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U.S. Marine Sanctuaries

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COVER: The *M/V Wellwood* hard aground on Molasses Reef in the Key Largo National Marine Sanctuary in early August 1984. The undamaged elkhorn coral, *Acropora palmata*, in the foreground survived both the grounding and the salvage. (Photo by William J. Harrigan)

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Chairman, Subcommittee on Oceanography, U.S. House of Representatives

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January 15, 1988

To the Editor:

It is timely that *Oceanus* examines the National Marine Sanctuary Program. This year the Congress must reauthorize the Marine Sanctuaries Act, look closely at the record of the program, consider how we might improve its performance, and decide how much money we should spend on sanctuaries. This issue of *Oceanus* devoted to the U.S. Marine Sanctuary Program makes our task considerably easier.

The major goal of the Sanctuary Program is to preserve and protect significant ocean resources. In the seven sanctuaries that have been established since 1975, these resources include threatened marine mammals and seabirds offshore California, unique coral reefs and related resources near the shores of Georgia, Florida, and American Samoa, and the site of the historic shipwreck, the *U.S.S. Monitor*, off the North Carolina coast.

These natural and cultural resources are well-protected by the program. Regulations have been issued restricting harmful activities. Management plans have been written that encourage multiple uses of sanctuary resources that are compatible with preservation and good management, and foster research, interpretive activities, and public involvement. When prohibited acts have occurred, enforcement actions have been taken. The *Wellwood* incident, described in this issue, which involved a vessel grounding in the Key Largo National Marine Sanctuary that substantially damaged the coral reef, is a good example of the kind of enforcement needed to protect valuable marine resources.

But there are important issues regarding the management of the Sanctuary Program that need attention. For example, the Marine Sanctuaries Act was extensively amended in 1984. Yet, with one exception—Fagatele Bay in American Samoa—no new sanctuary has been designated since 1984. Two candidate sites, Cordell Banks offshore northern California and the Flower Garden Banks in the northwestern Gulf of Mexico, have been under review for many years (in the case of Flower Garden Banks, for more than 10 years). I and many of my colleagues on the House Committee on Merchant Marine and Fisheries are concerned by this apparent lack of progress in completing the designation of these two sites.

In 1983, the National Oceanic and Atmospheric Administration (NOAA) identified 32 sites in the Atlantic and Pacific oceans, the Gulf of Mexico, and the Great Lakes that warranted further consideration for sanctuary designation. The oversight and reauthorization hearing I shall chair on 30 March 1988 will consider why so few sites on this list have been proposed for sanctuary status. This hearing will also examine whether the complex sanctuary designation process created by the 1984 amendments requires simplification, and whether there is a need to legislatively

designate new sanctuaries to protect significant ocean and coastal resources. We will also look at legislation introduced by my colleague Representative Gerry E. Studds (D-Mass.) that would allow the Sanctuary Program to use funds received from penalties and resource damage awards for program purposes. Finally, we shall consider whether the Sanctuary Program should have authority similar to that of the National Park Service to enter into contracts to provide services that are supportive of and compatible to the goals of the Program.

I believe strongly in marine resource management and protection. The Sanctuary Program has already proven its potential as an effective ocean management tool in the seven existing national marine sanctuaries. There are, however, many other ocean areas that need protection and good management under the Marine Sanctuaries Act. By focusing our attention once again on the difficult issues involved in managing marine resources, *Oceanus* has performed an essential service. I encourage its readers to ponder these matters carefully, and I welcome your comments and recommendations during our review of the National Marine Sanctuary Program.

Sincerely,

A handwritten signature in black ink that reads "Mike Lowry". The signature is written in a cursive, flowing style with a long, sweeping tail on the "y".

Mike Lowry
Chairman,
Subcommittee on Oceanography
U.S. House of Representatives
Committee on Merchant Marine and Fisheries
Washington, D.C.



AÑO NUEVO INTERPRETIVE ASSOCIATION



A volunteer nature guide describes the habits of the northern elephant seal to school children in the Año Nuevo State Reserve, south of San Francisco, California. Education and habitat protection are also goals in national marine sanctuaries. (Photo by James Milton)

Introduction:

The National Marine Sanctuary Program— *Policy, Education, and Research*

by Nancy M. Foster, and Jack H. Archer

The National Marine Sanctuary Program is 15 years old. Its origins lie in the aroused environmental concern of the late 1960s and early 1970s, when federal programs were created to clean up our streams and rivers, protect air and water quality, and manage coastal resources. For years, great quantities of toxic wastes and dredge spoil had been dumped into the oceans, with largely unknown effects. Fishermen were fishing more and catching less. Offshore oil development had quickened dramatically in response to Arab oil embargoes and the “energy crisis.” A 1969 blowout on a drilling rig in the Santa Barbara Channel spilled more oil in nearshore Pacific waters than ever before or since in U.S. history, threatening California beaches and major marine mammal and seabird habitats. A series of tanker spills around the world, and widely-televised scenes of oil fouling the coasts and killing birds and mammals added to the national concern.

Sanctuaries Act Becomes Law

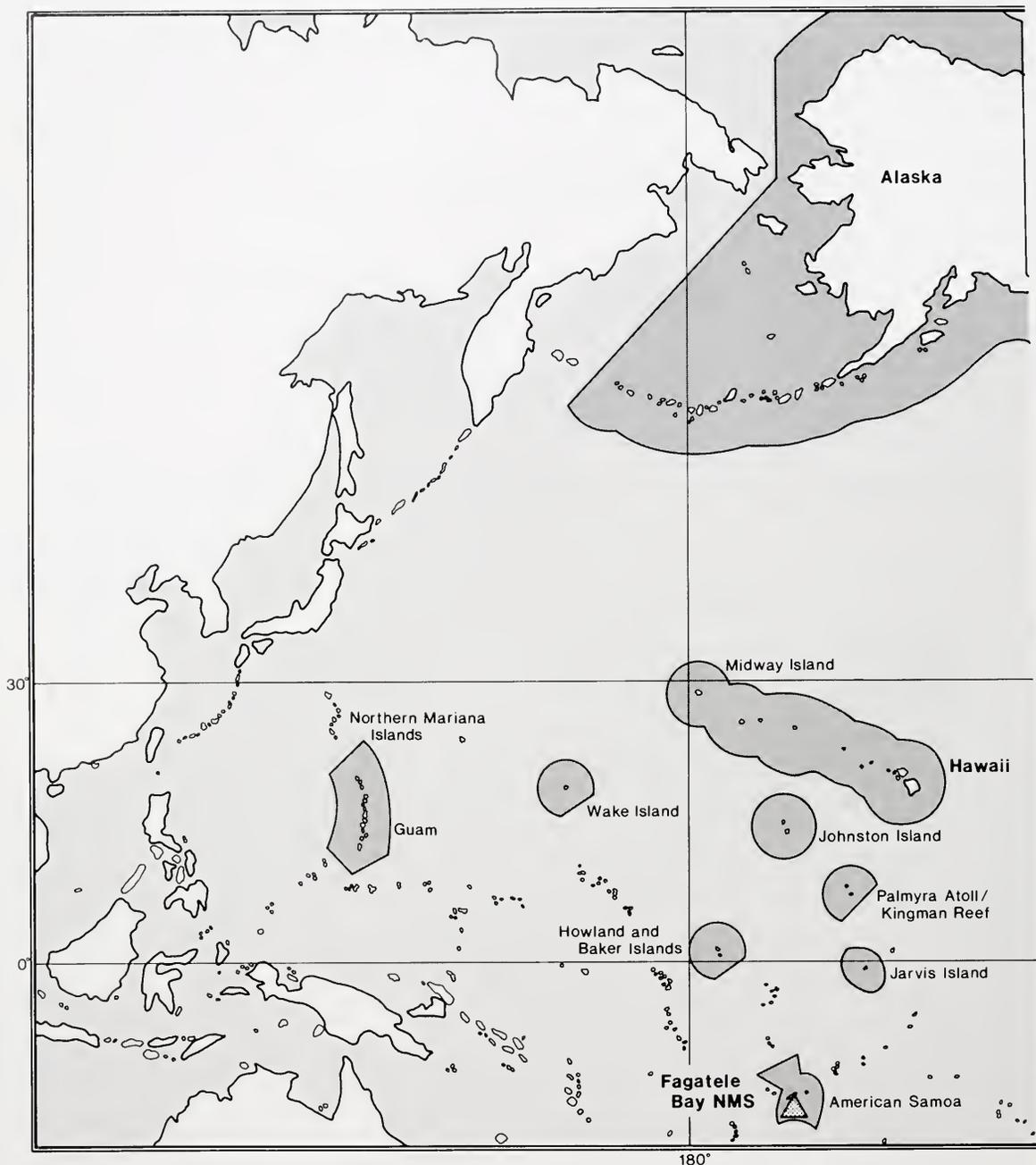
Such events helped focus national attention on protecting ocean and coastal resources from the potentially devastating effects of human activities. At the same time, as an environmental consciousness was being

raised, concerned citizens (and scientists) were learning more about ocean resources and the complex relationships between them. If action was not taken soon to protect marine areas and resources, they could be injured or eliminated as a result of the increasing use and exploitation of ocean resources.

In 1972, riding the crest of the environmental movement, Congress passed the Marine Sanctuaries Act to preserve ocean areas and resources from such threats. Under this law, the Secretary of Commerce may designate ocean and coastal waters, and areas of the Great Lakes, as National Marine Sanctuaries. Aside from protecting natural resources, such as fish, mammals, seabirds, and coral reefs, historic and cultural resources, such as shipwrecks, also could be included. The Marine Sanctuaries Act provides the only opportunity under U.S. law to designate and manage discrete, offshore areas as ecosystems—as opposed to managing individual resources, such as mammals or fish, under several different laws.

Conflicts and Solutions

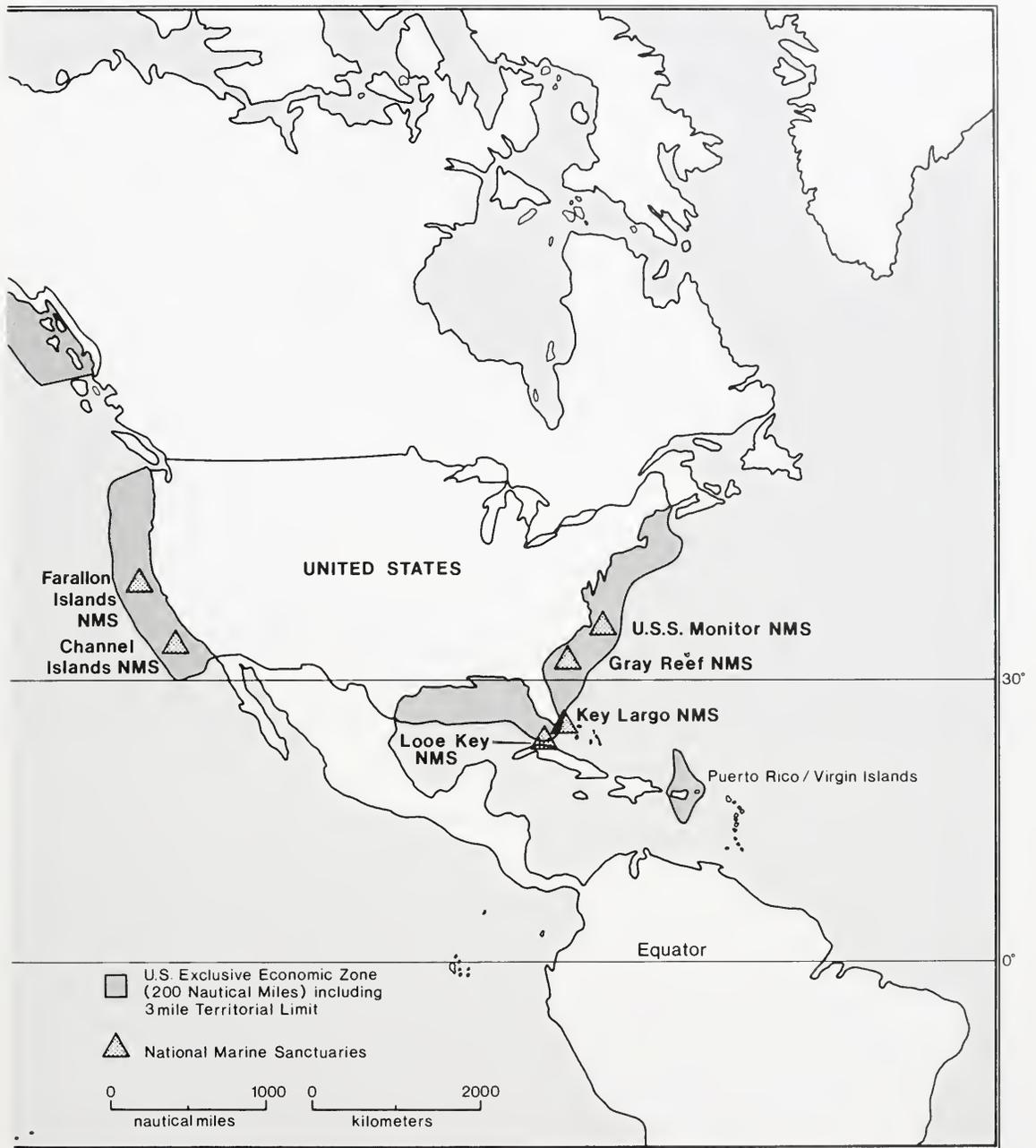
The goal of preserving valuable ocean and coastal resources has sometimes caused conflict. Fishermen in Hawaii objected to creating a sanctuary to protect the breeding



The seven U.S. National Marine Sanctuaries, and the U.S. Exclusive Economic Zone (EEZ). (Redrawn from a Mary Beath illustration)

grounds of humpback whales because they feared burdensome regulation and interference with fishing, as Michael Weber describes in his article (page 59) on the proposed humpback whale sanctuary. The oil industry opposed sanctuaries in the Gulf of Mexico and offshore California, and challenged the designation of the Santa

Barbara Channel Islands National Marine Sanctuary, because of restrictions on exploration and development. The issues and solutions involved in this controversy are discussed by Porter Hoagland and Tim Eichenberg in their article (page 66) on California's Channel Islands Sanctuary. Establishing a sanctuary in the territorial



waters of Puerto Rico (La Parguera, February 1985) was defeated at the last moment because a new governor believed it would mean the loss of authority over sanctuary resources to the federal government.

Despite these controversies, seven marine sanctuaries have been created since 1975 (refer to list on page 13). Sanctuaries in

the Atlantic, Gulf of Mexico, and the Pacific protect valuable corals, marine mammals, seabirds, turtles, fish, and one historic shipwreck—the *U.S.S. Monitor*. Ed Miller discusses the difficult problems of preserving cultural resources in the ocean environment, such as the *Monitor*, in his article on marine archaeology (page 25). Unknown to many

readers of *Oceanus* is the U.S. National Marine Sanctuary in Fagatelle Bay, American Samoa. William Thomas describes efforts to protect coral resources, and balance traditional cultural values and modern conservation methods (page 18).

The scenic and recreational values in several sanctuaries are themselves major resources, and often because of community involvement, public use of these sanctuary resources continues to grow, as described in Stephanie Kaza's article (page 75). Identifying problems and enforcing sanctuary regulations against foreign vessels that run aground on and destroy coral reefs are analyzed in the *Wellwood* case study by Stephen Gittings, William Harrigan, and Joan Bondareff on pages 35 to 45.

1984 Amendments

Congress made significant changes in the Marine Sanctuaries Act in 1984. These were partially in response to a number of concerns: 1) dispel a fear that large ocean areas would be tied up in sanctuaries, 2) provide assurance that there would be multiple-uses within a sanctuary, as long as the uses were compatible, and 3) guarantee that appropriate groups and agencies would be involved in the selection process, and in the writing of regulations. The amendments reaffirmed the program's original purpose of protecting significant marine resources, but changed the procedure by which sanctuaries are selected and designated—requiring more environmental studies, wider consultation, and greater attention to economic impacts. As a result of the conflicts during the program's early years, Congress recognized that protecting marine resources could be compatible with other uses of sanctuary space (such as fishing within sanctuaries designed to protect marine mammals or coral reefs), and wrote the principle of "multiple uses" into the law. The amendments also ensured participation by the public, Congress, interest and industry groups, and state and federal agencies in the designation of new sanctuaries.

The 1984 amendments also reflected a major change in the program's resource management philosophy—a shift from regulating and prohibiting, to management and planning, with greater emphasis on research and education. Management plans developed for sanctuaries since 1983 show this change clearly. Where the earlier sanctuary rules mainly described activities that were prohibited, the new management plans establish guidelines for research, describe

public participation and education goals, and, wherever possible, allow multiple uses of sanctuary resources and space.

The process by which sanctuaries are selected was also revamped entirely by the 1984 amendments. Evaluation teams looked at potential sites throughout U.S. waters, seeking areas that have high natural resource value. In 1983, the National Oceanic and Atmospheric Administration (NOAA) published a list of sites (page 14) from which "active candidates" would be selected for sanctuary designation. The agency hoped this new site selection process would be predictable and efficient, and provide a pool of sites meriting closer scrutiny as potential sanctuaries.

Education and Research

With this selection process in place, the program could turn its attention to individual sanctuaries. However, in recent years a declining federal budget* has required program managers to seek creative approaches to sanctuary operations—finding funds for facilities, providing cooperative enforcement, and arranging for research and interpretive activities. Almost all aspects of sanctuary management involve cooperation with one or more federal or state agencies, private institutions, or organizations. This cooperative and creative financing is highly visible in two key components of sanctuary management—education and research.

Early in the program, it was recognized that effective education was the best hope for successful long-term conservation of selected marine areas. For the sanctuary program to be effective, its managers needed to create a public awareness of the value of sanctuaries to marine conservation. Education programs designed to do this included an evolving ethic derived from land management experiences—stewardship. The care and management of an area for public benefit, which developed from the early concept of the public domain or ownership of land, was applied to man's relationship with the ocean and its resources.

Until recently, education was an underused tool in marine protected area management. This was the result, in part, of the relative newness of the concept, coupled

continued on page 11

* The Fiscal Year '88 marine sanctuary program budget is \$2.3 million. Of this, \$1.6 million is for projects (includes management and research). The FY88 research budget is approximately \$250,000, while the FY86 research budget was \$800,000.

Sanctuary Designation

Marine sanctuaries may be established in any area of ocean and coastal waters that are subject to U.S. jurisdiction, including the outer continental shelf and the Exclusive Economic Zone. State and territory governors must concur in a sanctuary that incorporates state or territorial waters.

In 1983, the National Oceanic and Atmospheric Administration (NOAA) published the Site Evaluation List (SEL) of potential sanctuaries. This list of possible sites was compiled by regional evaluation teams, based on criteria established by NOAA. One key objective is that the selected sites are representative of each region of the United States. There are currently 29 sites on the SEL (page 14); new sites may be added to the list.

The sanctuary designation process (page 10) begins when NOAA selects an active candidate from the SEL. NOAA consults with federal and state agencies on the proposed designation and prepares a draft environmental impact statement, draft

sanctuary management plan and proposed regulations. These documents are sent to the Senate Committee on Commerce, Science, and Transportation and the House Committee on Merchant Marine and Fisheries for review.

Either Committee may conduct hearings on the proposed sanctuary and issue a report, which must be considered by NOAA before designating the sanctuary. After the 45-day period of congressional review has expired, NOAA may issue a final environmental report, final management plan and regulations, and publish a notice that the sanctuary designation will become effective 90 days after the date of notice.

During this period, Congress may disapprove the sanctuary designation by passing a joint resolution. If the President approves such resolution, the sanctuary designation is withdrawn.

On the other hand, if all reaction is positive, and the proposed sanctuary is approved, a formal designation is made official by the Secretary of Commerce.



Windsurfing in Tomales Bay, Gulf of the Farallones National Marine Sanctuary.

Sanctuary Designation Process

As provided by the 1984 Amendments
to the
Marine Sanctuaries Act of 1972

Principal Task	Procedural Steps	Notification and Documentation
Site Evaluation List (SEL) established	Final SEL ↓ NOAA selects site from SEL ↓ Preliminary Consultation ↓	<ul style="list-style-type: none"> • FR⁴ Notice • FR Notice, Written Analysis of how Site Meets SEL Criteria • Public Notice
Active Candidates Identified (Active Candidate Selection Starts NEPA ¹ Process)	NOAA Selects Active Candidate ↓ Regional Scoping Meeting ↓ Prospectus to Congress for Review; DEIS ² , Draft Management Plan (Including Proposed Regulations) & Public Hearing ↓ FEIS ³ , Final Management Plan	<ul style="list-style-type: none"> • Disseminate Written Analysis • FR Notice, Public Notice • FR Notice, Public Notice • FR Notice & Public Notice
Sanctuary Designation	Designation by Secretary of Commerce and Issuance ↓ Congressional and Gubernatorial Review (90 days) ↓ Implementation of Management Plan	<ul style="list-style-type: none"> • FR Notice • FR Notice of Designation

¹ National Environmental Policy Act

² Draft Environmental Impact Statement

³ Final Environmental Impact Statement

⁴ Federal Register



Clamming on Dillon Beach, Gulf of the Farallones National Marine Sanctuary.

with inherent difficulties encountered when managers tried to apply terrestrial park management techniques directly to ocean areas. In the ocean areas, program managers faced problems of physical access to resources based in a medium that moves in three dimensions; species that may be within sanctuary boundaries today but not tomorrow, and the need to effectively educate the public about the value of a sanctuary's resources.

As a result, low-cost marine educational techniques are developing quickly, both in the United States and throughout the world. One successful example is the annual Underwater Photography Contest at the Key Largo National Marine Sanctuary in Florida. Prizes are donated by local merchants, and any diver with a camera can participate. The contest offers opportunities for aspiring photographers to demonstrate their skills and, it is hoped, to learn about sanctuary resources. These contests have generated publicity for the sanctuary, its sponsors, and the winning photographers. More importantly, they provide photos useful in educational

displays, call attention to the beauty and value of the resources, and involve the public with the sanctuary.

Through such techniques, sanctuary managers design education programs to communicate resource values, the need for protective measures, and resource-use issues to the public. Whether it is the Key Largo photography contest or the local marine science fair planned for the nearby Looe Key National Marine Sanctuary, fostering public involvement and commitment are the primary objectives.

Research Objectives

To predict the effects on sanctuary resources of both natural and human-induced events, and to establish human-use limits, program managers must understand the complex ecological systems in marine sanctuaries. Research funded by the program is designed to meet these management needs. In addition, the program encourages scientists to conduct their own research within sanctuaries—subject to the requirement that

such research is compatible with resource protection. To make this offer attractive to the scientific community, sanctuary personnel often provide substantial assistance, such as free transportation to sampling sites, work space in onshore facilities, and help with sampling and measurements.

Research products are intended to be useful to sanctuary managers, and to contribute to on-site operations both in the short- and long-term. Sanctuary research plans usually identify two types of information needs: longer-term needs, such as comprehensive inventories and monitoring that are usually more expensive to meet, and more immediate management needs that are addressed in special studies. The results of such research are applied to:

- determine appropriate sanctuary boundaries;
- monitor and predict population changes and habitats;
- plan for present and future use and development of the area, compatible with conservation objectives;
- predict and assess the impacts of regulations on resources and values; and
- interpret resource values and identify activities that directly and indirectly affect them.

A classic example of how research can be used to measure and evaluate management actions is an eight-year study at the Looe Key Sanctuary of the effects of a spearfishing ban on predatory fish populations. Compared to Key Largo, where spearfishing has been banned since 1961, Looe Key exhibited a much lower diversity of predator fish—such as grouper and snook. Using control reefs (where a spearfishing ban did not exist), the study showed an exponential increase in predatory fish in the first two years following the spearfishing ban. Thereafter, the population changes became more gradual and continue to date. This study demonstrated the effectiveness of regulation, as well as the resiliency of reef fish when exploitation is reduced. Marine sanctuaries are excellent laboratories for research of this type, providing useful information for resource management and public education.

Program Results

Evaluation of the sanctuary program by the General Accounting Office (the Congressional

watchdog agency responsible for overseeing federal activities) in 1981 concluded that the program plays an important role in marine resource management and conservation and should be federally supported. The review found that the program has authority and offers benefits that other federal ocean programs do not—including the comprehensive management of ocean resources to ensure their long-term preservation; environmental protection where gaps exist in other federal programs; and public appreciation of ocean resource values.

The basic policy of the program to protect significant marine and coastal resources has been maintained since the beginning. The changes made by Congress in 1984, and the shift in management approach, have quieted the conflicts between program managers and other users of ocean resources. However, despite the change in approach to selecting, designating, and managing marine sanctuaries, the program has yet to establish any new sanctuaries under the 1984 amendments. It is difficult to say whether this result is because of the complicated and lengthy site review and consultation process contained in the 1984 amendments, or to other causes. Recent program performance raises the question whether these new procedures should be simplified and greater discretion given to program managers in the designation process. Other important policy questions face the program. How many sanctuaries should be created? What level of support should be provided for marine resource management and research within sanctuaries?

The National Marine Sanctuary Program has demonstrated the value of marine resource protection and management, but to fulfill the promise of the program and the mandate established by the Congress in the Marine Sanctuaries Act, these questions must be addressed.

Nancy M. Foster is Director, Office of Protected Resources and Habitat Programs at the National Oceanic and Atmospheric Administration (NOAA), Washington, D.C. She is the former Chief of the Marine and Estuarine Management Division, Office of Coastal Resource Management, NOAA. Jack H. Archer is a Senior Fellow in the Marine Policy and Ocean Management Program, Woods Hole Oceanographic Institution. He is a former Counsel, House Subcommittee on Oceanography, and a former NOAA Senior Attorney.

Views expressed are those of the authors and do not necessarily reflect those of the agency/institution of affiliation.

U.S. National Marine Sanctuaries

U.S.S. Monitor National Marine Sanctuary

- designated in January 1975
- located southeast of Cape Hatteras, North Carolina
- protects the site of the Civil War vessel, the *U.S.S. Monitor*

Key Largo National Marine Sanctuary

- designated in December 1975
- located south of Miami, Florida
- protects 100 square miles of coral reef and associated reef species

Channel Islands National Marine Sanctuary

- designated in September 1980
- located offshore from Santa Barbara, California
- protects a 1,252 square mile habitat for marine mammals and seabirds

Looe Key National Marine Sanctuary

- designated in January 1981
- located east of the Florida Keys
- protects a 5 square mile submerged section of the Florida reef tract

Gray's Reef National Marine Sanctuary

- designated in January 1981
- located east of Sapelo Island, Georgia
- protects a 17 square mile submerged live bottom coral area and associated reef species

Gulf of the Farallones National Marine Sanctuary

- (formerly named the Point Reyes-Farallon Islands National Marine Sanctuary)
- designated January 1981
 - located northwest of San Francisco, California
 - protects a 948 square mile habitat for marine mammals and seabirds

Fagatele Bay National Marine Sanctuary

- designated in April 1985
- located near Tutuila Island, American Samoa
- protects deep-water coral terrace formations unique to the Pacific high islands

Candidate Sanctuaries

Cordell Bank

- declared an active candidate for designation in June 1983
- located west of San Francisco, California
- would protect a "submerged mountaintop" supporting an exceptionally large array of marine species

Flower Garden Banks

- nominated as a sanctuary in 1977. Declared an active candidate in 1979; dropped as active candidate in 1982; active status revived in 1984
- located in the Gulf of Mexico, 110 miles southeast of Galveston, Texas
- would protect 175 square mile coral reef and associated species

Norfolk Canyon

- declared an active candidate in 1985
- located 60 miles off the Virginia coast
- would protect a deepwater submarine canyon that contains large tree corals and "pueblo villages"—assemblages of large invertebrates and finfish that dig burrows in the canyon sides



Recreational diver in a sanctuary. (Photo courtesy of the Gulf of the Farallones National Marine Sanctuary)

The National Oceanographic and Atmospheric Administration (NOAA) National Marine Sanctuary Site Evaluation List (1983)

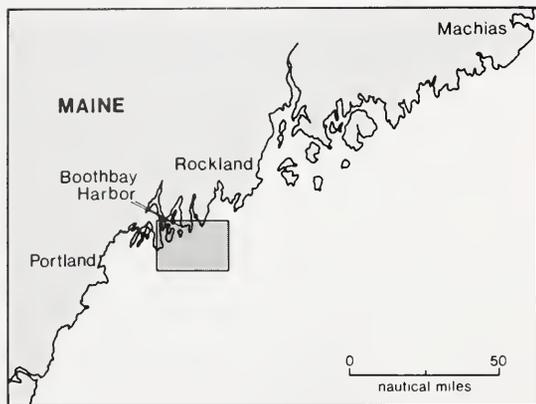
North Atlantic Region

Mid-Coastal Maine

Location: coastal Maine.

Size: 430 square miles.

Features: mouths of 3 major estuaries and 2 bays.



Stellwagen Bank

Location: 6 miles north of Cape Cod, off Provincetown, Massachusetts.

Size: 605 square miles.

Features: submerged bank; feeding and nursery grounds for marine mammals, fishery resources.

Nantucket Sound/Shoals and Oceanographer Canyon

Location: 3 areas in vicinity of Nantucket Island, Massachusetts.

Size: 1,805 square miles.

Features: variety of habitats—open bay, nearshore open ocean and shoals, and shelf-edge submarine canyon, large species diversity; commercial fishing area.

Virginia/Assateague Island

Location: state and federal waters off Virginia and Maryland.

Size: 1,200 square miles.

Features: estuarine waters and wetlands adjacent to barrier island and mainland along section of mid-Atlantic coast; great diversity of waterfowl, shorebirds, and other marine species.

South Atlantic Region

Ten Fathom Ledge—Big Rock

Location: consists of two areas, an inner shelf site, "Ten Fathom Ledge," 17 miles south of Cape Lookout, North Carolina; and an outer shelf site, "Big Rock," at the shelf break 36 miles offshore.

Size: 135 square miles and 36 square miles; total of 171 square miles.

Features: hard-bottom areas with high productivity and assemblages of tropical marine organisms at the northern extreme of their range. Ten Fathom Ledge includes popular recreational diving locations, one of which includes a WWII German submarine.

Port Royal Sound

Location: southeast coast of South Carolina.

Size: 55 square miles.

Features: large deepwater sound bordered by marshlands; shellfish and other commercial species, habitat for bald eagle, brown pelican, alligator, and marine turtles.

Florida Coral Grounds

Location: two areas off coast of Florida—the "worm" or "bathtub" reef at St. Lucie, and a portion of the Oculina Reefs 17 miles off the coast of east central Florida.

Size: 4.5 square miles and 92 square miles; total of 97 square miles.

Features: unusual formations of ivory tree coral; breeding and feeding grounds for fish; habitat for squid and rays.

Caribbean Region

Cordillera Reefs

Location: vicinity of Cordillera Islands within Commonwealth waters, off northeast coast of Puerto Rico.

Size: 62 square miles.

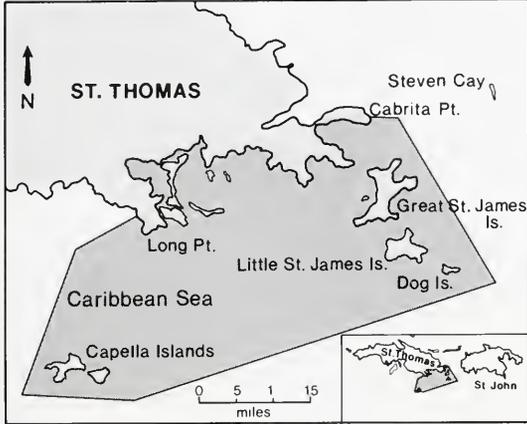
Features: extensive coral formations; habitat for manatees, hawksbill turtles.

Southeast St. Thomas

Location: U.S. Virgin Islands territorial waters south-east of St. Thomas.

Size: 12.3 square miles.

Features: diverse tropical marine ecosystems; coral reefs; marine meadows of algae and turtle grass.



East End, St. Croix

Location: adjacent to east end of St. Croix, including the waters east of Buck Island and the area of Lang Bank; U.S. Virgin Islands.

Size: 40 square miles.

Features: rich diversity of tropical species and marine habitats.

Gulf of Mexico Region

Big Bend Seagrass Beds

Location: "big bend" region of western Florida, extending up to 22 miles offshore.

Size: 100 square miles.

Features: productive seagrass beds; rich diversity of marine life, including manatee; several commercial fishery species including oysters, scallops, crabs, and shellfish.

Shoalwater Bay—Chandeleur Sound

Location: on a subsiding remnant of abandoned Mississippi River delta.

Size: 80.2 square miles.

Features: shallow-water seagrass beds provide habitat for finfish and shellfish, marine turtles; adjoining shelves support black mangrove and marsh grass communities; winter foraging site for migratory waterfowl.

Baffin Bay

Location: includes four bay systems within waters of southeast Texas.

Size: 95 square miles.

Features: intertidal salt flat communities; shallow mud-bottom bay communities.

Eastern Pacific Region

Washington State Nearshore

Location: waters around San Juan Islands within Puget Sound, Washington,

Size: approximately 275 square miles.

Features: rocky-shore, deep-water, and shallow-embayment habitats; rockweed and other algae; diverse and abundant marine invertebrates, marine mammals, and seabirds—including bald eagles.

Western Washington Outer Coast

Location: 90 miles of coastal area of northwestern Washington State.

Size: 230 square miles.

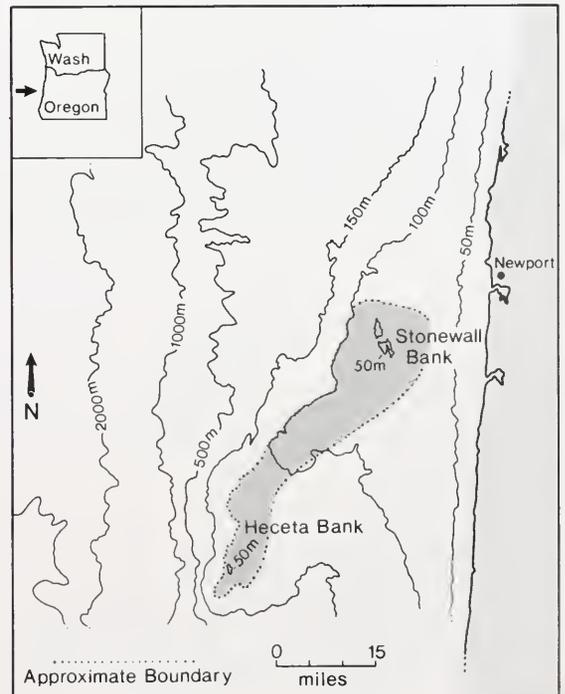
Features: high-wave-energy, rocky-shore ecosystem; breeding and feeding grounds for birds, mammals, and fish; includes kelp beds, pocket beaches, and estuaries.

Hecata-Stonewall Banks

Location: submerged bank off Oregon lying along the 100-fathom depth contour.

Size: 400 square miles.

Features: hard-bottom bank overlain by nutrient-rich waters caused by seasonal upwelling; commercial fish populations.



The Proposed Monterey Bay Marine Sanctuary

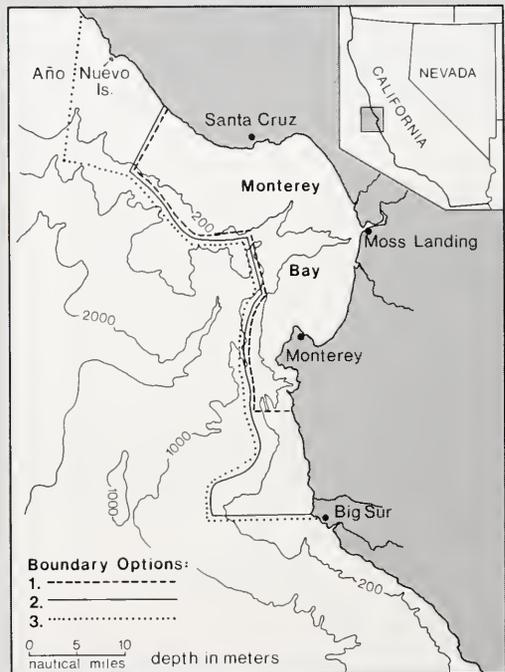
California's 750-mile coastline includes a great diversity of marine habitats for fish, mammals, seabirds, and plant life. Monterey Bay is unique to both California and the nation, because the country's largest submarine canyon bisects the broad curve of the bay. Within a few miles of shore, the bay's waters plummet to oceanic depths favored by pelagic species like blue and sperm whales. Upwelling of nutrients fosters an especially productive environment for marine life—such as the entire population of endangered ash storm petrels that feed in the bay part of the year. Nowhere else in North America is there such diversity of algal species.

The bay itself, and part of the Big Sur coastline south of Monterey, were proposed for consideration as a National Marine Sanctuary in 1977. In 1984, however, NOAA decided that California already had its share of sanctuaries (the Santa Barbara Channel Islands and Gulf of the Farallones sites), and dropped the Monterey Bay proposal from further consideration. Conservationists and local officials protested that this action violated the Marine Sanctuaries Act, and that NOAA had acted arbitrarily by not allowing public comment before eliminating Monterey Bay as a potential marine sanctuary.

This handling of the Monterey Bay proposal has provoked congressional interest. "NOAA's abrupt decision to remove Monterey Bay from the list of candidate sites was unwarranted and misguided," said Representative Leon Panetta (D-Ca.). Claiming that "NOAA had closed the door on creating a marine sanctuary through the established process," Panetta introduced a bill in January 1987, H.R. 734, which directs NOAA to reverse its 1984 decision and to move the Monterey Bay proposal through the sanctuary designation process. The bill

has attracted the attention of the U.S. House Committee on Merchant Marine and Fisheries, which will consider reauthorization of the Sanctuary Program in 1988. If approved by Congress, Panetta's bill will be the first successful congressional effort to designate a major ocean area as a national marine sanctuary.

—JHA



Morro Bay

Location: embayment south of the city of Morro Bay in San Luis Obispo County, California.

Size: 3 square miles.

Features: coastal salt marsh, tidal mud flat, and deep-water channel habitats; large wildlife habitat; extensive clam shellfishery; nesting area for egrets, herons, and falcons.

Tanner-Cortes Banks

Location: two sites west of San Diego, California.

Size: 10 square miles.

Features: relation to ocean currents produces combination of nearshore and offshore organisms; area contains rare and newly-discovered species; important area for scientific investigation and maintenance of rare species.

Northern Mariana Islands

Location: includes waters out to 12 miles around six unpopulated northern Mariana Islands.

Size: 700 square miles.

Features: biogeographical setting for marine organisms arrayed along a temperature gradient; includes whales, turtles, and birds.

Southern Mariana Islands

Location: selected sites off several southern islands out to the 150-foot depth contour.

Size: 18 square miles.

Features: fringing reef, barrier reef, and lagoon habitats; nesting areas for birds and green turtles.

Cocos Lagoon

Location: Cocos reef, lagoon, islets, and deep channels in coastal region of southern Guam.

Size: 3.9 square miles.

Features: variety of habitats and marine communities.

Facpi Point to Fort Santo Angel

Location: offshore waters on northern side of Umatac Bay, Guam.

Size: 2 square miles.

Features: rocky volcanic shoreline and beaches at the heads of three bays; reef habitat with coral and fish; turtles, archaeological sites.

Papalola Point, Ofu Island

Location: 3 miles of shoreline on southeast section of Ofu Island, American Samoa.

Size: 1 square mile.

Features: example of fringing reef community; diverse and abundant marine life; unique for presence of blue coral.

Cape Vincent

Location: northeastern corner of Lake Ontario.

Size: 450 square miles.

Features: gateway to New York's Thousand Islands resort area and the St. Lawrence Seaway; critical environment for many commercial and recreational fish species; habitat for migratory and indigenous waterfowl.

Western Lake Erie Islands, including Sandusky Bay

Location: Sandusky Bay, Ohio, wetlands, and southwestern Lake Erie waters.

Size: 440 square miles.

Features: migration area for waterfowl; historical bald eagle nesting area; fish breeding area; bottom community includes freshwater mussel species.

Thunder Bay

Location: includes Thunder Bay and vicinity in Lake Huron, northeastern Michigan.

Size: 400 square miles.

Features: underwater limestone sinkhole; large concentration of historical shipwrecks; habitat and breeding area for birds and gamefish.

Green Bay

Location: Green Bay and lake waters in northwestern portion of Lake Michigan.

Size: 1,300 square miles.

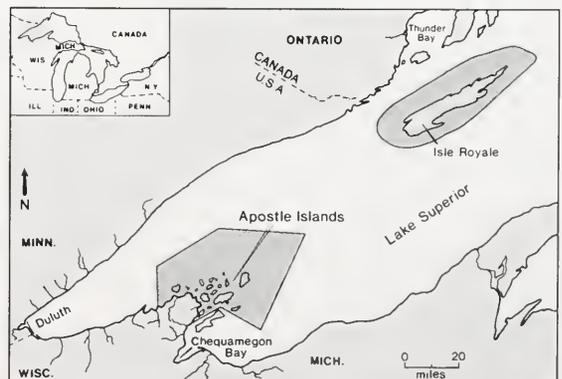
Features: nursery and spawning grounds for fish; bottom community.

Apostle Islands/Isle Royale

Location: two subunits in western Lake Superior adjacent to Apostle Islands National Lakeshore, and surrounding Isle Royale National Park.

Size: 1,031 square miles.

Features: habitat for commercial and recreationally important fish, wildlife, and waterfowl.



Fagatele Bay: A Sanctuary in Samoa

by William J. Thomas

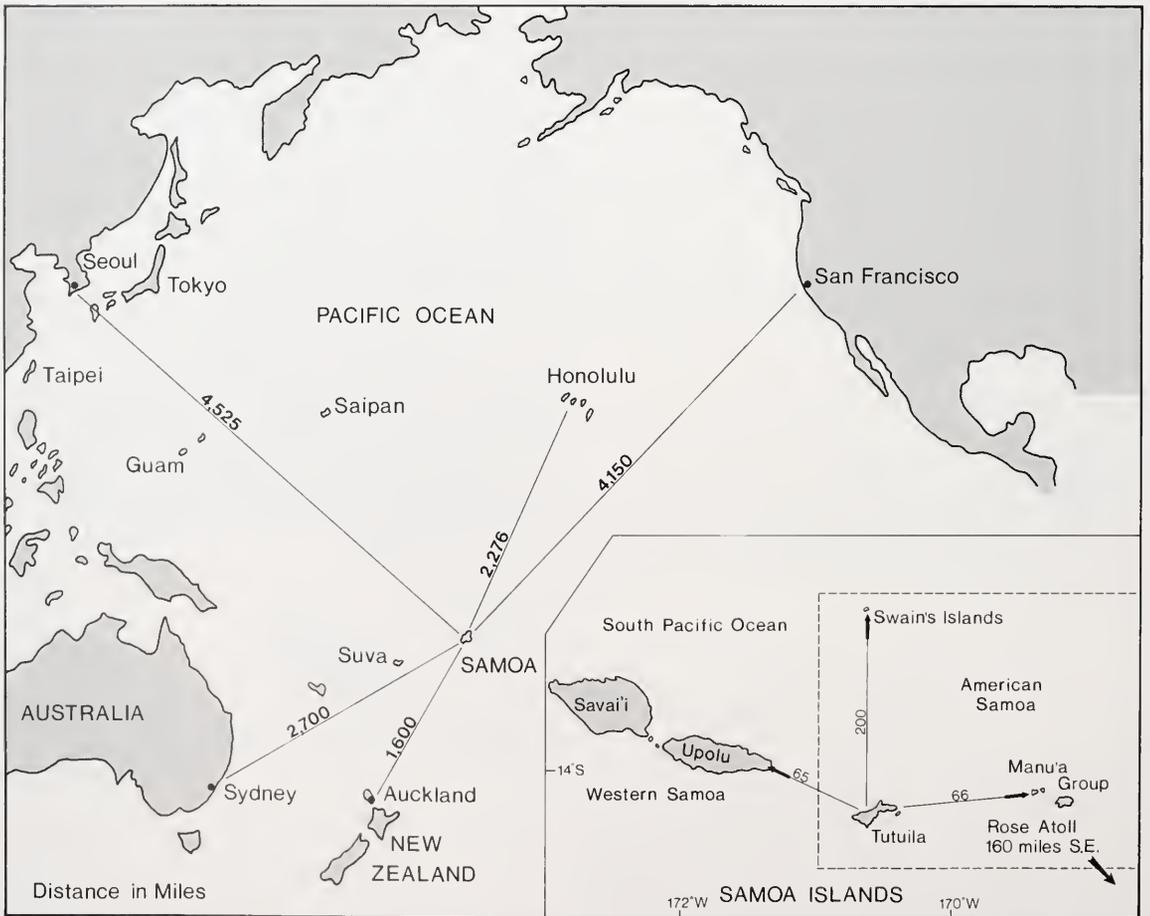
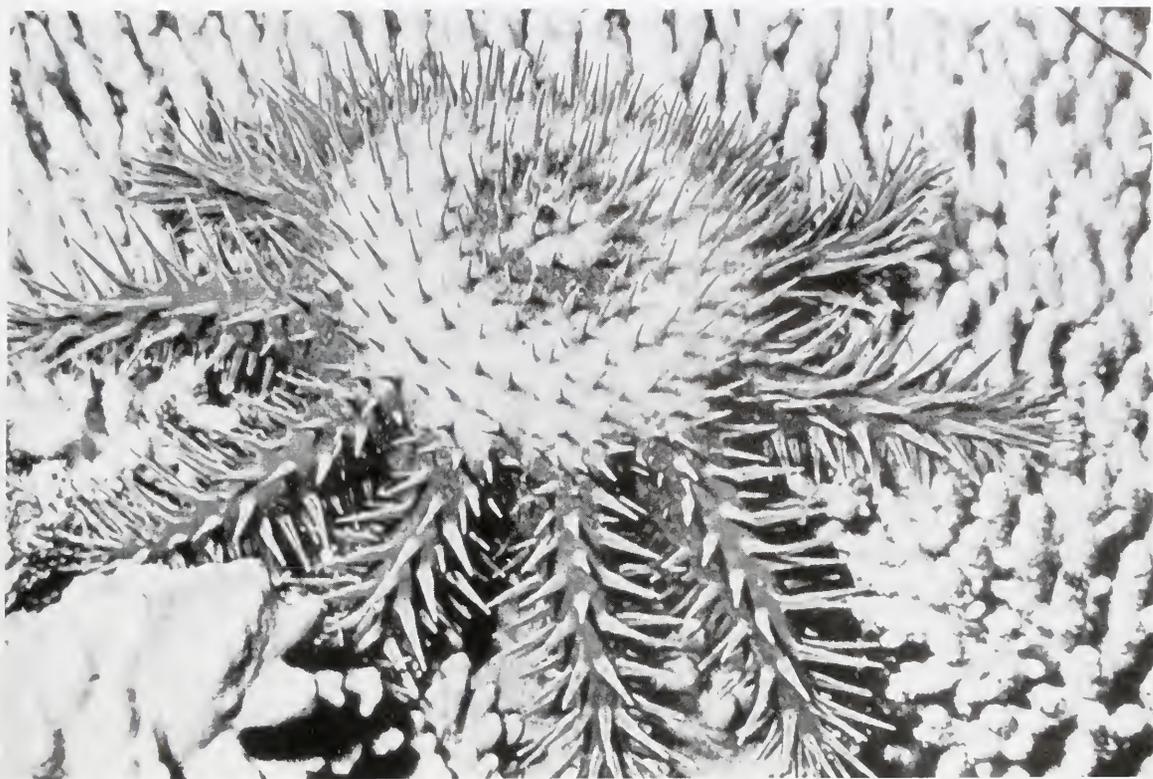


Figure 1. American Samoa, located nearly 2,300 miles south of Honolulu, has been a U.S. Territory since 1900. Fagatele Bay, on Tutuila, is the site of the United States' newest and southernmost National Marine Sanctuary.



The Crown-of-Thorns starfish, *Acanthaster planci*. (Courtesy Fagatele Bay National Marine Sanctuary)

Nearly 2,300 miles south of Honolulu, in the waters of American Samoa (Figure 1), an ecologically rich and pristine pocket of coastline, formed by the crater of an extinct volcano, was nearly devastated by an infestation of the coral-eating Crown-of-Thorns starfish (*Acanthaster planci*) in late 1978. Fagatele Bay (pronounced *fahng-a-teh'-leh*), which may possess the most diverse coral fauna in the entire Samoan archipelago, lost nearly 90 percent of its corals to these ravenous starfish. With much of the coral dead, many fish and invertebrates also disappeared from the bay. Their absence disrupted the traditional lifestyle of the Samoans living in the surrounding villages, severely curtailing traditional subsistence activities such as fishing and gleaning (gathering shellfish and algae) from the reefs.

The starfish infestation provided the impetus for Fagatele Bay's sanctuary designation in 1986. The American Samoa government recognized that national protection of the bay's diverse coral reef ecosystem would enable scientists to study the Crown-of-Thorns starfish and its impact on the bay's resources, enhance the Territory's conservation efforts, and assist in preserving Samoan culture. The formation of the Fagatele Bay National Marine Sanctuary represents an effort by the U.S. Government to blend traditional and modern conservation practices. Through a complete understanding of Fagatele Bay's resources and the

cultural heritage of the Samoan people, the sanctuary's management policies and techniques will serve as a model for other Pacific island nations with similar goals for coral reef management and the maintenance of traditional culture.

The Site

Fagatele Bay is a 163-acre embayment on the southwest coast of Tutuila (Figure 2), American Samoa's largest and most populated island. It has long been recognized as a resource of high ecological value by various federal, territorial, and private groups. Its pristine character has been virtually unchanged for many years because of the steep cliffs (rising vertically more than 200 feet) that rim the bay. Because of the difficult overland access, the bay has remained virtually isolated, and free from most human impacts. The cliffs, however, did not prevent the partial devastation of the bay's coral reefs from natural causes.

During late 1978 and early 1979, the starfish destroyed more than half of the coral reefs fringing Tutuila. Despite the devastating impact it had upon the live coral resource, this incident presented a unique opportunity to study and document the recovery of such ecosystems. Since periodic infestations of this starfish are common throughout most of the Pacific (see also *Oceanus* Vol. 29, No. 2, page 55), the results of this research could further

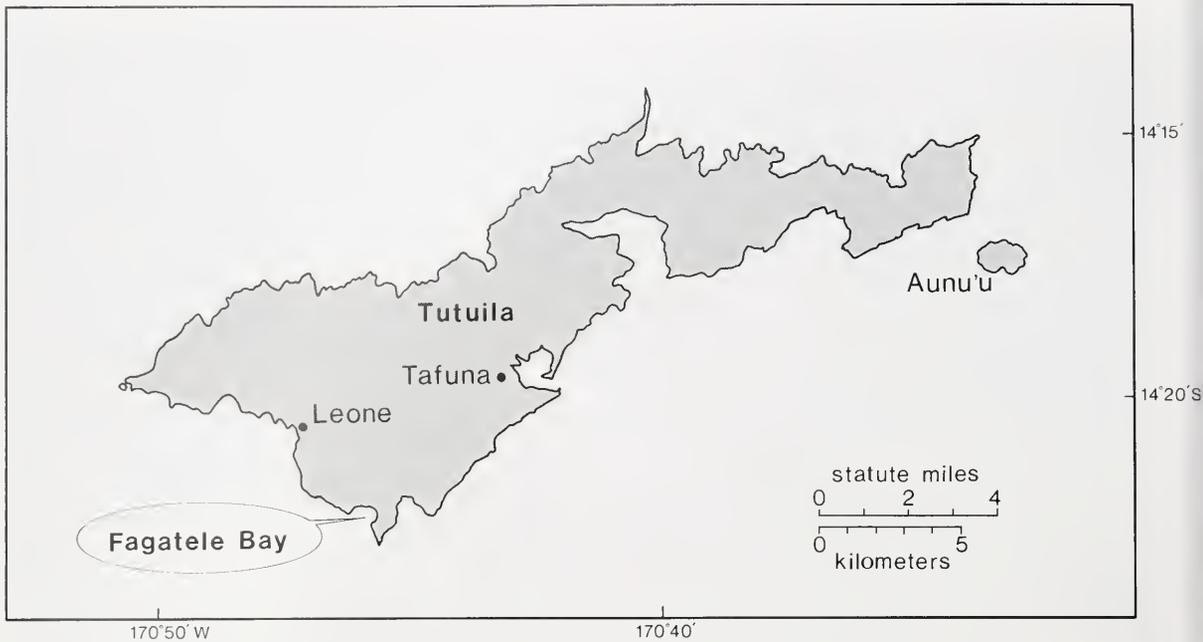


Figure 2. The Fagatele Bay National Marine Sanctuary is located on the southwest coast of Tutuila, American Samoa's largest and most populated island.

the understanding of coral reef recovery and help formulate sound management policies and techniques.

Traditional Culture and Fagatele Bay

The traditional Samoan lifestyle, known as *fa'a Samoa*, places great importance on the dignity and achievements of the group rather than on an individual's achievements. The traditional communal lifestyle revolves around the *aiga* (ah-eeng'-a), or extended family. The *aiga* is headed by a *matai* (mah-tie'), or village chief, who takes responsibility for the welfare of all his or her *aiga*. The *matai* manages the communal economy, protects and distributes family lands, and represents the family in councils.

American Samoa's system of land tenure is based on communal lands held by *aigas*. The basic claim of each *aiga* is recognized and respected by all *aigas*. Land transfers among *aigas* rarely occur. Land alienation laws, aimed at preserving this Samoan system, have existed since the first U.S. Navy administration in 1900 (see box on page 22).

The traditional Samoan village was supported by a self-sustained local economy requiring a minimum of trade and specialization. Land and marine tenure allowed for farming and harvesting specific areas. Access to both land and water areas adjacent to villages was controlled by the *matai*.

While no written history of Fagatele Bay's traditional use patterns exists, oral accounts and archaeological work revealed two village sites along the margin of the bay. The villages' uses of the bay may have included salt harvesting and subsistence fishing, with tenure boundaries comprising the entire bay.

Today, primary usage of the bay includes sport and subsistence fishing by villagers who live above the bay. They control land access to the bay via their communal land tenure system. Gleaning—gathering primarily shellfish, such as the giant clam *Tridacna*, and algae (*Dictyota*, *Laurencia*, and *Ulva*) from the nearshore reef areas—and pole and line fishing are the major subsistence activities, while rod and reel fishing are the dominant sportfishing activities. The most common species caught include butterfly fish (*Chaetodon* spp.), surgeonfish (*Acanthurus* spp.), goatfish (*Parapeneus*), and snappers (*Lutjanus*). Most of these activities, occurring along the nearshore areas of the bay, presently are conducted by less than 20 people from the nearby villages.

Cooperative Planning Effort

Recognizing the impact on the bay's resources resulting from the starfish infestation, the Pacific-wide need for coral reef management-related research, and the need to protect the site from additional human-induced stresses, a proposal was submitted in March 1982 by the American Samoa Government (ASG) to the National Oceanic and Atmospheric Administration (NOAA) nominating Fagatele Bay as a candidate for marine sanctuary designation.

In addition to describing the scientific justifications for sanctuary designation, the proposal also explained the role of culture and tradition and its importance to daily life in American Samoa. It was apparent that recognizing the existence of village regulations (non-codified) based on their traditional lifestyle, and protecting these traditions along with the bay's resources were vital to the sanctuary designation process.



Aerial view of Leone, a typical Samoan village near Fagatele Bay. (This, and following photos by the author)

Throughout the planning stages, local participation was encouraged by including appropriate village and territorial authorities identified by the ASG, the legislative and executive branches and Congressional office of the ASG, and the relevant Federal agencies. This wide consultation resulted in the early identification of five major issues.

The major issues were: 1) sanctuary designation may conflict with the traditional lifestyle and cultural heritage of the Samoan people; 2) traditional uses of the bay may be prohibited; 3) with the introduction of a Federal program, local participation in managing the site may be ignored; 4) the distance from Washington, D.C., may make management of the site impractical from the federal perspective; and 5) the availability of native Samoans qualified to manage the sanctuary may be a limiting factor in sanctuary management.

During the entire planning process, the concerns and lifestyle of the Samoan people, especially the continuation of traditional uses of the bay, were considered to be of primary importance. Since the territory lacks fish and wildlife regulations, the ASG also looked at sanctuary designation as a mechanism for establishing resource protection regulations at a specific site. These in turn could serve as a model for the ASG to use in formulating its own territorial resource protection regulations.

Sanctuary Designation

In April 1986, Fagatele Bay was formally designated (under the pre-1984 regulations) the nation's newest

and southernmost National Marine Sanctuary.

The designation of Fagatele Bay as a sanctuary established the basis for cooperative management of the area by the American Samoan Government and NOAA. The management plan includes regulations that delineate the Sanctuary's boundaries, and prohibits such activities as spearfishing, taking or damaging natural resources (including the Crown-of-Thorns starfish); the use of trawls, seines, trammel nets or any fixed nets; disturbance to the benthic community; the discharge of any materials or substances into sanctuary waters; removing or damaging cultural resources; and the taking of any sea turtles. Traditional activities, such as gleaning and subsistence fishing, are specifically allowed.

The plan achieves a number of goals. The resource protection regulations reflect the area's historical use, while at the same time addressing coral reef management needs and ensuring adequate protection of Fagatele Bay's resources.

NOAA and the territorial government also recognized the need to provide technical training to local Samoans to provide further assurance that local participation in the sanctuary's day-to-day management will not be ignored. Thus, another major emphasis of the sanctuary at Fagatele Bay is to provide a mechanism to assist in the training of local personnel in resource management techniques. With active involvement of the sanctuary manager, Samoans will participate in workshops and training

continued on page 24

American Samoa

American Samoa is the only U.S. Territory south of the equator. It consists of seven islands that possess a total land area of 76 square miles and a combined population of approximately 32,000 people. Approximately 90 percent of the population resides on American Samoa's largest island, 54 square-mile Tutuila (Too-too-ee'-la), while the remaining 10 percent live on nearby Aunu'u (Ow-noo'-oo) and the smaller eastern islands of Ofu (oh'-foo), Olosega (Oh-low-seng'-uh), and Ta'u (Tah-oo'). Rose Atoll, an uninhabited area approximately 160 miles east of Tutuila, is a National Wildlife Refuge. Swains Island, a privately-owned coral atoll, lies approximately 225 miles to the north.

The Dutch were the first Europeans to contact the Samoan people in the late 1700s. From 1840 to 1899, Germany, Great Britain, and the United States had a tripartite agreement to oversee Samoa's commerce. Their efforts to unify the islands were supplanted by their individual attempts to establish naval stations there. For example, in 1870, the United States launched a scientific expedition to the islands of Samoa led by Lt. Charles Wilkes. From the information provided by this expedition, the United States drafted a treaty with the Samoans in 1872 that would have granted its exclusive use of Pago Pago Harbor, had it been ratified.

The three powers nearly went to war over their exclusionary actions, but instead agreed to split the islands in 1899: the United States assumed jurisdiction over Samoa's eastern islands, Germany took control over the

western islands, and Great Britain withdrew. The German islands of Western Samoa were larger and more fertile than the mountainous eastern islands. During World War I, New Zealand landed troops and took over the German colony. The islands were then placed under New Zealand's direction, until Western Samoa gained its full independence in 1962. The eastern islands, which included Pago Pago Harbor, were awarded to the United States.

In early 1900, American Samoa became a U.S. Territory; and on February 19, 1900, the U.S. Navy was assigned responsibility for administering the islands by President William McKinley. During World War II, the U.S. Navy used Pago Pago Harbor as a refueling station for their Pacific and south Pacific operations. They also created a landing strip near the village of Leone that the U.S. Marine Corps jointly used. In 1951, President Harry Truman transferred administration of the islands to the U.S. Department of the Interior, where it remains today.

The Territorial government is an American-styled system with three branches. The Executive Branch is headed by an elected governor. A bicameral Legislature, the Fono, has law-making authority under the Territorial Constitution. Members of the House of Representatives are elected by adult suffrage for two-year terms. The House includes residents of all social strata. Senators are registered chiefs who are selected by County Councils for four-year terms. The Judicial Branch includes a High Court and five District Courts.



Tabletop coral in Fagatele Bay, at a depth of 20 meters. Diameter of largest is approximately 6 meters.



The Samoan Legislature building where sessions in both Samoan and English are conducted.



A village mayor (pulenu'u) repairing his one-man paopao, a traditional fishing canoe.

provided by NOAA and other Pacific resource management programs—such as the South Pacific Commission's South Pacific Regional Environment Programme.

Sanctuary Education Program

Sanctuary designation will also enhance American Samoa's public education. For many years, American Samoa's history was passed on in the oral tradition by village chiefs. Today, government officials who determine policies and standards use very different channels to communicate with people. The sanctuary education program is responsive to both the traditional and modern communication processes. Relying on a combination of local support, local experts, and non-island educators and scientists, the education program will not only convey the findings of scientists to the general public, but also will include the history of traditional rights in Samoa and other Pacific islands, and outline their roles in 20th Century conservation efforts.

Implementation of the education program is scheduled for this year. The program is divided into two stages, and will use the University of Hawaii's Curriculum and Development Group; and American Samoa's Department of Education, Community College, Department of Recreation, Development Planning Office, and Office of Marine Resources to facilitate its execution.

Stage I (1988 and 1989) will focus on identifying the sanctuary to the public and disseminating that information through the development of a marine science curricula in local schools, public outreach programs, and traveling exhibits. Stage II (1990–1993) will expand on Stage I to include areas outside the sanctuary, emphasizing the cultural and historical aspects of the bay and similar areas throughout the Pacific.

The cultural and natural history program will use legends, stories, and traditional conservation practices from Samoa and other Pacific islands to show the essential links between Samoans and the sea's resources. It also will establish bonds with other national marine sanctuaries, as well as other marine protected areas throughout the Pacific.

Centering around the desire to develop a strong environmental ethic, the sanctuary's educational program forms a solid foundation for individual and community actions that will promote environmental awareness on the whole island. The involvement of village matai will maintain the traditional lines of oral communication. In combination with on-site and off-site programs, involvement of the matai will also allow for greater acceptance of the program by the Samoan people. Thus, the sanctuary will serve not only as an environmental education laboratory, but also as a demonstration of how traditional and modern conservation practices may complement each other. In this manner, traditional rights and practices can re-emerge as tools for future resource conservation efforts.

The role of enforcement officials will include educating violators of Sanctuary regulations of the reasons for protecting Fagatele Bay's resources, and

how they can contribute to leaving a living legacy for future generations. Through this, public support for American Samoa's National Marine Sanctuary can be enhanced. With education and public support, the need for strict enforcement efforts ideally will be minimal.

Pacific Marine Resource Management

Although the Crown-of-Thorns starfish infestation provided the impetus for sanctuary designation of Fagatele Bay, it also pinpointed the need to effectively manage coral reef resources throughout the Samoan Archipelago and the Pacific. If left undisturbed, these fragile ecosystems can recover. However, on the land-poor, volcanic South Pacific islands, increasing population and land-use pressures on the limited flat land have led to increased pressure on all coastal resources. The filling-in of reefs and mangroves to extend the available flat land is a common practice in several island areas.

Since many of these practices are either condoned or ignored by the local governments, sound management of coastal resources requires not only a complete understanding of the coral reef ecosystem, but also complete support by the local population for research and management of these areas.

The approach to these issues will necessarily vary from island to island, depending on the degree of "westernization" of the culture. But, through a combination of research, education, and enforcement programs tailored to the needs of the various island cultures, many of the most important coral reef management issues, such as the Crown-of-Thorns, can be addressed effectively.

In keeping with a central goal of other conservation programs in the Pacific, the creation of other marine protected areas throughout the Pacific will help to preserve environments and traditions characteristic of other islands and regions. In this respect, it is believed that Fagatele Bay will eventually evolve to serve as a model for other Pacific island nations where coral reef management, environmental awareness, and the maintenance of traditional culture are, or soon will become, important issues.

Uniquely Samoan

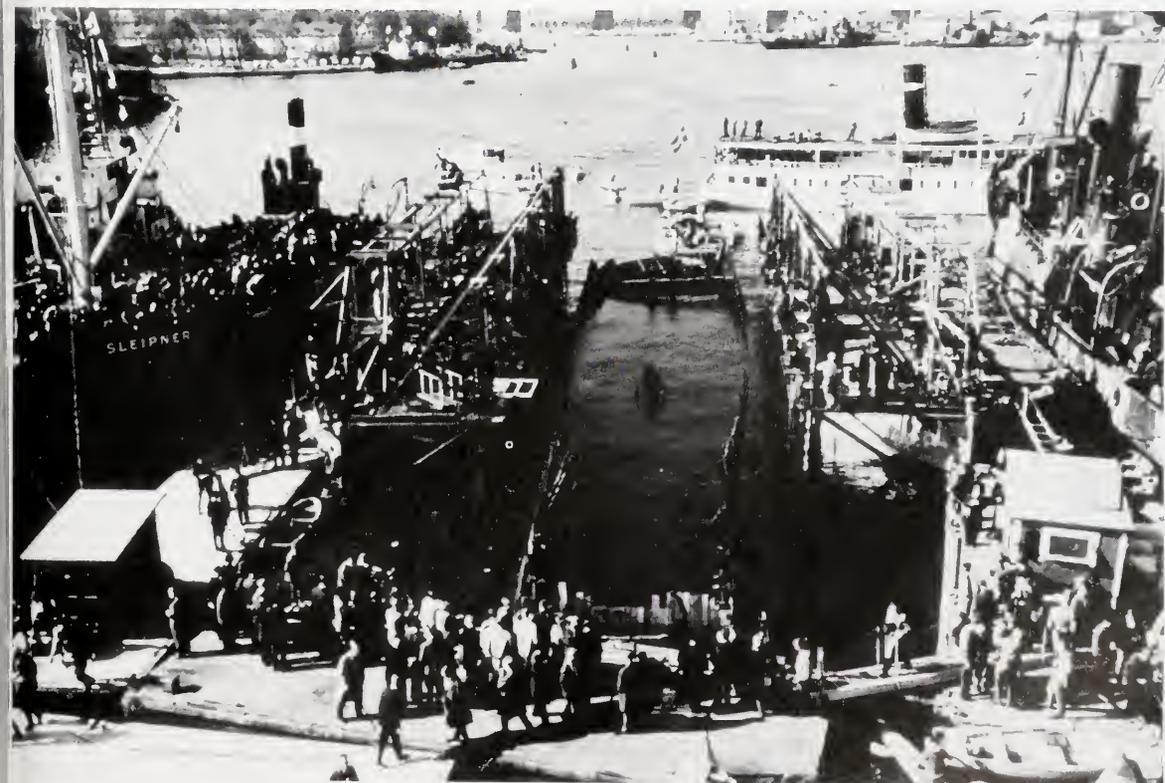
While coral reef management and environmental awareness are relatively new to American Samoa, continued cooperation from both Federal and Territorial governments will enhance the success of the sanctuary program. Through the Fagatele Bay National Marine Sanctuary, the legacy left for future generations of American Samoans will improve the quality of life, while maintaining a cultural heritage and identity that is uniquely Samoan.

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Views expressed are those of the author and do not necessarily reflect those of the agency of affiliation.

A Time for Decision on Submerged Cultural Resources

by Edward M. Miller



The 1628 Swedish warship Wasa was recovered from Stockholm harbor in 1961. This major shipwreck recovery project used conventional salvage technology, but the preservation of the ship required the development of new technologies for the conservation of waterlogged wood and metals. The Wasa is one of the largest tourist attractions in Sweden.

A conflict of interest exists between marine salvors and underwater archaeologists over the use of our nation's submerged cultural resources—mainly shipwrecks of historical value. The one side

hopes to preserve archaeological and historical information, while the other wishes to recover items of the greatest economic value in the shortest period of time.



Divers access to historical shipwrecks may be regulated if new legislation is passed. However, most wrecks will not receive this designation, and still will be available for recreational diving and exploration.

Presently, both interest groups seek "exclusive use" of the resource to achieve their desired ends, thus pitting the interests of science against profit. Archaeologists and marine salvors have argued recently for their interests in litigation and in Congressional testimony. Indeed, important legislation is pending in the House of Representatives—the Abandoned Shipwrecks Act of 1987 passed last December in the Senate. No national policy, however, for submerged cultural resources* has been developed. In the absence of such a policy, the courts have inconsistently based their decisions on the economic principles of maritime salvage law in disregard of the historical and archaeological values of submerged cultural resources.

Perhaps more important in view of the intensifying competition and resulting pressure on the resource as the result of modern technologies, little attention to date has been given by ocean policymakers to analyzing the public and national interests in these resources.

Salvage and Science

Archaeology is the science of studying man's historical and cultural past. Marine archaeology is a subspecialization of archaeology that uses many of the same underwater technologies as the other marine sciences. Similar to marine biology or marine geology, however, the technologies used, such as submersibles, diving systems, and remotely operated vehicles (ROVs), are not to be confused with the conduct of the actual science. They are merely the tools for scientific data collection. Typical of most marine sciences, much more time is spent analyzing data in the laboratory than in actual data collection at sea.

Keith Muckelroy, a prominent British marine archaeologist, defined marine archaeology as the "scientific study of the material remains of man and his activities upon the sea." As a science, the objective of archaeological research is to generate new insights and ideas through systematic research employing scientific theory and methodology. Where no written record exists, archaeology is the principal science that can provide information about man's past. Where historical records exist, archaeology provides information that either verifies or modifies interpretations of written documents.

Muckelroy describes artifacts as tangible forms of archaeological information. The ships, cargoes, fittings, or navigational instruments that the researcher is initially confronted with are ultimately used to study human behavior and culture. Archaeology is not, Muckelroy continues,

* Submerged cultural resources are those areas of the marine environment possessing historical, cultural, archaeological, or paleontological significance. They include sites, structures, and objects, significantly associated with, or representative of, earlier peoples, cultures, and human activities or events. Submerged cultural resources may generally be categorized as prehistoric remains; inundated cities, harbors, and shore installations; and shipwrecks. They are by their nature fragile, finite, and nonrenewable.

the study of artifacts simply for themselves, but rather for the insight they ultimately give about the people who made them and used them.

Marine archaeology employs principles, theories, and methods adapted for the marine environment from conventional archaeological research on land. To remove artifacts from a site without recording the archaeological context destroys the archaeological value of the object.

In contrast, marine salvage is motivated by profit. Herein lies the basis for the conflict over the use of submerged cultural resources between marine archaeologists and salvors. The concept of profit from underwater recovery, whether directly from the selling of artifacts, or indirectly from the awarding of a salvage prize, has its roots in ancient maritime law.

The law of salvage is based on assumptions of economic risks and the rescue of goods and vessels that are in peril on the sea. The emphasis is on rescue and uses economic reward as the motivation for the salvage act. The reward, apart from the saving of life, is based to a considerable degree on the value of the objects saved, which, after the filing of a salvage claim, is decided by the courts. Consequently, the salvor places the highest value on items having the greatest intrinsic value, and mostly discards all else. If the rightful owner does not assert any claim, the ship or cargo is declared "abandoned," and the salvor having already commenced the "act of salvage" can legally claim ownership of all recovered materials.

The *Atocha*, *DeBraak*, *Monitor*, and *Titanic* provide a representative sampling for comparison of the different approaches to dealing with submerged cultural resources as a method of evaluating where the "public" interest lies in their use.

Case Studies

The *Atocha* was a 17th-Century Spanish treasure galleon whose wreck was discovered off the Florida Keys in 1971. Initially, the salvage company that located the wreck entered into a salvage contract with the State of Florida because the wreck was thought to lie in state waters. However, the salvage company later filed a salvage claim in federal court challenging the authority of both the state and federal government over the site.

The federal courts found that while the federal government had asserted ownership and jurisdiction over mineral and other natural resources on the Outer Continental Shelf (OCS), the federal government had failed to assert similar authority over submerged cultural resources on the OCS. In the absence of any assertion of sovereign prerogative for submerged cultural resources, the courts applied maritime salvage law and awarded full rights and title to Treasure Salvors, Inc. This established the precedent that historic shipwrecks, lacking any enunciated policy to the contrary, would be treated as "ships in peril," and if determined abandoned, could be claimed by salvors having commenced the act of salvage.

This ruling set in motion a modern day "gold rush" by entrepreneurs seeking treasure-laden



A ship's lantern recovered from the Monitor site in 1977. It may have been used for the red signal of distress hoisted aboard the vessel the night she sank.

shipwrecks. The effects of this have been devastating on submerged cultural resources. Numerous nontreasure shipwrecks have been hurriedly and pointlessly torn apart by treasure hunters hoping to fulfill their dreams of discovering gold.

For more than 10 years, Treasure Salvors, Inc., headed by Mel Fisher, and financed by private investors who were promised a share of the treasure when it was discovered, searched for the illusive "motherlode" of the *Atocha*. To placate the mounting public concern for the methods that were being employed, workers attempted to conduct archaeological research. However, when there was a choice between archaeology and treasure, there was little question what they were seeking.

When the *Atocha* treasure was discovered in 1985, it was reported in the *Miami Herald* as "the greatest, the richest sunken treasure the world has ever known" and valued at more than \$200 million. Now, more than two years later, the treasure representing the largest assemblage of 17th-Century artifacts from the age of Spanish exploration of the New World has been largely dispersed for the sake of short-term economic gain. The archaeological and historical value of the recovered material has been greatly reduced, and the national interest in this aspect of the nation's heritage has perhaps been compromised.

In comparison, consider how a "treasure" of similar monetary value was treated on land. When the Tomb of Egypt's King Tutankhamun was opened, the world marveled, not only at the great

wealth that was uncovered, but also at the opportunity to reveal new information about the lifeways of earlier people. Many generations yet to come will be able to stand in awe of the grandeur and riches of the Egyptian civilization evidenced by the archaeological treasures that have toured the major cities and museums of the world. However, only two years after the discovery of the "motherlode" of the *Atocha*, the treasure has been distributed to profit-seeking investors, many of whom, as reported in the *Miami Herald*, are now contesting the amount of their "shares."

For those unable to view *Atocha* artifacts in the museum established by the salvors in Key West, Florida, and who did not invest in Fisher's treasure scheme, what remain are old issues of *National Geographic* magazine with photographs of the wreck, and gold coins, the numismatic value of which has been reduced because of the salvor's haste in cleaning them. There is also a loss to researchers, who will not have the opportunity to study the artifacts as a collection.

Similar circumstances unfolded in 1986 with the *DeBraak*, an 18th-Century vessel from the Colonial period of our history. The 1985 *Report to the President and the Congress of the United States* by the Advisory Council on Historic Preservation reported:

In Delaware, divers located the wreck of the 18th-Century British vessel DeBraak, one of the most exciting finds of recent years and one of the biggest discoveries ever of undamaged marine artifacts. The commercial salvors who discovered it are excavating the DeBraak under the direction of the State, which, as required under Delaware law, will take 25 percent of recovered materials. The archaeological community and other interested parties are watching this job closely to determine whether commercial and scientific interests and the public good can all be served at the same time.

The salvors recovery of the wreck and its artifacts using a clam-shell bucket approach, and the lack of any effort by the salvors or the state to properly conserve the artifacts pathetically validates the 1978 Council of Europe Report that the "motivation of profit dictates a speed and efficiency in salvage which is inevitably irreconcilable with the painstaking recording and controlled investigation of a site which archaeological standards require." Unfortunately, even some states, appearing greedy for their share of the treasure, states Dan Lenihan of the National Park Service, are "prone to view wrecks much the same way as treasure hunters do—as just another economic resource in the unharvested sea."

Today what remains of the hulk of the *DeBraak* and the once well-preserved artifacts are sad testimony that any plea for careful archaeological recording or proper conservation of recovered artifacts is either given token regard or completely ignored by salvors. The final irony of the *DeBraak* is that the destruction of the archaeological site, and even the actual recovery of the remaining hull structure, were undertaken by the salvors on the "rumor" that there was \$500

million in gold and silver aboard—but they found none.

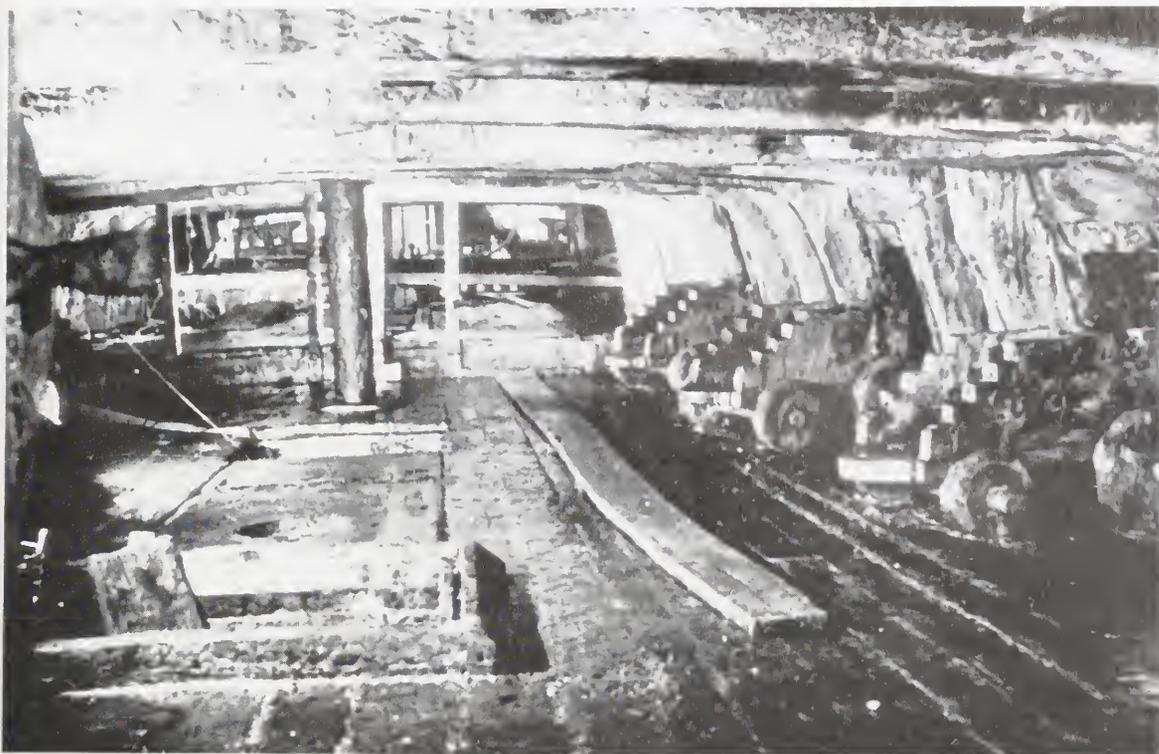
Some have expressed sympathy for the salvors who risked \$2.5 million of their investor's money in hopes of recovering gold, but we must ask ourselves: Who are the real losers in such cases? Unfortunately, the public interest in the cultural value of a fragile, finite, and nonrenewable resource has all but been totally destroyed in preference to its alleged salvage value. The people of the State of Delaware will never know the full value of what was lost, either materially or archaeologically, as the result of the depredation of their maritime cultural heritage. A "priceless" collection of 18th Century artifacts, perhaps rivaling some of the collections recovered from underwater sites in Europe, has been pointlessly destroyed. A sobering question is: How many other *DeBraak*'s have there been that have not made the headlines?

It may be instructive to reflect on the difference in outcome between the *Mary Rose* Project in England, or the *Wasa* Project in Sweden to that of the *Atocha*, or the *DeBraak*, in the United States. Today, the recovered 16th-Century Swedish warship has undergone conservation and is one of the biggest tourist attractions in Sweden. In Britain, generations of Englishmen will witness their cultural heritage in a maritime vestige of Henry VIII's England. In contrast, few Americans will have the opportunity to learn and appreciate the cultural heritage of this nation that has been preserved under ocean sediments for hundreds of years unless a national policy for submerged cultural resources is developed that balances short-term economic needs with the long-term public interest of preserving the cultural identity and heritage of the United States.

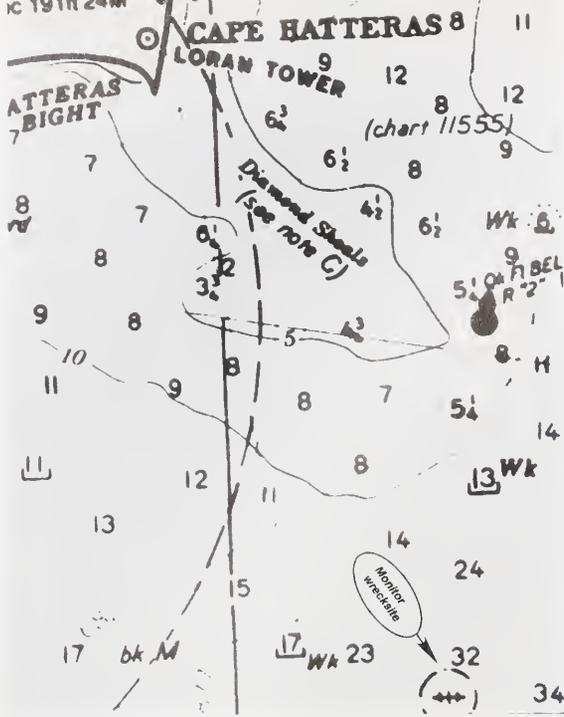
When the wreck of the famous Civil War Ironclad *USS Monitor** was designated the nation's first marine sanctuary in 1975, there was widespread public interest in the prospects that the wreck would someday be raised. However, it was soon discovered that there were many more questions than answers that needed to be addressed before any decision on the ultimate disposition of the shipwreck could be made if the wreck was to be treated in a responsible manner. One of the first questions has always been: What will it cost?

The decision after the 1978 National Conference on the *Monitor* to treat the wrecksite as an archaeological site and to proceed in a scientific manner created, in effect, the first federal underwater archaeological reserve in the United States. It was the general consensus then that "due to the ship's historical significance, and the high public interest in it, the project warrants careful and deliberate planning so that a maximum return

* At the beginning of the Civil War, the Confederates converted a warship into an innovative ironclad vessel, the *Virginia*, in an attempt to break the Union's naval blockade. The Union built their own ironclad, the *Monitor*, and launched her on January 30, 1862. The designs were a radical departure from previous naval warships, and led to several famous naval battles in the Civil War.



The 1628 Swedish warship Wasa has been preserved intact with remarkable success. Above, the lower gundeck on the port side. Below, The Wasa museum in Stockholm, one of the largest tourist attractions in Sweden.



Since designation as the nation's first marine sanctuary in 1975, the Monitor wreck site has been marked on navigational charts of the area. The sanctuary lies 20 miles southeast of Cape Hatteras, North Carolina, in 70 meters (230 feet) of water. No anchoring, dredging, diving, or other activities that may disturb the wreck site are allowed without a permit from NOAA. The close proximity of commercial shipping lanes, high currents, and poor visibility make diving in the sanctuary hazardous.

and benefit can be derived from the American public." This initial policy statement provided an early solid basis for the management program for the *Monitor*. Attitudes concerning the disposition of the shipwreck changed from what could be done in 1975, to what should be done after the conference in 1978, thus openly acknowledging the cultural responsibility associated with dealing with a historic shipwreck such as the *Monitor*.

A major emphasis has been placed on the decision-making process, which will hopefully ensure the maximum benefit for the American people, without degrading the historical and archaeological value of the site. Initial research has concentrated on learning more about the condition of the wreck and its interaction with the marine environment so that management decisions would be based on scientific data rather than speculation.

In 1982, the following goals were established for the sanctuary:

- To protect and preserve the *Monitor* and all its associated records, documents, and archaeological collections.
- To ensure the scientific recovery and dissemination of the historical and cultural information preserved at the *Monitor* site; and to develop the physical remains of the *Monitor* in a manner which appropriately enhances both the significance and interpretive potential of the vessel.

- To enhance public awareness and understanding of the *Monitor* as a historic and cultural resource by providing interpretive educational services and materials.

These management goals have guided the development of research and management objectives for the sanctuary. The initial management effort was directed at establishing an orderly review process for proposals from researchers. Because of the 230-foot depth of the wreck and the high currents recorded at the site, it is beyond the safe limits for sport diving. As a result, only institutionally-sponsored scientific expeditions using sophisticated diving equipment have been permitted to conduct research in the sanctuary.

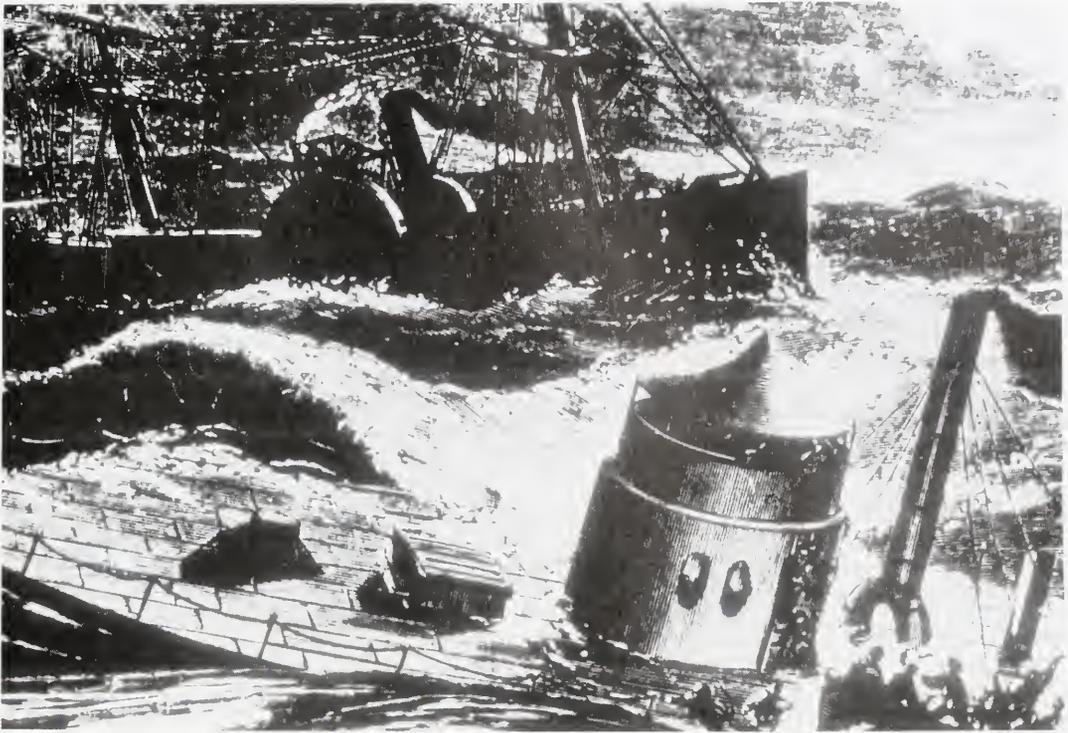
Since designation, 12 scientific expeditions to collect oceanographic, environmental, engineering and archaeological data have been conducted in the sanctuary. The National Oceanic and Atmospheric Administration (NOAA) has sponsored five of these. The most extensive was the 1979 joint expedition with the Harbor Branch Foundation and the State of North Carolina, which involved two research vessels and utilized the Johnson Sealink submersibles to conduct 49 dives in 26 days. The results included the collection of more than 100 artifacts from a test excavation, setting the record for the deepest archaeological excavation in the United States to date.

In June of 1987, NOAA and the U.S. Navy collaborated on the latest expedition, using the Navy's remotely operated vehicle, Deep Drone, as the survey platform. Through an interagency agreement with the Supervisor of Salvage and Diving, the latest technology for deep ocean search and recovery was made available and adapted to archaeological survey.

One of the most important surveys was the collection of corrosion data over the entire wreck. This study will tell us where active corrosion is occurring and identify what portions of the wreck are adversely affecting others, similar to the anode and cathode of a battery. Once this is determined, then the possibility exists to "manage" the future deterioration of the wreck by protecting areas of interest using modern corrosion engineering techniques developed for offshore structures.

The continuing corrosion of the remaining structure is one of the principal destructive mechanisms affecting the wreck today. The rate of deterioration of the historic structure to saltwater corrosion and the resulting threat of structural collapse due to the manner the hull is supported off the seafloor by the displaced turret is the major management issue confronting long-term planning for the *Monitor*. The structural collapse of the hull would severely disrupt the archaeological record at the site and greatly accelerate the rate of deterioration by exposing newly fractured surfaces to the corrosive marine environment.

The *Monitor* has rested on the seafloor undisturbed by man for more than 125 years. It may survive for another 100 years or, on the other



A Harpers Weekly engraving of the sinking of the Monitor on the morning of December 31, 1862. The Monitor was under tow in heavy weather to participate in the siege of Charleston. All but 16 of her crew were rescued by the U.S.S. Rhode Island.



Side-scan sonar image taken in 1985, showing the extent of the debris field around the Monitor wreck site. A primary objective of the 1987 survey was to determine the extent of the site, and identify as many of the scattered objects as possible. The 1987 survey also gathered corrosion data.

hand, it may be on the brink of collapse. The prospect of controlling the rate of deterioration, and perhaps even starting the conservation process on the seafloor, only buys time, and hopefully will insure that those portions of the wreck and its artifacts that may eventually be recovered will not deteriorate any further.

The long-term question of the ultimate disposition of the wreck is being addressed by conducting an alternatives study of all preservation options spanning a spectrum from nondisturbance to limited site excavation and recovery of loose artifacts, to complete recovery of the hull and turret. This effort is part of the development of the master plan for the sanctuary. No preservation option can be decided on until it is known what technologies will be required to implement not only the recovery, but also the conservation and display of any recovered items; and what the long-term costs of successfully completing the project will be.

It is for these reasons that recent emphasis has been placed on precisely determining the historical significance of the *Monitor* from a museum interpretation viewpoint so that those features can be preserved and possibly recovered from the site. Is the *Monitor's* technology represented by its engine or its novel turret? Is the *Monitor*, collectively, a symbol of American ingenuity? What preservation priority should any of these items receive?

In addition to evaluating the physical methods of preserving what remains on the seafloor, an ambitious program of historical and architectural documentation has been undertaken to improve our knowledge of how the ship was originally built. While this information is a

prerequisite for the evaluation of proposed preservation alternatives, this also provides some "downside" assurance that, regardless of the final disposition of the wreck, we will have at least preserved the existing record of the *Monitor* by preserving known historical records and artifacts, and organizing the national collection of *Monitor* artifacts and papers—comprising both public and private collections—as part of the national stewardship for this resource.

This comprehensive program of historical, engineering, oceanographic, and archaeological research and long-term planning prompted the Secretary of the Interior to designate the *Monitor* as the first shipwreck to be individually designated as a National Historic Landmark (NHL) for its exceptional national significance. This places the *Monitor* in the same category as Mount Vernon and the Statue of Liberty. During the same NHL ceremonies on March 9, 1987, commemorating the 125th anniversary of the Battle of the Ironclads, The Mariners' Museum in Newport News, Va., was designated as the principal museum for the National Collection of *Monitor* Artifacts and Papers. This renowned maritime museum will serve as the national repository for historical and scientific information on the *Monitor*.

While not every submerged cultural resource captures the public interest, or is as significant as the *Monitor*, the management experience gained with managing this shipwreck has provided the opportunity to develop programmatic policies and guidelines for submerged cultural resources.

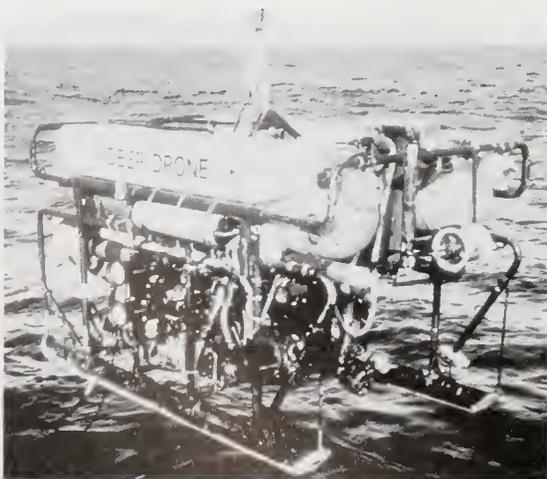
In 1984, the program's regulations were revised to reflect the implementation of the cultural resource component of the National Marine Sanctuary Program. The revised regulations provide the blueprint for designating other nationally significant submerged cultural resources, similar to the *Monitor*, as sanctuaries. Additionally, the program's policies and guidelines for submerged cultural resources apply equally for sanctuaries already part of the national system.

The program is developing a balanced approach to submerged cultural resources that reflects both public and private interests in these resources. Not only do historic shipwrecks have historical and archaeological value, but they also have recreational value for the growing number of sport divers who enjoy visiting these resources.

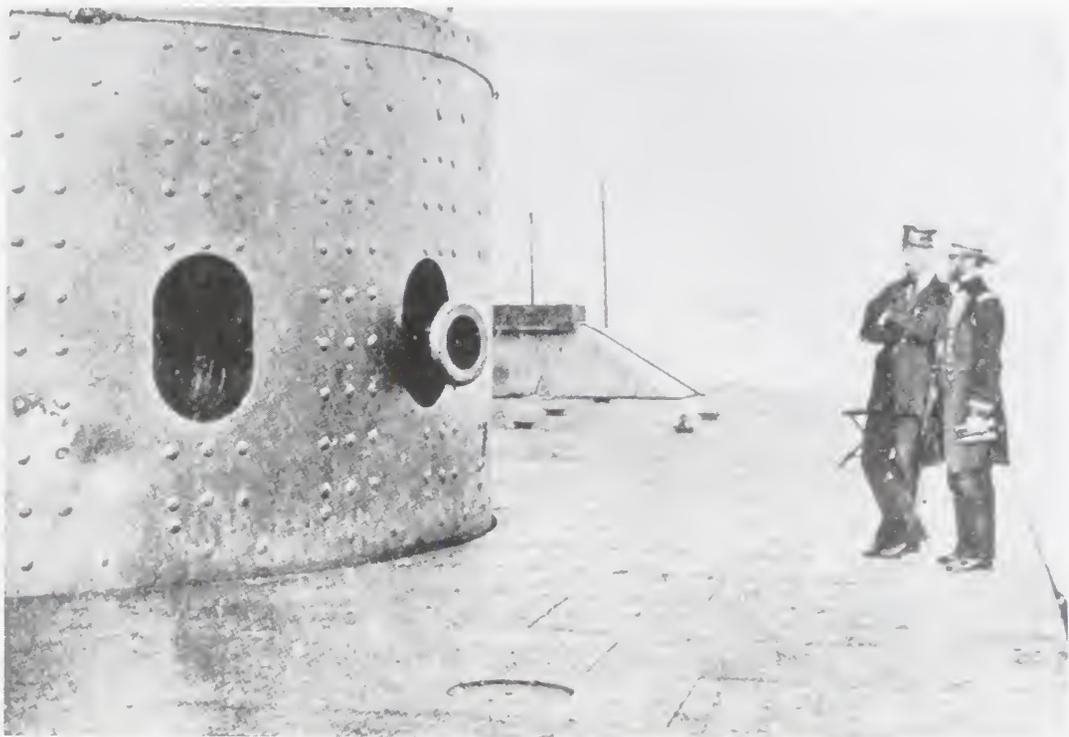
A Time for Decision

The National Marine Sanctuary Program is a relatively small federal program. It is the only mechanism for protection of nationally significant submerged cultural resources beyond the territorial sea. To better fulfill its Congressional mandate and continue the development of the cultural resource component by designating new cultural national marine sanctuaries, it is evaluating ways to better utilize the institutional resources within its own agency.

NOAA's potential as an agency to further develop the nascent marine science of underwater archaeology goes far beyond the scope of National Marine Sanctuaries. In areas such as technology



The U.S. Navy's ROV, *Deep Drone*, was used to survey the *Monitor* site in 1987. It carried 70-millimeter and 35-millimeter stereo, still, and video cameras, along with an acoustical navigation system. This was the first time this technology was used for archaeological survey.



Officers inspecting damage to the Monitor's turret armor after a battle. (From Photographic History of the Civil War)



A 1979 photograph of one of the Monitor's gunports protruding from the bottom, still sealed by the iron port stopper. The protruding rod was used to attach an external wooden shutter.

Shipwreck Legislation Pending in Congress

On Dec. 19, 1987 the Senate passed S. 858—The Abandoned Shipwreck Act of 1987. The bill has been referred to the House Merchant Marine and Fisheries Committee and the Interior and Insular Affairs Committee for consideration. Similar legislation has been introduced in the House. Final action is expected this session of Congress.

Summary of S. 858:

- Transfers to the States title to certain abandoned shipwrecks (excepting wrecks on Federal and Indian lands which remain in Federal or Indian ownership).
- Requires the Secretary of the Interior to prepare guidelines to help States and Federal agencies develop legislation and regulations.
- Encourages States to create underwater parks, and clarifies that funds from the Historic Preservation Fund may be used to

study, interpret, protect and preserve historic shipwrecks.

Two points are noteworthy: 1) shipwrecks lying outside the boundary of the defined 3-mile state waters are not addressed by this legislation, and 2) only a small percentage of total shipwrecks will be designated as historical shipwrecks, and subject to regulation.

The second point can be elaborated on. The majority of all wrecks will not receive the historic designation, and will remain available for recreational diving and exploration. Neither will those wrecks designated as historical automatically be closed to divers. Rather, it is recognized that while historic shipwrecks have historical and archaeological value, they also have recreational value for a growing number of sport divers who enjoy visiting these resources—undisturbed in their natural environment. By developing a program that provides maximum public access consistent with resource protection, sport divers of future generations will be able to enjoy wreck diving in marine protected areas. Rather than being dismantled and stripped, selected important wrecks will be preserved.

transfer, information exchange, international cooperation, the development of new technologies for archaeological research in the ocean environment, and the conservation of marine artifacts, NOAA has much of the technical expertise and managerial capabilities required.

In 1986, the U.S. Congress passed the *RMS Titanic* Maritime Memorial Act in response to the technological achievement of locating this wreck, and concerns that it would be exploited by treasure hunters and other entrepreneurs. This Act expressed "the sense of Congress" that shipwrecks having "major national and international cultural and historical significance," such as the *Titanic*, merit "international cooperation and protection from indiscriminate salvage due to their scientific, historical, and cultural value [emphasis added]." This legislation represented a significant milestone in the recognition of a shipwreck as a historic and cultural resource, rather than as a salvage prize.

On December 19, 1987, the U.S. Senate passed the Abandoned Shipwrecks Act of 1987. This bill (S. 858) asserts U.S. ownership of certain abandoned shipwrecks in state waters and transfers titles to the states, encourages the states to create

underwater parks, while guaranteeing recreational exploration of shipwrecks and protecting natural resources and habitat areas. Most significantly, however, it states that the Law of Salvage and the Law of Finds shall not apply to historic shipwrecks. While the bill, and several similar bills are still pending in the House, this attention by Congress may signify that the controversy for exclusive use of historic shipwrecks may be superseded by a concept of national interest in this marine resource.

These two Congressional actions appear to indicate a gradual awakening to the fact that the greater public interest lies, not in the economic value of submerged cultural resources, but in preserving their historical and archaeological values.

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Views expressed are those of the author and do not necessarily reflect those of the agency of affiliation.

The M/V *Wellwood* Grounding: A Sanctuary Case Study



The freighter M/V *Wellwood* hard aground on Molasses Reef in the Key Largo National Marine Sanctuary off Key Largo, Florida (August 1984). (Photo by Aerial Photos International)

AERIAL PHOTOS INTERNATIONAL

The Science

by Stephen R. Gittings, and Thomas J. Bright

In the early morning of 4 August 1984, the 400-foot, Cypriot-registered freighter *M/V Wellwood* ran aground on Molasses Reef in the Key Largo National Marine Sanctuary (Figure 1). The vessel remained firmly aground at a minimum depth of approximately 6 meters for 12 days. She was dislodged by tugs on 16 August after much of her fuel and cargo (animal feed grain pellets) were off-loaded to other vessels. Molasses Reef, located 5.5 nautical miles offshore from Key Largo, Florida, is one of a series of separate outer-bank barrier reefs that constitute the "Florida Reef Tract." It is a very popular reef for divers, snorkelers, and sport fishermen.

The *Wellwood* grounding turned a portion of this flourishing coral reef into what looked like a parking lot. Massive and branching coral heads were toppled, abraded, or simply crushed by the 6,000-ton ship. Many gorgonian corals (sea fans, sea whips, and sea feathers) not destroyed completely were reduced to skeletons by the harsh grinding of the ship over the reef. Numerous other bottom-dwelling organisms also were crushed by the ship. The most heavily damaged area of the reef lost virtually all its three-dimensionality; most cryptic habitats (for example, crevices and overhangs) previously utilized by reef invertebrates and fishes were eliminated.

It was obvious that extensive damage had

occurred to Molasses Reef. Because the federal government planned to bring suit against the owners, operators, and managers of the vessel, legal steps required the implementation of a scientific investigation to assess the extent of damage to the reef, and the potential for recovery. The National Oceanic and Atmospheric Administration (NOAA), which regulates activities within national marine sanctuaries, awarded a contract to the Texas A&M University Department of Oceanography (Thomas J. Bright and George D. Dennis) to study the affected coral and reef fish populations. In addition, NOAA asked the Harbor Branch Oceanographic Institution (M. Dennis Hanisak, John Reed, and Steve Blair), and the Smithsonian Institution (Mark and Diane Littler) to examine the algae community of the reef.

All three studies (coral, reef fish, and algae) used nondestructive sampling techniques. Coral and algae studies employed photographic methods and artificial substrates to quantify population levels and mortality, tissue damage and regrowth, and recruitment (recolonization by new individuals through settlement and growth of coral larval forms). The fish were examined visually to assess their population changes. Some video and time-lapse photography also were used to study behavioral patterns.

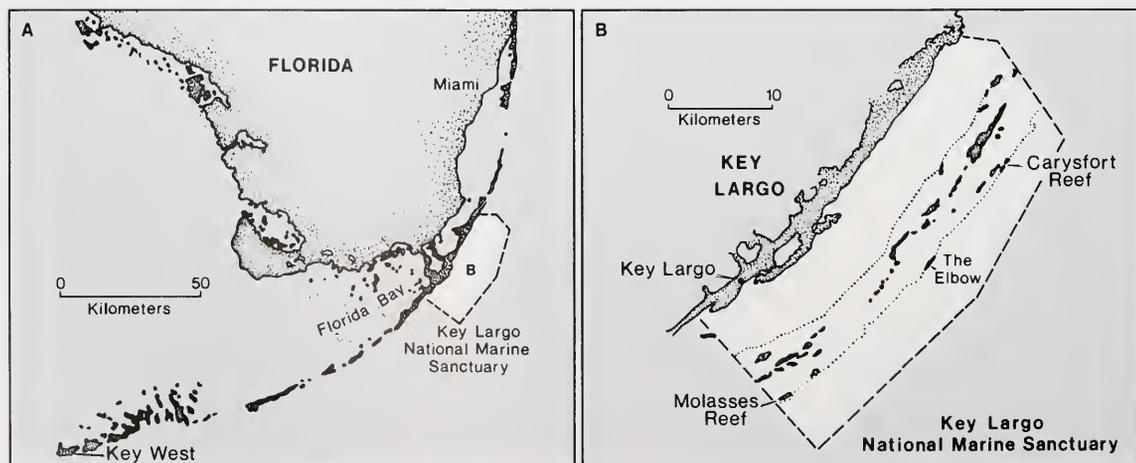


Figure 1. The Florida Keys (A), the Key Largo National Marine Sanctuary (B), and Molasses Reef.

Reef Damage

The grounding and removal of the ship caused substantial damage to the reef substratum and benthic marine populations to a depth of at least 15 meters. The damage suffered by Molasses Reef can be divided into three categories:

- **Primary Contact.** On her approach, the Wellwood apparently was traveling northeast, almost parallel to the reef face, but on a slightly converging course. Her first contact with the seafloor was in approximately 8 meters of water, southwest of the final grounding site (near Area BS in Figure 2). During this initial phase, large corals protruding more than a meter above the surrounding bottom were damaged. The species that were damaged most were the massive star coral, *Montastrea annularis*, and a large-grooved brain coral, *Colpophyllia natans*.
- **Grounding.** The Wellwood ran aground at a depth of about 6 meters on the upper forereef, just seaward of a narrow zone of elkhorn coral. Initially oriented northeast, the ship pivoted to port and finally lodged firmly on a course of 017 degrees. In the area under the bow and amidships (Area BB in Figure 2), the broad tops of forereef spurs were ground flat by the bottom of the ship, and linear piles of boulders were

thrown up on the port side. According to Carroll Curtis, formerly of NOAA's National Marine Sanctuaries Division, Area BB resembled "a graded roadbed covered with a veneer of coralline debris." In this area and in other areas flattened by the ship's hull, nearly all corals were destroyed. Area BB constituted approximately 1,500 square meters of the reef.

In the larger depressions beneath the ship, coral mortality was less severe. However, subtle but significant effects on hard corals were apparent. These corals were exposed to extreme shading for the 12 days the ship remained aground, in many cases expelling their zooxanthellae (symbiotic algae necessary for vigorous growth) because of a lack of sunlight. Zooxanthellae are vital to the growth of coral colonies—they assist in calcification, respiration and possibly act as a source of food. Their absence results in "bleached" corals which grow much more slowly than healthy coral. Significant tissue loss often occurs before the coral regains its full complement of algae (this generally requires 6 to 9 months). The massive star coral, *Montastrea annularis* was most often affected; some other species were apparently more resistant. The phenomenon affected many coral heads that had been lying on their sides or

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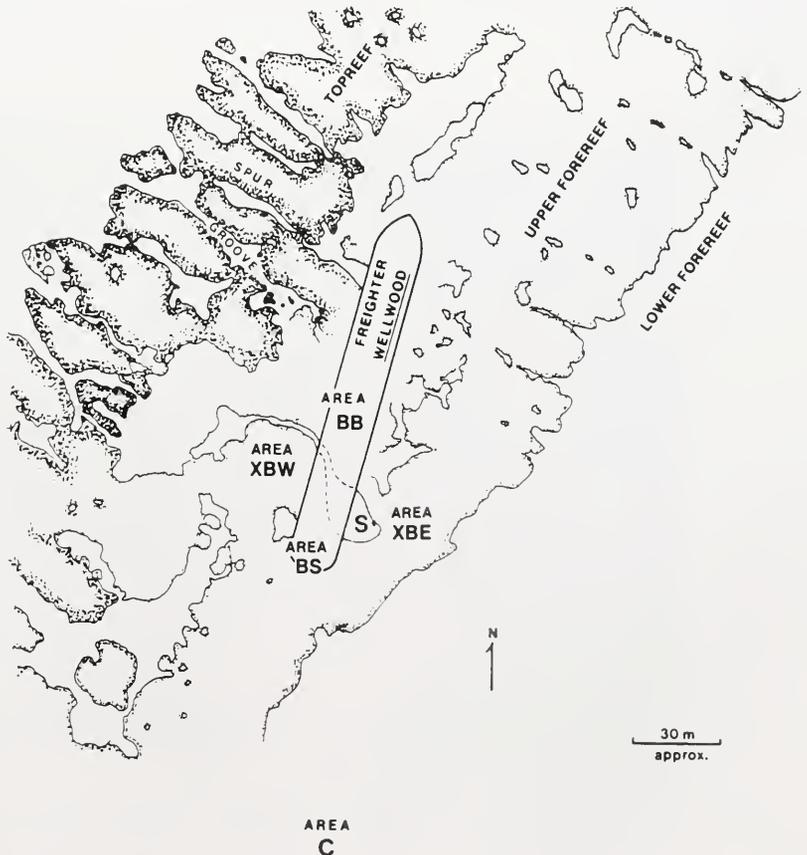


Figure 2. Location of the freighter Wellwood, hard aground between August 4 and 16, 1984, on the upper forereef of Molasses Reef, Key Largo National Marine Sanctuary (shallow water to the northwest, deeper water to the southeast). Areas BB and BS constitute the major grounding site and environs. Areas XBE and XBW are control areas to the east and west of the grounding site, respectively. Area C is the area of damage by towing cables. S is a sand basin chosen as a central work area.



A portion of the area on Molasses Reef most heavily disturbed by the grounding of the 400-foot freighter, M/V Wellwood (Area BB in Figure 2).



Partial recovery of tissue of the star coral, *Montastrea annularis*, over the fractured skeleton of a coral head. The recovery represents approximately 1 centimeter growth (almost half an inch) during a 1-year period following the grounding.



*Pillar coral, *Dendrogyra cylindrus*, damaged by the ship grounding in August 1984. The tall spire was reattached using underwater cement shortly after the incident. It had nearly completely recovered when this photo was taken in November 1986. The other spires were not reattached and the surrounding tissue had not yet grown over the exposed skeleton.*



Quarry tiles used as one of several methods of assessing hard coral recruitment at the grounding site.

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upside down (as a result of disturbance by the ship. These were later uprighted by John Halas, sanctuary biologist, and his colleagues.

• **Ship Salvage.** Corals and sponges also were damaged by tug cables used to pull the ship off the reef. This was the primary impact in the reef zones deeper than the Wellwood's 26-foot draft (especially Area C on Figure 2). Though deep on the forereef, Area C harbors an abundance of hard corals, gorgonian soft corals, sponges, and leafy algae. The dragging of cables in this area sawed off the tops of hundreds of large basket sponges, *Xestospongia muta*, which normally stand high above the bottom and are quite brittle in texture. The cables also damaged a number of large coral heads.

A great deal of loose reef rubble was strewn around Area BB. According to Lieutenant Commander William Harrigan, manager of the Key Largo National Marine Sanctuary at the time, much of this debris was produced by propwash during the ship's effort to free herself from the reef. One groove and part of a sand basin beneath the stern of the ship (S in Figure 2) were partly filled with cobble- to boulder-sized pieces of reefrock and broken coral heads by propwash. Numerous skeletons of recently dislodged gorgonian soft corals in the same sand basin served as further evidence of propwash damage.

Study Summaries

Coral Study. In the most heavily damaged areas of the reef, more than 90 percent of the hard corals and 98 percent of the gorgonians were destroyed by the grounding of the *Wellwood*. Where 10 to 15 hard corals per square meter had existed before, less than 1 remained. Virtually all of the 2 to 4 gorgonians per square meter in these areas were destroyed. In moderately damaged areas, the destruction was about half that in heavily disturbed areas.

We estimated that recovery to preimpact population levels may require about 7 to 10 years in moderately damaged areas, and on the order of two decades (12 to 27 years) in heavily disturbed areas of the reef, based on the limited recovery observed in the 2-year study period following the grounding. However, recovery of the corals to preimpact sizes will take many decades of growth following the re-establishment of preimpact densities. Furthermore, the number and severity of disturbances, primarily hurricanes, that occur during the reef's recovery must be a factor affecting complete recovery time.

The corals colonizing the damaged reef during 1985 and 1986 appeared to be the same ones that are common on undamaged portions of Molasses Reef. The lack of so-called "opportunists" may be important in enhancing the recovery of the reef. Opportunists are species that initially colonize disturbed habitats, compete for space and food, and can exclude or delay the recovery of the environment's dominant plants and animals.

We also found that coral recruitment was highest in damaged areas with at least some surviving adult corals. Recruitment was lower (one-half to one-sixth as high) in both denuded areas and undisturbed areas. This suggests that recovery can be enhanced in heavily damaged communities if the number of adult corals is increased. NOAA is now considering a transplanting effort in which adult corals will be cemented onto denuded areas of Molasses Reef. A pilot transplant effort was carried out for NOAA at the site by J. Harold Hudson of the U.S. Geological Survey. He found that, whereas stony corals transplanted and survived well, survival of gorgonians was lower (the most significant cause of mortality was Hurricane Kate in November of 1985).

Coral recruitment also was affected by the nature of the top of the reef after the *Wellwood* grounding. Corals that settled on broken, loose, or pulverized reef material generally did not survive. During storms and heavy seas, much of this loose debris was tossed about, crushing the fragile, newly-settled coral polyps.

Approximately 15 months following the *Wellwood* grounding (on 18 and 19 November 1985), Hurricane Kate passed approximately 120 miles south of Molasses Reef. The maximum sustained winds off Key Largo between 5 a.m. 19 November and 5 p.m. 20 November were between 50 and 60 knots, according to the National Weather Service. Seas, out of the southeast, were 12 feet or more.

Ironically, Hurricane Kate may have significantly enhanced the recovery of Molasses Reef. Debris and sediments created by the *Wellwood* as it ground onto the reef top filled numerous voids and depressions in the hard substratum. These were flushed out by the storm. This left a much more stable and irregular substratum, one more favorable to successful settlement and growth of corals.

These findings also may have important management implications. One measure that should be considered following a large ship grounding is the removal of loose and broken reefrock and the vacuuming of fine sediments. This would better prepare the remaining hard substratum for settlement by new corals and other reef biota.

A study of coral tissue growth on damaged heads of the massive star coral, *Montastrea annularis*, disclosed that corals tend to stabilize and grow quite normally after approximately 3 to 6 months recovery time—except for colonies displaced from their original locations onto sand flats or sand-filled depressions. Coral encrusting growth is generally very slow (growth of tissue over the substratum occurs at a rate of about 0.8 centimeters per year). But on coral heads displaced into sand, more than three times as much coral tissue was lost in the two years following the grounding than was gained by encrusting growth of the coral colonies. These corals should be considered candidates for transplantation, since they probably will continue to deteriorate if left in sand.

Algae study. Much of what was found in the coral study also applied to reef algae populations. Complete recovery, for example, was not found in either case. Both studies reported the existence of immature communities. These communities lacked the biological complexity (the number of species, for example), habitat complexity (three-dimensionality), and stability of well-developed communities. Also, recruitment and survival of algae during the first year of recovery were affected by the unstable nature of the substratum resulting from the grounding. Finally, Hurricane Kate, which cleared much of the unstable rubble and sediments from the reef top, allowed for higher survival of both algae and coral.

One difference noted between the algae and coral studies was the effect of seasonality on data analysis. Algae species, many of which grow rapidly, may be very different from one season of the year to another. It is often difficult to distinguish between seasonal and successional changes* in a study such as this.

Reef fish study. The ship grounding caused significant changes in the reef fish population at the grounding site. While the ship was on the reef, fish were actually attracted to the vessel much as they are to artificial reefs. Changes in fish behavior also were noted, particularly more active feeding on damaged and dead reef organisms. As soon as the ship was removed and the food was exhausted, the fish were gone.

Re-colonization during the first few weeks after the grounding was primarily by fish feeding on algae that commonly grow on fractured reefrock following a disturbance. The number of fish species in Area BB increased rapidly, but leveled off after 60 to 90 days. During the two-year study period, recovery of preimpact fish populations or biomass did not occur. The failure of the area to recover is probably attributable to the lack of substrate complexity in Area BB. Many fish species use the reef to escape predation and for food. Furthermore, the higher the reef complexity, the greater the amount of food. Increases in complexity and food, in turn, generally lead to more fish species and often to higher abundances.

* Succession is an orderly process of community development that involves changes in species composition and community processes.

Presumably, fish population recovery from now on will parallel the increase in reef complexity that takes place during the recovery of the reef coral and algae communities.

In summary, the studies predict that at least several decades will be required for the severely damaged portion of Molasses Reef to recover to preimpact coral, algae, and fish population levels and community structure. Recovery can probably be facilitated by appropriate management procedures, including 1) removal of loose sediment and rubble following such disturbances, thereby providing a more suitable substratum for natural biological recruitment, and 2) transplanting of adult hard corals into the damaged area to immediately increase population levels and, more importantly, to serve as a local source for coral larvae for recruitment.

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Acknowledgments

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Management: Coping With Disaster

by William J. Harrigan



Molasses Reef with the M/V Wellwood aground, looking northward. The Molasses Reef light tower can be seen at left.

The *M/V Wellwood* was a heartbreaking sight on Saturday morning, even from 5 miles away. The large freighter was obviously hard aground, very close to the Molasses Reef light tower, about a mile inside the southern boundary of the Key Largo National Marine Sanctuary. Only a month earlier—on the Fourth of July—the same reef had hosted 68 dive boats at once, many in the exact area now occupied by the stranded vessel.

The *Wellwood* was pointed northward, which was surprising because North-bound vessels usually stay well offshore to gain maximum benefit from the swift Gulf Stream. South-bound vessels frequently hug the reef line, and are at greater risk of running afoul of the reefs. The officers of the *Wellwood* depended solely on satellite dead reckoning to negotiate the Straits of Florida while enroute to Europe from New Orleans.¹ Using such navigational fixes as the sole means of determining the ship's position is not considered prudent, especially in areas of high currents and restricted passages. So, despite fully functioning radar and depth-sounding equipment, the vessel smashed into Molasses Reef at 10 knots just after midnight.²

The situation that August morning in 1984 included major natural resource damage to the most popular reef in the sanctuary, a non-communicative captain still desperately trying to back his ship off the coral, boats full of recreational divers loading up ashore, and a newly assigned sanctuary manager with only one functioning patrol

vessel. A 100-yard diver safety zone was immediately established around the ship. The vessel was then boarded and the captain was issued an initial legal citation. He was informed that further salvage attempts must have sanctuary approval. Then the call went out—loudly—for help.

Many Provided Help

Assistance arrived quickly and from many sources. A formal cooperative agreement to provide law enforcement support was already in effect between NOAA and the Florida Department of Natural Resources. The staff at nearby John Pennekamp Coral Reef State Park provided personnel, vessels, and communications during the incident. The Looe Key National Marine Sanctuary, located 70 miles away, provided people, boats, and equipment; Biscayne National Park brought a boat south, and the Florida Marine Patrol provided assistance on the scene and supplemented the work of a NOAA helicopter in the air. The Monroe County Sheriff's office also provided a vessel and personnel. Volunteers performed countless jobs and the community assisted everyone's efforts with general support.

An effective cooperative effort between NOAA and the U.S. Coast Guard was vital to the sanctuary during this incident. The reefs within the sanctuary boundaries are protected by NOAA regulations, while the Coast Guard intervenes throughout U.S. waters when a vessel emergency or the danger of a hazardous spill exists. Without specific agreements regarding vessel groundings, a working relationship rapidly developed on the scene in which the Coast Guard directed the actual vessel salvage with advice and approval from NOAA regarding possible impact of any operation of the reef environment. The problem was not just to move the vessel, but to move her with minimum further damage to the coral.

The *Wellwood* had been drawing 26 feet prior to the grounding, and now more than half her hull was solidly atop the reef in 20 feet of water. The *Wellwood* Shipping Company's representatives attempted to refloat the vessel unsuccessfully using various combinations of power: towing with a single tugboat; pumping saltwater ballast overboard; using the ship's main propulsion; and employing a large pulley system connected to an anchor called beaching gear. After 4 days, NOAA and the Coast Guard were both dissatisfied with the owner's attempts. The Coast

Guard Captain of the Port of Miami assumed formal command of the salvage on 8 August. During the following week, the salvage effort escalated. All oil in the hull's double bottom was removed, four more tugs and a second beaching gear were added, and finally 700 tons of the animal feed cargo were transferred out of the vessel. The fuel removal was necessary to prevent a spill in the event that one of the double bottom tanks, as yet intact, might be breached when the ship was finally moved. This procedure was successfully undertaken with extreme caution by a special Coast Guard team assisted by sanctuary personnel.

At NOAA's insistence, the feed removal was accomplished by vacuum hoist rather than clam shell grabs in order to prevent the introduction of large amounts of organic material to the reef environment. A fine dust of yellow feed made life miserable for two days in the immediate vicinity of the *Wellwood*. In directing the salvage, the Miami Port Captain received additional assistance from U.S. Navy salvage advisers and a contract salvage master.

Operations had now been under way for nearly two weeks. Representatives of the owners, the Coast Guard, NOAA, and the salvage companies were always on the scene, and NOAA personnel were frequently in the water guiding the salvage vessels, Coast Guard cutters, and barges while they maneuvered around the delicate reef and set gear on the bottom. Whenever a lull occurred in this activity, sanctuary staff returned to the task of mapping the coral damage.

Long-Term Studies Ordered

Assessing the extent of damage began on the first day of the grounding. Sanctuary biologists from both the Key Largo and Looe Key sanctuaries started marking, mapping, and photographing the area. They were joined by researchers and photographers from state, university, and private practice. Sixteen SCUBA tanks were in constant rotation from the air filling station to the sanctuary research vessel *Polyp*, stationed semi-permanently on scene.

The investigation disclosed that 5,805 square meters of reef had been almost totally destroyed by the vessel's hull during the initial grounding.³ When the magnitude of the damage became apparent, NOAA contracted with a team of scientists to begin comprehensive, long-term studies at the site.

As the salvage effort increased, the safety zone was expanded to 500 yards. Media interest also grew, and eventually reached national proportions. Television, newspaper, and magazine reporters were welcome. Public awareness is an important aspect of managing and protecting the national marine sanctuaries. But handling the media soon became a balancing act: on the one hand, providing information on salvage operations and damage assessment, and on the other, following the NOAA legal counsel's guidelines regarding statements to be avoided. The case against the vessel's operators and owners was already being prepared. Premature or inaccurate

statements could have jeopardized that process. On 7 August, a formal press session was held aboard a chartered glassbottom boat to allow the media a look at the scene. Other coverage continued throughout the incident with interviews conducted ashore and at sea. When media interest peaked, the number of news helicopters hovering over the grounded ship was enough to interfere with radio communications on the salvage boats.

Ship Finally Freed

On 16 August, a maximum-effort pull was made with four tugs, the ship's power, and two sets of beaching gear. Finally, after 12 days, the *Wellwood* slid backward and cleared the reef. She sailed to a Miami anchorage, and was immediately seized by U.S. Marshals until two bonds were posted in the amount of \$4.6 million to cover the sanctuary violations and damages.

The elation of the successful salvage was quickly dampened by grim reality; the stark whiteness of the broken coral in the damage area appeared even more extensive with the hull gone. At NOAA's request, the Coast Guard assisted in maintaining the safety zone for another day, while the initial damage survey was completed. Molasses Reef was entirely reopened to the public on 18 August.

The sanctuary had been unprepared in many ways to cope with the *Wellwood* grounding. However, new abilities were generated rapidly, and the necessary support came quickly from the national program office. Since that incident, many improvements have been made in contingency planning, communications, and equipment. The sanctuary's ability now to respond to such emergencies is much improved. Prevention of a similar incident is another issue—one of acute importance—because many ships still transit the sanctuary every day. Four large commercial vessels have grounded on Florida reefs since the *MJV Wellwood*, all in federally protected areas.⁴ The chances for a similar incident are as high today as they were on 4 August 1984.

William J. Harrigan is a Lieutenant Commander in the NOAA Corps. He managed the Key Largo National Marine Sanctuary from July 1984 to September 1987.

Views expressed are those of the author and do not necessarily reflect those of the agency/institution of affiliation.

Endnotes

¹ USCG On-scene Coordinators Report, *MJV Wellwood* (CY), 07-P-12804, 4-17 Aug. 1984.

² Personal observation aboard *MJV Wellwood*, 4 Aug. 1984.

³ *Grounding of the MJV WELLWOOD*, report from the Key Largo National Marine Sanctuary, 10 Oct. 1984.

⁴ *MJV Maloy G.*, Looe Key NMS, June 1986.

MJV Midas, Key Largo NMS, Oct. 1986.

MJV In God We Trust, Biscayne National Park, Dec. 1986.

MJV Mini Laurel, Key Largo NMS, Dec. 1986.

The Legal Issues

by Joan M. Bondareff

When the *Wellwood* ran aground on 4 August 1984, NOAA lawyers immediately braced for the legal action to come over the financial settlement for damage to one of our nation's living natural treasures. They had no way of foreseeing the interesting legal turns the case would finally take.

Anticipating that the freighter's owners intended to bring the vessel into port, and having filed a claim in Admiralty,* the U.S. Justice Department sent federal marshals to arrest the vessel when she came within the U.S. territorial sea (3 nautical miles from shore). The owners of the *Wellwood*—Wellwood Shipping Company, Ltd. of Cyprus**—posted two bonds totalling approximately \$4.6 million, which enabled the vessel to leave U.S. waters. The amount of the bonds was set high enough to cover the U.S. government's expenses in freeing the vessel from the coral reef, damages to the natural resources of the Key Largo National Marine Sanctuary, and associated civil penalties.

The destruction of coral within the boundaries of the Key Largo National Marine Sanctuary constituted a violation of federal regulations issued by NOAA. These regulations protect the Sanctuary, and for each violation of the Marine Protection, Research, and Sanctuaries Act (MPRSA), NOAA is authorized to assess a civil penalty in the amount of \$50,000. The official notice of a civil penalty assessment is given by issuing a Notice of Violation and Assessment of Administrative Penalty, or NOVA.

The lawyers for NOAA acted on the theory that each day the *Wellwood* was aground constituted a separate violation of sanctuary regulations. On 8 and 16 August 1984, lawyers for NOAA issued NOVAs totaling more than \$2 million in civil penalties against three defendants: 1) Wellwood Shipping Company, Ltd.; 2) Hanseatic Shipping Company, Ltd., the managing agent, also a Cypriot company; and 3) Christopher Vickers, a British citizen and master of the vessel. Subsequently, but before arresting the vessel, the Justice Department filed a \$22 million civil action in the Federal District Court for the Southern

District of Florida against the same defendants. The total figure included approximately \$20 million for damages to the coral reef, \$2 million for civil penalties and an additional amount to cover the Coast Guard's costs in freeing the vessel.

The ensuing legal battle focused on the federal district court action and, in turn, on two principal issues. First, did the defendants, non-U.S. citizens, have the necessary contacts with the United States for U.S. courts to exercise personal jurisdiction over them? (Due process principles require that a defendant have "minimum contacts" with the forum in which the case is litigated.)* Second, did the United States have a sufficient interest in Molasses Reef on which to base a claim for resource damages? The legal debate took place principally in pleadings filed by the U.S. Government and Hanseatic Shipping Company, one of the defendants.

On the due process issue, Hanseatic argued that it was not subject to the federal district court jurisdiction because it was a Cypriot company and did not do business in Florida; that the grounding did not occur in Florida; and, that the only reason a Hanseatic representative was in Florida was because the vessel was arrested outside Florida's territorial waters.

The federal government responded that Hanseatic was subject to the jurisdiction of the federal district court for several reasons: 1) because Hanseatic is a large ship management company owning several ships, many of which frequent American ports; 2) that due process only requires that a foreign corporation have substantial contacts with the nation as a whole; and, 3) that Hanseatic voluntarily brought the ship within U.S. territorial waters to conduct an insurance survey so that it became subject to U.S. service of process.

On two separate occasions, Federal Judge C. Clyde Atkins agreed with the United States and denied Hanseatic's motions to dismiss the claim. He found that due process was indeed satisfied and that Hanseatic was properly served under the Convention on the Service of Judicial and

* Admiralty or maritime law is that system of law which particularly relates to marine commerce and navigation.

** Cyprus ranks seventh in the world for the number of registered ships in global maritime trade.

* If a corporation's activities in a state are "continuous and systematic," the corporation may be sued in the forum state. On the other hand, the "causal presence" of a corporate agent may be insufficient contact on which to base a suit unrelated to the agent's activities in the state. Supreme Court: *International Shoe Co. v. Washington*, 326 U.S. 310 (1945).

Extrajudicial Documents in Civil or Commercial Matters (Hague Convention).*

The second and more significant legal dispute concerned the nature of the United States' interest in Molasses Reef. Hanseatic argued that the United States had to "own" the reef to recover damages, and that the reef was not owned by the United States because it was situated outside of U.S. territorial waters.

The federal government responded that the United States had a sufficient interest in the resources of the reef under international law on which to base its claim for damages. First, the government argued, the reef is located on the United States continental shelf, and under both the 1945 Truman Proclamation and the 1958 Geneva Convention on the Continental Shelf, the United States exercises sovereign rights over the resources of the continental shelf, including Molasses Reef. Furthermore, the United States has jurisdiction over Molasses Reef because it is a resource within the United States' 200-mile Exclusive Economic Zone (EEZ), proclaimed by President Reagan on 10 March 1983, and under customary international law a coastal nation is authorized to exercise sovereign rights over living and non-living resources within its EEZ.

The United States did not interfere with the *Wellwood's* freedom of navigation to transit the U.S. EEZ, but, rather, the *Wellwood's* voyage was interrupted by the negligent conduct of her master and crew who unsafely navigated the ship onto the reef. Judge Atkins agreed with the United States' arguments and ruled in his order of 17 July 1985, that "... the United States has a protectable sovereign interest in Molasses Reef."

* Entered into between the United States and 19 other countries, the Hague Convention is concerned with the service of process on foreign defendants who reside in countries that are party to the Treaty. Circuit Court of Appeals: *Vorhees v. Fischer & Krecke* 697 S.2d 574 (4th Cir. (1983).

After Judge Atkins' denial of Hanseatic's motions to dismiss the claim, the case continued with the filing of various legal motions. But, in December, 1986, before Judge Atkins could issue a final opinion, the parties entered into a settlement agreement out of court. On 9 January 1987, the court endorsed the agreement and dismissed all claims.

The settlement provides the federal government with \$6.3 million over a 15-year payment period. It is intended to cover the resource damage claim, the civil penalties and the Coast Guard's expenses. Initial payments will be used to reimburse the Coast Guard for its expenses. The remainder of the money appears to be destined for the Federal Treasury because NOAA lacks authority under the MPRSA to retain the funds for restoration of the reef. Legislation (H.R. 3640) was recently introduced in the 100th Congress, however, by Representative Gerry E. Studds, Democrat of Massachusetts, which would provide this authority. If enacted in time, this legislation may allow NOAA to spend some of the settlement money on restoration of Molasses Reef.

Joan M. Bondareff is Counsel to the Majority, Merchant Marine and Fisheries Committee, U.S. House of Representatives, and was formerly the Assistant General Counsel for Ocean Services at the National Oceanic and Atmospheric Administration.

The views expressed are solely those of the author, and do not necessarily reflect the position of her current or former employers.

Acknowledgment

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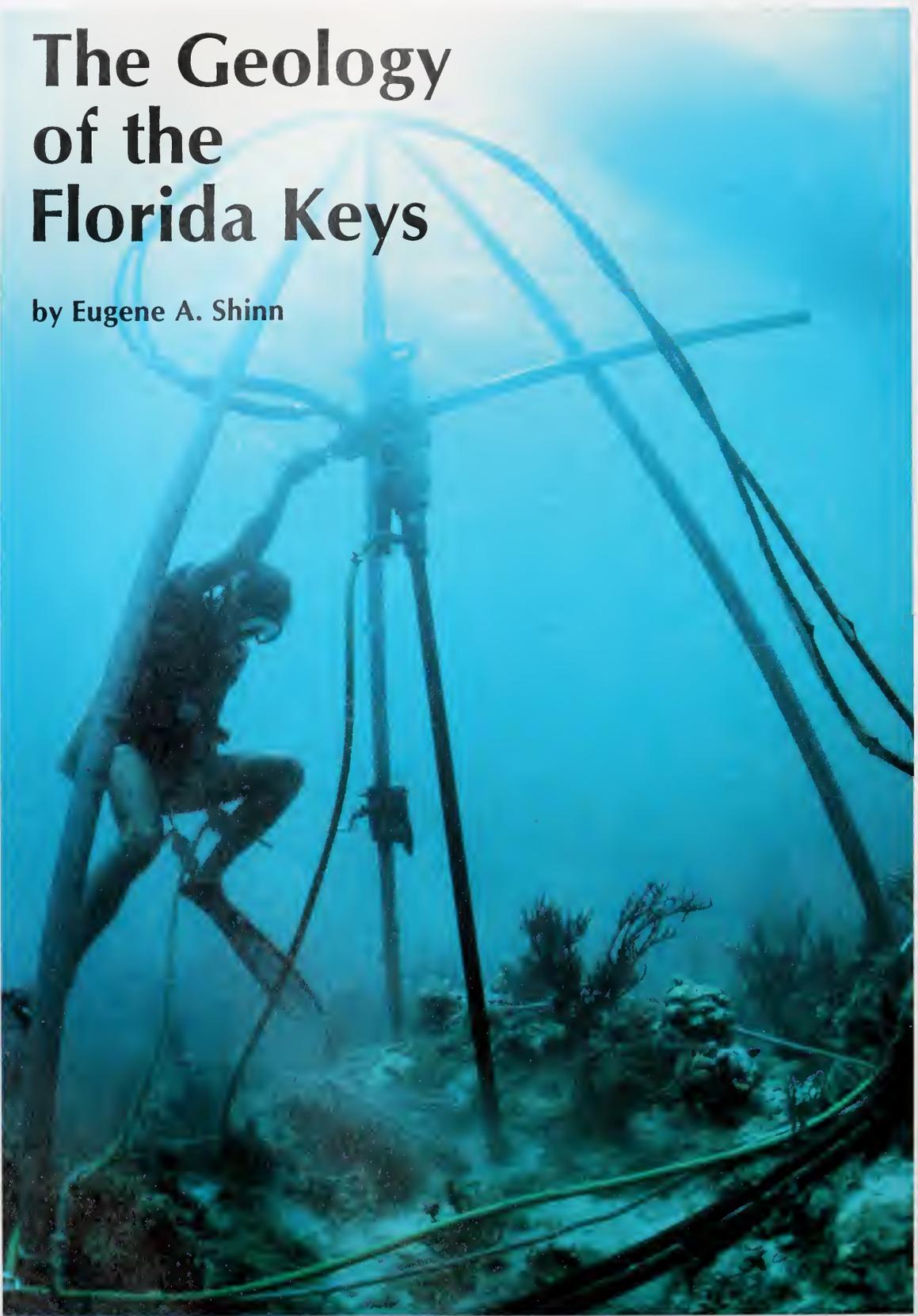
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The Geology of the Florida Keys

by Eugene A. Shinn



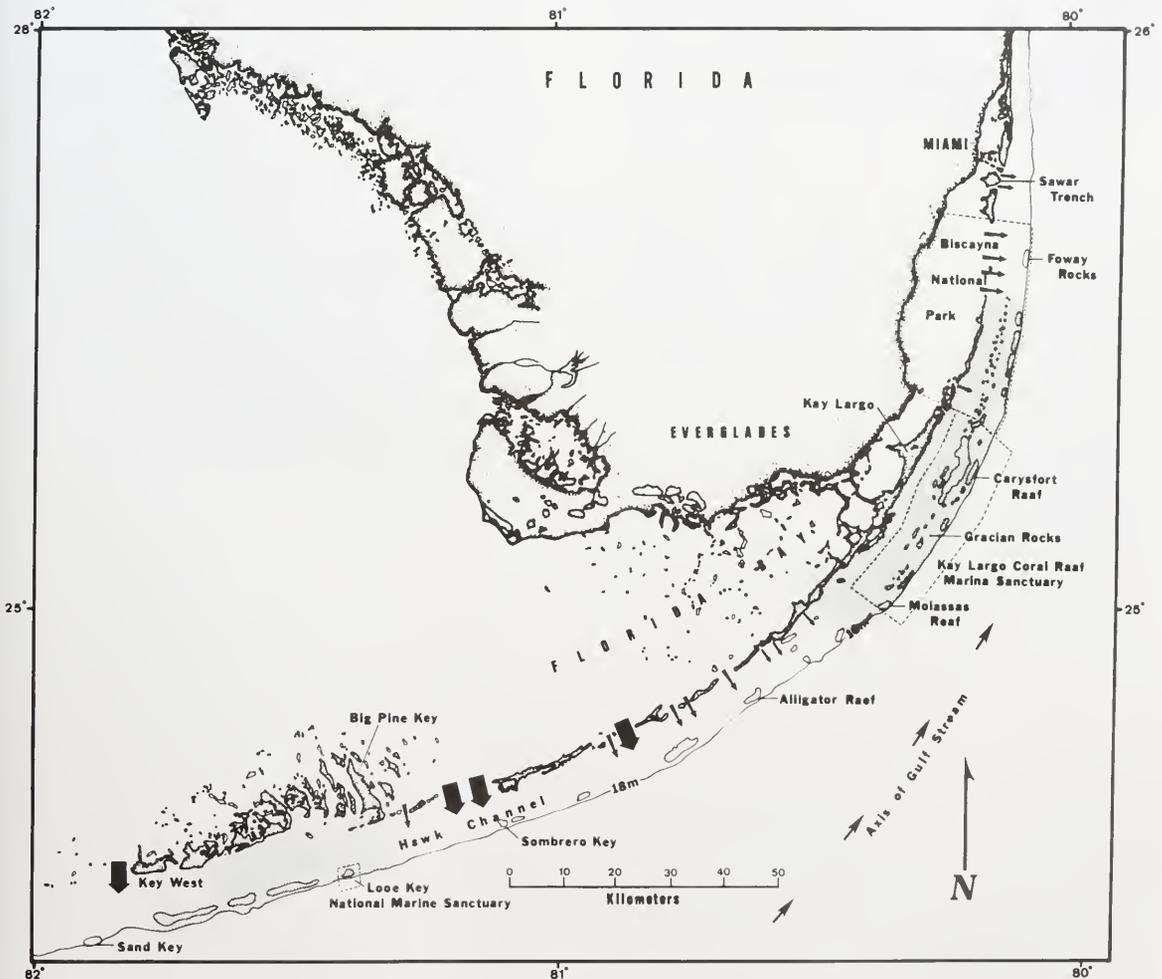
Research in south Florida waters, including work within the Key Largo and Looe Key National Marine Sanctuaries, has provided a cohesive picture of coral reef geology and some of its diverse facets. Miami and Key West are at either end of an ancient reef. These two population centers owe their existence on high ground to shifting sand shoals formed some 100,000 to 125,000 years ago. While the sand bars were being shaped by the strong tidal currents, and creating the foundations for the two cities, corals and sediment-producing algae were creating what

would eventually become Key Largo and the middle keys.

These ancient reefs were wider than their present outline would suggest. Sea level was at least 20 feet higher than now, and a deeper, coral-studded shelf extended eastward some 5 miles to the edge of the Gulf Stream.

To the west was a vast, shallow, shelf with a bottom of mud and sand much like the desert-like bottom of the Bahama Bank. Today, it is the hard rock underlying Florida Bay's mudbanks. Occasional coral patches broke the monotony, but, for the most part, there were no island barriers to prevent the interchange of Atlantic and Gulf of Mexico waters. The cross-bedded lime sand that is now preserved as the rock beneath Miami testifies to the existence of strong reversing tidal currents that swept back and forth between the Gulf of Mexico and the Atlantic.

At left, diver operating underwater hydraulic core drill. This type of device was used for obtaining much of the data described in this article. (Photo by Michael Topolovac)



South Florida, Florida Keys, and reefs, showing distribution of the principal reef-builder, *Acropora palmata*, or elkhorn coral (shaded areas). Lack of elkhorn coral in nonshaded areas is coincident with the larger tidal passes (emphasized with arrows) of the Middle Keys. Tidal passes and the shallows of Florida Bay were land about 3,500 years ago, and *Acropora*-dominated reefs thrived in these areas. Today, the most luxuriant growth is seaward of Key Largo and the Lower Keys from Big Pine Key to Key West.

The same currents that built the sand shoals also brought colder waters from the Gulf during winter months. Gulf water prevented, then as now, establishment of an important temperature-sensitive reef-builder, *Acropora palmata*, commonly called elkhorn coral. So while elkhorn was building large reefs throughout the warm Caribbean, the principal reef builders near Florida were instead the slower-growing head corals.

Had sea level remained at that high level a little longer, coral growth may have eventually joined all the keys, and extended reef growth to the edge of the Gulf Stream. But something happened to alter this course. The change helped prepare the foundations for reefs that live there today.

The Coming of the Glaciers

For reasons long debated among geologists and climatologists, the polar ice caps began to grow, drawing up moisture from the seas as they advanced across the land. Loss of water to the land caused the sea level to fall. Reefs began to die, and in time, became land. Exposure was not immediate, as at Urvina Bay in the Galápagos Islands (see *Oceanus*, Vol. 30, No. 2, p. 61, 1987), where sudden volcanic activity exposed a reef in a single day. For a period of time, however, the reefs of Florida must have resembled Urvina as trees sprouted from foundered corals.

As the sea continued to fall, soils formed and calcium carbonate leached by rain percolated into the sediment. Here it precipitated a form of lime that binds the grains to form rock. A characteristic brown laminated crust, called calcrete, formed over the surface of the land. It is this telltale crust that enables geologists to separate today's reefs from those of the past.

Through isotopic dating and paleotemperature studies of cores taken in the deep sea, elevated reefs at Barbados, and through the polar ice caps, geologists have concluded the great sea-level fall began about 100,000 years ago. At its extreme, sea level fell to more than 300 feet below present level. Exactly when the sea began its inexorable rise is debatable, but the best guess is around 15,000 years ago.

Better documented is the time when seawater once again invaded the south Florida shelf. Carbon-14 dating, most accurate for materials in the 10,000-year range, show that the corals returned about 6,500 years ago. Many such corals rest directly on the old calcrete crust.

In places, peat, which forms on land or on swampy ground, is found underwater, beneath reefs, and under reef sands. These peats also can be dated by the carbon-14 method. It is the dating of such peats that allows us to reconstruct the sea-level history of the last 10,000 years. Without this history, we would have difficulty understanding the growth history and distribution of reefs in south Florida.

Sea-Level Rise and Reef Distribution

The ancient reefs and sand shoals of 125,000 years ago laid the foundation for today's reef distribution.

The interplay between topography and sea-level rise explains why reef development today is poor off the middle keys of Marathon and Lower Matecumbe, but is flourishing off Key Largo.

When the last sea-level rise reached to within 40 feet of its present level, most of south Florida, including Florida Bay, was dry land. At the shoreline adjacent to the clear, warm Gulf Stream, fringing reefs composed primarily of elkhorn coral flourished. There were few breaks in this nearly-continuous reef, and it extended from well north of Miami to well south and west of Key West. Then, as sea level continued to rise, seawater spilled over the edge and began flooding low areas behind the reefs—an area that is known today as Hawk Channel.

At that time, 6,000 to 10,000 years ago, Hawk Channel was mostly a swamp. West of what is now the Florida Keys, Everglades-type conditions prevailed. Based on pollen analysis, the layer of peat that underlies Florida Bay is similar to that forming today in the Everglades. That layer can be traced down to 14 feet below sea level in the southern part of Florida Bay. The average carbon-14 age of this peat, 8 feet below sea level, is about 3,500 years old, so the flooding of Florida Bay had to occur after that time.

This creation of lagoons and bays forever changed the nature of Florida's reefs. With their creation came nutrient-rich, sediment-laden waters, which during summer months, were saltier than normal seawater, and during winter months, were colder than Gulf Stream waters—a lethal combination for corals. The waters of Florida Bay were now beginning to mix with those of the Gulf of Mexico. At times, unusually cold storms would sweep in from the north, chilling the waters to lethal levels for the reef-building corals, especially the elkhorn corals. Previously flourishing reefs opposite major tidal passes began to wane. Only off large islands, such as Key Largo, did the elkhorn reefs continue to thrive. The barrier provided by Key Largo, and the less complete barrier provided by the lower keys from Big Pine to Key West, prevents or retards the cold waters of Florida Bay and the Gulf of Mexico from invading the reefs.

The distribution of live reefs clearly reflects their relationship with major tidal passes. To the north, countercurrents bring colder northern waters down the coast, and with chilled waters from Biscayne Bay, this has served to retard reef growth north of Elliott Key. Lack of reef growth in this area was noted in the early 1900s by the famous coral researcher T. Wayland Vaughan. At the other end of the reef tract starting off Key West, the corals are often flushed by waters from the Gulf of Mexico.

This washing effect is especially noticeable to the west of the Marquesas Keys, where not a single island or shallow reef impedes the southward flow of cold Gulf waters during winter months. These reefs can best be described as hard bottom. Much of the area is simply lime bedrock from 125,000 years ago, populated by scattered coral heads, soft corals, and sponges. There has

been no coral reef development there during the last 6,500 years.

How can this scenario be proven? The evidence comes from coring, underwater excavations, outcrops made by chance ship groundings, and a sophisticated seismic tool called a "boomer." The boomer is much like a fathometer, except that it sees beneath the surface, and usually defines the distance between the surface of the sediment or reef and the underlying calcrite-coated older rocks. The boomer does not identify the corals, but, when used with coring and other exposures, the boomer allows an accurate history of reef development to be determined.

Reefs in the middle keys, and even those of Looe Key and the southernmost reefs in the Key Largo National Marine Sanctuary host few living elkhorn corals. Internal examination, however, shows that this species was once the major builder of these reefs. Outcrops made with explosives at Molasses Reef in the 1950s, and those made more recently by the grounding of the freighter *Wellwood* (see page 35) showed that elkhorn had built the impressive array of spurs and grooves there. Today, internal structure of the spurs is masked by a thin coating of fire corals and occasional huge head corals.

At French Reef, also in the Key Largo Sanctuary, Pleistocene bedrock is exposed in places between adjacent spurs. Pleistocene limestone with the brown calcrite coating is exposed at both Davis Reef and Alligator Reef in about 25 feet of water, and at the whistle buoy that marks the southern boundary of Biscayne National Park. These observations show that corals did not begin growing everywhere after the last flooding, but became localized and built individual reefs. Once sand or muddy sediment accumulates, it is difficult for reef corals to become established; thus, reef growth tends to stay centered where it first starts.

Topography's Role

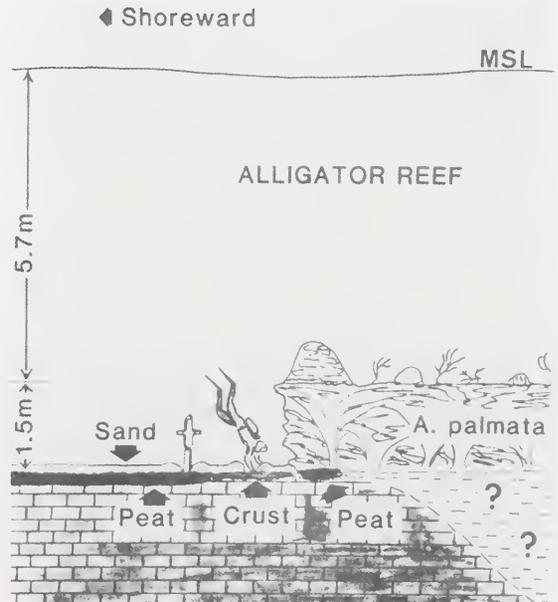
The influence of topography on lagoonal waters may explain the gross distribution of reefs, but what explains local buildups? One of the most beautiful and well-developed reefs in the Key Largo Sanctuary is Grecian Rocks. Grecian Rocks is part of a chain of reefs that lies about a mile in from the outer reef line. There are, in fact, several parallel rows of deeper reefs to the east of Grecian Rocks.

Coring shows that the reef is built on a pre-existing ridge created by an old Pleistocene reef. Carbon-14 dating of corals recovered in the cores shows a maximum age of 6,500 years. The transect of cores perpendicular to the reef shows also that much of the reef is underlain by carbonate sand, and that a process called *backstepping* has occurred during the last 6,000 years. This will be discussed later.

Off Miami, a 20-foot-deep trench was cut across the outer reef for a sewer outfall. The author in the 1970s found that this reef was built by



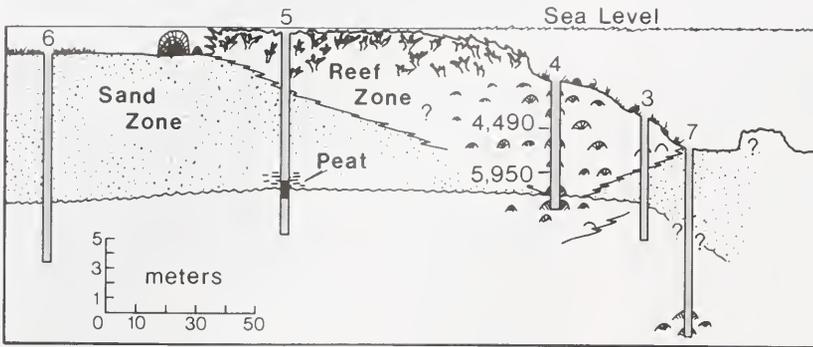
Core holes through brown soilstone crust (calcrete) that formed when the area was land. The crust is exposed at a depth of approximately 25 feet at Davis Reef. The rock beneath the crust is 125,000-year-old Key Largo Formation. The base of a 6-foot-thick Holocene reef built by elkhorn coral is visible in the background. The elkhorn coral that built this reef died around 3,000 years ago. Exposed areas, where corals never became established during the last 6,000 years of submergence, are surprisingly common on the Florida reef tract.



In the direct pathway of a tidal pass, Alligator Reef has exhibited limited coral growth. The "washing" effect of water through the pass has exposed Pleistocene bedrock, overlain by submerged peat and sandy sediment, and upon which coral reefs cannot grow. MSL = mean sea level.

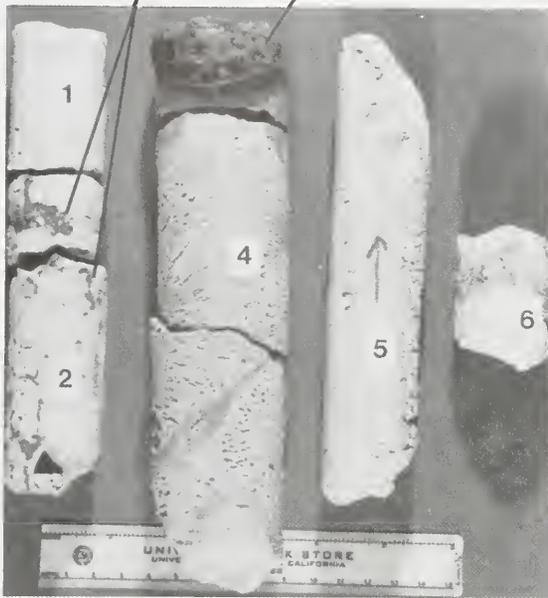
Northwest

Southeast



Grecian Rocks Reef, based on coring data. The reef began at a break in slope determined by cores 3 and 7 and has backstepped landward over backreef carbonate sands. Core 4 was dated using the carbon-14 method; numbers indicate that coral growth began about 6,000 years ago. In core 5, peat was recovered about 45 feet (14 meters) beneath the reef flat. Pleistocene limestone exists below the wavy line.

Root Molds Soilstone Crust



Cores of Key Largo limestone beneath Grecian Rocks, showing soilstone crust at top of Core 4, root molds in Core 2, and other features that indicate this was once land.

elkhorn coral, although that species is absent today. Even farther north, another sewer excavation off Fort Lauderdale disclosed a 20-foot-thick layer of elkhorn over a Pleistocene reef. The water is deeper there (as deep as 70 feet), and carbon-14 dates were a little older than those off the keys.

Off the north end of Miami Beach, dredging for a beach restoration project cut a perpendicular line across a north-south trending reef just a mile offshore. When examined by SCUBA divers, it was found to be localized over an old beach ridge containing cross-bedding, land snails, and the roots of land plants. The ridge, now 60 feet below sea level, was capped by an 8-foot-thick coral reef. Again, topography had localized reef accumulation, and surrounding sediment prevented establishment

of corals, thus restricting growth to the already established reef.

Topography played a major role in localizing Looe Key Reef. There, the reef began on a Pleistocene coral reef high located approximately 30 feet below sea level. As at Grecian Rocks, the reef backstepped to its present position. The common denominator of all these investigations was topography: corals first become established on topographically high areas.

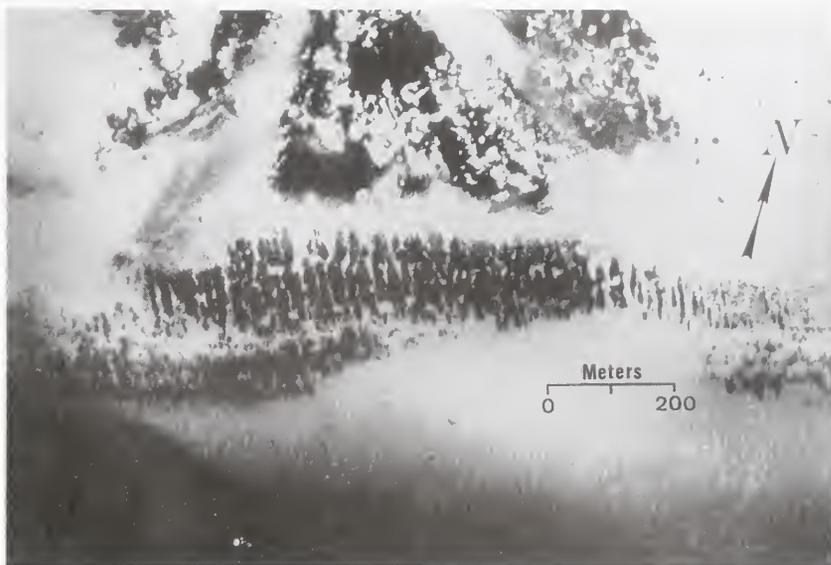
Spurs and Grooves

Finger-like projections called spurs and grooves are a feature common to all reefs exposed to wave action. They are especially well developed at Looe Key, and provide the major relief of Molasses, French, and many other reefs in the keys. Around atolls in the Pacific, the grooves are caused by erosion. There, the spurs have overhanging ledges and the grooves often have large, rounded boulders that roll back and forth during heavy seas. The adjacent spurs are often coral-capped, giving rise to a long-standing controversy as to whether spurs are erosional or constructional features. They can be both, as work at Looe Key has shown.

At Looe Key, coring showed that the spurs are composed of elkhorn coral underlain by about 10 feet of sand, thus proving that the features were not erosional and not related to any grooves or ridges in the underlying rock. In earlier work in the 1960s, the author showed how growth of elkhorn, similar to the growth of bristlecone pines in the tundra, can create finger-like spurs. Once the spacing is established, sand accumulates in the grooves to prevent settlement of coral larvae. Growth is therefore restricted to the spurs. Periodic storms and hurricanes also clean out the grooves of any coral that may become established there.

Backstepping and Ecological Zonation

At every reef drilled off Florida, the top or thickest part of the reef was found to overlie sand. Cores drilled at Grecian Rocks and Looe Key show that the ecological zones did not grow vertically, but rather shifted in a landward direction away from



Aerial view of Looe Key Reef, showing well-developed spur-and-groove system. Note carbonate sand beneath the word "meters" that smothered a line of reef visible east and west of bar scale. Dark areas in upper portion of photo are marine grass beds with numerous white "blowouts."

the sea, while growing upward at the same time. This is the process known as backstepping.

As the reefs have backstepped, they have spread landward over their own debris. Each major storm picks up both dead and living corals on the front side and literally throws them over the reef into the sand on the back side. The back side of most Florida reefs is paved with debris derived in this fashion.

Once debris forms on the back side of a reef, it becomes a suitable hard substrate for further coral growth, in turn causing the reef to extend in a landward direction. This process would not continue, however, if sea level were not rising. It appears, then, that as sea level has risen, the wrath of storms has retarded and even eroded the seaward side, resulting in reef retreat.

As the reef retreated, or backstepped, growth over the backreef debris caused the reef to grow landward. To relate the various effects of rising sea level, reef geologists have created some simple terms. Those reefs that have not grown fast enough to keep abreast of sea-level rise are called *give-up* reefs and those that have are called *keep-up* reefs. Reefs starting in deep water and growing toward the surface are called *catch-up* reefs.

The keep-up reefs in Florida have all experienced backstepping, while most others can best be described as give-up reefs. Give-up reefs, such as those east of Grecian Rocks, by far outnumber keep-up reefs along the Florida reef tract, and catch-up reefs are unknown.

Growth Rates

The major reef builder, elkhorn coral, grows several inches a year, but the rate is greatly influenced by water quality. Growth rate of its close relative *Acropora cervicornis*, the staghorn coral, has been more closely measured, and it is astronomical.

Studies by the author show that staghorn coral grows an average of 4 inches a year

(elsewhere in the Caribbean, it has been found to grow twice as fast), and once each year it branches. Each branch gives rise to about three new branches, and each one another three. Growing at that rate, a small colony with just 10 branches can theoretically produce 35 miles of branches in just 10 years! The effect of storms, fish, and a voracious coral-eating worm prevent the realization of such astronomical growth; nevertheless, the amount of coral framework produced by this species is large.

The massive head corals grow more slowly, although the amount of actual calcium carbonate produced by their skeletons may be about the same. Massive heads grow by adding a thin layer of skeleton, a little less than a half inch each year. Fortunately, the layers are laid down as distinct annual bands easily measured and counted in X-radiographs.

Past growth is therefore easy to determine by taking a core through the center, sawing the core into thin slices, X-raying them, and counting and measuring the bands.

The rate at which corals grow during any particular year can be measured and used as an index of water quality for that year. One large (10-foot-high) coral treated in this way was found to have begun growing at about the time the Pilgrims landed at Plymouth Rock. Furthermore, certain bands tell of unusually severe cold conditions, thus providing potential to extend weather records to prehistoric time.

If one assumed a growth rate of just 1 inch a year for the branching corals, then in 1,000 years a coral could grow upward about 83 feet. The rise of sea level in south Florida during the last 10,000 years, however, was never more than about 4 feet per 1,000 years; thus, even the slowest growing corals should have "kept up." These simple calculations serve to demonstrate the strength of lagoonal water, storm, and disease effects on coral growth and reef distribution.

Growth Balanced by Erosion

Once a coral dies, it is quickly attacked by a variety of organisms that reduces coral skeletons to mud and sand. Dead branching corals, for example, are quickly dispatched by organisms. Dead staghorn branches first become infested with algal turf. Next, parrot fish and urchins rapidly eat away the algae and branches. Often entire branches are consumed in less than a year.

Carefully controlled studies of erosion on massive corals show they are eaten away at about the same rate at which they grow. Thus, where it may take 100 years for a coral head to grow, it will be reduced to sediment in the same time after death. It is evident from these studies that for corals to be preserved as fossils in the geological record, they must be buried quickly, and thus be protected from the ravages of biological erosion.

Reef Sand

This article has concentrated on corals, but it should be emphasized that the bulk of the Florida reef tract is composed of carbonate sand, and only a small amount of this sand came from corals. By far the most prolific sediment-makers are calcified algae, and the most prolific of all is the green alga *Halimeda* (see also *Oceanus* Vol. 29, No. 2, pages 43–48). This alga consists of oatmeal-size plates which, after death, lose their chlorophyll, leaving only flakes of pure calcium carbonate.

Although these plants are relatively inconspicuous, their product is not. In places, their sands have accumulated to a thickness of 40 feet, roughly the thickness of the most well-developed coral reefs. Additional sand-producers include mollusks, foraminifera, bryozoa, sea fans, and corals. It is rare for coral fragments to make up more than 50 percent of the sand, even within the reefs themselves.

During the Pleistocene era, 100,000 to 125,000 years ago, ooid sands that precipitate directly from seawater were abundant, but for reasons unknown ooids are not forming anywhere in Florida today. However, across the Gulf Stream, 50 miles away, they are actively precipitating on the Bahama Banks. It is study of these active areas that has provided insight into how the land beneath Miami and Key West formed. The lower keys, from Big Pine to Key West, exhibit a trend perpendicular to the other keys because they are, in fact, preserved tidal bars.

Lime Muds

As corals and lime sands are degraded from mechanical and biological abrasion, they produce fine lime particles that accumulate as sticky gray mud. During stormy periods, the water throughout the Florida reef tract can become turbid from lime mud. When quiet conditions return, this mud settles out everywhere, but remains only in the areas geologists call sinks.

Mud may settle on the reef when the sea is extremely calm, but under prevailing winds and wave action, it is quickly resuspended and transported elsewhere. If the mud settles in deeper, quieter areas, such as Hawk Channel, it is likely to be trapped and bound there by extensive meadows of the turtle grass *Thalassia*. Mud is as much as 20 feet thick in some areas of Hawk Channel. During storms, some of this mud is resuspended, only to eventually be deposited in yet another sink.

The other sink, besides the depths beneath the Gulf Stream, is within the reef itself. Before the advent of scientific reef coring, geologists thought that the coarse sand around reefs should be within the reef as well; thus, it was a mystery to geologists why so many really old fossil reefs contained abundant quantities of mud. Core drilling changed that, and showed that lime mud does indeed filter down into the reef framework. Much of the original void spaces in living and fossil reefs are filled with either soft or cemented lime mud.

The Future (Stable Sea)

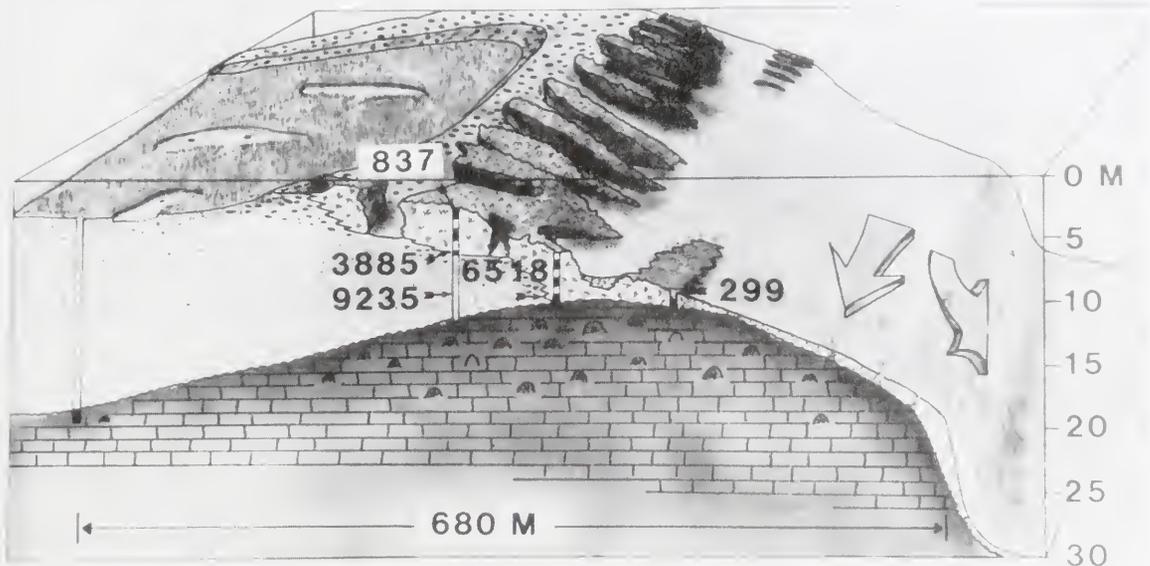
The future is best predicted with hindsight. Thanks to research in Florida, the future can be generally predicted. Two scenarios seem likely: either sea level will remain stable, or it will continue to rise.

Consider what might happen given stable sea level. Remember that the evolution of Florida reefs has occurred in a short period of time—less than 7,000 years. During this time, sea-level has risen as much as 4 feet for every 1,000 years. Despite this rise, some reefs have kept pace and have grown upward at least 40 feet.

If sea level were stable for just 1 million years, a geologically short period of time, the entire reef tract (the 5-mile-wide band from the keys out to the edge of the Gulf Stream) would fill up and probably produce a huge tidal flat or swamp. Filling of the lagoons, such as Hawk Channel and Florida Bay, would eliminate the source of potentially lethal cold water. Corals would grow unimpeded at the platform margin, bathed only by clear, warm Gulf Stream water. Backstepping would cease, and the reefs would begin stepping forward into the Straits of Florida. Given more time, even the Straits could be filled. If this sounds farfetched, consider this: recent seismic work on the Bahama Banks has defined a similar but deeper strait that extended north-south on the bank at the end of the Cretaceous period 65 million years ago. Since then, the 5,000-foot-deep strait has been completely filled with lime sediment and coral reefs that formed mainly by biological means on the adjacent banks.

The Future (Rising Sea Level)

Suppose, on the other hand, that sea level continues to rise, possibly to the level reached during the last interglacial 125,000 years ago. Those reefs that gave up will probably die and be attacked by biological eroders, and backstepping



A north-south section through Looe Key Reef at Looe Key National Marine Sanctuary. Note that reef and seaward tip of spurs began growing on Pleistocene high, then backstepped landward over backreef carbonate sands. Oldest date on coral "in place" is approximately 6,500 years. The spurs at Looe Key overlie carbonate sand and are entirely constructional (composed of *A. palmata*). A portion of the reef and steep slope seaward of the main reef is being covered by drifting carbonate sand. Large arrows show direction of drift. Pleistocene rock high is absent east and west of Looe Key and reef is absent, demonstrating the importance of underlying topography on reef distribution. Turtle grass carpets backreef sands, interrupted here and there by blowouts.

will continue. Eventual inundation of Key Largo will remove the barrier that prevents influx of Gulf water, and coral growth would be retarded further. The crests of the keys would become the favored sites of coral growth, and, with the elimination of temperature-sensitive elkhorn coral, only the same slowly growing species that built the keys would grow. This new growth would be separated from the old by a brown calcareous crust.

If this scenario appears unlikely, consider that coring in south Florida and the Bahamas has disclosed at least seven episodes of sea-level rise and fall. Five of the seven rock units formed by each fluctuation are capped by a calcareous crust; thus, what is proposed as the future has already happened seven times during the not-too-distant past. If the proposed greenhouse effect is valid, then the rise might be faster and the sea level may become higher than ever before.

Whether humans survive as a race may be debatable, but the corals, which have survived for the last 500 million years of Earth's history, will certainly live through the vagaries of sea-level oscillations well into the future. The protection afforded reefs today by marine sanctuaries will certainly augment their survival.

Eugene A. Shinn is Project Chief at the U.S. Geological Survey, Fisher Island Station, Miami Beach, Florida. He also is an Associate Professor of Geology at the University of Miami's Rosenstiel School of Marine and Atmospheric Science.

Views expressed are those of the author and do not necessarily reflect those of the agency of affiliation.

Acknowledgment

This article is dedicated to Dr. John Edward Hoffmeister, a distinguished coral specialist who pioneered coral reef studies in the South Pacific and who after a long and distinguished career at the University of Rochester, migrated southward to South Florida and the University of Miami. Ed was instrumental in inspiring the author in the early 1960s to conduct coral growth experiments. This article and the scientific endeavors of numerous outstanding researchers were influenced by Ed. His popular book, *Land from the Sea*, stands as a milestone for conveying a sense of appreciation for the geologically young land over which South Floridians walk and swim. His numerous scientific publications will continue to inspire students and coral researchers for as long as man endeavors to understand his planet.

Much of the research incorporated in this article was funded by the NOAA Marine Sanctuary Program, Washington, D.C.

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The Proposed Flower Garden Banks Marine Sanctuary

Protecting Marine Resources Under International Law

by Jack H. Archer

The Flower Garden Banks in the Gulf of Mexico were first proposed as a marine sanctuary in 1977 to protect some geographically-unique coral reefs and related resources. Vessels anchoring and discharging wastes and pollutants in or near the Banks were thought to be major threats. Oil and gas exploration and development activities, which were beginning in this part of the Gulf, also were considered significant risks to these resources. To date, no final action has been taken to designate the Banks as a sanctuary, although it is still under "active" consideration.

In the 10 years since the original proposal, concern has focused on anchoring by foreign and domestic vessels as the primary source of injury to the Flower Garden Banks. The coral resources of the Banks may be protected under U.S. law. But, prohibiting anchoring by foreign vessels in the Banks interferes with freedom of navigation, which includes the right for all to anchor on the high seas. There are, however, several possible legal bases for exercising authority over anchoring by foreign vessels within the boundaries of the proposed Flower Garden Banks marine sanctuary. Thus, authority over anchoring in this area would appear to be consistent with principles of international law.

Background

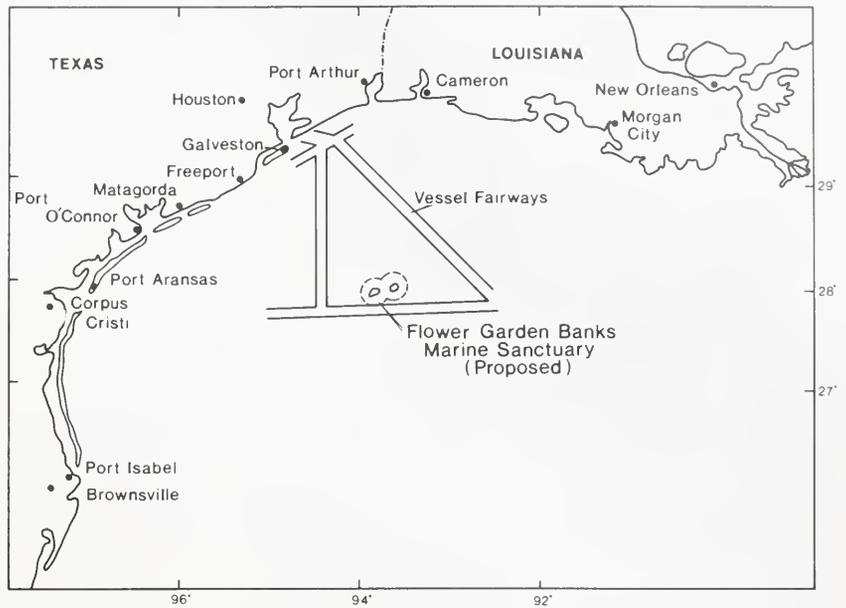
The Flower Garden Banks, located approximately 110 nautical miles southeast of Galveston, Texas, (Figure 1) are the northwestern-most living coral reefs on the continental shelf of the Gulf of Mexico. They are the only truly tropical coral reefs in this area of the Gulf. They contain at least 18 coral species, more than 100 species of Caribbean reef fish, and more than 200 invertebrate species. Scientific interest in the Banks is relatively high; the Banks also are valued by recreational divers and other visitors. Because the proposed sanctuary is located near shipping lanes leading to U.S. ports in Texas and Louisiana, concern has arisen over the potentially destructive activities of vessels passing

through or near the Banks. Vessels dropping and dragging anchors on the shallow coral reef have been identified by the National Oceanic and Atmospheric Administration (NOAA) as a major threat to the unique resources of the Flower Garden Banks. Because of the massive size and weight of ship anchors, even infrequent occurrences may have devastating effects.

Shortly after passage of the Marine Sanctuaries Act (MSA) in 1972, interest developed in establishing the Banks as a national marine sanctuary, with controls on the activities of both domestic and foreign vessels traveling in or near the Banks to protect their coral and associated resources. In 1977, the Flower Garden Banks were formally proposed for designation as a sanctuary under the MSA.

Since the original proposal in 1977, NOAA has pursued a shifting course in considering the status of the Flower Garden Banks area. In 1979, NOAA published a Draft Environmental Impact Statement (DEIS) and proposed regulations applicable to oil and gas, marine pollution, and recreational activities, as well as anchoring within the proposed sanctuary—a relatively small area of approximately 175 square nautical miles. Revised proposed regulations were issued in 1980 that relaxed previously proposed sanctuary restrictions on hydrocarbon activities, and relied on the oil and gas lease stipulations developed by the Department of the Interior under the Outer Continental Shelf Lands Act Amendments of 1978 to protect sanctuary resources. But no final action to establish the sanctuary was taken, primarily because of continuing opposition by the oil and gas industry, which viewed any proposed regulations potentially affecting the industry under the authority of the Secretary of Commerce (rather than the Secretary of the Interior) as an obstacle to offshore energy development and bad precedent.

In 1982, NOAA removed the Banks from its list of sites under consideration for sanctuary



The proposed Flower Garden Banks Marine Sanctuary, nearby Gulf ports, and vessel traffic lanes.

designation, in part because a proposed Gulf of Mexico Coral Fishery Management Plan prepared under the U.S. Fishery Conservation and Management Act would regulate vessel anchoring in the Flower Garden Banks—"the one remaining unresolved issue identified in the DEIS," according to NOAA. The final Coral Fishery Management Plan, however, did not include regulations applicable to anchoring.

In response, in 1984, NOAA revived its proposal to establish the Banks as a national marine sanctuary, and announced the preparation of a draft management plan and environmental impact statement. Since 1984, NOAA has taken no further action on the designation of the sanctuary. Thus, more than 10 years after the original nomination, NOAA has not yet created a national marine sanctuary on the Banks—despite considering the resources of the area to be of substantial significance.

Protection Under International Law

Because the Flower Garden Banks lie outside the boundaries of the U.S. territorial sea (3 nautical miles), where national sovereignty and jurisdiction is certain, and within the 200-nautical-mile Exclusive Economic Zone (EEZ), where there is a blending of national jurisdiction and international rights, protecting the resources within the proposed sanctuary involves a balancing of both national and international interests.

The Marine Sanctuaries Act authorizes the Secretary of Commerce to regulate activities within a marine sanctuary to protect nationally significant "resource or human-use values." It is in the exercising of this authority where legal nuances are encountered. Jurisdiction over both persons and vessels is involved. While the authority over U.S. citizens and U.S.-flagged vessels is clear, it is when

the authority is extended to foreign citizens and foreign vessels that legal questions arise.

The Marine Sanctuaries Act regulations are applicable to a person who is not a citizen of the United States if they are in accord with either generally recognized principles of international law or agreements between the United States and the foreign state of which the person is a citizen, or, if the person is a crewmember of a vessel, between the United States and the flag state of the vessel. In the case of the Flower Garden Banks, the activities of foreign vessels have received primary attention.

In 1984, before publishing its intention to proceed with designating the Flower Garden Banks as a marine sanctuary, NOAA obtained the opinion of the State Department on whether the United States could regulate anchoring on the Banks by foreign vessels in accordance with recognized principles of international law. The response asserted in part:

The Department believes that the United States does have jurisdiction to prohibit anchoring [by foreign vessels] in the [FGB], except for anchoring by force majeure [unanticipated or uncontrollable events].

Communication from the Deputy Assistant Secretary for Oceans and Fisheries Affairs to Chief, Sanctuary Programs Division, NOAA (April 19, 1984), cited at 49 Federal Register 30990 (1984).

This position, however, impairs the traditional freedom to navigate the high seas, codified in Article 2 of the 1958 Convention on the High Seas:

The high seas being open to all nations, no State may validly purport to subject any part of them to its sovereignty. Freedom of the high

seas is exercised under the conditions laid down by these articles and by the other rules of international law. It comprises [among other things] both for coastal and non-coastal states:
1) Freedom of navigation . . .

Moreover, Article 6 of the 1958 Convention provides that flag state jurisdiction is "exclusive" on the high seas. That is, authority over a vessel on the high seas rests solely with the nation in which the ship is registered.

Like the State Department, NOAA asserted in principle jurisdiction by the United States to prohibit anchoring by foreign vessels in ocean areas outside U.S. territorial waters. The 1984 announcement reviving NOAA's proposal to designate the Flower Garden Banks as a sanctuary, however, did not indicate any basis for this assertion.

Clearly, the right to anchor on the high seas is an essential part of freedom of navigation. Thus, any abridgment of the right of foreign vessels to anchor in the Flower Garden Banks must find its justification in other, countervailing principles. Two relevant principles examined in this article focus on the authority of coastal states to protect marine resources beyond national territory but subject to coastal state resource jurisdiction, and/or to condition entry to ports upon compliance with regulations applicable to such resources.

Sources of International Law

The Marine Sanctuaries Act applies sanctuary regulations to persons who are not citizens of the United States only if such regulations are in accord with either 1) the body of international law referred to as "customary international law" or "generally accepted rules of international law" that has developed from the practice of the states of the world, or 2) international agreements, treaties, and conventions binding on the contracting states and permitting such regulation. In certain circumstances, and often subject to controversy, international agreements, whether or not they have come into force between the contracting parties, may be regarded as sources of, or indicative of emerging trends in, customary international law. Indeed, the United States, although not a signatory to the 1982 United Nations Convention on the Law of the Sea (UNCLOS), considers that this agreement, except for the provisions pertaining to deep seabed mining:

. . . contains provisions with respect to traditional uses of the oceans which generally confirm existing maritime law and practice and fairly balance the interests of all States.
Statement by the President on the Exclusive Economic Zone of the United States (March 10, 1983).

There are, however, sources of authority other than UNCLOS that justify U.S. jurisdiction to prohibit anchoring in the Flower Garden Banks.

The 1958 Continental Shelf Convention

Under Article 2 of the 1958 Convention on the Continental Shelf, the United States has "sovereign rights [over the continental shelf] for the purpose of exploring it and exploiting its natural resources." Moreover, such sovereign rights are "exclusive," and do not depend on occupation or any express proclamation with respect to the shelf. These conventional rights over the resources of the continental shelf also are recognized generally to be customary rights in international law, and are replicated in Article 77 of UNCLOS.

There is no doubt that the coral reefs of the Banks are natural resources of the continental shelf and that the sovereign rights of the United States under the 1958 Convention are sufficient to prohibit any activity harmful to them. A U.S. court has held that, under the terms of the 1958 Convention, activities on the continental shelf damaging to coral (for example, dredging of and the construction of facilities on a coral formation) may be prohibited (*United States v. Ray*, [1970]). While Ray was a U.S. citizen, the matter of interest is that the court found that coral is a resource protectable under the 1958 Convention. Further, Article 5 of the 1958 Convention, which provides that the exploration and exploitation of the resources of the continental shelf must not result in "any unjustifiable interference with navigation," implicitly recognizes that the coastal state's sovereign rights over the resources of the continental shelf include the authority to impose "justifiable" limits on navigation. Article 78 of UNCLOS employs language similar to Article 5 of the 1958 Convention. Thus, a prohibition on anchoring within the relatively small area (175 square nautical miles) included within the boundaries of the proposed marine sanctuary, for the purpose of preventing damage to its unique coral resources, would appear to be justifiable under international law. That is, the principle of freedom of navigation (and anchoring) on the high seas can be superseded if the United States acts narrowly (defining a relatively small area) and responsibly (protecting a valuable resource).

Port State Authority

There is a second legal principle that may be called on. Although it has been argued that there is a general rule of international law allowing entry by foreign vessels to a state's ports, the prevailing view is that states may deny entry subject to relatively few restrictions. William T. Burke, Professor of Law, University of Washington, Seattle, Washington, and co-authors have stated:

There is no doubt that a state may condition entry into its ports as it wishes and that such conditions may effectively regulate acts outside national territory. The limits on these broad competences are to be found in the reciprocity and retaliations that maintain effective international exchange of goods by vessels.
National and International Law Enforcement in the Ocean (1975), page 47.

In accordance with this rule of international law, the United States has enacted legislation denying entry by foreign vessels to U.S. ports if such vessels have a history of incidents indicating that they are unsafe, "create a threat to the marine environment," or fail to comply with applicable U.S. law (1972 Ports and Waterways Safety Act). The Act defines "marine environment" to include the "seabed and subsoil of the Outer Continental Shelf of the United States, the resources thereof and the waters superjacent thereto." Certainly the Marine Sanctuaries Act seeks to protect the resources of the "marine environment," a term employed and defined similarly in the Act. Thus, regulations issued under the Marine Sanctuaries Act would appear to be "applicable" and enforceable under the Ports and Waterways Safety Act. Therefore, in cooperation with the Coast Guard, which administers the Ports and Waterways Safety Act, the Department of Commerce may issue regulations under the Marine Sanctuaries Act prohibiting anchoring by any foreign vessels on the Flower Garden Banks, and advising that any violation of such regulations may result in the denial of entry to U.S. ports. Enforcement actions, of course, would be the responsibility of the Coast Guard. Because a majority of foreign vessels passing over or near the Banks are transiting to or from U.S. ports, use of this authority as an enforcement mechanism to ensure compliance with sanctuary regulations would likely prove effective.



A tanker at anchor on the East Flower Garden Bank in April 1979. (Courtesy Dept. of Oceanography, Texas A&M University)

Exclusive Economic Zone Authority

The United States is one among 72 states that have declared an Exclusive Economic Zone extending 200 nautical miles from their shores. Using language closely paralleling Article 56 of UNCLOS, the United States asserts "sovereign rights for the purpose of exploring, exploiting, conserving, and managing natural resources, both living and non-living, of the seabed and subsoil and the superjacent waters" of the zone (A Proclamation by the President: Exclusive Economic Zone of the United States (March 10, 1983)—see *Oceanus* Vol. 27, No. 4, pages 3-6). Thus, as a matter of state practice, the establishment of exclusive economic zones and the broad principles of coastal state jurisdiction over the living and non-living resources of such zones are generally recognized under customary international law. However, whether the detailed provisions of Part V of UNCLOS setting forth the legal regime of the Exclusive Economic Zone also are to be viewed as customary law is not certain. Surely they may be regarded as indicating developing international practice.

Considered in this light, several articles should be noted. In exercising rights and duties respecting the Exclusive Economic Zone, coastal states are required to have "due regard to the rights and duties of other States and shall act in a manner compatible with the provisions of [UNCLOS]" (Article 56.2.). Reciprocally, other states must extend the same regard to the rights of the coastal state, and must comply with the laws and



Coral head fractured by the anchor of a commercial vessel on the East Flower Garden Bank in 1983. (Courtesy Continental Shelf Associates, Inc., Tequesta, Florida)

regulations adopted by the coastal state in accordance with international law (Article 58.3.).

In cases of conflict where UNCLOS does not attribute rights or jurisdiction in the Exclusive Economic Zone to the coastal state or to other states, the conflict should be resolved on the basis of "equity and in the light of all the relevant circumstances, taking into account the respective importance of the interests involved to the parties as well as to the international community as a whole" (Article 59).

As argued under the language of the 1958 Convention on the Continental Shelf, the rights of the United States to protect the coral resources of the Flower Garden Banks are in accord with both conventional and customary international law. Therefore, Article 58.3. requiring that other states comply with coastal state law would be pertinent to resolving conflicts arising from U.S. regulation of anchoring by foreign vessels on the Banks. Where the attribution of rights among coastal and other states is not evident, Article 59 indicates principles to follow in settling disputes.

Enforcement Under the MSA

If we accept that domestic law is consistent with international law, then there are grounds for extending U.S. law and policy to foreign persons or vessels. If an incident occurs within a marine sanctuary, the MSA authorizes civil penalties for violating sanctuary regulations. As noted previously, a majority of foreign vessels passing through the Flower Garden Banks are bound to or from U.S. ports; therefore, denial of entry for violating sanctuary regulations would probably ensure compliance.

For most practical purposes, however, enforcing the civil law under other circumstances depends on the person or vessel being physically within U.S. jurisdiction—that is, within U.S. territorial waters. Therefore, if an offending vessel voluntarily enters a U.S. port, the United States may assert jurisdiction to assess civil penalties for violations of regulations issued under the Marine Sanctuaries Act. In cases of actual physical harm to the coral resources of the Flower Garden Banks, the United States, by virtue of its "protectable sovereign interest" in the resources of its continental shelf and Exclusive Economic Zone, may seek damages (see page 44).

Regulating Vessels Under International Law

In addition to application of appropriate civil law, there also are opportunities to pursue direct international agreements. The Marine Sanctuaries Act authorizes the Secretary of State to negotiate "necessary arrangements for the protection of any national marine sanctuary." Keeping in mind the effective limitation ("reciprocity and retaliations") upon the exercise of port state authority to deny

entry to foreign vessels violating sanctuary regulations, the United States may choose to ensure compliance through the offices of the International Maritime Organization (IMO). Member states may propose, and IMO may adopt, vessel routing systems that avoid environmental conservation areas such as the Flower Garden Banks. Designation of the Banks as a national marine sanctuary under the Act would obviously assist in achieving international recognition of the Banks as a protected area.

This article has addressed only the issue of protecting the coral resources of the Flower Garden Banks under international law, from harm caused by vessels anchoring on them. If the United States seeks to restrict other activities of foreign vessels (for example, polluting the waters of the Banks and damaging its resources), then other authority must be considered. However, actions by coastal and port states to protect marine resources under their jurisdiction from such harmful activities also would be justified by the described principles.

Careful Decisions Are Required

Because protecting important marine resources outside the territory of a coastal state may affect the navigation rights of other states, it is prudent to conclude on a note of caution. The U.S. Congress has already declared a policy of protecting such resources in the Marine Sanctuaries Act. Yet, the execution of that policy allows considerable discretion to program managers, and requires close consultation with the State Department when issues such as those raised by the proposed Flower Garden Banks sanctuary must be resolved.

Decisions to protect these resources can be carefully framed to have minimum impact on the rights of other states. Some impact, however, is unavoidable. But if no action is taken to protect the resources of the Flower Garden Banks and similar areas, however justified and well-considered, because of its effect on the principle of free navigation, however slight, then the national policy to protect unique marine resources under U.S. jurisdiction is effectively checked. The oversight and reauthorization hearing on the Marine Sanctuaries Act to be held 30 March 1988 provides an opportunity for the Congress to consider this matter afresh.

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Should The *Koholā* Be Given *Pu'uhonua*?

by Michael L. Weber



Ten years after researcher James H. N. Hudnall first proposed that humpback whales (*koholā*) be given the protection of a National Marine Sanctuary (*pu'uhonua*) in Hawaii, some people are still asking the question posed by the title of this article. Other people believe that the sanctuary proposal will have the popularity of a virulent disease if it is resurrected from its dormant state.

Whatever the ultimate fate of the Hawaii sanctuary proposal, some lessons can be learned from its wayward course.

At Center Stage: The Humpback Whale

The humpback whale (*Megaptera novaeangliae*) is among the most widely recognized animal species in the world. The species' familiarity is partly because of its great size (35 to 45 feet, or 12 to 15 meters), its acrobatic leaps, and the haunting songs of males, whose discovery and recordings captured the interest of scientists and the public alike. The humpback's occurrence in shallow coastal waters also has made it one of the more easily observed species, and a popular subject for whalewatching.

Public concern about commercial whaling, along with the visibility of humpbacks, meant that whales in general, and humpbacks in particular, became a powerful symbol of the environmental movement. By 1965, when the International Whaling Commission (IWC) halted commercial hunting of humpbacks in the North Pacific, the population had been reduced to perhaps 1,000 animals from 15,000.

The legends of native Hawaiians do not refer to the humpback, but to a generic whale called *koholā*. In the 1820s to the 1870s, Yankee whalers who used the port of Lahaina on the island of Maui for reprovisioning took no note of humpbacks in

the area—although there was a shore whaling station at Kaanapali for a short time in the 1850s. Researchers have since learned that 650 to 1,000 humpbacks spend the winter in Hawaiian waters shallower than 100 fathoms. Many breed, calve, and nurse in even shallower, nearshore waters, such as Maalaea Bay.

Protection Under Federal Law

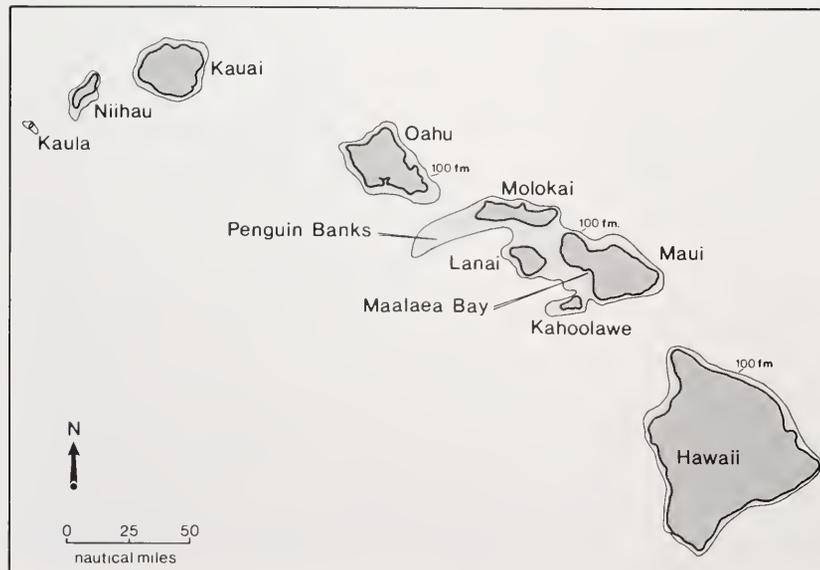
Government protection of humpback whales increased rapidly in the 1970s. In 1972, the U.S. Congress passed the Marine Mammal Protection Act (MMPA), which placed a moratorium on "taking" marine mammals. Importantly for Hawaii's humpbacks, the MMPA definition of taking includes intentional acts of harassment. With the exception of scientific research under permit, the Act does not allow taking species that are considered depleted, such as humpbacks.

In 1970, Secretary of the Interior Walter Hickel had humpback and other great whales listed as endangered under the Endangered Species and Conservation Act of 1969. With passage of the Endangered Species Act (ESA) of 1973, humpbacks received more formal protection. Like the MMPA, the ESA prohibits "taking" of endangered species; but the ESA expands taking to include unintentional acts, such as "harassment" in the course of research or whalewatching, for example.

Unlike the MMPA, the ESA provides authority to designate key species' habitats as "critical habitats" where federal agencies are to insure that activities conducted under their authority do not jeopardize the continued existence of an endangered species or result in destruction or modification of the critical habitat. Importantly, this provision does not apply to state or private actions.

The Secretary of Commerce, through the National Marine Fisheries Service (NMFS), is responsible for implementing the ESA with respect

Overleaf, a humpback whale (Megaptera novaeangliae) breaching off Lahaina, Maui. The behavioral significance of breaching by humpbacks is unknown. (Photo by Frederic L. Felleman)



A 1979 workshop sponsored by the National Marine Sanctuary Program recommended that a humpback whale sanctuary in Hawaii should include all waters within the 100-fathom isobath around the main Hawaiian Islands. This proposal was later modified to include only the waters west of Maui.

to all endangered and threatened cetaceans. The agency lists the humpback whale as an endangered species, but to date has not considered designation of a critical habitat.

Where Did The Whales Come From?

By the early 1970s, the island of Maui was coming into its own as a tourist destination. The spectacular, winding road along the Hana coast, the sandy beaches and sparkling waters near Kihei and Kaanapali, and the quaint old whaling port of Lahaina offered something for everyone.

Such was the situation in 1973 when Hudnall's relatives called him from a condominium on Maui, enthusiastically describing the whales they were seeing just offshore. Even after careful questioning of his relatives, Hudnall was unsure just what species of whales they were seeing.

This seems remarkable, perhaps, from today's perspective. But, Hawaii's humpbacks had not attracted much attention outside Maui County. There was a small group of whalewatchers on the island, but no systematic research effort. The early 70s also preceded the time when humpback whales would become television stars—with their own record album.

The next year, Hudnall set out for Maui, where he began his humpback studies. Several seasons of observing the whales from boats and cliffs established that the area was critical for the winter reproductive activities of humpbacks. Hudnall also observed that humpback cows and calves seemed to favor shallow nearshore waters, so vulnerable to disturbance by human activities, including boat traffic and runoff from nearby sugarcane fields.

Soon, television and popular articles catapulted humpback whales into the vanguard of national environmental concern. Film crews descended on Maui, as did researchers. Souvenir shops in Lahaina no longer emphasized the town's whaling past. Instead, they began to capitalize on the growing concern and fascination with humpback whales. Clearly, there was tourist money to be made in live whales.

Soon, Lahaina was seeing more and more tourists. Between 1971 and 1981, tourist expenditures in Maui County increased sixfold, from about \$75 million to more than \$425 million. Hotels and condominiums sprang up along the west coast of Maui to accommodate increasing numbers of tourists. Jet aircraft and a highspeed hydrofoil, which passed through an area favored by humpbacks, were bringing the island closer together. The first whalewatching boats were taking tourists out of Lahaina harbor into waters that were, until very recently, a quiet humpback hideaway.

Harassing Humpbacks

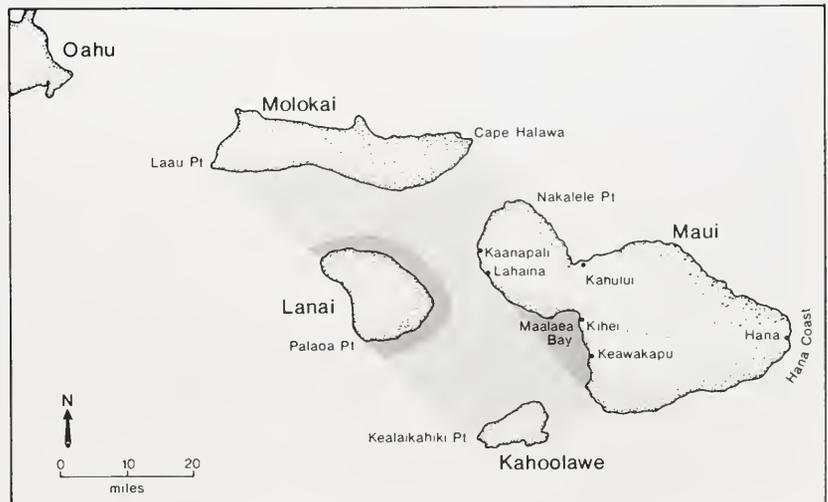
Both the MMPA and the ESA prohibit the harassment of humpback whales. Yet, every Maui observer has a favorite harassment story from those early days. An amalgam of several such stories follows.*

A humpback cow and calf loll at the water's surface in Maalaea Bay. A large vessel full of whalewatchers approaches within yards of the whales. The cow places herself between the calf and the vessel and begins to move off. Several small boats rush up, each carrying eager observers. One of the intruding boats displays a pennant indicating it is engaged in research.

The cow slaps the water with its pectoral flipper. One of the small private boats approaches the cow, and, miscalculating, rides up and over her back. The cow and calf dive. When they surface they are set upon again by a growing number of small boats and the large vessel. For the next hour, the cow and calf futilely attempt to evade their observers.

* The author notes that this amalgam is not a specific incident, and that all the elements did not take place at the same time. It does, however, accurately illustrate the conflicts that did occur, and may occur, between whalewatchers and whales.

In 1983, the National Marine Sanctuary Program proposed that a humpback sanctuary include only the waters of Maui County. In July 1977, the Maui County Whale Reserve Committee had suggested this area as a whale reserve. While the question of a reserve or sanctuary remains unresolved, this area is the focus for concerns about conflicts between whales and man. Place names are those referred to in the text.





The large, white flipper of a humpback whale in Maalaea Bay, a nursery area for humpbacks near the island of Maui in Hawaii. (Photo by Frederic L. Felleman)

In the mid-1970s, concern grew that similar incidents would multiply. In 1976, scientists working in Maui County expressed concern that humpbacks were leaving areas in response to harassment by boaters.

In July 1977, the Marine Mammal Commission sponsored a workshop on the matter—specifically aimed at the harassment question. Based on the findings of this workshop, in 1979, NMFS published guidelines on harassment of Hawaiian humpbacks. The guidelines had little legal force, but together with an educational program, they served to curb much of the harassment.

Meanwhile, a group of whale conservationists met monthly on Maui. The group included Roy Nickerson, a newspaperman who had been working on the manuscript of *Brother Whale*, and Jim Luckey of the Lahaina Restoration Foundation. The Maui Whale Watchers, as they called themselves, worried that tourist development might drive off the humpbacks, one of the area's new tourist attractions. If local government did not act, some feared, the federal government, whose presence is not always welcome in Hawaii, might intervene further.

In June 1976, Jim Hudnall and Joan McIntyre, who edited one of the seminal works of the whale movement called *Mind in the Waters*, met with several members of the Maui Whale Watchers, including artist Michael Wyatt, Roy Nickerson, and Jim Luckey. They, as a citizens' group with Jim Luckey as chairman, formulated recommendations on local humpback protection

for submission to the mayor of Maui County, then Elmer Cravalho. These recommendations were subsequently modified and were finally submitted to the mayor in July, 1977, by a different group of individuals (still including Jim Luckey as chairman) now calling itself the Maui County Whale Reserve Committee. The recommendations included seeking methods of establishing controls and supervision over the humpback whale habitat that would prevent harassment, working with NMFS to exchange information about whales and harassment, establishing an educational program for the general public and boaters, and enlisting the support of other organizations to provide funds for a whale research center on Maui.

This committee also formulated the idea of a "Maui County Whale Reserve," but they recognized in their opening paragraph to the Major on this concept that Maui County had no legal jurisdiction over its waters, and that the humpback habitat was "clearly the domain of the state and federal government."

In December, 1977, in response to the recommendations of the committee, Mayor Cravalho issued a Proclamation designating the months of "December through May of each and every calendar year as Whale Reserve Months in the County of Maui." The Proclamation directed the Whale Reserve Committee to take appropriate action during that period to encourage residents and visitors to comply with the laws regarding whale preservation, to cooperate with state and federal agencies to enforce existing laws, and to develop a marine research center and public awareness programs.

After three years, the Maui County Proclamation had resulted in no education or research programs. Like the state's designation of the humpback as the State Marine Mammal in 1976, the Maui County Whale Months Proclamation was an edifying gesture that did not challenge the *status quo*. Nonetheless, in later public hearings, opponents of a federal sanctuary often cited the "county reserve" as if it were a meaningful alternative.

Humpbacks and Impending Development

The early days of Jimmy Carter's presidency were euphoric for those who had been seeking an advocate for environmental protection. President Carter had already established his credentials as an advocate for whale conservation at the 1972 United Nations Conference on the Human Environment: then-governor Carter had played a key role in the passage of a resolution calling for a moratorium on commercial whaling.

But, with the experience of the Arab oil boycott still fresh in people's memories, the Carter administration decided to accelerate the leasing of the outer continental shelf for oil and gas exploration and production. To mitigate the effects of the offshore leasing program and other coastal activities, in his May 1977 Message on the Environment, President Carter called for the revitalization of the National Marine Sanctuary Program. The president specifically called for the



Commercial whalewatching is big business in Hawaii, where humpback whales breed, calve, and nurse in the winter. The number of commercial whalewatching boats in Maui alone has increased nearly 400 percent in the last 8 years. (Photos by Frederic L. Felleman)

identification and designation of marine sanctuaries, particularly in areas of impending development.

At about the same time in Washington, D.C., filmmaker Stan Waterman showed a film of Hawaii's humpbacks and Hudnall's research to various groups. The presentation included an appeal by Hudnall for a sanctuary of some sort. When Commander Phillip C. Johnson, a NOAA Corps officer who was the director of the fledgling sanctuary program saw the film, he referred Waterman to the President's recent statements and asked that Hudnall submit a proposal. Maui County was certainly a site of impending development. Hudnall, concerned that the recommendations of the July 1977 Marine Mammal Commission workshop would not be carried out in time, and knowing that Maui County could never create a whale reserve, submitted a proposal by early December 1977. It joined 150 other sanctuary proposals.

The purpose of the sanctuary, as proposed by Hudnall, was

... to preserve, protect, and manage the essential, specialized habitat of the Hawaiian humpback whales, and to conserve the genetic resources of the Hawaiian humpback breeding stock. In addition, the proposal is submitted to allow scientific research and education in support of humpback whale stock management, and to provide an ecological baseline to compare and predict the effects of man's activities on other humpback whale calving/ breeding areas.

Borrowing language from the ESA, Hudnall defined three critical habitats for consideration as sanctuary areas. The most critical area was the calving/ breeding area in Maalaea Bay that NMFS was to identify later as a special area in its 1979 harassment guidelines. The proposed boundaries did exclude some waters, such as Penguin Banks off Molokai, where humpbacks were known to gather, but where development was, and still is, remote.

The proposal to NOAA received the endorsement of many national and international organizations, including several that later opposed the sanctuary, such as the Pacific Whale Foundation. Although the Hawaii humpback sanctuary proposal seemed to be a sentimental favorite, the sanctuary program placed a higher priority on several more controversial proposals, including the Point Reyes-Farallon Islands and Channel Islands sanctuary proposals in California, where the sanctuary program was on a collision course with the Interior Department's offshore leasing program.

Lessons Learned

A critical point to emerge from the consideration of the Hawaii humpback sanctuary proposal is that the lack of a committed constituency early in the process may well have doomed the proposal. Lessons may be learned from contrasting the failed Hawaii proposal with the California proposals that

successfully generated sanctuary designations in the waning days of the Carter administration.

First, the opposition of the oil companies to the California proposals created a clear target for sanctuary supporters. Had commercial whalers been cruising through Hawaiian waters, humpback sanctuary supporters might have had their clear target. But, there was no clear target in Hawaii, except perhaps for some who might be expected to support a whale sanctuary, such as whale researchers and whalewatching operations.

In his proposal, Hudnall identified whalewatching boats and the SeaFlite hydrofoil (an inter-island ferry operating out of Honolulu) as the most serious and immediate encroachments on the habitat. With this, the proposal appeared to be a threat to the emerging whalewatching industry, which identified researchers as the primary source of harassment. The specter of federal regulation of any boating activity created nervousness among other commercial and recreational boaters, as well as among commercial fishermen, whose interests were advanced by State Senator Wadsworth Yee.

Although other state officials did not actively oppose the sanctuary, the lack of a broad local constituency for the proposal encouraged a wait-and-see attitude. The state government held no public hearings. Rather, the state relied on the federal government. Throughout the sanctuary review process, the state seemed an unwilling partner.

Late in 1979, the federal government convened a group of scientists and government officials to discuss the sanctuary proposal and other approaches to protecting humpbacks in Hawaii. Many people believed that a proposal that reflected the best judgment of scientists and government officials would generate broad support. But when invited participation at the workshop was restricted to government officials and scientists, it encouraged distrust in a curious and concerned public. When the scientists concluded that a sanctuary including waters out to 100 fathoms around the main Hawaiian islands was a good idea, many local people dismissed the advice.

In contrast, the California Coastal Commission sponsored several public hearings that fostered public support for the California sanctuary proposals. By the time the state signaled the federal government with its support for the proposals, a broad and involved constituency had been developed for completing the designation process. Indeed, this constituency adopted the proposals as their own, while the Hawaii sanctuary proposal was characterized as interference by haoles (outsiders).

Advanced To Active Status

In the early years of the Reagan administration, it appeared that, despite its difficulties, the proposal might advance toward actual sanctuary designation. At the end of 1981, after vacillating on whether to join the federal government in promoting continued review of the sanctuary proposal, the state government acknowledged international

support for the sanctuary proposal and agreed to proceed. In the spring of 1982, the federal government elevated the sanctuary proposal to active candidate status, circulated a document describing management issues and approaches, and held public hearings.

Faced with widespread opposition from the boating and fishing communities in Hawaii, federal officials sought to eliminate fears of additional regulation of boat traffic by insisting that the sanctuary's management would be nonregulatory. But the assurances did not eliminate the fears.

In retrospect, there is probably nothing that federal officials could have said to secure the support of these interests. The fishing community had decided in 1977 that the sanctuary proposal was a threat to their way of life, and no amount of written assurance could change that.

The federal government's efforts to accommodate the fishing and boating communities caused the environmental community to pause and wonder just what a sanctuary might do for the whales that was not already being done under the ESA and the MMPA.

One answer—international recognition of the special nature of this humpback habitat and increased stature of the area through designation, which has inherent in it high educational value—was deemed nebulous by some.

Committee Referral

In August 1983, Governor George Ariyoshi established an advisory committee dominated by boating and fishing interests. Questions also were raised when the state failed to transmit a critical document outlining the federal government's position to the committee before its first meeting. When the committee concluded its deliberations, a majority voted to recommend that the governor oppose any sanctuary at all. Support for the sanctuary among the remaining committee members was cautious.

In February 1984, public hearings on the Draft Environmental Impact Statement (DEIS) provoked still more vociferous opposition. Some opponents (and former supporters) began to talk of hordes of tourists descending on the waters of Maui County just to see whales in a National Marine Sanctuary.

Spokesmen for fishermen's organizations claimed that the sanctuary proposal forced a choice between jobs and whales. Some researchers flinched to hear a government agency talk about coordination of their research. Opponents of the sanctuary characterized support by national and international conservation organizations as more outside interference in the affairs of Hawaiians.

Even NMFS, a sister agency to the sanctuary program, complained that the proposal implied a failure on its part to carry out responsibilities under the ESA and the MMPA. Other federal agencies complained that they should have been more

closely involved in the development of the proposal.

As before, nearly everyone found some fault with this modest proposal that aimed at enhancement, not salvation.

In June 1984, the governor of Hawaii notified the federal government that he would disapprove the application of a federal sanctuary to Hawaiian territorial waters. With that, the federal government was confronted with a decision it has yet to make: to withdraw the sanctuary proposal entirely or to proceed with a sanctuary whose boundaries do not include most of the waters utilized by humpbacks while they are in Hawaii.

Questions on the Table

While the sanctuary proposal has languished, development has continued apace in Maui County and elsewhere in Hawaii. According to statistics presented by NMFS in support of new regulations restricting approaches to humpback whales in Hawaii, the number of registered vessels in Maui County has increased to 1,223 in 1985 from 835 in 1979. In 1983, a new boatramp was constructed at Keawakapu near Maalaea Bay, a humpback nursing and calving area; NMFS estimates that an average of 50 boats are launched into the bay each day, including a highpowered boat towing tourists on parasails. The number of commercial whalewatching boats increased to 65 in 1985 from 18 in 1979.

Business is booming. Maui county is an increasingly noisy place for tourists, natives, and humpback whales. Debbie Glockner-Ferrari, Mark Ferrari, and Paul Forestell, humpback whale researchers, have gathered evidence indicating that humpback cows and calves have been abandoning nearshore areas as nearshore boat traffic has increased.

As more humans arrive, will the whales leave?

Perhaps we will debate that question—as we debate the question of giving the humpback *koholā pu'uhonua*.

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Views expressed are those of the author and do not necessarily reflect those of the organization of affiliation.

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The Channel Islands National Marine Sanctuary

by Porter Hoagland III, and Timothy K. Eichenberg



Anacapa Island, near the eastern boundary of the Channel Islands National Marine Sanctuary. (Photo by P. Hoagland)

The Channel Islands National Marine Sanctuary, designated in 1981, is the keystone of the nation's marine protected areas. The marine region represented by the sanctuary, the Southern California Bight, arguably has had more influence on the shaping of United States domestic marine policy than any other.

The conflicts that surrounded the establishment of the marine sanctuary at the California Channel Islands have had an important influence on the evolution of the national program

during the last 10 years. In fact, the continuing controversies over the use of the resources near these islands raise questions about the efficacy of the designation "marine sanctuary" in the United States and whether management concepts, such as "multiple use," can be attained in the oceans.

A Recent Scare

On 21 September 1987, almost seven years to the day after President Carter approved the designation of a national marine sanctuary around the five

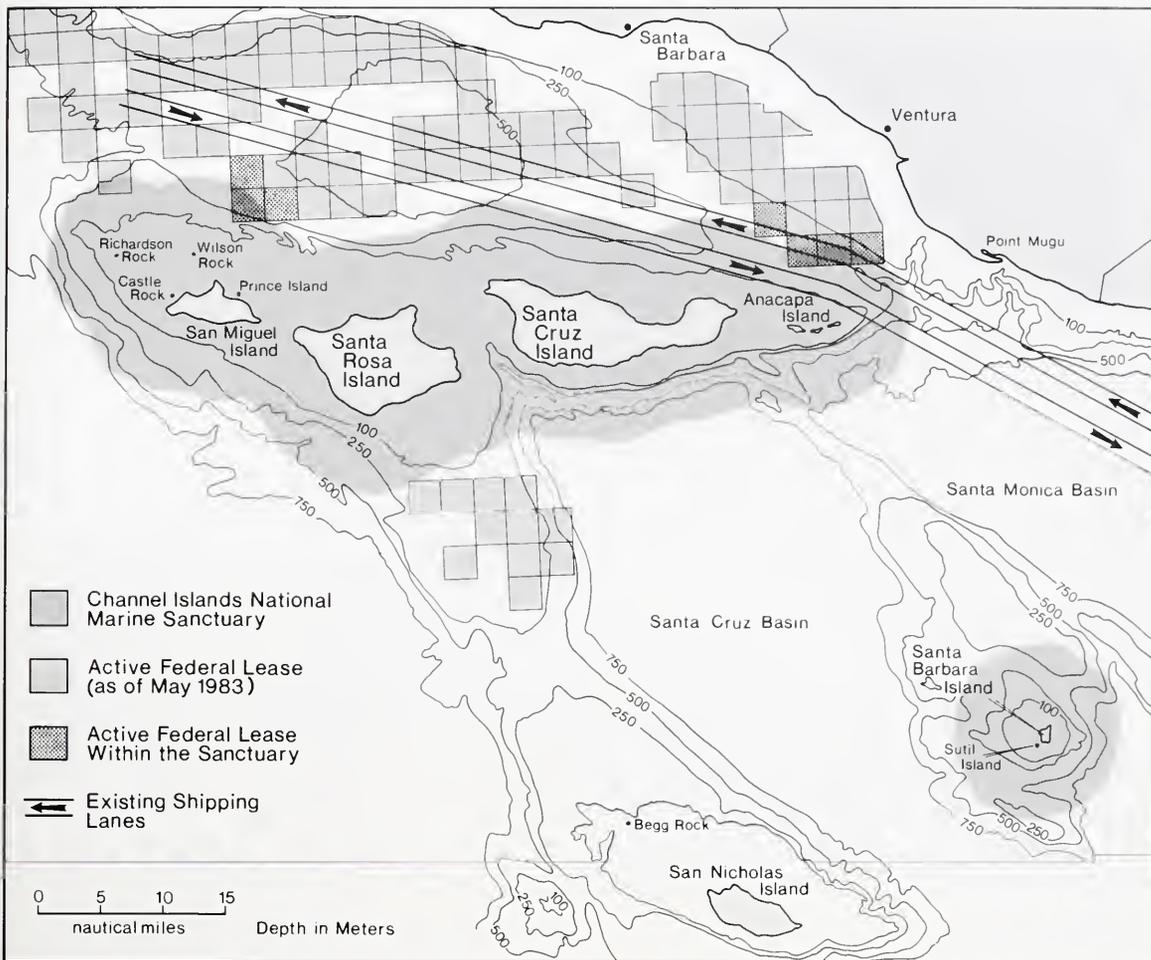


Figure 1. Marine protected areas and other enclosures in the Santa Barbara Channel, off southwestern California.

northernmost Channel Islands, an oil spill took place. The spill was the result of a collision between two foreign-flag vessels, the *Pac Baroness*, a Liberian-registered ore carrier, and the *Atlantic Wing*, a Panamanian-registered freighter carrying automobiles.

The collision occurred approximately 12 miles off Point Conception, just outside the charted vessel traffic lanes that run through the Santa Barbara Channel. The *Pac Baroness* sank almost immediately and began to leak Bunker C fuel oil. Three days later, the oil slick expanded to 18 square miles in area. The California Department of Fish and Game reported that the oil slick was the largest in the vicinity of the Santa Barbara Channel since the 1969 Union Oil platform blowout.

Based on presumed wind and current movements, state and federal natural resource officials became concerned that the spill would enter the Channel Islands National Marine Sanctuary (Figure 1). Officials from the California Department

of Fish and Game, the U.S. Coast Guard, the National Oceanic and Atmospheric Administration's (NOAA's) Marine Sanctuary, fishermen's associations, public interest groups, and Clean Seas, an oil spill cleanup cooperative operated by oil companies, mobilized to respond.

Because Bunker C is not as hazardous to marine life as crude oil, and because currents and winds worked to disperse the spill, the *Pac Baroness* incident ended as only a minor catastrophe. Although the ship continues to leak small amounts of fuel, damages to natural resources have been estimated at less than \$10,000.

The response to the *Pac Baroness* incident illustrates the concern for protection of the marine environment in this region. The accident itself highlights a smoldering issue about the potential for serious environmental damage associated with vessel traffic. Of primary concern are the substances that are transported, either oil or other hazardous materials, and the slowly growing number of obstacles in the Santa Barbara Channel—the oil

Natural Seeps

All the oil in and on the sea is not from spills or accidents. Natural seeps—where hydrocarbons are released as natural occurrences—are found worldwide. The hydrocarbons released range from natural gas, oil so light it evaporates on contact with air, crude oil, and solid asphalt. Seeps occur in offshore areas of Alaska, Australia, Canada, Mexico, the Persian Gulf, Trinidad, and Venezuela when oil- or gas-bearing geological layers are uplifted, eroded, or fractured. Shallow deposits can be exposed directly, or oil can make its way to the surface along fault lines.

On a worldwide basis, the input of petroleum hydrocarbons into the ocean from natural seeps is estimated by the National Academy of Sciences to be in the probable range of 0.02 to 2.0 million metric tons a year, with a best estimate of 200,000 metric tons a year. This best estimate value constitutes about 6 percent of the total input of petroleum hydrocarbons to the marine environment.

Southern California is well-known for its seeps. Los Angeles' La Brea tar pits, where large

numbers of sabertooth tigers and other animals were entombed, is still active. Along some southern California beaches, exposed sandstones in beachfront cliffs ooze asphalt on warm summer days.

It is in the Santa Barbara Channel where some of the world's most prolific seeps are located. Analysis of long cores in the Santa Barbara Basin reveals that petroleum has been seeping into the Southern California Bight for tens of thousands of years. Coal Oil Point, 10 miles west of Santa Barbara, is believed to be one of the world's largest oil seep sites—estimated to release about 50 to 70 barrels of oil a day.

The natural seeps at Coal Oil Point are the subject of a variety of oceanographic studies—including the biology of the animal communities living on the ocean floor in their vicinity. From these and other data, it is clear that oil is a part of the natural marine environment in southern California.

—JHWH

production platforms. Extensive efforts at all levels of government, including the creation of marine parks and other forms of environmental protection, have been devoted to restricting the development of marine hydrocarbon deposits in this region as a means to protect living resources and other amenities. Yet, attention to this issue may have eclipsed continuing problems with vessel traffic safety. The spill that occurred last September had more to do with traffic control than oil production. Indeed, for 20 minutes before the collision, radar operators on the Texaco oil production platform "Harvest" radioed unsuccessfully to warn the approaching ships of their intersecting paths.

Sanctuary Resources

Perhaps to a greater extent than other ocean areas, U.S. national marine sanctuaries are at the intersection of multiple human uses and a variety of important marine resources. The sanctuary that surrounds the northern Channel Islands off California may have greater diversity in this respect than any of its counterparts. The boundaries of the sanctuary include, or overlap, a national park, which extends 1 nautical mile offshore, the California State "oil and gas" sanctuaries and areas of special biological significance, offshore lease tracts, vessel traffic lanes, and other management enclosures.

Some of the earliest exploration efforts, including that of George Vancouver in 1793, reported that natural hydrocarbon seeps (see also

box above) existed in the Santa Barbara Channel, located between the eight Channel Islands and the California mainland. In 1897, the first offshore hydrocarbon production occurred from piers extending off the beach at Summerland, between Santa Barbara and Ventura, into the channel.

The most recent estimates by the U.S. Minerals Management Service for reserves (or commercially-recoverable amounts given current prices and technologies) on the federal outer continental shelf off southern California are 1.3 billion barrels of oil, and 2.1 trillion cubic feet of gas—making it the second most important offshore oil and gas region in the United States.

Among the living natural resources there, marine mammals are the most visible, and receive the most management attention. Of the research projects conducted in the sanctuary since its establishment in 1980, 13 of 19 have been concerned with the study of either cetaceans (whales and dolphins) or pinnipeds (seals and sea lions). The northern islands are breeding grounds for several pinnipeds, including the harbor seal, elephant seal (more than a third of the world population of 65,000 live on the islands), northern fur seal, California sea lion (almost half of the world population of 140,000 are found there), and Stellar sea lion. The rare Guadalupe fur seal, once thought to be extinct, has been sighted and may soon begin to breed on the islands. The sea otter, a fissiped (taxonomically related to dogs and cats), used to be quite common, as readers of Richard



Among the first wells drilled over water were these located on piers in the Summerland field, California, just south of Santa Barbara. This 100-acre field produced from a depth of 210 feet. The photo was taken circa 1920. (Courtesy of World Oil)

Henry Dana's description in his classic *Two Years Before the Mast* may know. (An early marine policy enthusiast, Dana took time off from Harvard for his adventure in the mid-19th Century.) Only a few sea otters now migrate through the area, to the delight of the abalone fishermen, who work the coastal waters of the islands for the otter's favorite mollusk. To the chagrin of these fishermen, however, the U.S. Fish and Wildlife Service has transplanted a small population of sea otters to the southern Channel Island of San Nicholas (outside of the sanctuary).

Of the 30 species of cetaceans that are known in the northeast Pacific, 27 have been sighted in the sanctuary, and at least 14 use the waters of the sanctuary as habitat or as a primary migration route. Saddleback (or common) dolphins are the most numerous of the small cetaceans, and in peak seasons as many as 125,000 may be found in the Southern California Bight. Other resident dolphin species include the bottlenose, Pacific white-sided, northern right-whale, and Dall's porpoise.

Gray whales are the most common large cetacean seen in the marine sanctuary, as they migrate through. Residents include the minke, short-finned pilot, and killer whales. A small number of

vessels is employed in the whalewatching trade, although this business does not appear to be as extensively developed in southern California as it is in other areas of the country, such as Massachusetts.

For about half the year, from late February to August, local wind patterns drive surface waters offshore and set in motion an upwelling of deeper, relatively nutrient-rich seawater. Because this upwelling takes place when the days are long, the combination of nutrients and sunlight increases the productivity of phytoplankton and algae. This primary production supports the productivity of fish, shellfish, marine mammals, and birds that inhabit the Channel Islands marine ecosystem.

There are extensive kelp forests in the nearshore waters of the sanctuary (*Oceanus* Vol. 27, No. 1, pages 19-24), and scientists believe that the natural conditions of the island waters, especially water clarity and the existence of high-relief rock outcrops, are responsible for increased species diversity, compared to kelp forests in mainland coastal waters. Kelp has been harvested from the waters of the sanctuary for at least the last 30 years. The islands are also a nesting area for the California brown pelican, an endangered species.

Marine Policy Concerns

The issues of public policy interest in the Channel Islands sanctuary span a wide range, and include the impacts of industrial development and vessel traffic; the benefits and impacts of recreational uses, such as boating, sport diving, and whale watching; the allocation of public funds for scientific research and education purposes; the management of threatened or endangered species; the conservation of cultural or historic resources; and the interaction between government agencies at federal and state levels.

One issue has received the most attention, and, more importantly, has shaped both the federal government's National Marine Sanctuary Program, as well as the designation and implementation of the Channel Islands sanctuary. That issue concerns the external effects of the industrial development of marine oil and gas resources.

A Watershed Event

The oil spill that occurred almost 20 years ago, from Union Oil Company's platform A, well A-21, on 28 January 1969, played a major role in launching the environmental movement in the United States. It was certainly a watershed event for legislative efforts to establish a national program of marine parks. The spill, which had an immediate effect on the beaches of Santa Barbara County (but no effect on the Channel Islands), resulted in the establishment of a permanent "federal ecological preserve" and a contiguous temporary "buffer zone" on the submerged lands beyond the 3-nautical-mile state-controlled territorial sea. This is one of only three times that the Outer Continental Shelf Lands Act (OCSLA) of 1953 has been employed to permanently "reserve" areas of the outer continental shelf from hydrocarbon mineral development.* Perhaps more significantly, congressional initiatives for the establishment of marine parks were given a substantial boost. The Nixon Administration put forth proposals for marine reserves with a fervor, including one that specifically would be located off the island of San Clemente (where Nixon owns a home)—the southernmost of the eight U.S. Channel Islands.

In congressional testimony in 1970, Secretary of the Interior Walter Hickel voiced the position of the Nixon administration:

... [W]e have reached that state of historical refinement where—in some cases—we willingly trade financial for nonmonetary returns, knowing that the long-term benefits to society exceed by far the short-term economic gains Let it establish a continuing creed for this government

*Section 12 of the OCSLA gives the President authority to "withdraw from disposition any of the unleased lands of the Outer Continental Shelf." In 1960, the Key Largo Coral Reef Preserve was created as the first such withdrawal. When OCSLA was amended in 1978, Congress included a provision that withdrew submerged lands extending 15 miles seaward from the Point Reyes National Seashore (northwest of San Francisco and east of the Farallon Islands).

that from this time forward the economic value of a refinery is no less and no more than the spiritual value of a sanctuary.

Shortly thereafter, in 1972, the Marine Protection, Research, and Sanctuaries Act (MPRSA) was passed into law. Also known as the "Ocean Dumping Act" because it regulated the dumping of all types of materials into the marine environment, the Act included a provision for the Secretary of Commerce (through NOAA) to preserve or restore areas of the ocean as marine sanctuaries. A budget for designating marine sanctuaries initially was authorized at \$10 million a year in 1973 (a figure closer to \$25 million in today's dollar terms), but was never appropriated. It was not until six years later, in 1979, that Congress actually appropriated a modest half million dollars for this purpose.

In the meantime, NOAA allocated funds internally for a sanctuary program, and by 1975 had created the first two sanctuaries: the site of the wreck of the *U.S.S. Monitor* (see page 26), and the coral reef off Key Largo, Florida (page 35). In 1978, NOAA began active consideration of the Channel Islands as a potential marine sanctuary, and in March 1981, the Channel Islands National Marine Sanctuary was officially designated. The deceptively short period of time from consideration to designation masks the difficulties encountered in establishing this sanctuary, and the contentious debate among development and preservation interests over this area.

The Channel Islands Designation

President Carter's approval of the sanctuary designation in 1980 was one of the last acts of an administration known for its concerns about environmental protection. From the outset, officials at NOAA argued for the complete prohibition of hydrocarbon development within the area proposed for a marine sanctuary around the islands. At that time, however, NOAA was limited in its ability to establish marine sanctuaries, and could only include ocean "waters." Responsibility for marine resources on the submerged "lands" of the outer continental shelf (particularly oil and gas) came within the regulatory purview of the Interior Department. (In 1984, amendments to the MPRSA gave NOAA authorization to establish marine sanctuaries in ocean waters and on submerged lands.) Because the U.S. Geological Survey and industry experts believed the potential for hydrocarbon resources on the lands beneath the proposed sanctuary to be significant, NOAA's proposed prohibition ran full force into the plans of Interior Department officials to consider leasing blocks of submerged lands to oil companies for hydrocarbon exploration and development. An additional complication was that there were existing leaseholders (of oil and gas tracts) within the area. NOAA faced the prospect of having to compensate these leaseholders for "taking" their exploration and development entitlements.

Supporters lined up on both sides. California, which had already established state oil and gas sanctuaries in the territorial seas surrounding the



Ship traffic and an oil rig in the Santa Barbara Channel. (Photo by P. Hoagland)

islands, local town governments, and environmental groups threw their weight behind NOAA. The oil industry, including the American Petroleum Institute and the Western Oil and Gas Association (WOGA), two large industry associations, sided with Interior.

NOAA engineered a compromise, one that could be argued as a true-to-life "balancing of multiple uses"—a management concept never written into the MPRSA, but which lies buried in its legislative history.

NOAA stuck with its plan to prohibit oil and gas activity, but compromised on three points:

- Existing leaseholders of tracts located within the sanctuary would be allowed to continue their exploration and development work.
- Developers on leases adjacent to the sanctuary would be permitted to drill directionally to tap oil and gas deposits that might exist within the confines of the sanctuary.
- NOAA selected a sanctuary boundary that extended only six miles off the coast of the islands, a boundary less extensive than other proposals examined in the development of alternatives for an Environmental Impact Statement (EIS), but which still contained the most biologically productive areas.

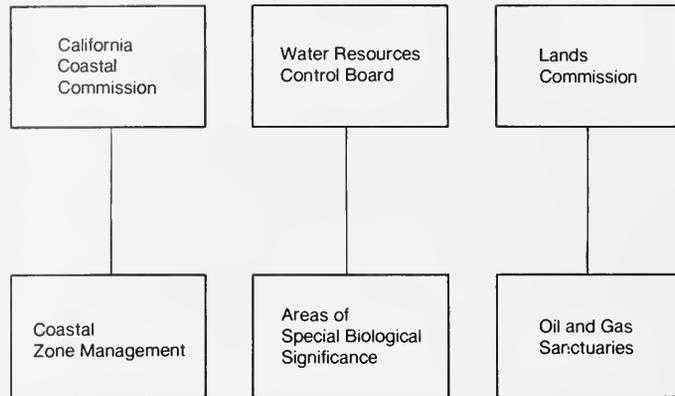
Finally, NOAA buttressed its position by conducting an "economic impact analysis" (not required by law), which showed that the costs of foregone hydrocarbon activity incurred by creating the sanctuary were insignificant.

The general management of a designated marine sanctuary is carried out by regulations or rules drafted by NOAA. A process of public hearings and written publication of these rules in draft and final forms is a part of the designation. In 1980, because of a statutory requirement, a national marine sanctuary could not be designated officially until a continuous 60-day gubernatorial and congressional review period of the proposed designation had expired (the 1984 amendments shortened this period to 45 days). By the time this review period had ended for the Channel Islands sanctuary, a new President and administration were in office with a perceived "mandate" to cut back on the influence of government in the nation's economy.

As a first step to carry out this mandate, President Reagan temporarily suspended all federal rulemaking for two months, including those rules that would provide for the management of the Channel Islands sanctuary. In particular, the proposed rules for the prohibition of hydrocarbon activity stood out as a clear example of government restriction of private enterprise, and industrial interests began to garner support within the new administration to block them. There are indications that the issue of preservation versus development over this 1,252 square nautical miles of ocean space (about 0.2 percent of the U.S. Exclusive Economic Zone) was discussed at the highest levels of the executive branch, perhaps even considered by the President himself during the hectic first months of office.

Administration and management of the Channel Islands Sanctuary area involves coordinated efforts of several agencies at the state and federal level. Not shown in this diagram is that responsibilities over specific resources and uses may be shared among several agencies. Many of these same agencies also have enforcement roles, in conjunction with the Environmental Protection Agency, the National Marine Fisheries Service, and the Fish and Wildlife Service at the federal level; and the Department of Fish and Game at the state level.

State of California



NOAA handled the delay of its proposed sanctuary designation and rising political pressure from within the administration with aplomb. The agency could have proceeded with the final publication of the sanctuary rules after the two-month general suspension, but a changed political climate and a new executive order dictated another tactic. First, NOAA finalized all of the Channel Islands sanctuary regulations except the hydrocarbon prohibition as soon as the general suspension was lifted. Then NOAA volunteered to conduct a "regulatory impact analysis" (RIA) of the hydrocarbon prohibition under the provisions of a newly-issued presidential executive order governing "major rules." In the order, major rules were broadly defined according to several criteria as those that might have a substantial adverse effect on the national economy. For the Channel Islands case, a review of the hydrocarbon prohibition would involve a detailed cost-benefit analysis weighing the costs of foregone oil and gas activity against the benefits of natural resource protection. If, upon review, the rule was found to be a major one, then it might require additional modifications or, in the extreme, NOAA might have been prevented from issuing it at all.

NOAA's move raised the hackles of the agency's primary supporters, particularly environmental groups and the state of California, because NOAA was seen as bending to the pressures of the Interior Department and the President's Office of Management and Budget. But more likely, this tactic was a calculated risk. NOAA hired the same consulting firm that earlier had conducted the economic impact analysis for the sanctuary, and after almost a year of exhaustive accounting and valuation of natural resources, concluded:

Because of the wide variation in cost and benefit values, associated with no development or full development of the hydrocarbon resources, as well as the uncertain level of risk, it is virtually impossible to assess the relative benefit-cost differentials among the five levels of regulation which are evaluated in the RIA.

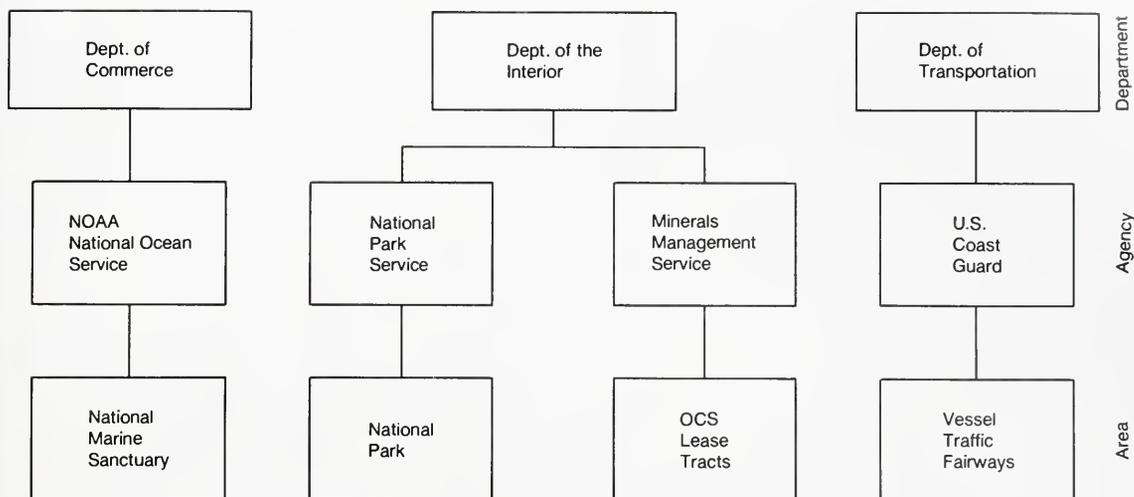
Without a conclusive result that demonstrated a sizable effect on the national economy, the hydrocarbon prohibition could not be shown to be a major rule. As the last act in the establishment of a body of law governing the use of the resources of the sanctuary, NOAA published its final rulemaking in April 1982.

The 1984 Amendments

The conflicts that played themselves out in the designation process for the Channel Islands were concerned fundamentally about the rights to manage existing and prospective resources. However, experience in the Channel Islands and other sanctuaries designated to that date had generated criticism of the designation process. Incorporating the views and responsibilities of other federal agencies appeared to be a primary concern.

In 1984, several substantive amendments to the MPRSA were enacted, virtually replacing the existing provisions governing marine sanctuaries. The experience over the sanctuary designation at the Channel Islands clearly left its mark in these modifications. Among these amendments were provisions requiring the Secretary of Commerce to consider the "public benefits to be derived from sanctuary status," and the "negative impacts produced by management restrictions on income-

Federal Government



generating activities" including hydrocarbon development. Also added to the Act was a requirement to prepare a "resource assessment report" as part of the EIS. The amended Act is quite specific as to the role of the Interior Department in contributing to this report:

The Secretary [of Commerce], in consultation with the Secretary of the Interior, shall draft a resource assessment section for the report regarding any commercial or recreational resource uses in the area under consideration [for sanctuary designation] that are subject to the primary jurisdiction of the Department of the Interior.

Because of these changes, it may become increasingly difficult for future marine sanctuary designations to include terms that prohibit industrial activities, especially those activities that are regulated by other government agencies.

Court Challenge

Shortly after NOAA completed the process of promulgating regulations, WOGA, representing the oil companies with interests in the Santa Barbara Channel, filed a lawsuit in the central California federal district court challenging the designation of the sanctuary and its regulations, as well as the adequacy of the EIS published by NOAA as part of the designation. In April of 1985, Judge Alicemarie Stotler ruled that the designation of the sanctuary was necessary to provide for the "comprehensive management" of the sanctuary waters, and for "incremental protections against the oil spills, aural and visual disturbances, and air and water pollution—all attendant upon normal hydrocarbon

operations." Moreover, the court found that even though WOGA did demonstrate an "injury in fact" resulting from the prohibition on hydrocarbon development in the sanctuary, the industry association had no "standing" under the National Environmental Policy Act to challenge the adequacy of the EIS. This was because the court considered the environmental consequences of the designation of a marine sanctuary to be an issue separate from the injury suffered by WOGA.

Balancing of Multiple Uses

The prohibition of hydrocarbon activity within the Channel Islands National Marine Sanctuary was a significant step toward providing for natural resource protection. The compromises struck in the sanctuary's designation demonstrate an important way in which multiple uses have been balanced in this area. However, some critics have claimed that the sanctuary does not really achieve its primary purposes, among which include habitat protection that is perhaps most significant.

For example, in 1982, the Union Oil Company proposed a plan of exploration to the Interior Department, which included drilling, on a lease tract that was partially within the sanctuary, less than 5 miles from Anacapa Island. For Union to know whether or not there were producible oil reserves on its tract, it would have to drill from an exploration vessel located inside the boundary of the sanctuary.

California was concerned about the potential effects of the exploration activity on the California brown pelican at its primary breeding ground on Anacapa. However, it was clear that the existence of the national marine sanctuary would not prevent the exploration activity, because Union's lease was one



The northern elephant seal. (Photo by T. Eichenberg)

of the leases that was in existence prior to the sanctuary designation.

California relied instead on another statute, the Coastal Zone Management Act, under which the state exercised its right to review Union's exploration plan, to determine whether or not the plan was "consistent" with the state's federally-approved coastal zone management plan. After review, California objected to the proposed plan.

Union Oil appealed the California objection to the Secretary of Commerce, then Malcolm Baldrige. Baldrige overrode the state's objection, but, in the process, measures were adopted by Union to mitigate the potential adverse effects. These measures included promises to drill during the months of November through January, when the number of brown pelicans on the island is small, fledglings are absent, and no breeding takes place. In addition, Union Oil agreed to refrain from depositing drilling muds and cuttings within the sanctuary and to locate any future production platforms outside the sanctuary bounds.

The result in the Union Oil case is further evidence of the balancing of uses in this area, but this was not directly related to the existence of the sanctuary. Union eventually did explore its lease with no apparent adverse environmental effects.

Future Concerns

The Santa Barbara Channel is becoming increasingly congested. In the future, vessel traffic safety may become one of the most critical issues to be faced by the sanctuary. More than 60 percent of the shipping through the Santa Barbara Channel carry petroleum or petroleum products, and the potential for a catastrophe more serious than the *Pac Baroness* sinking remains.

Beyond the 3-nautical-mile territorial sea, foreign-flag vessels cannot be required by law to follow the traffic lanes that course the channel. Clearly it would be folly to stray from these lanes, but foggy or stormy weather conditions might enhance the likelihood of navigational errors. The traffic lanes run through the eastern end of the sanctuary and recently have been rerouted even further within its confines to lessen the probability of collisions and to avoid obstructions. Oil platforms are the primary obstructions, and 18 already exist in the Santa Barbara Channel and nearby Santa Maria Basin. By the turn of the century, 26 additional oil platforms are expected to have been constructed. The displacement of an industrial activity or its side-effects into the sanctuary (like marine transportation) looms as the most significant future management concern.

The effectiveness of a national marine sanctuary as a mechanism to prevent the destruction of the unique resources of the Channel Islands has not really been tested. The very nature of the ocean and subsea environment that surrounds the Channel Islands means that conflicts will not disappear.

The designation process is the primary mechanism by which multiple uses are balanced in ocean areas that become national marine sanctuaries. Whether the marine sanctuary is a viable institution for balancing these uses as environmental conditions shift, as more knowledge is gained about the sanctuary resources, and as human needs and tastes change, remains unanswered.

The establishment of a national marine sanctuary was intended, at least in part, to provide a framework within which conflicts could be managed, while at the same time protecting what is an exceptional oceanic ecosystem. As surely as they have in the past at the Channel Islands, the existence of hydrocarbons, either naturally occurring or transported, will influence this sanctuary's future.

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Acknowledgment

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Community Involvement



in Marine Protected Areas

by Stephanie Kaza

In the Queen Charlotte Islands, off British Columbia, loggers and local tribes battle over pristine coastal habitat slated for a new national park. In the Dominican Republic, humpback whale breeding grounds have received some protection, but few people are aware of it. In Panama, a threatened estuary loses government support because of a change in leadership. In the Galápagos, rare black coral is disappearing, as sales of it flourish in tourist shops.

In these and similar situations, resource management will strongly affect the quality of life nearby. In each case too, there is an opportunity for local support to be a major contribution to managing and conserving coastal resources. In a number of marine protected areas around the world, community involvement has already proven to be such a contribution. While specific management

practices are often unique to the communities employing them, techniques to encourage local support may prove to be broadly applicable.

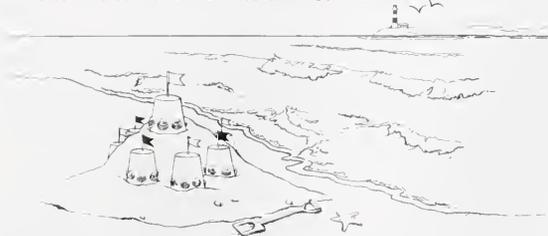
Seminars For Managers

In September 1987, The U.S. National Marine Sanctuary Program sponsored an international seminar in Denver, Colorado, to address management and educational challenges for marine protected areas. The two-day course, held in conjunction with the 4th World Wilderness Congress and the Oceanic Wilderness Symposium, drew representatives from 12 marine/coastal zones.

Above: Guides at Año Nuevo elephant seal breeding reserve in California often receive college credit for interpreting this area to its many visitors. (Photo by James Milton)

the seashore code

ENJOY THE COASTLINE AND WILDLIFE WITHOUT HARMING IT



keep your car off the beach

Beaches, and particularly sand dunes, are easily damaged by cars

- keep access to footpaths clear
- park in designated car parks



don't drop litter - it can kill

Litter on the beach is unsightly and can also be dangerous; many sea creatures die through entanglement every year

- please take all your litter home, hurrying it is no solution
- try and keep dogs from fouling the beach
- report canisters, drugs or drums that may be washed up on the beach



avoid disturbing seabirds

You can see seabirds at their best when they are at ease.

To do this

- it is best to watch them through binoculars
- keep some distance from them, especially if they are nesting
- make sure dogs are kept well clear of birds
- never, never, throw things over the cliff edge



They came to exchange ideas about developing public awareness and community involvement. Participants learned low-cost techniques for implementing interpretive programs to support sustainable use, effective conservation, and cooperative management. With the help of Ann Hillary of the National Marine Sanctuary Program, the author designed the course handbook and interpretive sessions.

The Denver session built on the results of a wide-ranging seminar held during June 1986. The earlier meeting—the first international session on planning and managing marine protected areas—was held at sites on both coasts of North America. Participants were able to see a variety of management opportunities first hand, illustrating the need to develop educational and interpretive materials that fit each site's cultural and physical characteristics. Although marine education in the United States is still in its infancy, it is farther along than in many countries. As marine interpreters in the United States have ideas important to developing programs around the world, we have some things to learn from these programs as well.

The Key To Success

Community involvement is central to developing successful interpretive programs for many marine protected areas. At sanctuaries with limited staff, local nonprofit groups can cooperate to produce educational materials. At a reserve in the Philippines, university students work as resident marine advisors. In Britain, SCUBA divers are enlisted to protect underwater marine life. With involvement comes understanding, with understanding comes public support and commitment. In this way, resources receive "grass roots" protection out of a sense of familiarity. In the long run, this seems to be more effective than generating laws and regulations that have no means of enforcement, and may run against community traditions and values.

In most instances, effective resource protection requires strong community awareness of the resources in question. With education and involvement, a community's understanding can expand to include the needs of both the local population and visitors. The focus of planning can then shift from day-to-day concerns to long-range, sustainable efforts. Efforts are now underway in the Galápagos to accommodate the increasing numbers of tourists, while monitoring lucrative sales of rare black coral by islanders. In the Santa Barbara channel, off southern California, oil companies have cooperated with the local natural history museum and marine sanctuary to sponsor a "Sea Center" for wharf tourists. Economic and cultural interests are as important to consider as recreational values.

For most marine protected areas, the question is not so much *why* community involvement is effective, but rather *what kind* of community involvement is effective. Inevitably, there will be some community response to establishing and developing a new marine reserve or estuarine sanctuary. The challenge for organizers is to mesh these contributions into a positive and supportive

Above and far right: Working with local volunteer groups, the Marine Conservation Society in Britain has developed a seashore code of manners and interpretive materials for divers. (Courtesy of the Marine Conservation Society)

whole. In the various forms it can take, community involvement must allow for the interests of all. In the Gulf of the Farallones sanctuary, for example, an interpretive plan was created only after consulting the spectrum of interested organizations—from bird watchers to commercial fishermen.

Managers of marine protected areas need to design effective educational programs. At the Denver seminar, we addressed this need by borrowing from land-use planning methods. Of course, such methods can only go so far when dealing with a dynamic environment altered by tides, storms, and animal migrations. In any event, the land-use methods were adapted to deal with tropical and temperate marine habitats, such as mangrove forests, coral reefs, open ocean, rocky offshore islands, beaches, and tidepools. In many cases, we improvised ideas based on each situation, its distinct resources, and challenges. The practical task was to find interpretive strategies that would engage the community to effectively address management and conservation problems.

A Cohesive Framework

Interpretation that focuses on isolated facts or individual organisms can be fragmented and directionless. But tied together into a cohesive framework, all efforts at public awareness or community involvement become more powerful and effective.

First of all, the heart of a protected area is its physical, biological, and cultural resources. Interpretive programs must include discussions of vulnerable habitats, typical species, and special physical features. At the Denver meeting, some of the topics we considered were turtle nesting areas, endangered fish, coastal headlands, and coral reef zones. For the cultural resources of an area, we asked about historical artifacts, scientific and spiritual importance, and economic uses—such as fishing and tourism. Seminar participants learned how to consider the value of an area as it relates to people, animals, and plants.

A second point in designing an interpretive program is that of identifying tools and staff resources available for education. In most cases, these resources run far short of what is needed. Some marine protected areas have exhibits or posters—but few have brochures, school activities, or slide programs. Visitor centers are small if present at all. Many areas have little or no educational staff, or volunteers to work with the public.

The third important factor in the framework is the area's specific management problems. Some of the major concerns that face marine protected areas around the world are habitat loss, overcollecting or overfishing, and poor logistics of access and enforcement. Speakers at the Denver seminar encouraged participants to consider whether the specific management problems facing them were merely the "growing pains" of a new sanctuary, or the inherent effects of a site's history, geography, and politics, and to deal with them accordingly.

the cliff code

Cliffs are slowly but surely being worn away - this makes them very dangerous

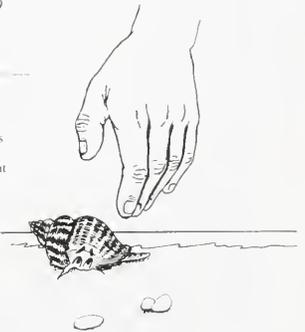
- keep to the marked footpaths
- at the top, stay away from the edge - it often crumbles
- Don't sit directly under a cliff - rock falls *do* happen



empty sea shells are the best sea shells

Shells come in all shapes, sizes and colours. Many contain living animals so check to make sure a shell is empty before taking it home with you.

- Don't buy shells - most were still the homes of live animals when collected



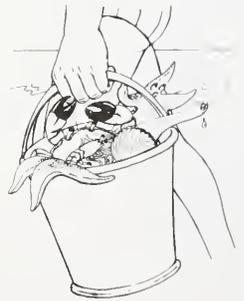
care for sea creatures

Seashore creatures are marine animals. They have to avoid drying out when the tide is out. Some have shells for protection, but many need to hide under rocks or in the sand. That's why exploring the seashore is so much fun - there are lots of surprises.

BUT do remember:

- put animals back where you found them
- try not to keep them out of the water for too long
- never take the animals' home
- turn back the rocks you have moved
- leave seaweed in place - there is plenty of loose seaweed on the strand line

Or else you will kill the sea creatures



Marine Conservation Society

THE MARINE CONSERVATION SOCIETY is a rapidly expanding national conservation organisation which seeks to protect the marine environment and promote its practical management. Its activities include authoritative lobbying and campaigning on marine issues, research on marine life and, more recently, the wardening of certain coastal sites. The Society publishes scientific reports, marine life identification guides, and other educational material such as slide sets. It has considerable interest in the establishment of marine nature reserves.

Members receive the Society magazine "Marine Conservation" four times a year, along with a range of other literature. The Society is a constituted, registered charity with a regional organisation. Further details can be obtained from the central office at 4 Gloucester Road, Ross-on-Wye, Herefordshire HR9 5BU Tel (0989) 66017.





Birdwatching in quiet estuarine waters generates support for wetlands protection. (Photo courtesy of Point Reyes Bird Observatory)

Educational Tools

In the context of a marine protected area's physical, biological, and social environment, we have found the following techniques to be helpful in fostering community involvement in conservation and management.

- Personal contact.
- Visitor facilities.
- Printed materials.
- Mass media.
- Working with local schools.
- Community outreach.

Personal contact in the form of tours or talks is common in developed countries. Nature walks and campfire circles with rangers or docents* are quite popular in state and national parks.

The person-to-person approach is very effective in conveying conservation values and agency presence. But most marine parks do not have funds to support full time educational staff. Even in the United States, the largest marine sanctuaries have only two or three staff members to cover

resource protection, enforcement, administration, planning, and education. Personal contact is an expensive budget item and requires skilled people. College students or local volunteer groups can easily be trained, and provide help in these areas. At Año Nuevo elephant seal breeding reserve in California, volunteer docents and students host more than 50,000 visitors each year. To assure informed community participation, Parks Canada will use local natives to interpret tribal lands and waters at South Moresby Island, British Columbia.

Facilities, such as visitor centers, exhibits, trails, and wayside signs, provide a focal point for the site's identity. There is no mistaking the entrance to Monterey Bay Aquarium—an outstanding educational institution built out of an old sardine cannery. At Point Lobos, California, and the U.S. Virgin Islands, underwater trails reveal subtidal natural history to snorkelers and divers. Wayside signs in Point Reyes National Seashore in northern California point out the offshore waters as the Gulf of the Farallones National Marine Sanctuary. Outdoor interpretive aids work well for the self-guided visitor, but are subject to vandalism and weathering. If members of the community are involved in the plans, design, and construction of facilities, this may encourage protection. For example, at Point Reyes, community groups help maintain coastal trails in their Adopt-a-Trail program.

Printed materials, such as brochures, posters, pamphlets, and books establish an image for a marine protected area, or communicate important conservation messages. Even inexpensively-produced posters can promote community support for the marine environment by presenting beautiful and inspiring images of local fish, birds, or other marine scenes. In Malaysia, posters of coral reef fish caught the much needed attention of government officials. In the Caribbean, environmental comic books reach school children to promote marine awareness.

Mass media, such as movies, television, and newspapers, have the advantage of reaching large numbers of people. Visually-effective material, such as footage of humpback whales on Silver Banks, Dominican Republic, can create widespread public and government interest in marine area protection. Promotional clips from pristine, but unfunded protected areas may generate interest and financial support from wealthy western countries concerned about conservation. Although they can be very effective, mass media coverage in developing areas is rare because of the high cost of equipment and production.

Working with schools reaches right to the heart of the community, and serves as an avenue for contact with parents and other adults. Developing an environmental ethic in future generations is essential for long-term success in caring for protected marine habitats. There are a number of marine education curricula in the United States that can be used as models for other regions. Production of school materials is usually not a top priority for new marine protected areas because they require extensive preparation and teacher training to be effective. But where enthusiasm runs high, staff members or

*A part-time or volunteer instructor or guide.

volunteers usually want to work with children with or without materials, because of the community interest it generates.

Community outreach through special events, extension programs, liasons with local leaders or nongovernmental organizations may have the most direct influence in changing local traditions that harm the marine environment. Fishing villages in the Philippines benefited by community marine ecology classes and local marine management groups. In Britain, sport divers learned about local marine life by participating in a nation-wide sea urchin census. In the state of Oregon, more than 5,000 citizens participated in a major beach clean-up campaign to get rid of unsightly debris; the program is now a model for other states' efforts. The Gulf of the Farallones Marine Sanctuary approached leaders of the community, and coordinated agencies in developing a plan for needed research. Community outreach requires diplomacy, but it is often the most important arena for interpretive efforts.

Given the range of possibilities for community involvement, the participants at the Denver seminar matched interpretive approaches to management goals. By considering which audience they need most to reach—local residents, government officials, or tourists—they can tailor their educational approaches. Seminar leaders encouraged strategic planning to achieve cohesive management and avoid piecemeal efforts.

Three Model Programs

Seminar participants had the opportunity to hear from three marine interpreters. In each case, the practices of community involvement crystallized into the techniques presented in the seminar. Susan Gubbay of the Marine Conservation Society described the voluntary reserve system developed in Britain. Although there is only one officially-designated reserve there, many voluntary reserves have been established thanks to local support. These reserves are popular among SCUBA divers. In favorite seaside areas, the society brings users and residents together in peer forums on local problems affecting the marine environment. These groups will then draw up voluntary behavior guidelines to be promoted in the community. This process has been remarkably successful while avoiding the cumbersome mode of legislative action. In some areas, volunteer liason "wardens" serve to keep the guidelines visible through positive peer pressure. The society has taken the lead in developing community involvement and public awareness of Britain's marine life, pushing the government to consider official recognition of important marine resources.

On the other side of the globe, Alan White of the International Center for Living Aquatic Resources Management in the Philippines, fostered a community development approach. Around Sumilon Island, the marine region was given protection because its outstanding coral reef was suffering

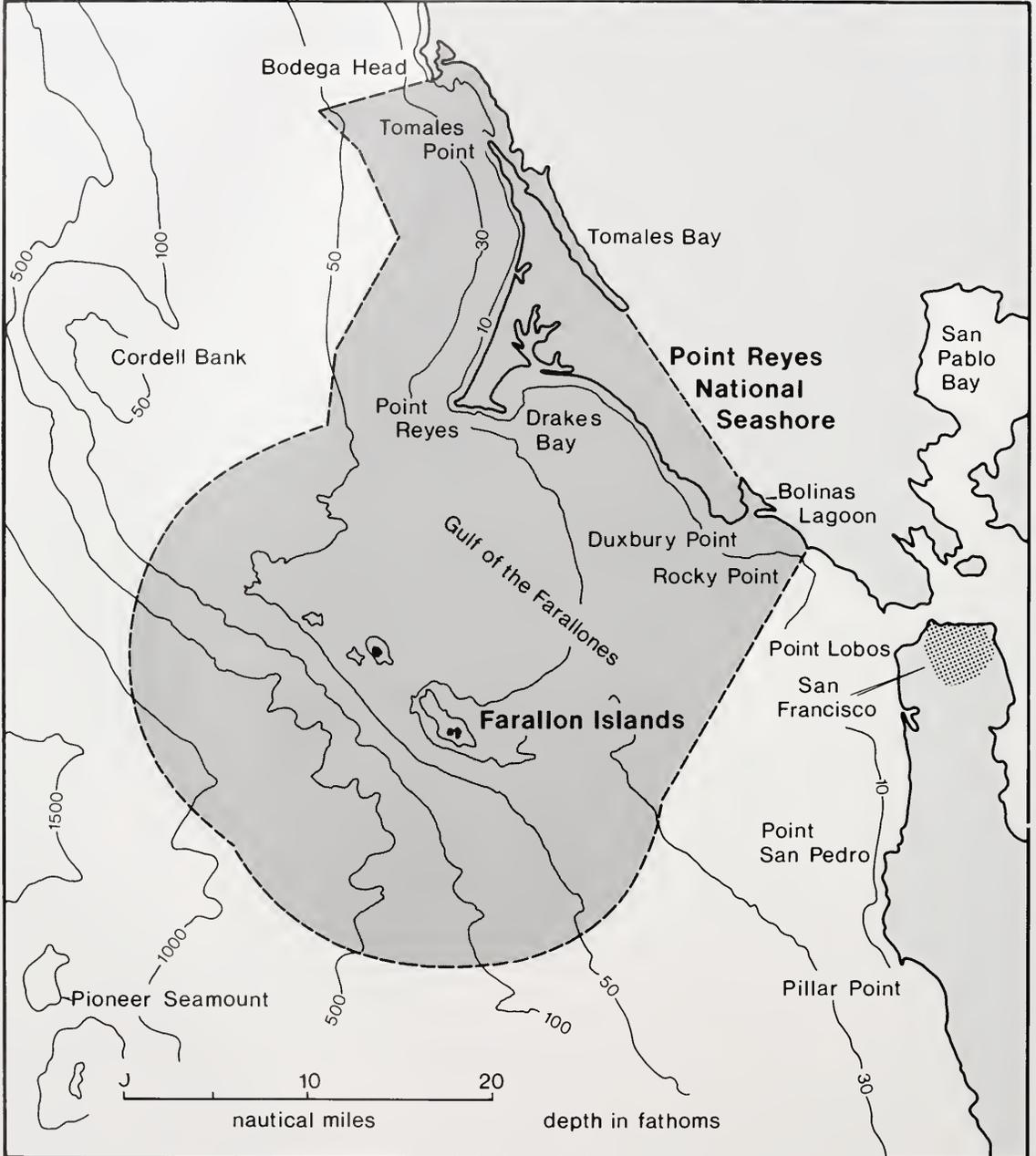


Children learn about local marine habitats through art projects, science labs, writing activities, and field trips. (Photo by C. Strang)

because of local fishing pressure. Funded by international aid programs, White's project placed resident field workers (graduate students from nearby universities) at the site to gather information and promote community education. His staff attended local meetings, helped build core groups around areas of interest—reforestation (to reduce siltation of mangroves), mat weaving (to build another economic base), marine management (of the fishery), and mariculture (of lab-raised giant clams).

They started marine ecology classes on the island and helped to build a community/visitor center. During a period of several years they formalized the core groups and offered leadership training to establish a self-sustaining conservation program. In this way, field workers helped residents initiate and manage their own programs, that eventually became independent of outside assistance.

For the Gulf of the Farallones National Marine Sanctuary, near San Francisco, Nancy Stone



The Gulf of the Farallones National Marine Sanctuary is a model for other Marine Protected Areas. Local organizations have helped staff members to arrange activities and produce printed materials, including a detailed map with access points, buoys, and ocean bathymetry.



A weather-proof sign at the tip of Point Reyes explains the significance of rich, offshore waters now designated a national marine sanctuary. (Photo courtesy of Gulf of the Farallones National Marine Sanctuary)

explained the research and planning process underlying the interpretative program. Near a large urban area, the main challenge here was to develop a site identity and sense of presence. With no central visitor access, 60 miles of shoreline, 948 square nautical miles of marine environment to interpret, and no staff assistance, the obvious direction was to work cooperatively with other agencies and marine education and conservation groups. While under contract to the sanctuary, the author developed an education and interpretation plan surveying local organizations, user groups, and potential interpretive sites. The plan led to the selection of priority projects. Since then the sanctuary has collaborated with local organizations on a marine mammal poster, a whalewatching checklist, a marine science slide program for teachers, public symposia, school curriculum packets, whalewatching guidelines, and public field excursions.

The sanctuary has its offices at the Golden Gate National Recreation Area, and has developed a strong presence in the San Francisco Bay area. Local groups know they can find support, funding assistance, and a willingness to cooperate on conservation projects. This marine protected area has become a leading force in promoting awareness of the marine habitats of the central California coast.

These three case studies present exciting possibilities for marine protected area interpretation in support of management and conservation goals. They illustrate the diversity of situations and effective techniques. As participants of the seminars learned, each protected area is a unique combination of habitat, management challenges, and community resources. Less-well-developed interpretive programs can look to these case studies, and others, for direction and models in developing public interest and awareness.

Uncharted Territory

Community involvement in marine interpretation and conservation is exciting territory. Managers are experimenting to see what actually works in the local culture and environment. Even so, shining examples are still few and far between. Materials and money are scarce in many places, and management problems often overtax the ability of managers to solve them. Marine and estuarine habitats are less known and less understood than terrestrial ones—by ecologists and the general public. Rough water, poor access, and little infrastructure are common logistical challenges in many marine protected areas.

The managers and educators of marine protected areas are part of a new adventure in expanding public awareness. Marine conservation is a new idea, just as land conservation was a new idea more than 100 years ago. Marine parks and protected areas may some day be as common, as effective, and as well supported as terrestrial parks are today. Community involvement can be the crucial link to building a long-lasting program. Although challenges face managers on every front, public interest is growing as countries investigate their wealth of marine resources.

The rewards can be great if we remain open to innovative management strategies. Our attraction to the water is natural and powerful: the marine environment may teach us something not yet revealed by the land.

Stephanie Kaza is a consultant in marine education curriculum design to The Oceanic Society, San Francisco. She has worked with the Gulf of the Farallones National Marine Sanctuary, Monterey Bay Aquarium, National Park Service, and Point Reyes Bird Observatory in a variety of community education programs about marine and estuarine protected areas.



Charterboat fishing activity is a growing industry in and near marine protected areas in developed countries. (Photo courtesy Gulf of the Farallones National Marine Sanctuary)

Approximately 1,000 coastal and marine protected areas around the world are under some form of conservation- or preservation-oriented management.* About 430 of these sites can accurately be called marine protected areas, using the International Union for the Conservation of Nature and Natural Resources' (IUCN's) criteria.** In the last two years more protected marine habitats have been designated, most notably the large Galápagos Marine Resources Reserve west of Ecuador (see *Oceanus* Vol. 30, No. 2, Summer 1987).

Marine protected areas around the world have a variety of designations. Among these are marine national parks, marine components of coastal parks, fisheries reserves, voluntary marine reserves, and marine sanctuaries. Management policies and effectiveness vary as well. Occasionally, the size, configuration, or

management of a sanctuary is inadequate to safeguard more than fragments of the marine ecosystems that they are intended to protect. Often, financial and human resources are inadequate for the task at hand—a problem that confronts managers in both developed and developing nations.

International cooperation may help to overcome these problems. In many ways, the United States has taken a leadership role in the protection of marine areas, and in identifying successful management and planning strategies on national and international scales.

International Leadership

Nancy M. Foster, former director of the U.S. National Marine Sanctuary Program, recognized that agencies managing marine protected areas in the United States and other nations would benefit from an international seminar that focused on their planning and management. The Parks Service of Environment Canada, and the National Parks Service in the United States had co-sponsored an international park management seminar annually since 1965; but historically, it had been devoted to terrestrial park issues.

Foster's recognition of marine agencies' needs resulted in the first International Marine Protected Area Management Seminar (see also page 75), organized in June 1986 by the Marine and Estuarine Management Division of the National Oceanic and Atmospheric Administration (NOAA) and the U.S. State Department's Man and the

* From a 1986 report of the Marine Policy and Ocean Management Center by Maynard E. Silva and others at the Woods Hole Oceanographic Institution.

** The IUCN's Commission on National Parks and Protected Areas (CNPPA) promotes the establishment and effective management of terrestrial and marine reserves. CNPPA manages protected areas through its establishment of management categories as determined by objectives, the classification of natural habitats for conservation purposes, and the creation of a monitoring and inventory system. For more information write to: CNPPA-IUCN, Avenue du Mont' Blanc, 1196 Gland, Switzerland.

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witnessed the successes and difficulties of
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marine environment, and discussed similar
programs in their own nations.

During the seminar, consensus emerged on seven priority requirements fundamental to the success of marine protected areas. An Action Plan for Managing Marine Protected Areas, developed by Foster and Michèle H. Lemay, addresses these points in detail. The need for innovative, management-oriented, education and interpretation programs and an international network of marine protected area managers, two of the priority requirements, clearly illustrate the United States' commitment to cooperation on both a national and international level.

Education and Interpretation

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all be overcome.

Recently, officials of the NOAA-managed U.S. National Marine Sanctuary Program have concentrated more on developing education and interpretation programs than on establishing new sanctuary sites—incorporating cooperative efforts in every plan. The fiscal benefits of these efforts are immediately apparent to any manager faced with insufficient financial and human resources to mount a comprehensive, single-agency management effort. In the face of fiscal constraint, successful programs have required collaborative efforts with, for instance, the Florida Department of Natural Resources at Looe Key and Key Largo; the National Parks Service; and the Santa Barbara Museum of Natural History at Channel Islands. Cooperation with volunteer organizations has also proven invaluable. This is particularly evident at California's Gulf of the Farallones sanctuary, where numerous non-government environmental organizations lend their support to the sanctuary staff's efforts. Industry also contributes to these programs. For example, Chevron Oil partially funded the Santa Barbara Sea Center.



In tropical waters, underwater trails add to visitors' appreciation of corals and other creatures. Techniques for developing such trails are shared among marine sanctuary networkers. (Photo courtesy of Looe Key National Marine Sanctuary)

Erratum:

Because of a printer's error, the title and author's name were omitted from the top of article that begins on page 82. It should read:

International Networking of Marine Sanctuaries

by Douglas B. Yurick



Charterboat fishing activity is a growing industry in and near marine protected areas in developed countries. (Photo courtesy Gulf of the Farallones National Marine Sanctuary)

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Biosphere Program. The 12-day seminar convened in Florida for the first 6 days and then moved to California. Twenty-nine invited participants representing 22 nations attended. Their lands bordered on tropical, warm temperate, boreal, polar, and freshwater seas. Through presented papers, working group discussions, and site visits (Key Largo, Looe Key, Channel Islands, and Gulf of the Farallones National Marine Sanctuaries, NOAA's Southeast Fisheries Center in Miami, and the Monterey Bay Aquarium), participants witnessed the successes and difficulties of American efforts to protect and interpret the marine environment, and discussed similar programs in their own nations.

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Education and Interpretation

To be successful, any marine protected area program must be understood by those who

ultimately support it—the citizens of a nation. This presents unique challenges in carrying out education and interpretive programs in and about offshore environments. Problems of physical access to protected areas, limited funding, public "marine illiteracy," and management agencies' relative inexperience in designing and delivering effective marine education and interpretive programs must all be overcome.

Recently, officials of the NOAA-managed U.S. National Marine Sanctuary Program have concentrated more on developing education and interpretation programs than on establishing new sanctuary sites—incorporating cooperative efforts in every plan. The fiscal benefits of these efforts are immediately apparent to any manager faced with insufficient financial and human resources to mount a comprehensive, single-agency management effort. In the face of fiscal constraint, successful programs have required collaborative efforts with, for instance, the Florida Department of Natural Resources at Looe Key and Key Largo; the National Parks Service; and the Santa Barbara Museum of Natural History at Channel Islands. Cooperation with volunteer organizations has also proven invaluable. This is particularly evident at California's Gulf of the Farallones sanctuary, where numerous non-government environmental organizations lend their support to the sanctuary staff's efforts. Industry also contributes to these programs. For example, Chevron Oil partially funded the Santa Barbara Sea Center.



In tropical waters, underwater trails add to visitors' appreciation of corals and other creatures. Techniques for developing such trails are shared among marine sanctuary networkers. (Photo courtesy of Looe Key National Marine Sanctuary)



Whalewatching has provided unforgettable experiences to many visitors of marine sanctuaries. (Photo courtesy Gulf of the Farallones National Marine Sanctuary)

The Channel Islands sanctuary provides two examples of cooperative and innovative education and interpretation programs. The reversal of a sharp decline in the sole remaining California population of brown pelicans on Anacapa Island required the combined efforts of NOAA sanctuary managers, the National Parks Service, California's Department of Fish and Game, and the Friends of Channel Islands National Park. The latter group developed a highly successful, management-oriented information program alerting sport fisherman to one component of the problem (pelicans ingesting fish already hooked by fishermen) and advised them how to avoid or correct it.

The second example is the outstanding Sea Center at Santa Barbara. It was developed cooperatively with the Santa Barbara Museum of Natural History and provides a second locus for visitor education and outreach programs, well removed from both the sanctuary and the main visitor access point at Ventura. The center incorporates innovative interpretive displays, including an interactive computer system that allows visitors to selectively study a storehouse of recorded data on the sanctuary and its resources. To those who participated in the International Marine Protected Area Management Seminar, the high degree of public support for—and involvement in—the Channel Islands and Gulf of

the Farallones sanctuary programs were eye-opening lessons. They also were impressed by cooperating organizations and corporations' contributions to the seminar.

International Network

Another priority requirement identified during the first marine protected area management seminar was the need for continued information exchange on protected area site planning and management. Because existing marine information networks relate primarily to the basic or applied marine sciences, seminar participants urged the creation of a new network devoted to information exchange that included government and non-government marine specialists, such as managers, educators, and policymakers along with scientists.

The International Marine Protected Area Network is the result of this need. Its purpose is the international exchange of information and expertise among the individuals working in marine protected areas, and the enhancement of international awareness of—and commitment to—marine protected areas worldwide.

Foster volunteered NOAA resources to move the network from concept to reality. Accordingly, NOAA staff have been instrumental in initiating the following network activities:

- The development of a computerized directory of network members and their areas of expertise. Information is available upon request from NOAA—Office of Ocean and Coastal Resource Management, 1825 Connecticut Ave., Washington, D.C. 20235 telephone: (202) 673-5122;
- The publication of a quarterly newsletter, *The Marine Connection*. Information is available from The Marine Connection, c/o the United States Man and the Biosphere Program, OES/ENR/MAB Department of State, Washington, D.C. 20520 telephone: (202) 632-2786;
- The provision of technical assistance to network members. Staff or affiliates of the National Marine Sanctuary Program traveled to Ecuador and Thailand, for example, to help their governments develop management plans for new marine protected areas, provided on-the-job management training to Malaysian marine park staff at the Florida sanctuaries, and assisted at the on-site installation of mooring buoys in the Cayman Islands and Saba marine parks in the Caribbean;
- The organization of subsequent, smaller marine protected area seminars under the umbrella of large, international congresses. These include a half-day session on



Narwhals, *Monodon monoceros*, are summer visitors to Milne Inlet and other areas within Canada's proposed Lancaster Sound National Marine Park. (Photo by D. Yurick)



Within the proposed Saguenay marine park, the marina in Tadoussac, Quebec, is a popular destination for yachts. (Photo by D. Yurick)

managing marine protected areas at Coastal Zone '87 in Seattle, Washington; and the four-day Ocean Wilderness Seminar during the 4th World Wilderness Congress at Estes Park, Colorado, in September 1987. The latter event was preceded by a two-day marine interpretation techniques workshop in Denver, Colorado, organized by sanctuary program staff.

Members of the network who attended the Ocean Wilderness Seminar succeeded in having the World Wilderness Congress adopt an Ocean Conservation resolution. The resolution urges national governments, and international and non-government agencies, to implement integrated ocean management strategies consistent with the objectives of the World Conservation Strategy.

So far, progress toward network objectives has lacked the full cooperation of members outside of NOAA. All network members are encouraged to participate more actively in its work if it is to succeed as a truly international initiative. If working groups within the network were established, as agreed by participants during the international management seminar discussions in June 1986, the network may attain its goals of international information exchange and greater global awareness of marine protected areas. A volunteer could coordinate a working group for each of the priority requirements of marine protected areas. Regional groups whose interests and expertise overlap these subject areas are also a distinct possibility, and they might interact with scientists and managers involved in the Regional Seas Programme of the United Nations Environment Programme.

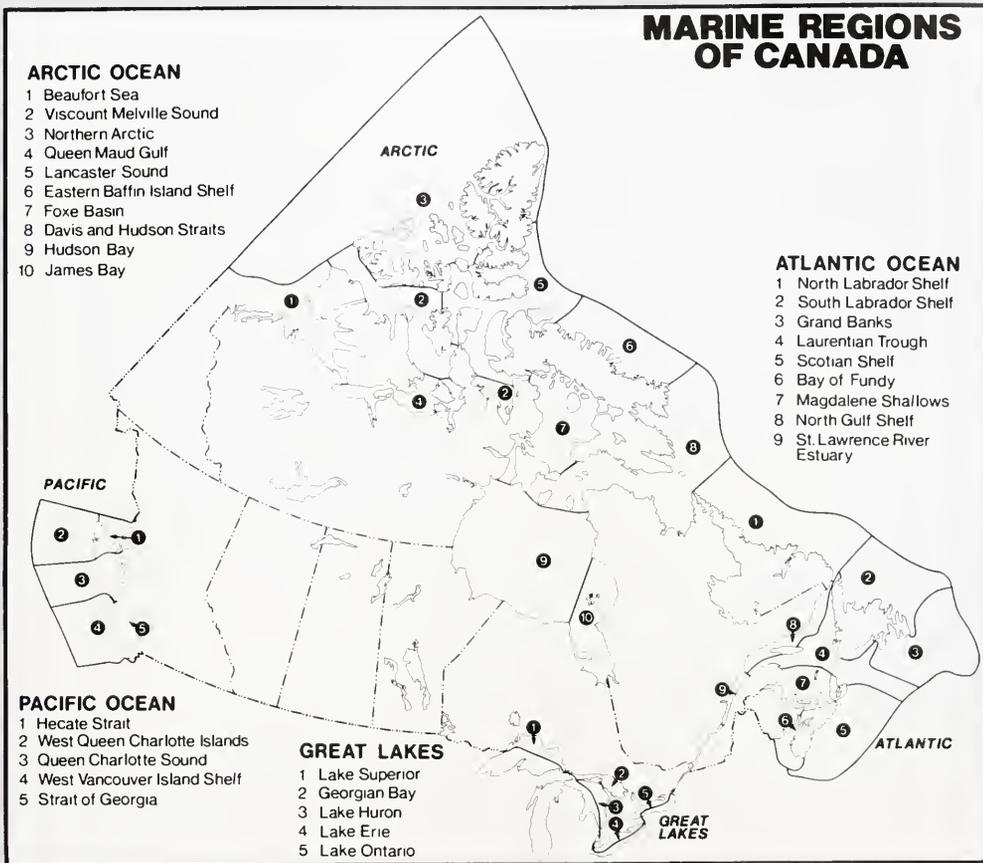
Other means of enhancing the network's success might include theme issues of "The Marine Connection" coordinated by guest editors, and regional or thematic seminars. For example, several network members in Canada and other northern nations are developing a workshop devoted to the unique issues of planning and managing marine protected areas in polar and cold temperate seas.

From the organization of the first International Marine Protected Area Seminar to the organization of the International Marine Protected Area Network, the United States' commitment to the protection and management of marine environments stresses cooperation. Its National Marine Sanctuary Program, internationally respected among managers of marine protected areas, proves that cooperative management works. The program's management techniques and education and interpretation programs serve as both model and teacher for planners and managers around the world.

Douglas B. Yurick is Senior Planner, Marine Parks, National Parks Systems Branch, Environment Canada-Parks in Ottawa. His responsibilities include policy development, park area identification, and pre-establishment park feasibility studies and negotiations.

Views expressed are those of the author and do not necessarily reflect those of the agency of affiliation.

Developing Marine Parks in Canada



With a coastline longer than any other nation, Canada has proceeded cautiously in its designation of marine protected areas. It first developed a comprehensive National Marine Parks Policy that was approved by the Minister of the Environment in 1986.

Recently, the government established Canada's first national marine park, Fathom Five, in Lake Huron. Other marine parks are expected to follow in places as diverse as the South Moresby area of the Queen Charlotte Islands off the coast of British Columbia, Lancaster Sound in the eastern Canadian Arctic, and at the confluence of the Saguenay River with the estuary of the St. Lawrence River.

Like other nations, Canada has profited from observing the benefits of the United States' cooperative management policy, a fundamental principle of the marine sanctuary program. For example, California's Department of Fish and Game, which regulates and administers fisheries, cooperates with NOAA in managing the Channel Islands and Gulf of Farallones

sanctuaries. Canada, like the United States, has recognized that the management of certain activities (like fishing and shipping) in marine protected areas is usually best left to the agencies that have had that responsibility in the past.

Although in Canada matters under provincial administration normally are transferred to the federal government at the time of park establishment, in marine parks management of fishing and marine transportation will remain with the agencies currently responsible. Interdepartmental agreements between Environment Canada, the Department of Fisheries and Oceans, and the Department of Transport will specify each agency's role in the cooperative management of marine park areas. While this practice represents a marked departure from Canada's longstanding practice of single agency management for terrestrial national parks, officials are confident it will succeed because they have observed successful cooperative management in the U.S. National Marine Sanctuary Program.

Letters

To the Editor:

[We] were delighted to receive the copies of the *Oceanus* winter issue. The reproduction quality of the photographs was excellent, and we were impressed with the entire issue.

One small point: The inset piece ["Caribbean Conch Culture," on page 61] about conch mariculture is somewhat contentious, in that the commercial viability of this venture is far from established, despite the opinion offered by the owner of the enterprise. Most recent public reports suggest that there are serious problems with survival of juveniles, and that efforts are now being made to promote markets for very small conch as "escargot." I hasten to add that no criticism is implied here, but I know the importance of accuracy to a publication like *Oceanus*.

Melvin H. Goodwin
Caribbean Program Manager
South Carolina Sea Grant Consortium
Charleston, South Carolina

To the Editor:

I've been enjoying the recent Winter issue of the magazine. It's nice to see the introduction of some color, making such a nicely designed format even more attractive.

[I have one] note of correction in response to a photograph on page 22 of a "Clapper Rail." The photograph is of a fledgling Green Heron (*Butorides virescens*). Mr. Canupp [the photographer] will probably wish to know this, although the caption may not of course be a result of his information in the first place.

Robert V. Clem
Chatham, Massachusetts

AUTHORS' REPLY: Mr. Clem is quite right—the photo is of a Green Heron. The error resulted from an inadvertent mix-up of photos and captions as we were preparing the article.

To the Editor:

I am thoroughly enjoying each issue of *Oceanus*, and I thought you might enjoy hearing how timely and appropriate several of the articles have been. My husband and I and our crew of one schnauzer are enroute to the Caribbean from New England aboard our 50-year-old wooden Gloucester schooner. Initially we made two attempts in November to go the direct route from Beaufort, N.C., to the Virgin Islands (where we shall be based for the next few years doing crewed chartering), but early and unusually severe weather twice beat us back—so we have island-hopped along the "Thorny Path" through the Bahamas, Turks and Caicos, and Dominican Republic, from where I write.

The Summer 1987 issue was enlightening on marine iguanas, as we tried to introduce ourselves to the inhabitants of Allen's Cay, Exumas. We can appreciate how Custer may have felt when the Indians appeared from horizon to horizon. These fearless Bahamian iguanas

advanced on us, chirruping strategies to their legions, until we retreated back to the sea from which we had come.

Your "Galápagos Tales" was hilariously enjoyed by, no doubt, your readers in banana republics everywhere, and we know that the stories are oh, so true. It has taken us three days to buy bread, and the entire country seems to be out of propane gas!

Summer 1987's article on sperm whale behavior was consulted again yesterday after we came within one boat length of colliding with a humpback whale. This occurred off Balandra Point in Samaná Bay. I thought that having the depthsounder on and the engine ticking over were commonly known methods of alerting whales (and submarines, for that matter) to a boat's presence, but this whale must have been soundly sleeping. It reacted quickly when it finally awoke. This incident occurred at 0600.

Finally, the Fall 1987 issue's article on Columbus' Landfall was enjoyed on passage through those very islands. Imagine the delights of actually being in the spot you are reading about! The currents, reefs, and weather patterns which prevail in the Bahamian out Islands and along Hispaniola's coast give an added dimension of respect toward Columbus' immense skill and determination. He was some navigator.

The Spring 1987 issue, *Japan and the Sea*, has been a delight from cover to cover.

We have often sailed into Woods Hole and taken a mooring by the yacht club—several times with youth sail trainees aboard. We never tire of walking around through WHOI, though it may be a few years before we get back there.

Anyway, thanks for your fine touch on a wonderful publication.

Karen S. Day
Schooner *Windsong*,
Samaná Bay,
Dominican Republic

To the Editor:

I am writing in reference to the article by Drs. Richardson and Goldsmith in *Oceanus*, Volume 30, No. 3, pages 2–10, Fall 1987.

Their computer-generated track of Columbus' first transatlantic voyage is an important contribution to our understanding of the accuracy of the log's sailing distances and directions. It provides new evidence that landfall was in the vicinity of latitude 24°N. By reasonably eliminating Rum Cay as an option, the authors conclude that Columbus made a minor net navigational error, and suggest that Watling Island [San Salvador] was the landfall.

However, a completely different conclusion can be reached if an apparent error in calculating the distance sailed on October 9th is corrected. Luis Marden's [*National Geographic*, Vol. 170, No. 5, November 1986] data has Columbus sailing 20.5 leagues that day and night. The log, however, states that ". . . in all, he made eleven leagues in the day and in the night twenty and a half leagues. . ." (from Cecil Jane's translation of the Las Casas transcription). Thus, the total distance for October 9th should have been 31.5 leagues, not 20.5.

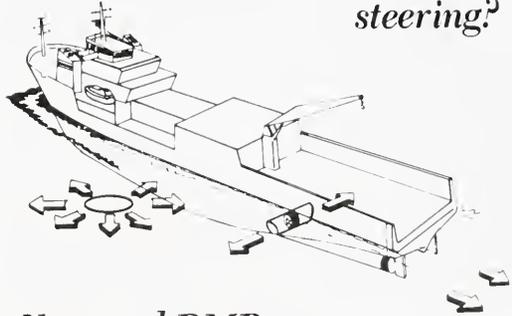
The addition of 11 leagues would move the autumnal endpoint 31 nautical miles to the west; this would be a shortfall of 1 percent in the total transatlantic distance sailed. Using vector analysis, the effect of the 0.6 knot northwestward-flowing Antilles Current can be calculated.

The resulting deflection of the final east-west leg of the crossing suggests that landfall was at Conception Island [to the West of either Samana Cay or San Salvador]. A total distance underestimate of 1.2 percent in the location of the autumnal endpoint would place the fleet 2 leagues from Conception at 2 A.M. on October 12th.

A track between Watling Island and Rum Cay is corroborated by Columbus' log entry for October 11th. Four hours before sighting land "as the Admiral stood on the sterncastle, he saw a light". Those who saw it thought "it might be a light or torch belonging to fishermen or travelers who alternately raised and lowered it, or perhaps were going from house to house. . ." (from Benjamin Keen's translation of Ferdinand Columbus' *History*). The *Santa Maria* was under full sail; in order to be seen only from the poop deck, the light must have occurred to the side (north or south) of the vessel. The light would have been seen 12 leagues (34 nautical miles) east of the hypothesized Conception Island landfall. This position is directly south of prehistoric Lucayan Indian village sites along southeastern Watling Island.

In 1945, Conception Island was proposed by Rupert Gould as the location of Columbus' landfall. However, it was not until the summer of 1987 that the first scientific exploration of this small, uninhabited island was undertaken. As a part of an Earthwatch Expedition, I led a team of scientists and volunteers in a preliminary geologic and oceanographic survey of the island. The data gathered supports Conception Island as a better match for Columbus' log than Watling Island, Samana Cay, or any other island in the Bahama Archipelago.

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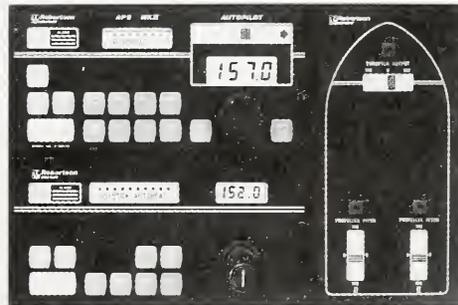


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I urge readers to consider that the computer-generated transatlantic track of Drs. Richardson and Goldsmith provides new evidence suggesting that *EITHER* Watling Island OR Conception Island was the location of Columbus' landfall.

Steven W. Mitchell
Department of Geology
California State College
Bakersfield, California

AUTHORS' REPLY: The main point of our article is that if Columbus's cruise is corrected for set and drift of currents and for leeway, the endpoint of the cruise lies very close to San Salvador (Watling Island). In 1986 *The National Geographic* published papers by Joseph Judge and Luis Marden claiming that the corrected track ends near Samana Cay. Our corrections are more realistic than Marden's in that we used vector average currents for the set and drift corrections and we used leeway corrections for the entire voyage.

During our study we came to realize that the location of the endpoint is highly dependent on the poorly known magnetic variation for 1492. Thus, although our best corrected cruise endpoint lies very close to San Salvador, there is a large uncertainty to this point due to the uncertainty in magnetic variation and navigational details, such as the average course steered. Dr. Mitchell points out that a very small shift in the endpoint would place it near Conception Island. We agree, and feel that the uncertainty of the endpoint is sufficiently large to preclude unambiguously choosing any one of these islands as the first landfall based solely on the cruise track. However, we still think the data favor San Salvador over the other two islands.

Philip L. Richardson
Associate Scientist
Department of Physical Oceanography
and
Roger A. Goldsmith
Research Scientist
Department of Ocean Engineering
Woods Hole Oceanographic Institution
Woods Hole, Massachusetts

EDITOR'S NOTE: The *Oceanus* article on Columbus' landfall produced a large number of letters. Following are a few additional examples.

To the Editor:

I read the article, in Vol. 30, No. 3, about Columbus' landfall with great interest, especially since I have been following the debate for some time, in the *National Geographic*, and elsewhere. I note on page 4 that the WHOI Oceanographers relied heavily on corrections for the effects of leeway or wind, and set or current, although calculations on and following page 6 only seem to apply for leeway. Although certainly no expert, I have studied piloting and navigation, and have sailed many off-shore miles. Yet, I find the calculations confusing in the extreme; especially I find it difficult to see how set was factored into the calculations.

Secondly, I note that the landfall—a very low island—was sighted at 0200, from approximately 2 leagues, or 10 kilometers (roughly 5 nautical miles) out. As a sailor, I find it amazing that even a very alert lookout could spot a low island unless conditions of visibility, and sea state were

ideal, and the island was in the path of the Moon.

Finally, the WHOI investigators note that they have only considered the transoceanic portion of the voyage, and that they have not compared the physical descriptions of the island. Common sense dictates that such a comparison is crucial to definitive identification, since the transoceanic data is subject to so many variables, and needs so much manipulation, while the actual physical description of the island is hard factual evidence. Having read the *National Geographic* article, and also having spoken with one of the researchers, I find it hard to agree that San Salvador is the definitive landfall.

Perhaps a later article could clarify some of this for people, such as myself, who are confused.

Virginia C. Jones
West Tisbury
Martha's Vineyard, Massachusetts

To the Editor:

I have followed with great interest and equal skepticism the careful efforts to reconstruct Columbus' landfall in the New World by applying leeway, current, and magnetic variation corrections to Columbus' reported course.

Having myself sailed over 100,000 miles, including a trans-atlantic crossing comparable to Columbus', I believe the assumptions underlying this scientific effort to be unreliable. As the Richardson-Goldsmith article (*Oceanus*, Vol. 30, No. 3, Fall 1987, page 9) correctly points out, determining the Western Hemisphere landfall from the Canary Island departure would require the track of the *Santa Maria* "to be known to better than ± 1 degree."

I own a George Adams steering compass made in 1770, which is undoubtedly far more sophisticated than what Columbus would have had available, and the points are only divided to sixty-fourths of a circle (5.63°). Furthermore, the compass is not damped, nor do we have any assurance that there was no magnetic deviation in relationship to the compass used. Finally, even with a modern, fully damped compass marked to single degrees, very few sailors would have the temerity to suggest that they could sail a 2,500 mile course with a steering error of less than 1 degree.

Also, even if the compass and helmsman were near perfect, the recording devices commonly used would not afford a 1 degree precision. The helmsman commonly recorded his course on traverse boards. No traverse board I have ever seen contains divisions closer than $\frac{1}{32}$ of a circle (11.25°). The ship's officers would then take the data from the traverse boards, and incorporate the information into the ship's logs. Obviously, the logs could be no more accurate than the data originally recorded on the relatively imprecise traverse board.

I believe that an analysis of Columbus' voyages within the West Indies is more likely to authenticate his landfall than an attempt to reconstruct it based on his transatlantic crossing.

Richard Kelton
The Kelton Foundation
Santa Monica, California

book reviews



The Log of Christopher Columbus, translated by Robert H. Fuson. 1987. International Marine Publishing Company, Camden, ME. 272 pp. + xviii. \$29.95

As the quincentennial of Columbus's discovery of America approaches, one can now follow Columbus's first voyage in his own hand. Follow Columbus as he sails from Spain to the Canaries, where he prepares for his voyage seeking Japan. Sail with him across the Atlantic, seeing with his eyes the Sargasso Sea. Navigate with him westward. Discover the first landfall on San Salvador and meet the Lucayan Indians. Explore with him the Bahamas, Cuba, and Hispaniola. Return back to the Azores and to Spain, surviving with him a terrible storm that nearly cost him his life.

Robert Fuson gives a new translation of Columbus's 1492 voyage log. The log is more than merely a seaman's log book; it is a fine description of a 15th-Century voyage of discovery, and the personal daily record of perhaps the world's best dead-reckoning navigator. Descriptions of the crew, ships, navigation, ocean features, and encounters with Indians are all written as Columbus observed them. The log is an excellent description of the discovery of the West Indies, and the beginning of the European settlement and exploration of America. The uniqueness of this first glimpse of America in 1492 more than makes up for the repetitious courses and distances sailed, and the endless wonderful harbors described; Columbus makes the Caribbean sound very good—too good. His overblown accounts of how rich the new World was become wearisome, yet the log remains interesting for its access to Columbus, his amazing voyage, and of uncolonized America.

Especially interesting to the geographer are descriptions of Columbus's voyage across the Atlantic when he describes for the first time, on September 17, the westerly magnetic declination that occurred in the mid-Atlantic:

Last night the pilots took a reading on the North Star and found that the compasses declined to the NW a full point. This caused some apprehension at the moment, but I ordered the North to be fixed again just before sunrise, and the needles were found to be true. This is because the North Star moves, not the compasses.

The average of dusk and dawn sights gives a western variation of half of a point or about 6 degrees.

The log documents the Sargasso Sea for the first time by detailing Columbus's daily observations of Sargassum. On 15 September he writes:

The sailors caught a little fish, and we saw much weed of the kind I have already mentioned, even more than before, stretching to the north as far as you can see. In a way this weed comforted the men, since they have concluded that it must come from some nearby land. But at the same time, it caused some of them great apprehension because in some places it was so thick that it actually held back the ships. Since fear evokes imaginary terrors, the men thought the weed might become so thick and matted that there might happen to them what is supposed to have happened to St. Amador, when he was trapped in frozen sea that held his ship fast. For these reasons we kept as clear as possible from those mats of weed.

After 18 days at sea, and long before landfall on October 12th, he writes on about unrest among the crew, which he had to control or lose everything he had strived for.

I am having serious trouble with the crew, despite the signs of land that we have and those given to us by Almighty God. . . . They have said that not only am I willing to risk my life just to become a great Lord, but that I have deceived them to further my ambition. They have also said that because my proposition has been contradicted by so many wise and lettered men who considered it vain and foolish, they may be excused for whatever might be done in the matter. . . . I am told by a few trusted men (and these are few in number!) that if I persist in going onward, the best course of action will be throw me into the sea some night. They will then affirm that I fell overboard while taking the position of the North Star with my quadrant. Since I am a foreigner, little or no account will be asked of the matter, but rather, there will be a great many who will swear that God had given me my just desserts on account of my rashness. . . . I am also confident that if I lose command, the fleet will never reach the Indies and will probably never get back to Spain. With God's help I shall persevere.

Most of the book consists of the translation of the log, the most accurate and complete log ever produced during its time. Although the original log presented to Isabella and Ferdinand has been lost, an abstract of a copy of it by Bartolomé Las Casas remains. The abstract is thought to contain 80 percent of the original log. Most of this book is a verbatim copy of the original, which Fuson edited and modernized to make it more readable. Some missing elements have been added from other sources, the first person restored, redundancies eliminated, and archaic language avoided. Another translation and transcription of the log, by Dunn and Kelley, is presently in press; the interested reader might also want to consult this version when it appears.

In addition to the log are a foreword by Luis Marden; and three chapters describe the background of the log, Columbus the man, and Columbus's ships and navigation. Seven appendices discuss the various landfall theories, the crews of the vessels, Columbus's voyages before 1492, and his death and burial. Historical charts and illustrations are liberally interspersed with the text. Columbus's route through the islands is also illustrated so one can read about the voyage and compare it to modern names and places. The additional material is as interesting as the log itself.

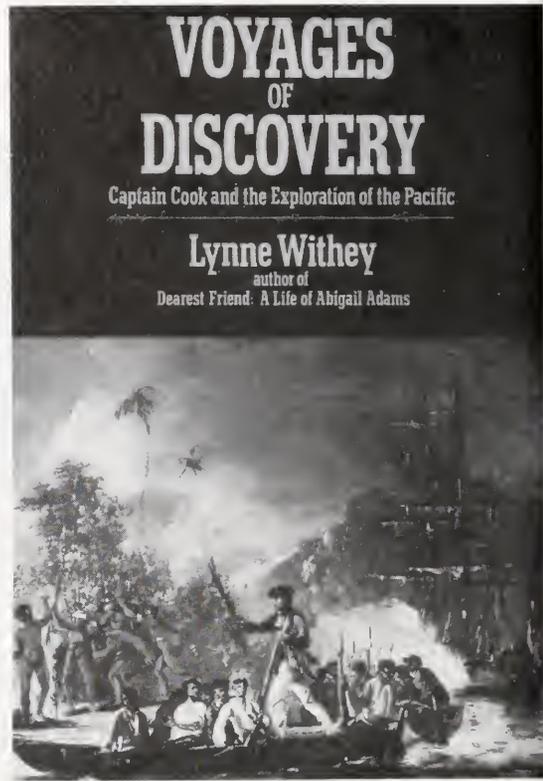
Fuson comes out strongly for Samana Cay as being Columbus's first landfall, in agreement with Joseph Judge and Luis Marden of the *National Geographic* magazine. Fuson was consultant to the *Geographic* on this study. He briefly reviews some of the other landfalls, illustrates twelve of them with figures, and gives many references so that those interested in the debate can read more about it. Nine different islands have been proposed as the first landfall, and many geographers are actively working on the correct identification today. The two leading contenders seem to be Samana Cay and Watling Island, championed by Samuel Eliot Morison (and others), and now named San Salvador. The *National Geographic* publicity of the landfall problem stimulated many of us to join in debate. With this new version of Columbus's log you, too, can follow his courses and his descriptions of islands and work out your own best first landfall.

Philip L. Richardson
Associate Scientist
Physical Oceanography Department
Woods Hole Oceanographic Institution

***Voyages of Discovery: Captain Cook and the Exploration of the Pacific* by Lynne Withey. 1987. William Morrow and Company, New York, NY. 512 pp. \$19.95.**

"A general silence ensued throughout the ship, for the space of near half an hour: it appearing to us somewhat like a Dream that we could not reconcile ourselves to for some time. Greif was visible in every Countenance . . . for as all our hopes centred in him; our loss became irreparable and the sense of it was so deeply Impressed upon our minds as not to be forgot." In this way, midshipman George Gilbert recorded the death of Captain James Cook, clubbed and stabbed during a melee on the beach of Kealakekua Bay, Hawaii, on February 14, 1779. And by spicing her history of Captain Cook's Pacific voyages with an appetizing blend of such quotes, Lynne Withey succeeds in making these tales of exploration come alive for us today.

Cook's three famous voyages to the Pacific drew the curtain on the great age of European exploration, and in a sense were a prologue to modern oceanographic cruises. Crossing the Pacific from the Bering Strait to the Antarctic, and from the California coast to Australia, he put to rest the centuries-old fiction of geographers, "Terra Australis Incognita"—the southern continent supposedly necessary to equalize land masses in northern and southern hemispheres. At the same time, he discovered the Hawaiian Islands and rediscovered many islands that never had been accurately charted. He used some of the first chronometers, vastly improving the accuracy of longitude determination at sea; he proved the importance of certain foods in preventing scurvy; and he encouraged



(relatively) enlightened dealings with native Pacific Islanders. For his scientific accomplishments, he was elected to Britain's Royal Society.

Withey's book is admirable because of its breadth of scope. While using quotes from Cook, his crew, and from London newspapers of the late 18th Century, she also employs what modern anthropologists know about the peoples of the Pacific at that time to give a perspective on how the islanders understood their first encounters with Europeans. She frames Cook's first Pacific cruise, officially undertaken to observe the 1769 transit of Venus, in the context of British and Continental politics of the era. Britain knew that France had imperial and commercial aspirations in the Pacific, and both countries knew that the Spanish were now too weak to defend the territorial claims they made in their "lake" during the previous two centuries. Withey also gives due consideration to the popularity of adventure/travel literature in 18th-Century England, and the rivalry among the aristocratic scientists aboard Cook's ships to be the first to publish their accounts of the voyages.

The early meetings of native Pacific peoples with Europeans perhaps makes for the most interesting reading in Withey's account. Cook and upperclass English naval officers often saw natives such as the Tahitians as living examples of Rousseau's "noble savage"—unashamed of their bodies, and innocent of the greed associated with commercialism. Most of these educated Englishmen, however, were also able to see a hierarchy of Pacific cultures reflected in the color of the islanders' skin. Thus Sydney Parkinson, Cook's artist on the first cruise, described the very dark aboriginal Australians as: "the most wretched sett I ever beheld or heard of." Cook, covering the other end of the hierarchy, claimed that the lighter-skinned, and hard-working, natives of Tongatapu

showed a "higher state of civilization" than any other culture he encountered on his explorations.

Withey entertainingly brings out the personalities of the men aboard Cook's ships by illustrating their reactions to the seemingly innocent Pacific Islanders. These people had never seen iron before, but quickly valued it on a level with their most highly-prized ornamental object—red feathers. Premarital chastity was a nonconcern to 18th-Century Polynesians, and the novelty of liaisons with eager British seamen—to say nothing of the exchange value of their iron nails—was more than sufficient to get a lively exchange of genetic material going. George Roberston, master of the *Dolphin*, promised to return to Porea, a high-caste Tahitian woman, and again "Sleep with her in my Arms." But surgeon's mate David Samwell had a less romantic point of view: "having been used to many strange Scenes since we left England, we spent no time in staring about us with vacant astonishment but immediately made love to the handsomest woman in Company." For his part, Cook made attempts to keep such activities under control, partly out of concern for the spread of venereal disease. But a few weeks before his murder, Withey claims that "so many women had taken up residence on board that Cook complained they interfered with sailing the ship."

Throughout the voyages, Cook showed an unusual leniency with petty theft by native peoples, by his reluctance to use firearms against them. He also treated his own men with a remarkable degree of respect for those times, as long as his authority was not seriously challenged. Withey claims he consistently received the respect he deemed necessary from the islanders, and her storytelling craft finds its *métier* in showing why he was perhaps the most popular captain in the English navy at that time. Late in the book, however, Withey goes into some detail to build a case that the combination of Hawaiian mythology and a deterioration in Cook's judgement, ironically resulted in his violent death.

Although *Voyages of Discovery* is, strictly speaking, a history book, Withey succeeds in having it read like an engaging adventure novel. Her characters are human, and the emotions of both English and Pacific Islanders are sensitively brought to life. It is a rare book that can package so much scholarship so vividly.

T. M. Hawley
Editorial Assistant
Oceanus

***Between the Devil and the Deep Blue Sea: Merchant Seamen, Pirates, and the Anglo-American Maritime World, 1700-1750* by Marcus Rediker. 1987. Cambridge University Press, New Rochelle, NY. 322 pp. + xv. \$24.95.**

The first half of the 18th Century was a time of incredible globalization of markets and developing international relationships. The pre-eminent method of global trading was maritime, and Imperial Britain was at the apex of a strong and orderly international market chain that led to the Americas, Africa, and "around the Horn" to the Indian subcontinent. While the mercantile class of London was becoming heady with the risks and rewards of the trade ventures being organized at a coffee house known as Lloyd's (later to become Lloyds of London), thousands of men toiled under harsh shipboard conditions for low pay to link the producers and consumers of the world. The common seaman was thus a key player in the growing and maturing trade relations that were leading to our modern global economy. However, these seamen remain largely enigmatic figures, known to us primarily through the

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*Merchant Seamen, Pirates, and
the Anglo-American Maritime World
1700-1750*



Marcus Rediker



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romantic and adventurous descriptions of early maritime historians. In *Between the Devil and the Deep Blue Sea*, Professor Rediker takes the reader on a voyage of discovery through the real world and cultural milieu of the seaman during this amazing period of history.

The author's approach to debugging romanticized history relies heavily on Marxian analysis of the seaman as an international worker of the world, a sort of Wet Wobbly. This approach allows the author to analyze the seaman as a barometer of the social and economic changes of the time. For example, seamen were one of the earliest and largest groups of free wage laborers in the British and American economies; thus, their experiences provide insight into early capitalist development. This might not sound like rollicking good reading on a rainy summer evening in the cabin of your sailboat, but Rediker makes this somewhat stodgy analytical approach more palatable by serving it in a spicy stew of sociology, history, culture, economics, and damned good writing. Further, the depth and breadth of analysis provided by the author is so compelling and well documented that it is sure to encourage further research on the "elusive but important workers who inhabited a wooden world."

The seaman was stuck, indeed, between the draconian system of employment overseen by the captain and mate (representing the Devil) and the physical dangers of a life on the waves (the Deep Blue Sea). Rediker brings this world vividly into his analysis through the use of quoted passages from seamen and their chronicler's accounts. Thus, the colorful, yet simple, poetry and narratives of the seamen become transformed into blunt commentary on the working conditions and production relationships of the era. Not even those most romantic figures of seafaring times, the pirates, escape Rediker's analytical cutlass, as he plunges into the political, social and economic lives of these "social bandits." Pirates are seen to express "the collectivistic ethos of life at sea by the egalitarian and comradesly distribution of life changes, the refusal to grant privilege or exemption from danger, and the just allocation of shares." Pirates constructed a culture of "masterless men," far removed from traditional authority. Surprisingly, Rediker seems to abandon his scholarly and analytical distance when cavorting through the world of pirates. For even though piracy may have been a reaction to the shipboard excesses of authority and, hence, appealing to the Marxist labor analyst, it was also, as noted by Frank Sherry in *Raiders and Rebels*, a brutal and primitive existence. Thus, in this context, Rediker falls prey to the same romanticizing as the early historians he otherwise so brilliantly rebuts.

Dean E. Cycon
International and Maritime Attorney
Providence, Rhode Island

***Dive Into History: U-Boats* by Henry Keatts and George Farr. 1986. Published by the American Merchant Marine Press. 183 pp. Available in hard cover from Fathom Press, Eastport, NY. \$29.50.**

Henry Keatts is an avid SCUBA diver, a Biology Professor at Suffolk Community College in Riverhead, New York, and an amateur historian with an abiding interest in the history of German submarines. In *Dive Into History: U-Boats*, Keatts has teamed up with George Farr to produce a fascinating collection of documentary photographs and historical accounts of the development of the German U-boat. The book has a specific emphasis on submarines in United States coastal waters within diving range of explorers using SCUBA.

Using black and white archive photographs, the authors describe the development of submarine construction and history of submarine warfare in World Wars I and II. They capture much of the romance and adventure of this era, chronicling daring feats of German U-boat captains. The book concentrates on six specific U-boats.

The UC-97 was a mine-laying submarine, surrendered in 1919, and turned over to the United States for technical study. Put on tour in the United States to promote the sale of Victory Bonds, the sub was eventually used by the U.S. Navy in a gunnery drill in Lake Michigan and sunk approximately 20 miles east of Highland Park, Illinois. The UC-97 has not yet been located, a tempting prize for divers challenged by the possibility of discovering this most fascinating remnant of World War I.

Historical surface and underwater photographs grace the chapters describing the history and sinking of five other U-boats in American waters. Keatts and Farr describe in detail the U-85, U-701, and U-352, lost off the Carolinas; the U-853 off Block Island, Rhode Island; and the U-2513, sunk in gunnery practice off Florida.

The authors present eyewitness reports and possible locations for the U-701, sunk in the Gulf Stream in July 1942, somewhere off Avon, North Carolina. The clues may tempt enthusiasts to search for this elusive phantom, while other divers explore the more accessible U-352, sunk off North Carolina two months earlier, or the last casualty in American waters, the U-853, sunk off Block Island.

The U-505, on display in Chicago's Museum of Science and Industry, was the first enemy ship captured on the high seas by the U.S. Navy since 1815. *Dive Into History* uses pictures of this intact memorial to submarine warfare to add a realistic dimension to underwater photographs taken from the submarines explored by the authors and their friends.

John C. Fine,
Scarsdale, New York

Books Received

***The Environment of Life* by Colin Tudge. 1988. Oxford University Press, New York, NY 10016. 248 pp. \$35.00.**

***Marine Invertebrates of the Pacific Northwest* by Eugene N. Kozloff.**

1987. University of Washington Press, Seattle, WA 98145. 511 pp. + vi. \$35.00.

***Microbes in the Sea* edited by Michael A. Sleight. 1987. Ellis Horwood Ltd., U.S. distribution by John Wiley & Sons, New York, NY 10518. 241 pp. \$59.95.**

***Reproduction and Development of Marine Invertebrates of the Northern Pacific Coast: Data and Methods for the Study of Eggs, Embryos, and Larvae* by Megumi F. Strathmann. 1987. University of Washington Press, Seattle WA 98145. 670 pp. + xii. \$35.00.**

Advances in Soil Science, Volume 7 edited by B. A. Stewart. 1987. Springer-Verlag, Secaucus, NJ 07094. 228 pp. + viii. \$75.00.

Antarctic Science edited by D. W. H. Walton. 1987. Cambridge University Press, New Rochelle, NY 10801. 280 pp. + viii. \$39.50.

The Cartography of North America: 1500-1800 by Pierluigi Portinaro and Franco Knirsch. 1987. Facts On File Publications, New York, NY 10016. 319 pp. \$40.00.

Gravity Currents: In the Environment and the Laboratory by John E. Simpson. 1987. John Wiley & Sons, New York, NY 10158. 244 pp. \$61.95.

Karst Hydrology: With Special Reference to the Dinaric Karst by Ognjen Bonacci. 1987. Springer Series in Physical Environment Volume 2, Springer-Verlag, Secaucus, NJ 07094. 184 pp. + x. \$79.50.

The Mediterranean Was a Desert: A Voyage of the Glomar Challenger by Kenneth J. Hsü. 1983. Paperback edition, 1987. Princeton University Press, Princeton, NJ 08540. 197 pp. + xv. \$8.95.

Mixtures and Mineral Reactions by Jibamitra Ganguly and Surendra K. Saxena. 1987. Minerals and Rocks, Volume 19, Springer-Verlag, Secaucus, NJ 07094. 291 pp. + xii. \$59.00.

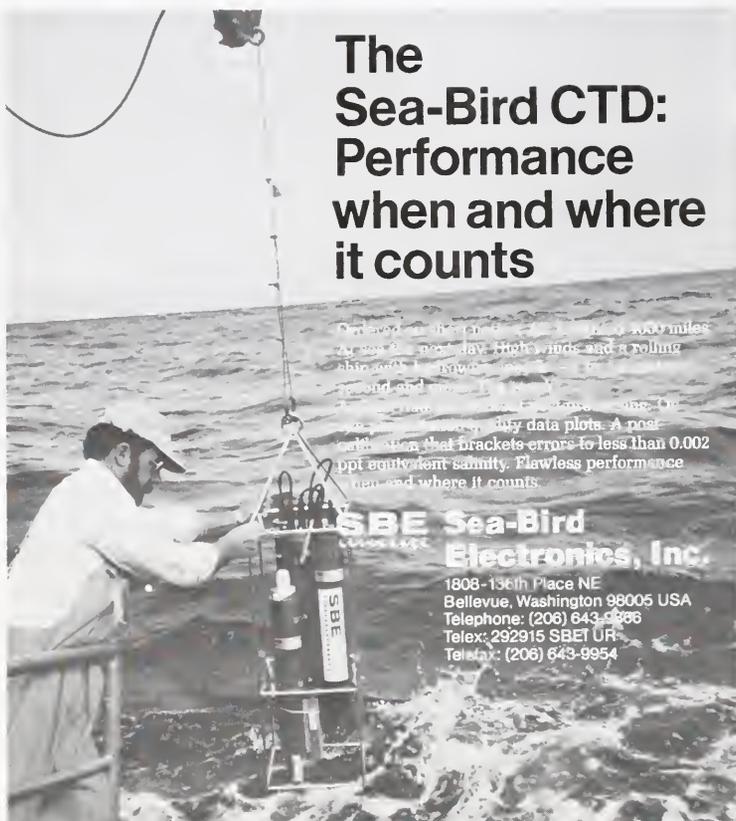
Monsoon Meteorology edited by C.-P. Chang, and T. N. Krishnamurti. 1987. Oxford Monographs on Geology and Geophysics No. 7, Oxford University Press, New York, NY 10016. 544 pp. \$85.00.

Paleokarst edited by N. P. James, and P. W. Choquette. 1988. Springer-Verlag, Secaucus, NJ 07094. 416 pp. + xi. \$64.00.

Paleomagnetology, technical editor: D. H. Tarling. 1987. Springer-Verlag, Secaucus, NJ 07094. 308 pp. + xix. \$107.50.

Systematic Geomorphology by Adrian E. Scheidegger. 1987. Springer-Verlag, Secaucus, NJ 07094. 285 pp. + ix. \$59.00.

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Three-Dimensional Coastal Ocean Models edited by Normal S. Heaps. 1987. Coastal and Estuarine Sciences, Volume 4, American Geophysical Union, Washington, DC 20009. 208 pp. + ix. \$30.00.

The Bhopal Syndrome by David Weir. 1987. Sierra Club Books, San Francisco, CA 94109. 210 pp. \$17.95.

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World population and the United Nations: Challenge and Response by Stanley P. Johnson. 1987. Cambridge University Press, New Rochelle, NY 10801. 357 pp. + xxxviii. \$22.95.

Fisheries Technologies for Developing Countries: Report of an Ad Hoc Panel of the Board of Science and Technology for International Development. 1987. Office of International Affairs, National Research Council, National Academy Press, Washington, DC 20418. 168 pp. + vii. \$15.00.

An Ocean in Mind by Will Kyselka. 1987. University of Hawaii Press, Honolulu, HI. 244 pp. + xi. \$14.95.

Descartes' Dream: The World According to Mathematics by Philip J. Davis, and Reuben Hersch. 1986. Harcourt Brace Jovanovich. Paperback edition, 1987 by Houghton Mifflin Paperbacks, Boston, MA 02108. 321 pp. + xviii. \$12.95.

From Deterrence to Defense: The Inside Story of Strategic Policy by Michael Charlton. 1987. Harvard University Press, Cambridge, MA 02138. 154 pp. \$20.00.



WOODS HOLE

Marine artist West Fraser has captured Woods Hole on an early summer evening in this signed limited edition print.



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Portraits of Earth by Freeman Patterson. 1987. Sierra Club Books, San Francisco, CA 94109. 180 pp. \$35.00.

Shark: A Photographer's Story by Jeremy Stafford-Deitsch. 1987. Sierra Club Books, San Francisco, CA 94109. 200 pp. \$19.95.

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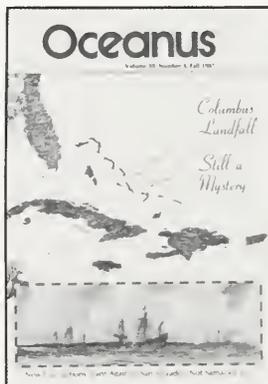
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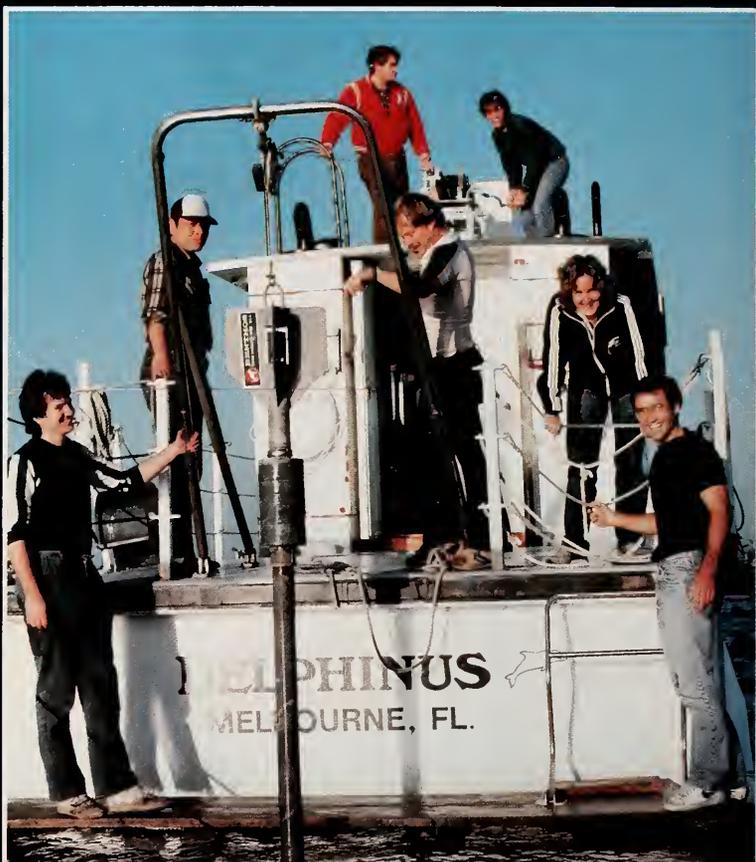
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