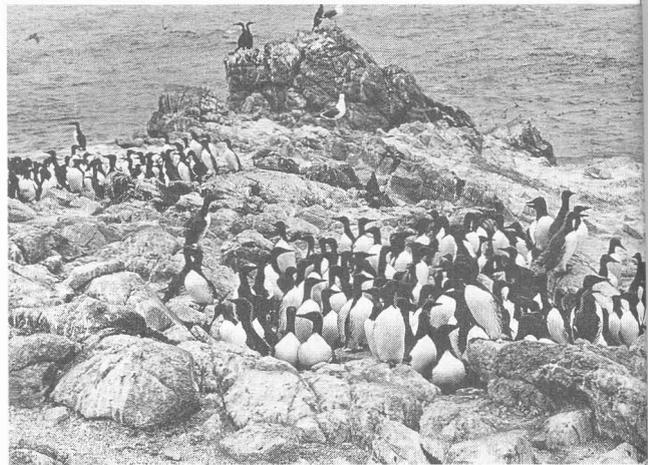
must first determine where they are. Toward that end, Herman Karl of the U.S. Geological Survey has been charting the sea floor with side scanning sonar, dragging a probe underwater after a ship. The probe sends out sound waves that map the floor, feeding the information to an on-board computer. So far, he has mapped 80 percent of the 350- to 400-nautical-square-mile (one nautical mile is equal to about 6,100 feet) area within which the drums are scattered. Besides the drums he found many other things, including a large ship, which he believes may be an oil tanker or the *U.S.S. Independence*, used in above-ground nuclear tests on the Bikini Atoll.

In addition to counting the drums and pinpointing their location, Ueber plans to hire an investigator to try to identify who did the dumping, where and when, and what the contents are. The National Oceanic and Atmospheric Administration and the EPA together have received \$900,000 for this purpose this fiscal year, thanks to Representatives Barbara Boxer and Doug Bosco, who won Congressional approval of the funds. Ueber hopes there will be money left to start a risk assessment too.

Back in 1961, marine biologist Rachel Carson warned in her book, *The Sea Around Us*, that "it is only a matter of time until the contents of all such containers will be free in the ocean waters." The turbulence, underwater streams, upwelling, and other movements of the water "all result in a gigantic mixing process that in time will bring about universal distribution of the radioactive contaminants." In addition, and perhaps even more importantly, she noted that the radioisotopes may be

concentrated by marine life and move up the food chain.

The Gulf of the Farallones is a highly productive fishing ground. Tests conducted so far have shown that fish from here are safe to eat, although they do contain higher levels of radioactivity than fish from other areas.

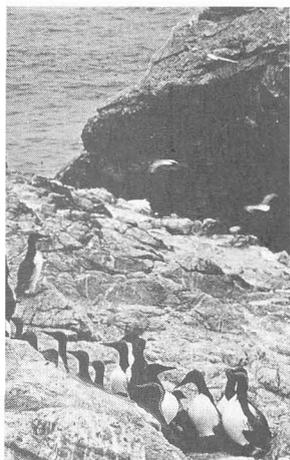


Common mures on the Farallones.

There are other ocean dump sites with unknown contents in California waters and the Exclusive Economic Zone. For example, fishermen out of Morro Bay have pulled up drums from a chemical munitions dumping area about 40 miles off La Purisima Point when they fish for Dover sole in the Santa Lucia Banks. Lieutenant Commander Eugene Okamoto of the Navy's Pacific Missile Test Center at Point Mugu said he has no records of what has been disposed of in the area. About 20 miles southwest of the Farallones sanctuary, a naval munitions dump site is now viewed as a possible disposal site for dredge spoils from the Port of Oakland. There is some concern that upwelling in this area could cause spoils to drift into the sanctuary, further complicating an attempt to study the radioactive drums and their effect on fish and marine life. The risks of using the ocean as a dumping ground are daily becoming more obvious. □

If one considers that the marine outfalls represent only part of the wastewater flow into the California ocean—hundreds of other dischargers dump into rivers, streams, and wetlands that eventually flow into the ocean, while storm sewers and nonpoint sources add further volumes of dirty flow that lack any control whatsoever—the dimensions of our ignorance on this vital issue begin to emerge. Without having any clear idea of what we permit to be dumped into the ocean environment, we cannot begin to evaluate the impact of all this pollution on our coastal waters and the ocean beyond. In effect, we cannot manage coastal ocean resources. "It all starts with understand-

ing what kinds of toxics are in the water. We don't know, and we don't have an approach to find out," said Robert Sulnick, executive director of the American Oceans Campaign, a non-profit organization based in Santa Monica dedicated to preventing coastal pollution, offshore oil exploration, and use of deep sea drift nets.



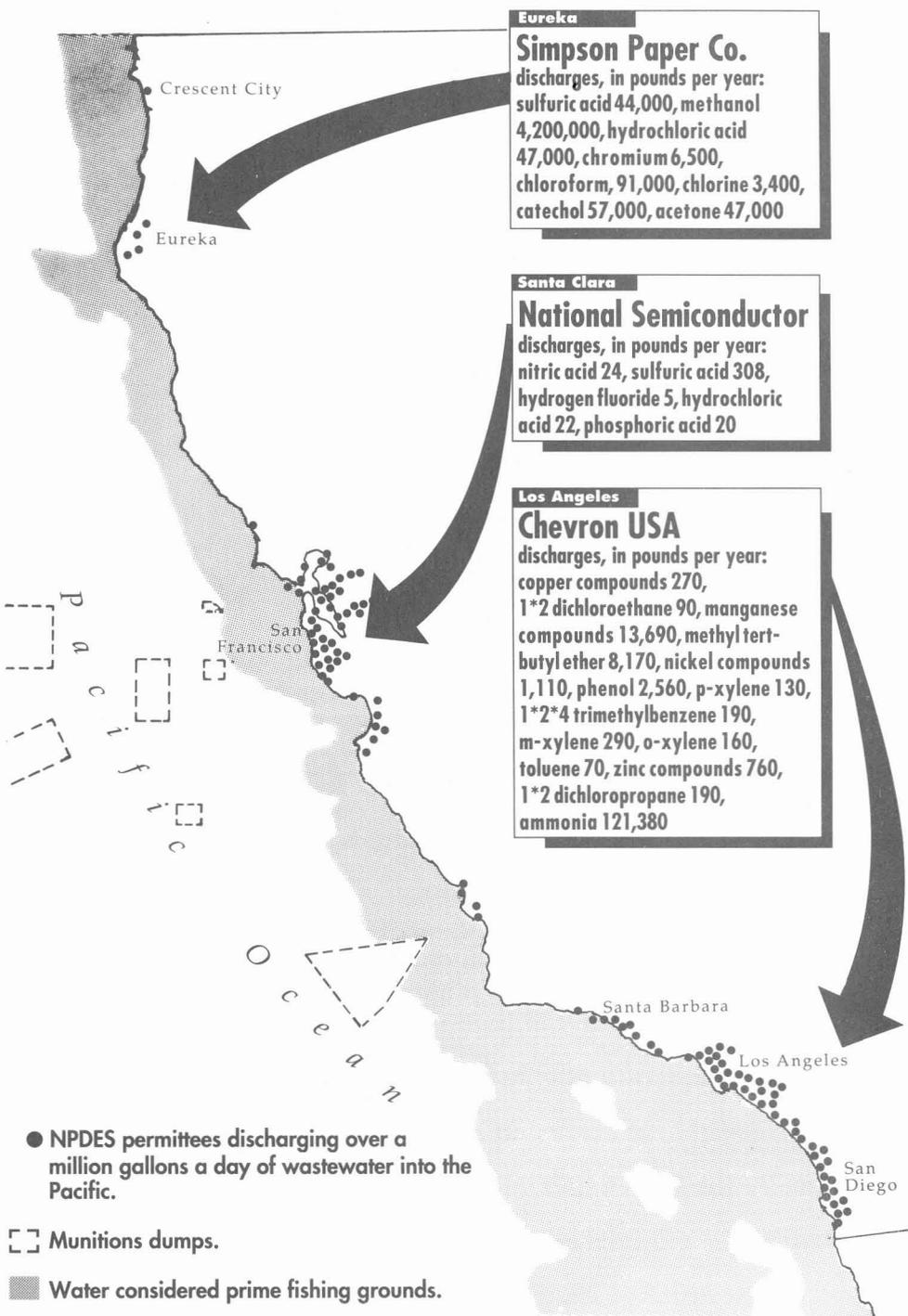
Operating in the Dark

Why has no statistical or visual picture of the cumulative impacts of ocean outfalls been compiled for California? One reason: dischargers are not required to follow a uniform system of reporting. "Some of the major dischargers file monthly reports with over 1,000 data points, each uses its own computer system, and we can't specify how they comply with the reporting requirements of their permits," said Stephen Hill, section leader of the Surface Water Protection Division of the Water Resources Control Board, Region 2, which regulates about 200 major dischargers in the nine Bay Area counties. These reports are "data dumps" to understaffed and overworked regulatory agency staff, who would have to have vastly greater resources to analyze and compile them.

Like the air, the ocean is a commons on which all life depends. The growing concerns about climate change and the depletion of the stratospheric ozone shield have increased

California Dumping

State-approved wastewater discharges (three examples), and former federal munitions dumps often coincide with prime fishing areas.



Map drawn by Joy Dorst.

Sources: State Water Resources Control Board; Environmental Protection Agency, Toxic Chemical Release Inventory; and the National Oceanic and Atmospheric Administration.

awareness of the atmospheric commons. A similar awareness about our dependence on the ocean is now emerging. Since the passage of the 1988 Ocean Dumping Act and the Clean Water Act (last amended in 1987), it is no longer legal to use ocean waters as a general dispose-all. However, the lack of coherent attention to the impacts of wastewater going into the ocean shows that we do not yet recognize

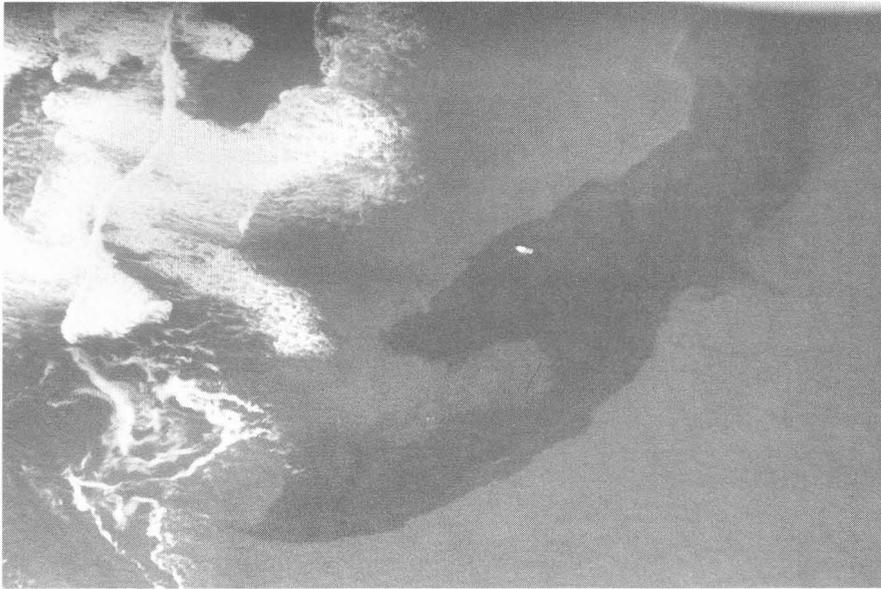


PHOTO COURTESY OF THE EPA.

The plume of wastewater discharged to the Pacific from two pulp mills on the Samoa Peninsula is visible from the air.

the need to protect coastal waters. Although the law says that the burden of proof is on those who seek to pollute the oceans, in reality the burden falls on those who are affected by the negative impacts.

Discharges Often Illicit

Wastewater enters the California ocean through three kinds of pipes: the outfall pipes from public and industrial wastewater treatment plants, and storm water discharge pipes. For the first two, permits are required under the Environmental Protection Agency's (EPA) National Pollution Discharge Elimination System, issued in this state by regional water quality control boards. Such permits will soon also be required for some storm water runoff. Also, toxic and health-threatening fluids enter coastal waters by seeping or flowing from land, especially where it is paved or eroding. This nonpoint source pollution requires a variety of land-based measures to control.

Among California's 332 ocean discharge permit holders are about 50 publicly owned treatment works, which carry toxic wastes, some from households and commercial establishments, but also from industries that dis-

charge to coastal waters indirectly via public sewage systems. Provisions to prevent such discharges are missing or inadequate in some of the most industrialized areas, says a recent study by the Citizens for a Better Environment.

For example, the National Oceanic and Atmospheric Administration is prosecuting a case filed against the Los Angeles sanitation districts for discharging through the public sewer system hundreds of tons of the pesticide DDT and PCBs dumped into the system by eight companies some 40 years ago. (The firms are being sued separately.) This is one of the few federal cases filed under the Comprehensive Environmental Response Compensation and Liability Act of 1980, which makes parties that dispose of waste responsible for restoring the environment.

The CBE study found that an estimated 24 million pounds per year of toxic pollutants from industrial facilities pour into California's coastal waters through public sewers. "Every pound of nondegradable toxics that enters public sewers ends up in our water, land, and air," according to CBE's report, *Hidden Polluters of California's Coast*, published in October, 1990. Yet, "in the most industrialized areas of the state, the cities of Los Angeles, San Jose, Palo Alto, and Sunnyvale fail to regulate sewer discharge from more than 11,000 manufacturing facilities," CBE found.

The water board's Stephen Hill questioned the accuracy of that figure: "Not all of those 11,000 places are manufacturing facilities—some are office buildings." Greg Karras, the author of the CBE report, responded that the number came directly from the Commerce Department's Census of Manufactures.

Hill said Region 2 is encouraging industry to set up pretreatment programs that require industry to remove metals and other contaminants before they enter the wastestream. Studies here and in Europe have shown that the most effective, if not the only, way to prevent industrial toxins from entering the aquatic environment is stopping them at the source. Step one is to find out who is putting what into the pipes—data that are not being compiled.

The toxicity of industrial discharges through public systems is not only hidden by lack of controls, but also by current methods of monitoring, according to the CBE study. "Government's focus on the concentration of toxics . . . hides pollution behind the dilution provided by vast amounts of wastewater. Allowing dilution of toxics wrongly puts the

Although the law says that the burden of proof is on those who seek to pollute the oceans, in reality the burden falls on those who are affected by the negative impacts.

least regulatory pressure on the most environmentally threatening discharges."

Hidden Polluters concluded that "true public and government access to real information on these hundreds of dischargers requires computer entry of all compliance data."

Court Actions Reveal Problems

In 1984 the Sierra Club Legal Defense Fund filed suit against the Pacific Gas & Electric Co., Tosco (the Oil Shale Co.), Shell Oil Co., and Union Oil Co. (Unocal), alleging that they had violated their discharge permits. With the exception of Unocal, the companies paid a fine and installed new control equipment.

The Unocal trial revealed problems with the current monitoring system. On December 24, 1979, a heavy rain storm hit the San Francisco Bay Area and one of Unocal's overflow basins in Rodeo, on San Pablo Bay, spilled, releasing into the bay several million gallons of untreated wastewater containing phenols, oil, grease, toxics (including benzene), and other contaminants, according to trial testimony. Unocal did not report this violation, and it only came to light five years later, when a former employee approached the Legal Defense Fund.

The Unocal employee testified that at the beginning of the year he had been given a list of days on which samples of effluent would be

taken to monitor compliance, and that he had been told to keep hard-to-treat wastes out of the treatment plant on these days. He also said he was taught to pour out dirty sample bottles and refill them with cleaner water.

The Legal Defense Fund identified 2,398 Unocal permit violations. In an out-of-court settlement Unocal agreed to pay \$5.5 million—at the time, the largest penalty ever applied via the citizen-suit provision of the Clean Water Act, according to the Legal Defense Fund.

Recently, the EPA and the U.S. Department of Justice joined a suit brought under the Clean Water Act last summer by the Surfrider Foundation, charging that two pulp mills in Humboldt County have violated their permits 15,000 times each since 1984. Surfrider alleges that Louisiana Pacific Corp.'s and Simpson Paper Co.'s mills are polluting a popular surfing spot with a combined discharge of over 40 million gallons a day of bleached kraft pulp mill effluent. The plume the effluent forms in the water is visible from the air.

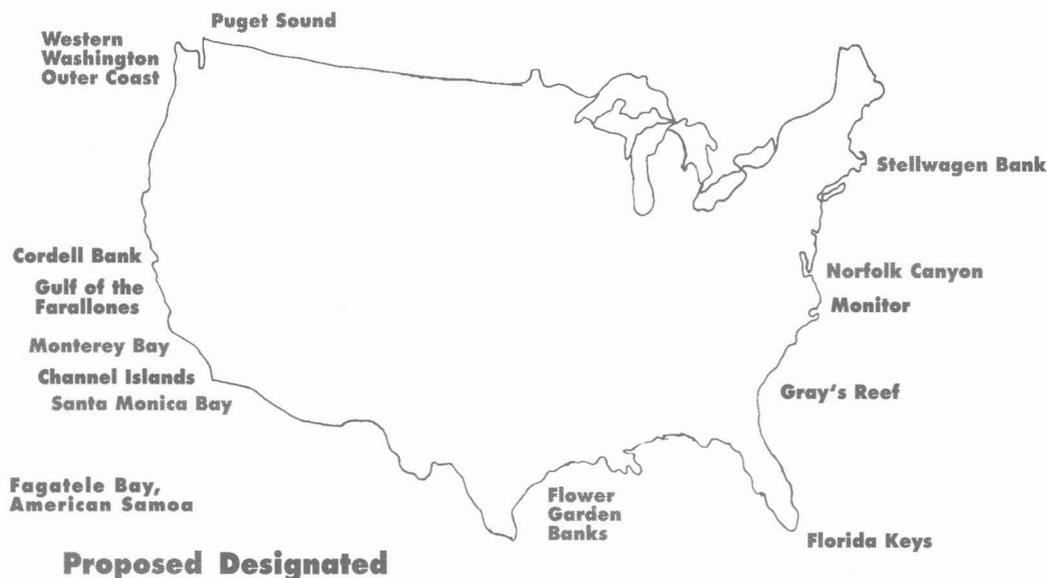
Storm Water Runoff

Storm water runoff, by its very nature, is not required to undergo any treatment before being discharged. This, however, is about to change, as a result of Congressional action responding to public health concerns.

"In the most industrialized areas of the state, the cities of Los Angeles, San Jose, Palo Alto, and Sunnyvale fail to regulate sewer discharge from more than 11,000 manufacturing facilities,"
Citizens for a Better Environment found.

National Marine Sanctuary Program

The National Oceanic and Atmospheric Administration expects to designate Monterey Bay as the nation's tenth national marine sanctuary soon, protecting the bay's richly diverse algal community and its 70-mile-long submarine canyon that plunges to depths of 10,000 feet within a 2,200-nautical-square-mile preserve. California has three other national marine sanctuaries: Cordell Bank, the Gulf of the Farallones, and the Channel Islands. Another candidate for sanctuary status is Santa Monica Bay. The largest (2,600 nautical square miles) and newest is the Florida Keys Marine Sanctuary, which extends from south of Key Biscayne to the Dry Tortugas. The federal sanctuary program started in 1972 to protect special ecological, historical, recreational, and aesthetic resources in coastal waters.



MAP COURTESY OF NOAA.

"There is a glaring need for a nationwide monitoring system and for effectively reporting findings to the public, the scientific community, and policy makers," the National Research Council study states.

The EPA provided funding and guidance for the Nationwide Urban Runoff Program, which found that some storm water from residential and commercial areas, construction sites, and landfills contained heavy metals, fecal coliforms, pesticides, suspended solids, and nutrients. Other studies have shown that sewers receive a variety of illicit untreated discharges, spills, and wastes, particularly used oils.

In California, the Santa Monica Bay Restoration Project, a coalition of the public, federal, state, and local agencies, and industries, has published a study that found viruses and bacteria indicating the presence of human fecal material in bay water near one of the storm drains. The Santa Monica Bay Restoration Project has asked the Los Angeles County Department of Health Services to expedite the posting of signs in English and Spanish at two storm drains emptying into Santa Monica Bay to warn that the water is contaminated. The group plans further studies designed to find the source of the contamination, which it said could come from illegal sewage connections, leaking sewer lines, blocked sewer overflows, and the local homeless population.

In an attempt to curtail such problems, the EPA finalized a rule on November 16, 1990 that established permit requirements for storm water discharges. Cities with populations of over 100,000 have two years and certain industries have one year to apply for permits. The affected industries, numbering about 100,000, include lumber, paper, chemicals, rubber, petroleum, stone, and clay. To secure compliance with these permits, as with those issued for sewage treatment plants and outfall pipes, the state's regional water boards will rely on self-monitoring and fines for enforcement. The EPA has not yet issued a list of specific cleanup measures to be required for permit applicants. The state water board has prepared a draft request to have its budget augmented by raising consumers' fees to deal with the increased work load.

Developing a Coherent Picture

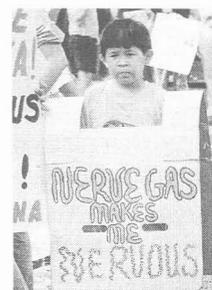
The most extensive marine monitoring in the state is being conducted in the Southern California Bight. Some \$17 million dollars a year is spent toward this purpose by public utilities, government, and industry in this region, which extends along 357 miles of coast from Point Conception in Santa Barbara to

HOT SPOTS COLD WA

Johnston Island is a 1.5-square-mile island some 800 miles southwest of the big island of Hawaii. It is part of a 12-mile-long coral reef estimated to be 75 million years old, designated as a U.S. National Wildlife Refuge in 1926. It is the foraging area for the endangered green sea turtles and Hawaiian monk seals, and a stopping place for thousands of seabirds.

Johnston Island has a history of military activities nobody wants in his neighborhood. It has been the drop site for several atmospheric nuclear tests, and 24 acres of the island are now off limits because of plutonium pollution. A program to move the contaminated soil to a landfill on the continent is expected to start in July. The island was also the storage site for more than a million gallons of Agent Orange, some of which leaked, contaminating one to two acres with dioxin. The Air Force is performing a risk assessment on this fenced off area. Now, despite objections from numerous governments and groups, the U.S. Army is using the island for incinerating obsolete chemical weapons, which had been stored in Okinawa and Germany.

About 1,200 people, including contractors, biologists, and Army personnel, now reside here because of the Army's Johnston Atoll Chemical Agent Disposal System (JACADS). They all carry gas masks and syringes with an antidote for nerve gas. No spouses or children are permitted. JACADS was built to incinerate bombs, shells, and rockets armed with mustard gas and two types of nerve gas. In four separate incinerators it burns chemicals, explosives, metals, and miscellaneous



ENDS ON PACIFIC ATOLL

contaminated material. The munitions are disassembled by robot. Since even tiny concentrations of the gases are lethal, they are burned at less than one atmosphere so that if there is a leak, the gases will not escape into the air. The Environmental Protection Agency is monitoring the process.

The gases now on the atoll, 5 percent of the nation's unitary chemical weapons arsenal, are to be disposed of during the next four and a half years at a cost of about \$240 million. Disposing of the entire U.S. obsolete chemical arsenal will require an estimated \$4 to \$5 billion. Federal law requires that these weapons be destroyed. They are being replaced by binary chemical weapons, which are safer to keep and handle because, unlike unitary weapons, they explode only when two inert agents are combined.

Pacific Islanders Are Protesting

"Our main objection to the burning is the continued use of the Pacific Ocean as a cesspool," said Hayden Burgess, interim chairman of the Pacific Asia Council of Indigenous Peoples, which opposes the use of the atoll for weapons disposal, as have the Federated States of Micronesia, the Hawaiian State Legislature, the City Council of Honolulu, the Hawaiian Teachers Association, the Congress of Churches of Pacific Island Nations, and others. At the autumn 1990 session of the South Pacific Forum, a meeting of the governments of Pacific nations, Australia, and New Zealand joined the protest.

Having already endured atomic atmospheric tests during the 1950s and 1960s, Pacific islanders now fear that eventually, the entire obsolete chemical weapons arsenal will be brought to the atoll. Though the Army plans to build eight similar disposal facilities within the continental United States (in Alabama, Arkansas, Colorado, Indiana, Kentucky,

Maryland, Oregon, and Utah), local resistance is mounting on the mainland. If other plants are not built, the Army might ship a total of some 3 million chemical weapons to the atoll, according to a recent report in *Chemical & Engineering News*. An Army spokeswoman said the Army has no plans to do this.

Islanders point out that official explanations for the choice of Johnston Atoll are contradictory. According to the Army, it is safer to incinerate the gases where they are stored, and much of the stockpile on the atoll has been stored here since 1971, when it was brought here from Okinawa. But this logic does not seem to apply to the recent arrival of more chemical weapons from Germany.

These should have been destroyed in Germany, or, if that was not possible, at the Aberdeen Proving Ground near Edgewood, Maryland, half the distance from Germany, argued Burgess. The Army explained that Public Law 91-672 prohibits the return of any chemical stocks to the continental U.S., and also that the Aberdeen site is on Chesapeake Bay, an ecologically sensitive area. "Our Pacific Ocean is no less sensitive," Burgess responded.

To make sure the lethal chemicals are completely destroyed, the incinerators on the atoll are equipped with carbon filters and stack-top air monitors. Chimneys are cleaned by flushing with salt water, which, now contaminated with lead and other heavy metals, is being shipped to Texas for deep-well injection into the ground. A dryer is being modified, and when it is operational the water will be evaporated and the brine, along with left over ash, will be transported to Kettleman City, California, for burial in a hazardous waste dump operated by Chem Waste Inc. A plan to dump the contaminated salt water in the Pacific was scrapped

after Congress outlawed ocean dumping of hazardous wastes in 1988.

Despite all the precautions, islanders worry that the incinerators might not destroy all the harmful chemicals they emit, and that some accident could contaminate the food chain. Because even tiny doses of these chemicals are lethal, there is no room for error.

The Army is paying for extensive

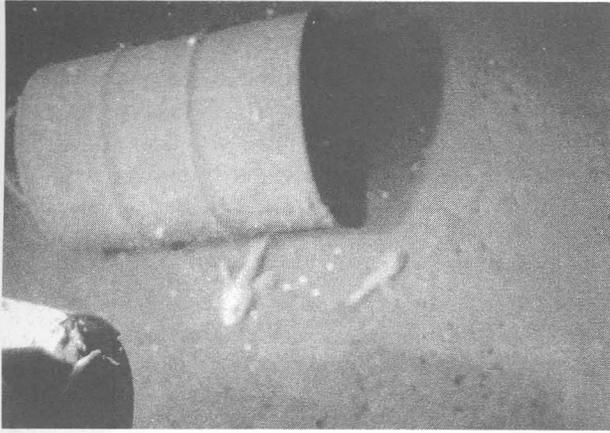


PHOTOS COURTESY OF THE PACIFIC ASIA COUNCIL OF INDIGENOUS PEOPLES

biomonitoring, including most of the salaries of two Fish and Wildlife biologists living on the atoll and marine research by Dr. Philip Lobel of the Woods Hole Oceanographic Institute. Fish and Wildlife biologist Roger DiRosa saw the incineration effort in a positive light: "This island is more in compliance with environmental laws and regulations than most communities in the United States." He observed that birds now find more nesting sites on the island than they used to because land has been added to the island by fill. The island community has set up an Environmental Health and Safety Council and an Environmental Committee to evaluate ways to safeguard the island. Residents plan to recycle their metal and glass and are studying plans to use clean sludge from the sewage treatment plant for fertilizer. "I'd much rather breathe the air and drink the water here than in Los Angeles," DiRosa said.

After the burning is completed, plans call for the incinerators to be dismantled and the island to be returned to its original condition.

— Regina McGrath



PHOTOS COURTESY OF THE EPA.

Waste packages from the Farallones National Marine Sanctuary showing (top) no, (center) mild, and (bottom) severe hydrostatic implosion.

Cabo Colnett, Baja California, Mexico. Seven major municipal dischargers and some state and federal agencies jointly fund the Coastal Water Research Project to conduct both basic and applied research relevant to the discharge of municipal wastewater. Yet a recent National Research Council study of the effectiveness of this monitoring found that "it is difficult—if not impossible—to present a coherent picture of the bight as a whole." In its report, *Monitoring Southern California's Coastal Waters*, the Council's Marine Board attributed the problem to a fragmented approach to assessing environmental quality, the fact that monitoring is organized primarily around discharge permits responding to water quality regulations, and a lack of mechanisms for integrating the various monitoring activities.

The EPA made a promising start in the early 1970s toward applying available technology to develop more coherent pictures of the impacts of wastewater on the environment by establishing a nationwide computerized permit compliance system for dischargers classified as "major." The system matches permit conditions with the effluent data that dischargers periodically report to the state, and which the state then passes on to the EPA. The computer signals if any apparent violation has occurred. This system could be an excellent monitoring tool if the regulators exercised some quality control over the data collected, according to Wesley Marx, a member of the National

Research Council study group.

"We never have enough people to do this job," said Steve Fuller, a supervisor who has worked on the wastewater discharge permits division of the EPA for 16 years. "We have fewer people than we did five years ago but more requirements. The state and local people are supposed to pick up the slack, but they are strapped too."

The State Water Resources Control Board has chosen not to use the EPA's program, having found it is not user friendly. "The EPA database is a national system maintained in Washington, D.C., and we'd have to go through an elaborate procedure to get the information we want," explained Al Friedman, sanitary engineer in Region 2. Archie Matthews, chief of the regulatory section of the state board, said California couldn't even use the system until after 2:00 P.M. because the East Coast states were on it. He also said the EPA's system relies on the discharger to calculate its own average daily discharge, which "leaves some room for error."

Region 2 is working on its own software with the Aquatic Habitat Institute in Richmond. About a dozen major dischargers now file their monthly self-monitored reports using the system, which Friedman hopes could eventually be used throughout the state. "We absolutely need a central computerized system in the state," Friedman commented.

More Than Water Quality

Monitoring for water quality alone is not enough to form a coherent picture of the changing ocean environment. "A real hole in marine monitoring concerns the condition of living marine resources, from kelp forests to fin fish to coastal wetlands," according to Marx. "Some coastal states, including Maryland, put out an annual report on the condition of their marine environment and its inhabitants; California doesn't, even though the State Fish and Game Department collects much of this information." Yet an excellent model of a good monitoring system—used by researchers worldwide—exists in California.

The California Cooperative Oceanic Fisheries Investigation program (CalCOFI), started in 1948 to monitor the distribution and health of sardines and later expanded to include other forms of marine life, including plankton, within the California Current ecosystem. The program keeps a computerized database that the

National Research Council found to be "unparalleled among marine resource monitoring programs in terms of its commitment to a long-term time-series assessment." The council pointed to CalCOFI as an example of "the ability of large-scale sampling programs to describe important patterns that cannot be detected by point-source monitoring programs." The program is a joint effort by Scripps Institution of Oceanography, the State Department of Fish and Game, and the National Marine Fisheries Services. Mexico also cooperates. Recently, however, this program has been diminished by budget cuts.

Fish and Game is beginning another ecosystem study. It plans to use a computerized database to monitor sport fish. Called the Bay, Estuarine, Nearshore, and Ecosystem Study, it will initially focus on California halibut, spotted sand bass, striped

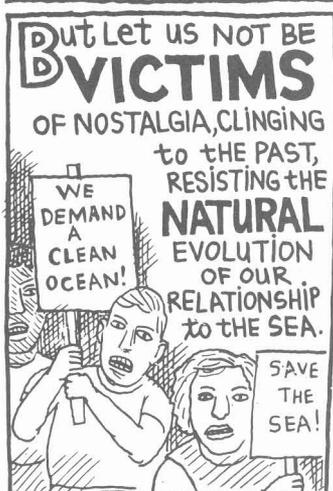
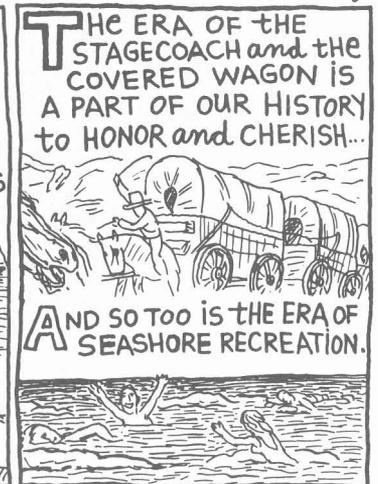
mullet, and gobies in the Southern California Bight. It is budgeted at \$300,000 a year, 75 percent of which will be federal money from the Federal Aid For Sport Fish Restoration Act.

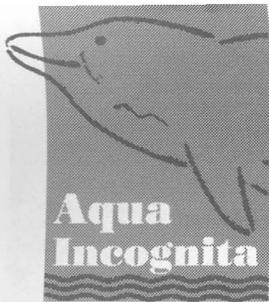
"There is a glaring need for a regionwide monitoring system and for effectively reporting findings to the public, the scientific community, and policy makers," the National Research Council study states. "Only through an integrated systemwide approach can important environmental and human health objectives identified by society be successfully attained: ensuring that it is safe to swim in the ocean and eat local seafood, providing adequate protection for fisheries and other living resources, and safeguarding the ecosystem." □

Regina McGrath is associate editor of California Coast & Ocean.

WASHINGTON

Mark Alan Stamaty





Onwards and Downwards

**SYLVIA EARLE GOES WHERE NO
PERSON HAS DARED GO BEFORE. NOW
NOAA CHIEF SCIENTIST, SHE DIVIDES
HER TIME BETWEEN THE OCEAN REALM
AND WASHINGTON, D.C.**



Sylvia Earle.

Her recent appointment as chief scientist, the National Oceanic and Atmospheric Administration, has put Sylvia Earle in a key spot to shape federal policy for the oceans she knows as deeply and intimately as any scientist and explorer. A strong believer in studying the seas by direct experience as well as with advanced technology, she has spent more than 5,000 hours under water, often in places never before visited by humans. In 1966, her doctoral dissertation in marine botany became a landmark in her field. She was one of the first marine scientists to use scuba gear in her research. In 1979, she made the deepest dive ever made without a tether and walked the floor of the Pacific at 1,250 feet in a Jim diving system, pioneering the use of this equipment for research.

Since 1984, she has made many dives into unexplored regions in *Deep Rover*, a one-person submersible designed and built by her husband, Graham Hawkes. This craft goes deeper, stays down longer, and is easier to operate than other undersea vehicles and has been described as a deep ocean sports car. Mark Wheelley and Rasa Gustaitis interviewed Sylvia Earle for *Coast & Ocean* during a recent visit to her office in San Leandro, at Deep Ocean Engineering, the design and construction firm she founded with Hawkes.

Coast & Ocean: You have just come back from Antarctica?

Sylvia Earle: Yes. My visit was initiated before the [NOAA] appointment in November 1990. It did blend very much with my objectives, though. This trip was under the auspices of the National Science Foundation and involved looking under the ice to see the fate of the debris that has been placed there over some 30 years, and to evaluate whether to leave it in place or try to recover it. Everything from scrap metal to drums of waste material were historically placed in the water. Not anymore, of course. Now such things are packed up and taken out. It is a sign of the times that we were looking at what's there. I believe that it may be okay to leave some things as they are, like shipwrecks, because they have become artificial reefs. In some cases, removing them could be more disruptive to the environment than leaving them in place. But that's to be resolved.

C&O: Did you go under the ice shield?

SE: We used a ROV [remotely operated vehicle] to go down and look and film below the

ice. I also went via helicopter to the edge of the ice sheet and watched minke whales go by. It was a tremendous experience, seeing penguins coming up very enthusiastically to see who these strange human creatures were.

C&O: *What new perspectives do you have on the oceans from your new position?*

SE: I can tell you that better a year from now. The office of chief scientist was created to make sure that science would be represented in the top management of NOAA. Administrator John A. Knauss is, fortuitously, also a scientist, an oceanographer, retired as dean of the College of Oceanography at the University of Rhode Island. Science is also well represented throughout the agency otherwise.

C&O: *With all the attention to the atmosphere recently, is the ocean being neglected?*

SE: The impression given by many is that the atmospheric "A" has had more emphasis than "O" in NOAA. But the "A" is very important. The Weather Service performs fundamental functions. I don't see a sharp line of demarcation. We are looking, really, at the planet as a whole.

C&O: *Oh yes? Is this a new direction for NOAA?*

SE: I think so. Knauss refers to NOAA as the "earth systems agency." The aim is to see physical, biological, chemical processes, to find out what drives the whole globe, not only to look at pieces, as we have historically; not that we would stop that—but rather, for the first time, to take advantage of the ability to have a global assessment and to digest massive amounts of information and pull out patterns; to use computer technology, satellites, and a whole network of underwater stations as well to provide some information. It's easy to take the surface temperature of the ocean, for example, with satellites, but it's not easy to find out what's happening 100 feet below the surface. So we're trying to get some stations under water—I guess you can equate them in some ways with weather stations.

C&O: *Will the oceans get the kind of concentration that NASA received at the beginning of space exploration?*

SE: That's our intention. And I think the cli-

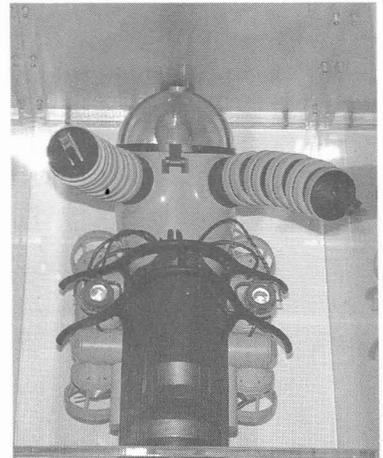
mate is ripe for that. People are very concerned and interested. It takes the critical mass of public support to motivate the legislative branch to appropriate the funds. But it also takes a plan so the money will be wisely spent. I think it's appropriate to go into high speed with ocean exploration and research. There are great obvious areas of unknowns that we need to explain. Our problem had been with access to the sea. Onwards and downwards, as they say.

C&O: *We were reading how easy it is to operate Deep Rover. Are we soon going to have the equivalent of snowmobiles tearing through the ocean, disturbing the fish?*

SE: We're a long way from that. There is but one Deep Rover. We're comparing a handful of little submersibles to millions of automobiles. I do take your point, though, that there is the potential for abuse of this technology. But side by side there is the awareness that we are already abusing the oceans in ignorance. [The submersibles] will give us access so that we can, first of all, find out what's going on and then, second, maybe address what to do. With the caring that inevitably comes with knowing we can forestall abuses. One encouraging sign is the establishment of some new marine parks and sanctuaries. We need to do a great deal more, however.

C&O: *My impression is that the marine sanctuary program doesn't have any teeth.*

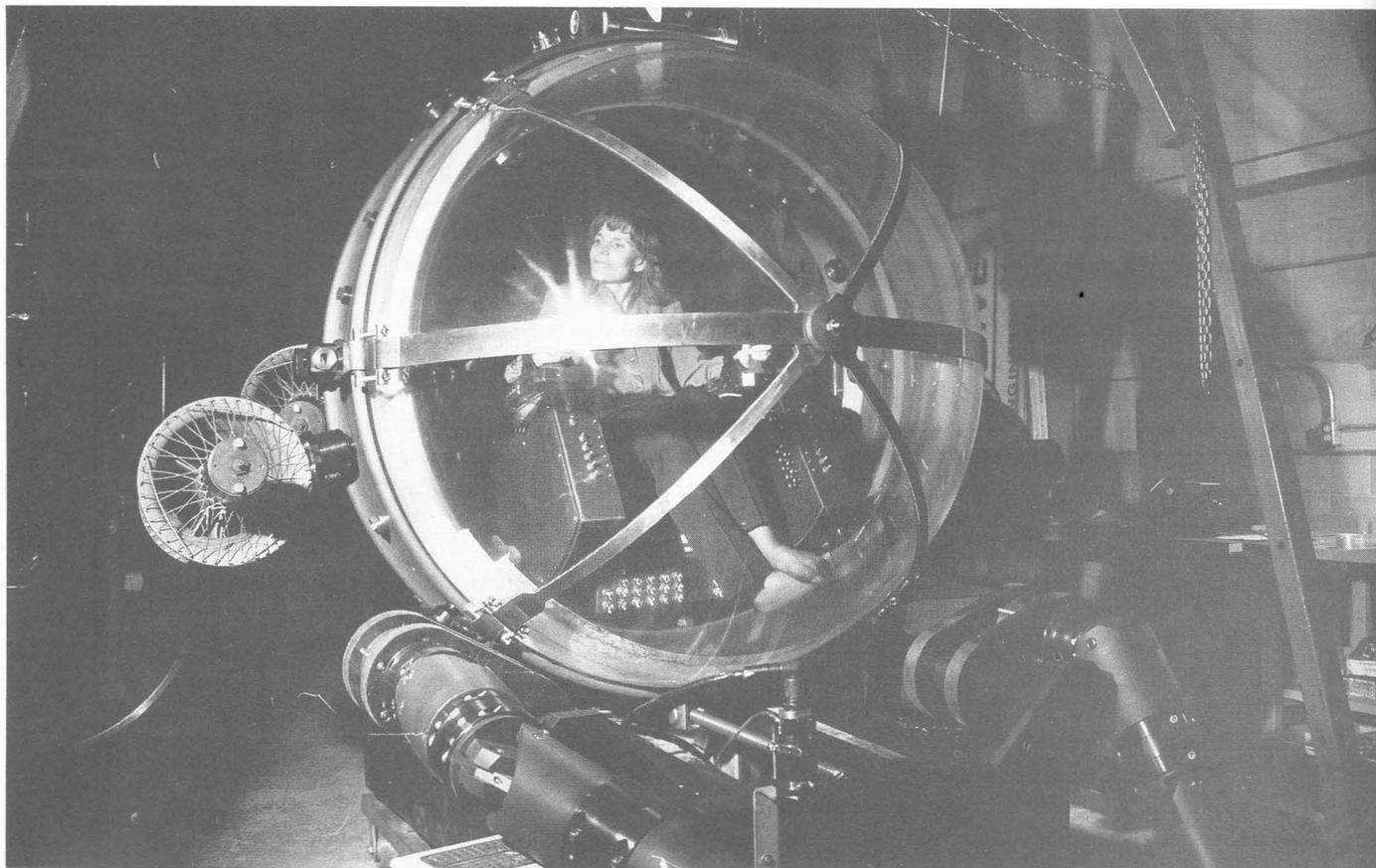
SE: Areas designated as marine sanctuaries presently have few restrictions, but various proposals are being considered. Conservationists, scientists, and others are trying to see what to do to protect the health of the planet and maintain its viability as habitat: that means the atmosphere, good weather, all those things we take for granted. They are looking at sustainability of living resources; and they are looking at protecting the diversity of life. What the ocean is already doing for us has a great big dollar sign on it, or a yen sign, or a ruble sign. The benefits we are already deriving are priceless. Most people think of the value of ocean resources in terms of what they take out—fish or minerals. But there are other, priceless values, such as a hospitable climate, breathable air, a generally healthy earth ecosystem. We must protect that system.



"The Jim suit is very much like the astronauts' life support systems. But I was an aquanaut on a walk through inner space," Sylvia Earle reported after her historical untethered dive in 1979.

There are still textbooks that talk about the biomes of the world with all the terrestrial masses nicely carved up and the oceans as just big blobs of blue.





Sylvia Earle requires no special clothing (or footwear) to visit the ocean floor in Deep Rover, which is maintained at one atmosphere.

C&O: California considers itself progressive in coastal management. Is it progressive regarding the ocean?

SE: The policies of this state have been pace setters in many respects. California has been forward-looking in setting up shoreline parks. It is to California's credit that some efforts have been made in recent years to hold the line with aggressive policies on pollution control that set a standard for other areas.

C&O: Do you expect any change in direction with the new governor?

SE: I hope to meet with Governor Wilson's staff to discuss the special opportunities that the governor has to make a difference with respect to ocean policy. His experience at the federal level as well as on the local level in San Diego, and his interest in technology are particularly relevant. One thing is clear. Policies about the ocean for California affect far more than California. The waters of this state influence—and are influenced by—the Pacific Ocean as a whole.

C&O: Yet there is still a great tendency to try to tuck things away in ocean provinces. We're burn-

ing nerve gas brought back from Germany on Johnston Atoll off Hawaii. Hawaiians are very upset but we don't even hear about that here.

SE: It will affect California. It affects the globe. It's going into the atmosphere—diluted, but it's there, part of the inheritance, like the oil spills.

C&O: You looked at the effects of the Exxon Valdez oil spill in Alaska. What can you tell us?

SE: Nature is a great restorer, we know that from experience elsewhere. But despite significant funding—\$2 billion to clean up Prince William Sound—the restoration has largely been the result of natural processes. Money did not buy the natural elements that restore health. It didn't buy clean water that came in twice a day with the tides, nor any baby barnacles or otters or young herring. As part of the restoration effort, it might make sense to protect adjacent waters, to dedicate a significant area as a reserve to help ensure that an ongoing source of the components of the complex Prince William Sound ecosystem will be available into the future.

C&O: Is this a good time to do that?

SE: It certainly is. There is no better time. Should have been done 50 years ago. It will only be more difficult as, increasingly, vested interests get locked in place.

C&O: What about reserves on the international level as well? Most of the biospheric reserves are on land, aren't they?

SE: That's right. It is just amazing that the oceans have historically received such short shrift. There are still textbooks that talk about the biomes of the world with all the terrestrial masses nicely carved up and the oceans as just big blobs of blue.

C&O: *It's almost impossible to find a map with the Pacific Ocean at the center.*

SE: Only when you look at a map of New Zealand or Australia. They naturally put things in perspective from their point of view.

C&O: *Now we have the Exclusive Economic Zone, it's being called the biggest land annexation since the Louisiana Purchase. There are calls to go out there and map resources. But for what? For exploitation? For preservation? Resources management? Or . . . ?*

SE: Increasingly it's beginning to dawn on people that we are already "exploiting" the resources of the sea with each breath we take, with each day lived on a planet made hospitable for humankind by the ongoing interactions of the physical, chemical, and biological components of the planet—especially the ocean components.

C&O: *How can we take costs into account when we know so little?*

SE: Let's put environmental costs on the balance sheet.

C&O: *You have spent so much time below the surface. Would you have everyone put on a mask and go down there?*

SE: If I could, I would. For their sake as well as the ocean's. Such an experience will change your life forever. You'll not only see the ocean, you'll see yourself in a different way. After you see that fish have personality, you just can't look at a filet the same way anymore.

I would love to get everyone to go out into the sea on a one-on-one basis. It's simple to put on a mask, fins, and snorkel. Anybody can do it. My mother did it for the first time when she was 81. Of course the ocean along California is a little chilly, a little rough, and much of it is murky. But the rewards are worth the effort.

C&O: *Is this necessary for research, now that we have technology for remote viewing?*

SE: I'm a strong believer in using the best tools to accomplish a piece of work. But for basic exploration, there's no substitute for being there. Personal access brings to the scene the experience, the judgment, the subtle sensory information that most of us take for granted. We don't know how to program some things into a machine. We can use camera eyes, but we don't know how to achieve full spatial correspondence. There are some cameras that enhance vision. There are robots that can go where we cannot go, and we should use them—and any other useful tools as well. But why fight being there? Why not just enjoy it? Why not package ourselves to dive, just as we do to go to the moon? We fly seven miles up, why not dive seven miles down? It's so reasonable.

C&O: *What about sharks?*

SE: Sharks tend to mind their own business. I have great respect for them. They have been around for 250 to 300 million years. They preceded dinosaurs, but they are vulnerable to our activities. I don't eat sharks. I figure if I respect them I have a better chance of them respecting me, that they won't put me on their menu either.

C&O: *What are your favorite diving spots off California?*

SE: I plan to dive among the Channel Islands soon. I particularly like diving off the Farallones, it's really beautiful out there. And Monterey of course. The kelp forests are hard to beat for sheer heart-stopping magnificence. Of course, the cold water is a little heart-stopping too.

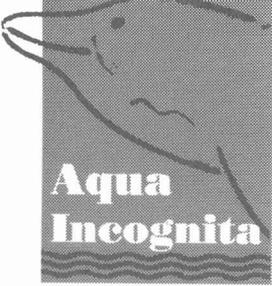
C&O: *Your job has not kept you from diving?*

Sylvia Earle smiled, "To remain certified as a NOAA diver I am obliged to go diving at least twice a month." □

After you see that fish have personality you just can't look at a filet the same way anymore.



Deep Ocean Engineering designed this ROV for underwater filming. It can operate at depths of 1,000 feet and is tethered to a boat on the surface, where the photographer sits in comfort. The Australian Broadcasting Co. is currently using one to film killer whales.



Aqua
Incognita

Pieces



Drawing by Dan Hubig

of the Puzzle

Atmospheric and ocean processes change constantly and are all interrelated. Only by collaborating across institutional and disciplinary boundaries will scientists see the picture as a whole.

by Gary Sharp

For at least 20 years, most national research on the atmosphere and the oceans has been done within a fragmented information context. Consequently, a great many people are making a great many decisions without being able to base them on all the facts.

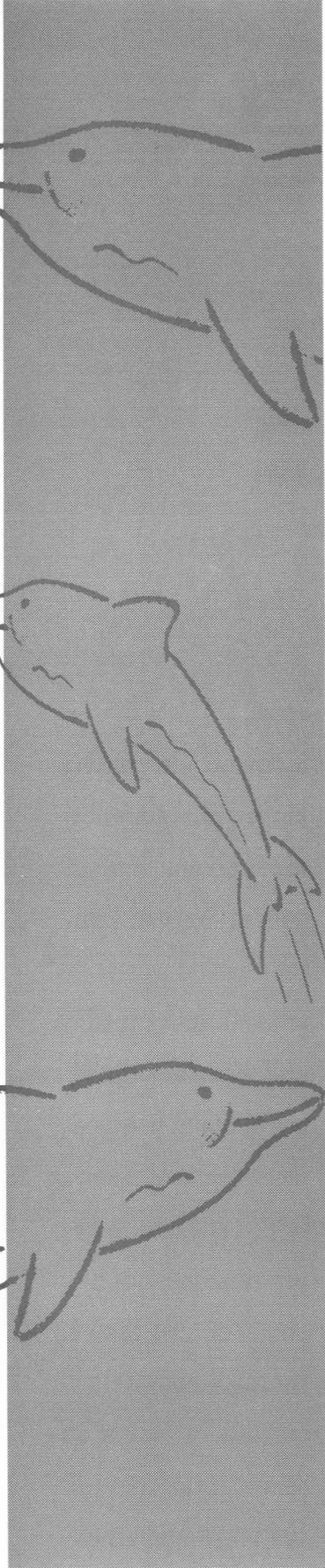
Few people realize how little we understand of atmospheric and ocean dynamics and how little real observational data is collected. We think weather satellites can tell us about tomorrow's or next week's weather because every evening we can see, on our TV screens, the last few hours of infrared cloud patterns and hear the meteorologist's carefully phrased projections. The forecasts are always fuzzy, however, because the information and understanding we have is insufficient to permit confident projections beyond the near trivial.

This holds equally true for the atmosphere and for the oceans. Technological advances seem to promise certainty where none exists. We now have lasers that allow us to identify schools of fish from the air, acoustical equipment that allows us to eavesdrop on whales, remotely operated vehicles that have revealed the existence of deep ocean life forms that we

did not know were possible. But we still cannot measure the oceans and atmosphere in sufficiently short time and small enough space scales for long enough periods to resolve the emergent patterns. As scientists, we are in the position of trying to put together a very complex picture puzzle that keeps changing even as it is being constructed. What is more, some of the pieces are either missing, or on somebody else's table.

The ocean sciences comprise quite a number of very distinctive topics and disciplines, all related via the hydrosphere link. However, the subject matters are often considered to be so esoteric from one discipline to the next that their interrelations are ignored. Thus we keep losing small but often key pieces of our grand picture puzzle.

The attempt to define, identify, and predict an El Niño offers a case in point. El Niño is the label given to the erratic but seasonal warming of the oceans off South America that occurs near or about Christmas (hence the popular name). It originates far west of Peru. In fact, it may originate in atmospheric processes affected by Indian Ocean monsoons and the



Tibetan Plateau. It travels along the coast toward both poles and can cause enormous disruption of marine life. During the famous El Niño of 1982-83, seabirds died in foul-smelling anoxic waters resulting from the infusion of nutrient-poor warm surface water that induced higher respiration in plankton and fishes. This increased respiration, in turn, reduced the oxygen content of the upper ocean and suffocated the fish and planktonic creatures that reside there. These animals were then unavailable for the birds to eat, and they, in turn, starved. The severity and extent of such consequences vary with each occurrence of the El Niño.

Was There a 1990-91 El Niño?

Last November, the fleet manager for a high seas tuna fishing firm called the office of the National Oceanic and Atmospheric Administration's Center for Ocean Analysis and Prediction wanting to know whether there was going to be an El Niño. If so, he said, he would move his fleet so as not to catch any more large yellowfin tuna, as their market price was unfavorable. I asked him what the vessels were catching. He replied that they had had a run of larger schooling yellowfin. "You have just given me the information you have asked for," I then told him. The presence of larger yellowfin in surface schools in the western Pacific was an indicator that El Niño had begun.

The larger yellowfin are only rarely found in surface schools in the western Pacific because they cannot long tolerate that region's upper ocean temperatures (30°C or 86°F), which to them are excessively high. They only school in abundance where the warmest upper ocean layer is shallow enough to allow them to find quick refuge in cooler subsurface waters.

One of the symptoms of the beginning of an El Niño is a shallowing of the upper ocean layers in the western Pacific. The surface winds that usually blow to the west along the equator relax, and the upper ocean sloshes eastward. (These winds usually maintain a sea level in the western Pacific that is higher than elsewhere in the hydrosphere. When they die down, the water seeks to come into balance with the earth's gravity field.) This sounds simple enough, but the problem is that the process is neither uniform nor easily monitored because it is part of a continuously changing global ocean and atmospheric interplay. The presence

of schools of yellowfin was therefore significant as a piece of the grand puzzle. It indicated that the ocean was sloshing eastward, resulting in a shallowing of the upper layers, and thus signaling a Niño event.

At about this time there was a constant buzz in the oceanography community about a pending El Niño. There was disagreement as to whether it actually materialized. This disagreement was in part a result of different and overly limited definitions, or, we could say, the result of a failure to put together pieces of the puzzle in the possession of different players at different tables.

According to many professional El Niño watchers, particularly the physicists, there was no El Niño last year because the temperature did not rise 2°C off the coast of Callao, Peru. In 1980, physical oceanographers defined El Niño by such an observed warming.

The folks who study birds, fishes, and the currents of central and southern California, however, had seen all the symptoms of a classic El Niño starting early fall 1989 and continuing through January 1990: Birds were found starved to death along beaches. Fish were emaciated and in many cases their reproduction failed. A pool of warmer than usual oceanic water moved into various areas off the California coast. For the biologists, fishermen, and naturalists, these observations defined El Niño.

Meanwhile, the team of Naval Postgraduate School oceanographers studying the nearshore currents along a periodically sampled transect that runs from near the Point Sur coast, offshore for more than 100 miles, observed the northward flow of the ocean from the surface down to depths well below 2,000 feet. This is a phenomenon that has recently been identified as an indicator of ocean warming events that derive from equatorial El Niño sources, as opposed to surface wind-driven ocean warming events that derive from North Pacific atmospheric pressure patterns, in a study by Jerrold Norton of the NOAA Pacific Fisheries Environmental Group.

There were also many reports of somewhat higher ocean temperatures off northern South America, and some dead anchoveta along the beaches, but no really significant bird die-offs, or infusions of unusual sea creatures such as the oceanic crabs that were features of the 1972 and 1982-83 El Niños.

During the entire period from late summer 1989 to April 1990, an experimental upper ocean nowcast (a "forecast" describing the

present) modeling program at the Naval Ocean and Atmosphere Research Laboratory in Bay St. Louis, Mississippi, tracked and documented the sequence of events that started with a steepening of the sea level gradient from west to east in the tropical Pacific Ocean, and the evolution of a "Kelvin" wave, or a surface wave of warm water that passed from west to east, and onto the Pacific coast of the Americas, where it traveled poleward to about the San Francisco Bay area, and offshore.

This sequence was set against a backdrop of a quite reduced eastern Pacific Ocean upper ocean heat content, and lower than usual sea surface temperatures resulting from a general regional cooling that had been in process since just after the 1982-83 El Niño. The critical point is that all the physical events looked like an El Niño, as did many of the biological observations, but they did not trigger the physicists' definition of El Niños they had monitored during the previous decades of relative warming trends.

The point I am trying to make is not that we did or did not have an El Niño last year but that this controversy occurred because we do not at present have any systematic observing and monitoring system in place to provide the information needed to track such important processes, outside the equatorial region. The studies that are being done, along the California coast and elsewhere, are not being collated and brought to bear on such questions.

If we cannot yet state with any certainty what causes such dramatic events as bird and fish reproductive failures and die-offs, then what is necessary to begin the systematic observations that might allow us to explain such events better, and perhaps even make fewer disruptive, false accusations? The secret lies in putting those small puzzle pieces together.

A Corner of the Big Picture

A hopeful beginning was in evidence at the December 3-7, 1990 American Geophysical Union meetings in San Francisco. An entire day-long session was dedicated to the importance of developing a systematic mechanism for coordinating research programs within the context of the recent developments along the California coastline of several national marine sanctuaries. Ed Ueber, director of the Cordell Bank and Gulf of the Farallones National Marine Sanctuaries, and I co-chaired these sessions in an attempt to inform the many research

and ocean monitoring communities within the central California region of the opportunities that well-coordinated research activities might provide.

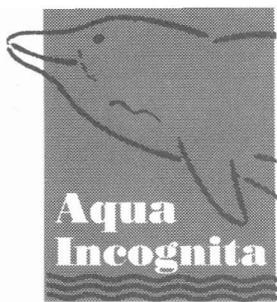
The individual national sanctuary directors are responsible for each sanctuary. They are responsible for maintaining the health and conditions of the living marine resources: birds, fish, and the plants and animals that live in the benthic bottom regime. They have legal domain over most of commercial shipping, recreation, and other activities that occur within these areas. They also have authority to manage scientific activities and their coordination. This is an important opportunity to promote better and more complete research. One of Dr. Ueber's first actions upon taking the position last year was to invite those with programs in the oceanographic, geologic, and biologic topics for the region to open discussions on how to start these interactions.

The AGU session provided the first glimpses of what portends to be a real success story. There were reviews on all aspects of ocean and resources research and monitoring, so that the larger community of interested and responsible institutions might open their ranks and encourage multi-institutional and interdisciplinary collaborations. Both new and tried and true sampling tools and strategies were presented, each useful in promoting better understanding of the complex workings of the atmosphere and ocean physics, and the ecological consequences. It remains only to organize the applications of these tools in a systematic, hierarchic way, so that each provides context for the other. This is not unlike matching up the straight border pieces, and each of the various hues for our picture puzzle.

The facilities, expertise, and geopolitical conditions within the central and southern California sanctuary regions provide unique opportunities to do useful science and collate knowledge in an organized, informative fashion. Ed Ueber and I will continue to work on developing a forum for such collaborations, and we expect to be able to look back each year at new exciting progress as each contributor puts his or her piece of the puzzle into the constantly emerging BIG PICTURE. □

Gary Sharp is a marine biologist, physiological ecologist, and visiting scientist, NOAA Center for Ocean Analysis and Prediction, Monterey, Calif.

According to many professional El Niño watchers, there was no El Niño last year because the temperature did not rise 2°C off the coast of Callao, Peru. The folks who study birds, fishes, and the currents of central and southern California, however, had seen all the symptoms of a classic El Niño: Birds were found starved to death along beaches. Fish were emaciated and in many cases their reproduction failed. A pool of warmer than usual oceanic water moved into various areas off the California coast.



SHOULD THE LAW OF THE SEA GOVERN U.S. FISHERIES?

by Paul Siri

During the past two years, the American public has been witness to vivid images of the brutal efficiency of high seas drift nets, which drown seals, sea lions, dolphins, porpoises, and seabirds as they indiscriminately gill net fish of many species. For environmental organizations, drift net fishing became the newest symbol of careless marine resource exploitation.

One political byproduct of the drift net fishery has been grassroots activism that led to the passage of Proposition 132 last November, banning gill net fishing in nearshore waters off the southern coast. (Nearshore gill netting in northern California had already been prohibited by state resource agencies, in great part because it had been shown to cause high seabird and mammal mortalities.) During the campaign, some groups used high seas drift net images as arguments for coastal gill net closure, although nearshore gill nets are designed to be more species-specific and are arguably less destructive of marine life than the miles-long drift nets used on the high seas.

The case of Proposition 132 is but one example of the increasing complexity of fisheries management issues. With the growth of worldwide interest in both fisheries and marine re-



Courtesy of John Jekabson.

source conservation, pressures on managers have increased at both the local and the international ends of the legal spectrum. Even as the state's voters, by means of Proposition 132, mandated a change in fishing practices off the California coast, new internationally developed legislative concepts were being advanced in the draft Law of the Sea (LOS) agreements, requiring the United States, as a nation, to decide to what degree it will embrace international law and its resultant interpretation within its 200-mile Exclusive Economic Zone (EEZ).

Since the first United Nations Convention on the Law of the Sea in 1958 (called by the United Nations to draft a "constitution for the oceans"), four international agreements have been developed regarding territorial seas, the continental shelf, the high seas, conservation of living resources and fishing. The agreements will come into force as international conventions when 60 nations have ratified them. So far, 45 have done so. Interestingly, no developed nation is among them.

Regardless of whether or not they have ratified the Law of the Sea, most nations recognize most of its provisions. The decision to ratify appears to depend, in large part, on whether a nation sees anything to gain in the

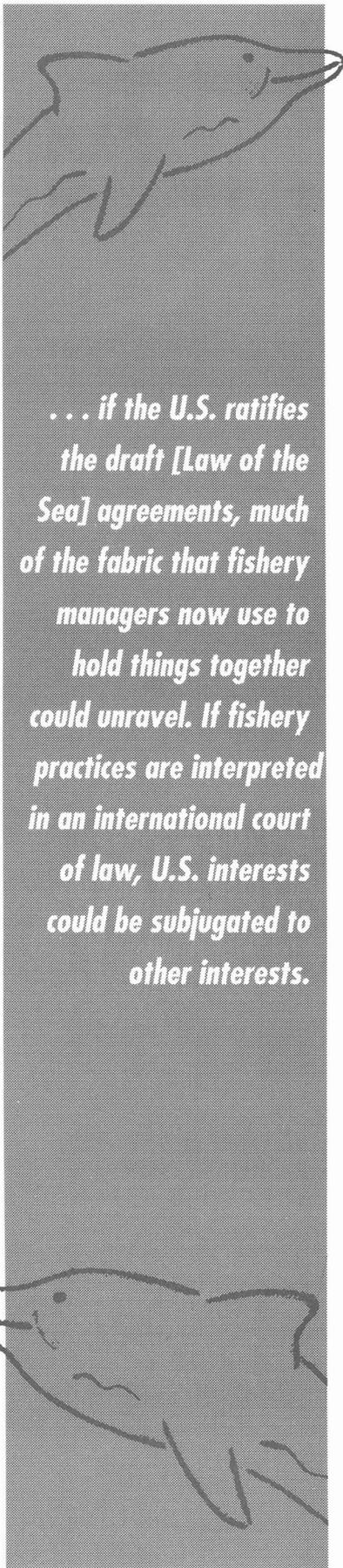
provisions on sea bed mining. The Administration and State Department staff working on these issues hold that the United States is satisfied with ocean management conventions already in place. They believe that most U.S. regulations regarding ocean management, including those concerning fisheries, are consistent with Law of the Sea provisions, except where these concern sea bed mining.

Were the United States to ratify the Law of the Sea, it might subjugate some of its authority over fisheries in the EEZ to international agreements.

More Problems Could Be Spawned

Many fisheries managers believe that such an action would also add, unnecessarily, yet another in a long series of complex statutes that now govern the fisheries, compounding the many difficulties that already exist in managing the enormous size and value of the Exclusive Economic Zone.

At the time President Reagan proclaimed the establishment of the EEZ, in 1983, it was estimated to contain almost one fifth of the planet's edible fisheries. The economic value of these and other fisheries has grown with



... if the U.S. ratifies the draft [Law of the Sea] agreements, much of the fabric that fishery managers now use to hold things together could unravel. If fishery practices are interpreted in an international court of law, U.S. interests could be subjugated to other interests.

increased demand for seafood and increasing exploitation of the resource. According to reliable estimates, nearshore (within three miles) seafood landings on both the east and the west coasts of the United States have dropped significantly since the early 1980s. This decline is mirrored by the world's fishing nations.

Since 1976, fisheries within the EEZ have been governed under the Magnuson Fishery Conservation and Management Act, which at the time of its passage was considered radical because it extended jurisdiction over fisheries from three to 200 miles. In effect, this law made the National Marine Fisheries Service the lead agency for managing the EEZ seven years before the EEZ was proclaimed. It has proved workable for 15 years.

More Work, Less Money

U.S. fisheries managers are mandated to investigate growing fishing pressure on dwindling fishing stocks, and, at the same time, to assess complex biological problems, even while the financial resources allocated for their work are diminishing.

Any sound resource conservation regulation must be based on a reliable measure of the resource it is designed to protect. When considering the oceans as nurseries and harvest areas, this is difficult because the physical and biological processes that sustain living ocean resources are not precisely understood. Even when scientists and fishery managers believe they "know" a species, the assumptions on which they base predictions about various stocks may be negated by environmental perturbations such as El Niño in the oceans, and by impacts of weather and climate changes, such as the current West Coast drought.

Environmental considerations pose difficult problems now for multiple resource agency jurisdictions with overlapping geographical provinces. It is fair to assume that these difficulties will be exacerbated when resource agencies in the United States encounter new interpretations by a larger legal province.

The basic premise that resource managers apply to harvestable stocks is maximum sustainable yield (MSY), and from that, optimum yield. The MSY refers to a stock's consistent catch at a given level of fishing. At best it is a theoretical number based on the best efforts to describe a species abundance over a range of harvesting values (for example, thousands of tons per year). The optimum yield is then

determined. MSY has proved to be a workable tool for U.S. management and conservation.

To date, the National Marine Fisheries Service has had sole responsibility for managing the EEZ fishery resources. Within three miles of the shore, it shares some of that responsibility with state resource agencies. Regional councils appointed by the Fisheries Service and various state authorities establish and oversee management plans for individual species or generic groups of commercially valuable fish. The argument has been made that the regional fisheries plans are cumbersome, their policies are inconsistent from one regional plan to another, and the Service is overburdened, having to deal with many different council interests while its information-gathering ability is shackled by flat or shrinking budgets. But ratifying the LOS would add nothing to this nation's ability to manage fisheries based on the best scientific data we have.

Critics of the LOS also argue that it would open the door to greater access by other nations to our EEZ resources. The United States has nine international fishing agreements with over 50 nations. The Fisheries Service assists the State Department in recommending access to "unused" or "underused" EEZ fisheries. Here is one of the real sticking points. Under the LOS, how would determinations be made about what constitutes reasonable access to "unused" or "underused" fisheries?

An exploration of the long debate among legal scholars about the language in the international body of law represented by the draft Law of the Sea, and an examination of the predicted results of differing interpretations lead to the conclusion that if the U.S. ratifies the draft agreements, much of the fabric that fishery managers now use to hold things together could unravel. If fishery practices are interpreted in an international court of law, U.S. interests could be subjugated to other interests.

Current U.S. policy gives first priority to the domestic fishing industry, next to joint ventures with fishermen from other nations, last to foreign nationals. Lately U.S. fishermen have shown increased interest in joint ventures in fisheries that are not in domestic demand, especially hake (whiting) and some species of rockfish or bottom fish. The Soviet Union, meanwhile, is seeking access to soft-belly rockfish, which is not valued by the U.S. fishing industry. As a result, the National Marine Fisheries Service has the opportunity to develop a pro-active management plan for these

fisheries, taking account of ecological considerations and sustainability of this species in relation to U.S. interests. If an international body, instead of the Fisheries Service, considers these fisheries, U.S. interests would clearly be subjugated to other needs and interests.

Proponents of the Law of the Sea argue that each sovereign nation would retain sufficient rights to exercise a variety of options to exclude or limit other nations' activities within the EEZ. Proposals to the Law of the Sea Convention do not necessarily use conservation as a basis for interpreting use and access. If one country is managing salmon stock in part based on local environmental conditions and another country that harvests those salmon deems they are abundant, then questions of abundance will be discussed in a larger forum that may not be as sympathetic to local management.

This nation's experience with enforcement and compliance over such a geographically large domain as defined by the Magnuson Act (and later the EEZ) has been telling. Fishery managers will testify that most of our enforcement occurs at the point of landing—not on the high seas. Within the 12-mile territorial sea, the United States has not always been effective in policing for fishing violations. With the EEZ the task became even more difficult. A new body of law set in the international arena is not likely to prove any more useful than our practice in the last 15 years.

Recent Policy Changes

Two important changes in fisheries management policies have recently occurred. The first came in November 1990, when President Bush signed an amendment to the Magnuson Act, effective January 1992 for domestic fisheries, to exert fisheries management over all tuna species. These species had been declared exempt from international agreements recognized by the United States, in part because the tuna industry did not want to have coastal states exerting authority over tuna. Now the industry is ailing in the face of foreign competition, which is related to the controversy over incidental catches of dolphins in purse seines. This opens the door to discussions of new agreements that may give the United States access to new tuna fishing grounds.

In the second significant policy shift, the National Oceanic and Atmospheric Administration is tightening the definition of optimum yield. The guidelines will be stricter for all

Troubling Questions About Deep Sea Mining

In 1977, scientists exploring the Galapagos rift west of Ecuador, inside a two-person submersible, were astonished to find life forms nobody knew existed in the deep and dark abyss, where it had been assumed that nothing lived. Along the spreading centers of the sea floor, where the planet's crust is pulling apart, hot water gushed from ocean springs, or hydrothermic vents. Around them, the explorers found big red clams, huge blood-red worms protruding from forests of white tubes, and other strange creatures that shattered assumptions that all life is based on solar energy. The creatures in the abyss were part of a food chain based on an anaerobic process called chemosynthesis.

Hydrothermal vents occur along a geologically active 40,000-mile-long ocean range and rift system that extends across the bottom of the four oceans of the world. As cold sea water penetrates into fractures and percolates downward, it reacts with hot crustal rocks, heats, and leaches sulfur and heavy metals, including

manganese, copper, zinc, silver, and cadmium.

While the discovery of the amazing life forms caused a revolution in marine science, the discovery of the sea bed minerals caught the attention of those interested in deep sea mining. It added to the controversy about mineral exploitation of the deep abyssal plains, which had focused primarily on manganese nodules—chunks of iron, manganese, and other minerals—including nickel, cobalt, and copper—that are precipitated from sea water in the deep plains.

Disagreement over who shall benefit from mining the abyssal plains, which under the Law of the Sea are the "common heritage of mankind," led the United States and other nations to refuse to sign the Law of the Sea Treaty. Now an additional question has been raised: How can humanity get access to the minerals and at the same time protect the ocean environment, which we once again have discovered to be far richer and more diverse than we had first believed? *Mark Whetley*

species, both for U.S. fisheries and for those of other countries looking for access to "underused" fisheries in the U.S. EEZ.

As this country focuses more attention on the fisheries resources of the EEZ, it is clear from both the U.S. electorate's increasing interest in conservation and the U.S. government's interest in protecting our ocean resources that our fishery management policies will continue to be grounded in issues of resource protection. To uphold the vision that conservation maintains the resource and fisheries, the United States must take care not to become enmeshed in any international agreements that might place harvest goals before long-term sustenance of the resource. □

Paul Siri is assistant director of the University of California's Bodega Marine Laboratory.

From Other Shores

BELIZE

The Eighth Wonder of the World

by Liza Riddle

Belize . . . a vaguely familiar name, but hard to place. British Honduras until it gained independence in 1981, Belize is only slightly larger than Massachusetts, never wider than 75 miles, just south of Mexico's Yucatán Peninsula, and borders Guatemala on the west and south. Its 180-mile-long coastline is fringed by what the Belizeans claim is the eighth wonder of the world—the Belize Barrier Reef—the second largest structure built by living organisms on earth after Australia's 1,200-mile Great Barrier Reef.

This relatively pristine 200-mile-long reef, a country rich in natural and cultural resources, a peaceful democracy in a region wracked by turmoil, combined with the charm and diversity of the

Belizean people—Creoles, Mayans, Black Caribs, Mestizos, East Indians, Chinese, Lebanese, and Mennonites—are factors certain to place Belize prominently in the minds of those

seeking new adventures.

The Belizean government is keenly aware of both the benefits and potential pitfalls of embracing tourism with open arms, and instead is promoting what has come to be termed ecotourism: a tourist industry that does not damage natural resources and provides income to local inhabitants who depend on those resources.

The government has launched a multidisciplinary effort to plan for the development and protection of its coast and reefs. Three ministries—fisheries,

natural resources, and tourism—are working with the Belize Audubon Society to develop a coastal management plan by 1992. Audubon is the most active conservation organization in Belize and has a long track record of establishing and managing resources. Audubon's president, Janet Gibson, describes the organization's role in the coastal planning effort as increasing public awareness, building a conservation ethic, and developing trust in the final plan.

Though the government supports the concept of conservation (Permanent Secretary Victor Gonzalez points to the establishment of nearly 200,000 acres of protected forestland in the last year: 102,000 acres for the Cockscomb Basin Wildlife Sanctuary and 92,000 acres for

Bladen Nature Reserve), it can be a difficult concept to sell to locals dependent on exploiting those same resources.

Gonzalez says the "key concept" in the

government's plan is that "there must be an economic return to the native people who rely on resources for their livelihood." This goal is yet to be translated into specific policies, however. Development and the tourist industry are still largely unregulated. The best the government can do is to encourage the mostly foreign-owned and operated resorts and dive boats to use Belizeans in their operations, to buy fish and supplies from local people, and to explain the need to protect natural resources to visitors.

Belize's efforts are in a race with development, which is occurring at an alarming rate, even on the reef, threatening to destroy the very natural treasures that attract visitors here. The sandy islands or cayes (pronounced "keys" in Belize) where the reef breaks the surface, if they are large enough, are already sites for rather lavish resorts. Ambergris Caye, at 25 miles long the largest caye, has daily air and boat service, roads, and 25 hotels—most with diving and fishing facilities. Other, much smaller cayes, including Caye Caulker, Caye Chapel, St. Georges Caye, Turneffe Islands, and Glover's Reef, all have tourist developments. New facilities, mostly unregulated, continue to be built. "Without proper guidelines, we run the risk of ruining what we have that attracts people to Belize," warns Janet Gibson. Her concerns include the obvious physical effects of dredging, filling, and damage from anchors, and the more insidious effects of increased nutrient levels from the tourist population explosion on the cayes. According to the Caribbean Tourist Organization, there was a 34 percent increase in tourists here between 1988 and 1989.

As one of these tourists, I recently had the opportunity to glimpse the wondrous living landscape on and around the reef while spending seven days on a 100-foot dive boat. The captain and dive master were American, the three-man crew was Belizean, and the 16 passengers were from the United States. We motored about 50 miles east of Belize City to Lighthouse Reef, which is named for the solar-powered lighthouse that stands as lone sentry on Half Moon Caye. Shipwrecks on this section of the barrier reef are all too common.

Half Moon Caye is a 45-acre island created by incessant waves depositing coral fragments, shells, and other debris on the reef top. The guano from thou-



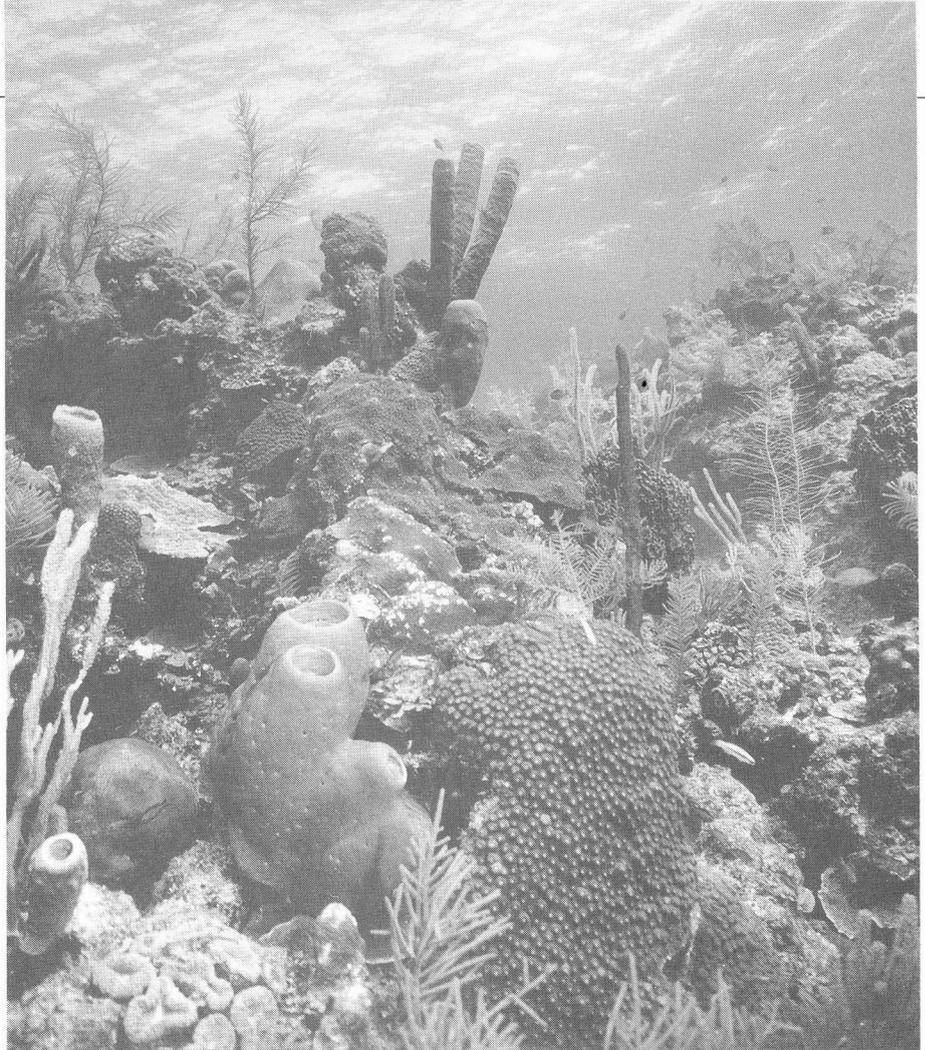
Brain coral.

sands of seabirds that have nested here for centuries has enriched the otherwise barren cay. The Belizean government designated Half Moon Caye as the first marine conservation area in Belize, to protect the surrounding reef and the more than 4,000 nesting Red-footed boobies—found only here and on an island near Tobago—in a rare white color phase. The island is managed by Belize Audubon Society.

Like all large boats visiting the island, we were required to anchor in the sandy-floored lagoon on the leeward side of the island to protect the living reef.

Anchored in shallow water, we gazed at an idyllic tropical island. The shallow waters over a sandy bottom near the cayes were a light, effervescent green. The deeper waters over the limestone reefs—crystal clear even at depths of 100 feet—were a deeper, moody, and mysterious blue. Beneath the surface, the mysterious is inhabited by the inexplicable: plants that look like animals, animals that look like plants, animals and plants together as one, and each in every imaginable color. At the Belize Barrier Reef I was particularly struck by the endless variety of sponges—animals, not plants—that pull huge volumes of water through small pores, filter out plankton (microscopic plants and animals), and force the water out through large exhaust holes. There are ten-inch-high smooth yellow tube sponges, delicate iridescent blue vase sponges, giant coarsely textured beer-barrel-like sponges, each with a three-foot-diameter mouth; brilliant red boring sponges with volcano-like exhaust openings, and every other conceivable shape—fingers, softballs, trees, pillows, and cakes.

With each dive, new and stranger creatures revealed themselves, all living within, on, and supported by the coral reef—yet another strange creature. Corals, thought by Darwin and other



Photos: Liza Riddle, Mark Goudy

early explorers to be plants—as recently as the 1800s—are actually animals, with plants living within their skeletal structure. During daylight hours, the plant companions (called zooxanthellae, “yellow pigmented animals,” now classified as plants) convert solar energy to oxygen, removing the carbon dioxide from surrounding water and neutralizing acidic water that would otherwise destroy the coral’s limestone skeleton. In return, at night when the coral actively snares and feeds on its microscopic prey, it secretes a nitrogen-rich fertilizer for its plant companions. Only corals with plant companions can form hard skeletons.

Belize’s efforts to conserve the reef have not gone unnoticed. International conservation organizations, including World Wildlife Fund, Wildlife Conservation International, and the International Union of Conservation of Nature, as well as the MacArthur Foundation, have provided funding and technical assistance to Belize. In July 1991, the Carib-

bean Tourism Organization and the Belize government are cosponsoring an international conference on ecotourism (see box). Belize could be a model for other developing countries if it strikes a balance between tourism and protection of its rich natural resources, before development overtakes its promising efforts. The challenge to Belize is to protect this reef, truly one of the world’s living wonders. □

Liza Riddle is manager of the Coastal Conservancy’s resource enhancement program.

A conference on “Ecotourism—Its Development and Management in the Wider Caribbean,” will be held July 9-12, 1991, in Belize City, sponsored by the Caribbean Tourist Organization and Belize Ministry of Tourism and Environment. For information, write to Vera Anne Brereton, Caribbean Tourism Organization, Marine Garden, Christ Church, Barbados. A follow-up conference is tentatively scheduled for November 27-December 6, 1991. Write to Victor Gonzalez, Ministry of Tourism and Environment, Belmopan, Belize.

From Other Shores

GULF OF MEXICO

National Sacrifice Ground

by Wesley Marx

In the inshore waters of the Gulf of Mexico, commercial fishermen catch shrimp, menhaden, red snapper. The shallow sea bed is crisscrossed by pipelines carrying oil and gas from 12,000 offshore wells to the nation's largest refineries onshore. These pipelines are supposed to be buried so vessel hulls will not rupture them.

In 1987 a vessel fishing off the Louisiana coast ignited in a fireball, incinerating two crew members. It had collided with an exposed pressurized gas pipeline. In 1989, off Sabine Pass, Texas, another pipeline collision shattered a fishing boat, killing 11 of the crew.

In 1990 the federal agency that regulates pipelines, the Department of Transportation, alerted the 30,000 operators of gulf fishing vessels that "exposed pipelines pose a threat to the safety of crews of fishing vessels in shallow coastal waters . . ."

Why can't fishermen count on regulators to protect them from being blown up at sea by pipelines that are supposed to be buried? The regulations governing pipelines had failed to anticipate erosion, which is more rapid on the gulf coast than anywhere else in the nation. The pipeline in the 1987 incident was buried onshore in 1968. It now lies uncovered in waters a mile away from the receding Louisiana coast.

The transformation of buried pipelines into deadly underwater minefields is only the latest in a series of environmental backlashes to overtake the gulf region. While other stressed coastal regions, such as Puget Sound, Chesapeake Bay, and San Francisco Bay, have made some progress in reversing degradation, the gulf region continues to

reel from the nation's worst extremes in marine pollution, habitat loss, and worker hazards. Some examples:

- Almost 60 percent of the region's shellfish growing areas are permanently or periodically closed. They are too polluted to support safe oyster harvests.
- Up to 3,000 square miles of bottom waters off Louisiana and Texas are a "dead zone" to scientists because oxygen levels are so low.
- Louisiana loses 30 to 60 square miles a year to coastal erosion.
- The Texas shore absorbs up to six tons per mile per year of trash—tops in the nation.

Some coastal problems are beyond state or local control. Take the case of the trashed Texas shoreline. Much of the trash that makes sections of Padre Island National Seashore resemble an industrial junkyard comes from offshore sources: tankers, merchant ships, fishing vessels, and marine oil activities—almost all beyond state control.

Texas state officials and environmental groups appealed to Congress, which in 1988 finally ratified Annex 5 of MARPOL that bans disposal of plastic trash at sea. The oil industry is also trying to teach its marine crews not to

dump at sea. However, 30-mile-long drift lines of floating trash continue to wash up; passing a trash ban is much easier than catching dumpers in the act.

At the request of the United States, the International Maritime Organization last November set in motion a procedure that could lead to the designation of the Gulf of Mexico as a closed sea. This designa-

tion would outlaw any marine dumping in the gulf, as it has in the Baltic and Mediterranean seas. The proposed ban would extend to the Caribbean. Nations including Mexico and Cuba don't want to get the trash instead.

The Widening Dead Zone

Dealing with marine debris is a piece of cake, though, compared with other marine pollution challenges. To clean up sewage discharges and storm runoff that pollute 3.4 million acres of shellfish beds will require billions of dollars in local and state funds at a time when such funds are scarce. To revive the offshore dead zone may require the cooperation of the entire Mississippi drainage area. Laden with upriver sewage and farm runoff, the big river dumps nutrient-rich, oxygen-depleting waters into the gulf.

Can the problems get any more formidable? Try habitat loss. Levees that protect low-land development from river floods also greatly accelerate erosion; they block the overflows that once delivered an average 300 million tons per year of life-giving silt to form the marshy

delta plain. Gates can be installed in the levees to restore silt flows, but some coastal residents are opposed, fearing they might have to move away from revived flood ways.

Oil company canals slice and dice remain-

ing wetlands, permitting more salt water to intrude, thus killing more sweetwater marshes and cypress forests. Abandoned canals can be filled in or gated to resist salt intrusion, but construction of new oil canals has offset these gains. The land that erodes also sinks as oil pumping reduces underground pressures. Sinking delta communities raise more levees and

The more shellfish and fin fish habitat is lost, the more dependent the region becomes on oil industry paychecks and taxes.

dike off more wetlands as a short-term defense against the advancing gulf.

The destructive cycle accelerates. The very activities that degrade the coastal environment are seen as critical to the economic survival of coastal Louisiana. The more shellfish and fin fish habitat is lost, the more dependent does the region become on oil industry paychecks and taxes. Economic and social pressures grow against environmental protection.

Any Solutions?

Since 1986, the Coalition to Restore Coastal Louisiana, composed of over 100 organizations that range from Catholic Social Services to the League of Women Voters, has worked hard to make citizens aware of the need to treat the land they live on better. In 1989 voters approved creation of a state coastal restoration fund, funded by oil and gas revenues. More pilot projects to restore wetlands are underway to determine if the awesome erosion rate can be slowed down, if not eventually reversed. Some experienced observers are not very hopeful. "We're going to lose south Louisiana. We're only going to be able to hold on to a few museums of marsh," predicts Dr. Oliver Houck, a Tulane University law professor and conservationist. Plaquemines Parish, south of New Orleans, could be under water within 50 years, even without a hurricane, according to wetland scientist Sherwood Gagliano.

Some residents blame their environmental woes on other coastal states. "We have become a national sacrifice area because you guys in California don't want to sully your seascapes with oil rigs," a drug store owner told me.

The Environmental Protection Agency has formed the Gulf of Mexico Program (GMP) to help coordinate and strengthen federal and state conservation efforts. Backed by citizen and technical advisory



Exposed pressurized oil and gas pipes are hazardous to fishermen. Photo: Wesley Marx

boards, GMP will recommend policy actions for consideration by all levels of government. Will GMP be more successful than the environmental groups and scientists who have been calling for reforms for over two decades? To do so, GMP must galvanize public support from mainstream citizens whose economic well-being remains tied to activities that continue to degrade wetlands and coastal waters. Over 90 percent of the fish stocks caught in the gulf spend part of their life cycle in estuarine and delta shallows—the very areas most under development pressures. Will the federal government back up friendly advice with funds to help reverse the region's plight? Federal agencies have sponsored the flood control and navigation projects that subvert the coastal plain. The U.S. Treasury has received over \$56 billion from gulf marine oil leasing since 1956.

However, the gulf's harsh environmental squeeze is also victimizing the U.S. taxpayer. The advancing gulf intensifies flood and hurricane exposure; Louisiana is now a leading recipient of federal disaster aid, year after year. It leads all states in the number of repeat flood claims made to the National Flood Insurance Fund.

The United States can continue to issue calamity checks to cover the drowning of coastal Louisiana—or consider other options. In 1990, Congress approved a bill, sponsored by Louisiana Senator John Breaux, provid-

ing federal funds for more wetland restoration. Stronger controls on hazard-prone development are also being advocated. Geologist Dag Nummedal of Louisiana State University observes, "We should start discouraging development in the low lands. We cannot afford to lose New Orleans, but we don't want to create other potential traps like it." The Federal Emergency Management Agency (FEMA) could require that such a policy be adopted as a condition of further disaster aid for Louisiana. This might be considered undue federal intervention in one state's affairs, but the time for easy, cheap solutions to the gulf's problems has come and gone. If the gulf advance continues, FEMA could be picking up the tab to relocate entire delta communities. In California, the sinking Sacramento-San Joaquin Delta has required considerable federal funds (*Coast & Ocean*, Fall 1989).

Meanwhile, oil rigs march further into the gulf, canals cut into more wetlands, and fishermen ponder the alert issued by the Department of Transportation. One day, a visitor from the United Kingdom checked into a motel in Houma, Louisiana. The motel clerk wondered what had attracted the visitor. "He was studying global climate change and possible impacts from rising sea levels," the clerk told me. "He said Louisiana was the best place in the world to preview this." □

Wesley Marx is author of The Frail Ocean; The Oceans: Our Last Resource; and Acts of God, Acts of Man.

CrossCurrents



Reflections off Prince William Sound

by Molly Freeman

Molly Freeman, daughter of a commercial fisherman and a student at Brown University, worked as a field research assistant for the North Gulf Oceanic Society last summer at a whale research camp in Prince William Sound, near her home in Homer, Alaska. Then she sailed across the Atlantic as part of her studies at the Sea Education Association in Woods Hole, Massachusetts. "I believe that everything essential to an education in the marine environment—and in anything else, really—emerges from that place and moment at which each thing seen newly forms and captivates the memory," she wrote, explaining why she has chosen the ocean as her university classroom. Many educators would agree. Moments such as those she describes in these journal excerpts imprint essential perceptions about our place in nature.

21 June 1990, *The Longest Day—Prince William Sound*

Finally there is so much sunshine. We swam today because I wanted to go down and float in all that deep water; to feel the place where salmon fin the rips, where halibut waver over the rocky bottom. There is bull kelp with fronds like a woman's hair that flows back, dragging down the current. I don't know how to dive, I think, as I take off my boots, pull at my socks, run barelegged over glossy black rock to a waterfall to fill our bucket with fresh water for rinsing. Standing on the dark rocks, I imagine this dive. I want an inner tube body like a whale's. With my arms outstretched I push off with my feet from the barnacled groove in the stone. The water takes my legs first, swallows me, and ripples against my body. It brings me down to where a jellyfish pulses above bubbles of kelp. I surface and float. My skin and breath return with the sudden cold.

27 June

I am learning the beach. The sun is a

flame flying down the stones of the island, all the cobbles go dark past midnight. Sometimes, when with the whales, we smell a humpback's breath. They blow a great wet plume smelling of wet skin, seaweed, fish, and salt. Yesterday I watched one breach, five times, coming completely out of the water upside down. Today we must have seen 20 humpbacks, and listened to their vocalizations with a hydrophone. They sang scales! At times they swam directly underneath the skiff.

We are not presently working in an area where we could survey the specific bays and islands most heavily devastated by the oil spill—a huge percentage of which isn't even in Prince William Sound, but on Alaska's Gulf Coast—but its effects seem to surround us. Where does the residual oily-like sludge we saw yesterday in the Southern Passage come from? On islands and bays close by, crews are spraying beaches with a toxic material that contains bacteria, which Exxon claims might "eat" the tar-like residues. To prevent animals from roaming in these poisonous areas—they

Mammal-hunting killer whales of Prince William Sound feed on Dall's porpoise and harbor seals. This whale has just bounced a porpoise off his nose, to stun him. Photo by Eva Saulitis.

look as though they have been covered with asphalt—crews tie huge, brilliantly red metallic balloons, such as you might see at a carnival but with frowns painted on them, to small stones and pieces of wood on the beaches. This is so absurd as to verge on the cynical. Many of the balloons float away, of course, and we pick them up on the water and haul them back to shore.

The other day, swimming off the beach at our field camp, and running barefoot across the stones, we found small areas sprayed with crude. Often we see Exxon cleanup crews' boats anchored in critical whale feeding areas for days, seemingly without purpose, but controlling several marine radio channels. We watch their planes hover above and their small boats harass whales at close range, causing these whales to dive. For weeks a beach cleanup crew with backhoes, fire hoses, and several boats has been overturning and digging up a beach in the Southern Passage. This is a beach and bay with a salmon spawning stream. I am concerned that the Sound is not protected in any way, and that the random and negligent beach cleanup efforts are destroying more than just one critical salmon spawning stream. They are not being monitored by the Alaska Department of Environmental Conservation and are as destructive as the spill itself.

25 July

Last night, after following killer whales for two hours, north of camp, I felt so good. They are difficult to photograph and must have been swimming at least 15 miles an hour. Our skiff followed them through the rising wind. And when we returned to the tent, with all its good and infusing heat, rain was bursting on the tarp overhead. To be on the ocean edge, listening to and following the tide

as it passes in and out over the beach, is everything complete.

4 August

Last night, the wind gusted 45 miles an hour, shaking everything, laying down the plants above the beach, dropping great torrents of water everywhere, as I see when I walk out on the beach in early morning. There is a core group of the same humpback whales we have seen feeding in the same area every day. This rain comes down forever.

8 August

I discovered a place, on the northernmost island in the center of the Southern Passage, where I could see in every direction for miles and miles. I sat on this exposed and windy compass point and looked north onto mountains, east and west onto islands and passages and channels and narrows. From this windy place, I felt like a seabird watching a world. I saw green-ridged islands of trees rising. I saw every bone shard, feather, seed, plant, and color of grass on the dark ground. And I could also look far down into the rushing clear cold water. Sitting there, I felt that it might have been possible to see the currents traveling clearly and smoothly down these deep ocean passages.

Postscript

Alaskan coastal waters have been the center of my life experience: ocean close to land, alive, cold, and green, extending all the way around the world. Six months later I sensed their fragility in a new way as I studied the distribution of plastic across the Atlantic. We saw no floating cups or bottles, but each time we pulled up a water sample it was there, in tiny pieces everywhere, floating on the surface of living realms we are only beginning to know. □

Were they oiled?

Killer Whales Reported Missing

In the summer after the *Exxon Valdez* oil spill in March 1989, seven killer whales were missing from the pod of 35 or 36 that regularly visits Prince William Sound to feed on herring and salmon. Several more disappeared the following year. Killer whales are known to stay with their pods. Scientists believe that when they die they sink. Therefore it is assumed that the missing whales died. "The usual mortality is less than one percent per year," said

"This is the most friendly pod in the Sound."

marine biologist Eva Saulitis. "The year after the spill it was about 19 percent."

"This is the most friendly pod in the Sound, approachable and easily observed," said Saulitis, who has been watching the whales as part of a study by the National Marine Fisheries Service. Some years earlier, this same pod had come into conflict with long line fishermen by taking fish off their lines. Between 1984 and 1986, several were photographed with bullet wounds and seven vanished. Scientists conducted an education campaign among fisherman and no unusual disappearances were observed in the ensuing two years. In fact, the pod had enough calves to bring its size back to what it was before the shootings, said Saulitis. In the spring and summer after the oil spill there was no long line fishing in the Sound and therefore no interaction between whales and fishermen. Saulitis said she had seen whales swimming in the oil after the spill, but that no firm causal relationship had been established with the oil spill.

In other resident whale pods, which visit the Sound less frequently, she said "no astounding mortality" had been observed. □

Letters

Tree Planting

Editor:

We do not understand how Mr. Jacob Sigg determined the premise of *The Simple Act of Planting A Tree* to be advocating "indiscriminate planting of large numbers of trees" in his review of TreePeople's newly published book in the fall issue of *Coast & Ocean*. Individual action and responsibility is the book's single most important premise. We never advocated tree planting as a substitute for other forms of environmental protection. On the contrary, community tree planting lays the groundwork for much greater understanding and commitment to improving other aspects of the environment.

Andy and Katie Lipkis

Andy and Katie Lipkis are the authors of The Simple Act of Planting a Tree.

Jacob Sigg replies:

My main criticism—that massive tree planting schemes are a one-dimensional, inappropriate, and probably self-destructive response—was not addressed in this rebuttal, an admission of its justness. In their comment on the book, *Whole Earth Review* observed, "It may be that the unintended consequence is our civilization's most lasting invention."

Exhortations from TreePeople regarding the lesser point of taking care of the planted trees will not reverse the rapid decline of maintenance. The average life span of an urban tree is eight years. And yes, planting 1 million trees for the Olympics is indiscriminate.

Open Space

Editor:

"Local Land Trusts as Farm Protection" (Fall 1990), provides useful information on the role of land trusts in protecting agricultural land. Unfortunately, it badly misrepresents the role of regulation in making land trusts effective.

In Marin County, the difficult action of the Board of Supervisors in 1972 and its subsequent unwillingness to waver from its regulatory resolve saved farmland, not the Marin Agricultural Land Trust. MALT is a superb institution, but it is primarily the tough general plan and zoning that have made Marin's dairyland secure.

As in the relationship between the Coastal Commission and the Coastal Conservancy, it is only when regulation plays the "hard cop" that acquisition groups, which by their nature shun conflict, can play productive roles. It is appalling to see this fact glossed over in Dick Wayman's article.

Also troubling is Wayman's comment that planning has only "slowed down" development and the real need is to devise compensation strategies. Long-standing general plans and voter-approved ballot measures give many hundreds of thousands of acres in just the Bay Area very high levels of regulatory protection. To suggest that land trusts, which together in the Bay Area have acquired far less than 30,000 acres of farmland in 20 years (at no small cost), should be looked to for protection of the 2 million acres of the region's farmland (to say nothing of California's tens of millions) is not very useful.

Land trusts are extremely important in conserving natural resources. But their work should be seen in the context of the fundamental role of planning and regulation. It would be useful to see *Coast & Ocean* explore this issue more.

Larry Orman

Larry Orman is executive director of Greenbelt Alliance.

Dick Wayman replies:

I did not write the article to diminish the role of regulation in protecting agricultural land, but to endorse the efforts and highlight the accomplishments of

private land trusts. As for compensation strategies, their effectiveness has been demonstrated repeatedly. For example, California's Williamson Act, which compensates farmers by reducing their taxes, is the most successful tool employed statewide to prevent the conversion of farmland to other uses.

Student-run Hatchery

Editor:

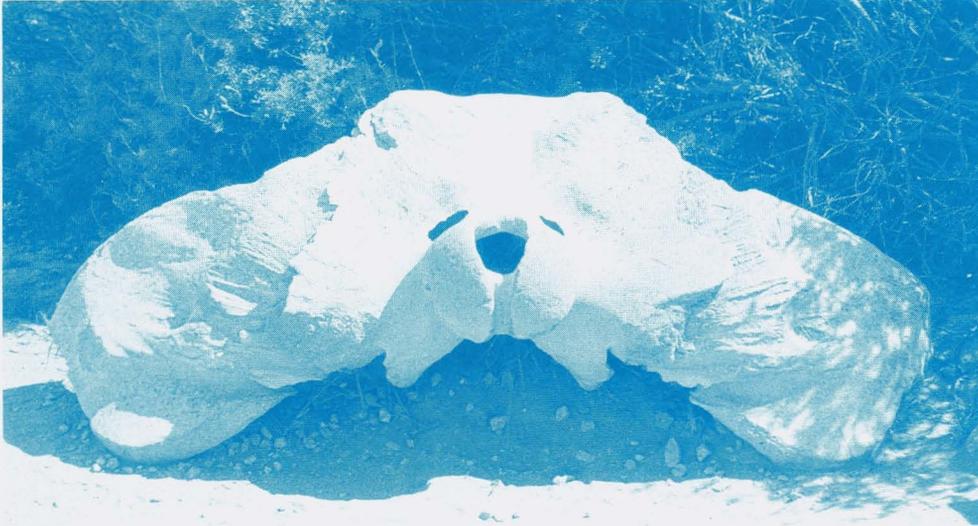
I think the program at Petaluma High School (Fall 1990) is wonderful. However, you might investigate another student-run hatchery at Chimacum High School in Washington state.

Andrea Fontenot

C&O replies:

The first student-run hatchery in the contiguous United States is alive and well at Chimacum High School on the Olympic Peninsula, making the one in Petaluma's Adobe High School number two—our error. Since 1970, about 300 students have helped raise some 100,000 coho fingerlings a year and released them into Chimacum Creek. The creek runs through the middle of the campus and flows well all year, instructor Ron Lowrie says.

In recent years only a handful of salmon have returned to the creek to spawn. Now students are also building traps to learn whether their fingerlings are getting out to sea. Lowrie said his program, funded by the school district's vocational education fund, trains students for jobs in fishing, stream restoration, or hatcheries. Some students are restoring 300 feet of damaged spawning channel on a Chimacum Creek tributary. Lowrie says they have compiled some of the oldest baseline data available on small streams, which they lend to interested parties. Contact Ray Lowrie at (206) 732-4481 for information. □



REGINA MCGRATH

Mystery Photo

What's this? Someone's lost propeller? Identify it and win a free subscription to *Coast & Ocean*. Extra credit given if you can tell us the location of this mysterious object.

Last issue's mystery solved:

Three of our readers correctly identified our last mystery photo as a stack of real estate "for sale" signs on Tomales Bay. The exact location: Millerton Point. Congratulations to Bill Kent and Anne and John West.



JOHN MACCIUKA

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