Designing Ocean Parks for the Next Century

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> If human stewardship has been lax on land, it has been even worse in the sea.
>
> *National Park System Advisory Board, 2001*[1]

Fishing in national parks

FISHING HAS LONG BEEN A TRADITIONAL USE OF NATIONAL PARKS. Fishing has been part of park lore and attraction, from 19th-century commercial cutthroat trout fishing in Yellowstone Lake to world-renowned sport fishing for tarpon and bonefish in Everglades National Park's Florida Bay and the annual 70,000-ton take of market squid from Channel Islands National Park in the late 20th century.[2] National Park Service policies that direct fishing have been published for decades, with a stated goal to preserve wild, native species in their natural habitats, while providing fishing opportunities that do not interfere with preservation efforts. Such policies could also have been developed for other "renewable resources" such as birds, bees, and redwood trees, but were not. The removal of marine wildlife in parks still occurred although there is no authority that exempts fish and other aquatic wild life in parks from the protection of the 1916 Organic Act, which directs NPS to "conserve … the wild life [in parks] and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired.…" The 75 ocean units currently in the national park system include large submarine areas of Glacier Bay, Alaska, Dry Tortugas, Florida, and Channel Islands, California, that entered the park system early, in the 1920s and 1930s. Narrow strips of ocean adjacent to a host of barrier islands and beaches in national seashores from Cape Cod to Point Reyes, Great Lakes lakeshores, recreational areas, and parks like Redwood and Olympic came into the park system, mostly in the 1960s and 1970s. A few park units are virtually all underwater, such as Biscayne National Park, Florida, and Buck Island Reef and Virgin Islands Coral Reef national monuments in the U.S. Virgin Islands. Inclusion of these sites in the national park system clearly indicates the legitimacy of affording ocean ecosystems the protections such designations afford terrestrial resources. The apparent *de facto*, unstated, hypothesis for ocean parks seems to have been that protecting

habitats and water quality would be sufficient to mitigate the negative effects of fishing mortality and leave exploited populations and ecosystems unimpaired. That hypothesis is falsified repeatedly in virtually every national park system unit in which it has been examined. In light of this new information, it is time to re-evaluate the assumptions of sustainable fishing and unimpaired ocean wild life in national parks.

A vision for future generations

Place-based conservation in the ocean lags a century behind similar endeavors on land. Establishment of Yellowstone National Park in 1872 and the passage of the Marine Protection, Research, and Sanctuaries Act a century later in 1972 provide emblematic mileposts. As a consequence of this circumstance, wild life in ocean parks has been neglected and abused. It is high time to close that land–sea gap, especially as we envision the future of national parks in another century of NPS stewardship. To achieve the vision of the Organic Act, wild life in ocean parks must be fully protected. Also, coastal parks in which park boundaries fragment ecosystems, thus depriving wild life of essential habitats by being politically cut off from the sea, need to be made ecologically whole by adding adjacent submerged lands and waters to adequately protect foraging and other ocean habitats essential to the daily survival of park wild life, such as seabirds and seals (Figure 1). The confluence of human interests with coastal watersheds and ocean waters should drive designs of new ocean parks and differentiate them from other marine protected areas.

Forecasting the long-term future is needed to achieve more than just incremental adjustments in the park system. Significant change will come only with inspirational visions of great things that will

Figure 1. Shorelines are artificial boundaries that distract viewers from seeing connections among mountain watersheds and deep seascapes; they obscure the dependence of coastal wild life on both realms, and mask powerful links between land and sea. Photo by Dorothy A. Davis, © 2002 G.E. Davis & Associates.

stir passions in people to achieve them. To that end, I propose that at the bicentennial of the National Park System in 2116, people visiting ocean parks should expect to see and experience:

- Well-managed, fully protected ocean parks with spectacular features as iconic as those of Yellowstone, Grand Canyon, and Yosemite;
- Park wild life in the ocean as pristine as it was before the Industrial Revolution (Figure 2);
- Wilderness in ocean parks that inspires people to be better stewards of nature; and
- Ocean parks that are living laboratories teaching people about nature and how to improve human health and well-being.

These goals, well within our grasp today, are rapidly slipping through our collective fingers, and windows of opportunity are closing. If the current generation of park professionals does not act decisively now with broad and persistent public support, no subsequent generation will have an option to know the sea as we first experienced it, to know the joy of fishing, or to wonder at the beauty of coral reefs and kelp forests. These experiences are fading now. Irreplaceable species critical to the integrity, stability, and beauty of ocean parks are perilously close to extinction.

In spite of dire conditions in ocean parks, one can find glimmers of hope in the general sea of despair regarding ocean conservation and preservation of maritime heritage. One of the brightest was establishment in 2006 of the 89.5-million-acre, fully protected Papahanaumokuakea Marine National Monument in the near-pristine northwestern Hawaiian Islands. Administered jointly by the U.S. Fish and Wildlife Service and the National Oceanic and At-

Figure 2. Diversity of wild life in the ocean dwarfs biodiversity on land, stretches human imagination about life forms, and offers opportunities for communities to act locally in ways that can reduce global forces challenging human health and well-being. Photo by G.E. Davis, © 2006 G.E. Davis & Associates.

mospheric Administration, this one national monument is larger than the entire U.S. national park system. Elsewhere, much remains to be done to repair the damage from decades of denial and neglect of special places in the ocean. Knowing how this situation developed may help avoid the mistakes of the past and guide us to a different outcome in the future.

Expectations and sliding baselines

Expectations are powerful forces of human nature. As a child, I loved to fish. So my first job was a dream come true. In June 1957, I became a deckhand on the commercial passenger fishing vessel *Fisherette* out of San Diego, California. I loved the adventure of fishing. The boat captain taught me where, when, and how to catch yellowtail, tuna, and marlin. Our passengers caught their limits of 20-plus-pound yellowtail nearly every day. Striped marlin that tipped the scales at 150 pounds were plentiful. One day we landed ten marlin, limits for all five passengers. In the beginning, my mentors seemed to know all there was to know about fishing and the ocean, and they shared that traditional knowledge with me freely. Every day I learned something new. I was in paradise.

As we slipped out of San Diego harbor each morning in the pre-dawn darkness, twinkling city lights reflected on the smooth dark water, invoking visions of the romantic lyrics of "Harbor Lights," a popular tune of the day. Our first order of business each morning was "making bait"—catching the sardines, anchovies, or mackerel we used later to catch the gamefish our sport fishing clients desired. We proudly reported our daily take of gamefish to the local newspapers. The papers published box scores of the landings to let prospective clients know what they could expect to catch if they went fishing with us.

Then in 1960, everything changed. The yellowtail failed to appear as they "normally" did in June. After searching desperately for weeks, we finally located schools of albacore tuna far offshore in early July. For the next few years we chased elusive schools of tuna as they mysteriously appeared and disappeared along the coast. Any concept of "normal" seemed hopeless as we struggled to make sense of our new experiences and to provide good fishing opportunities for our passengers.

The mysteries of these early years led me to university training in fisheries science and marine ecology. Now we understand that 1957–59 was one of the strongest El Niño events of the 20th century. It marked the beginning of a decadal oscillation of warm water some oceanographers are calling El Viejo (father of El Niño) that lasted 50 years. What I naively thought was normal in the 1950s from my personal experience turned out to be one of the most extreme natural events in a century. The apparently elusive comings and goings of albacore were also a function of predicable patterns in nature. When colliding "fronts" between cool and warm ocean water masses remain stable in sun-lit surface waters for more than two weeks, nutrients in the cool water have enough time to be converted into food webs that produce the small forage fish sought by tuna. Before satellites gave us synoptic ocean views, it was difficult to see and understand such patterns in oceanic water masses. Such new ecological knowledge helped us understand and rationally explain nature's variability. It also provided even more power to exploit an apparently vast inexhaustible ocean.

Newspapers still report daily landings

by commercial passenger fishing vessels in southern California. The big difference now is that they report the number of mackerel they caught. After 50 years of science-based fishery management, we are now proud to report that we caught the bait. The current generation of fishermen accepts catching mackerel as normal because it is what they first experienced when they discovered the ocean, just as I had expected the El Niño conditions of 1957–59 to continue forever as "normal." Fishermen discovering the southern California ocean at the onset of the 21st century have set a new baseline, with substantially lower expectations of the ocean's bounty than the one my generation did just a few decades earlier. Such lowered expectations aid and abet continued degradation of ocean resources. Setting appropriate expectations as a fixed baseline is critical for rebuilding the nation's ocean heritage (Figure 3).

Oceans obscure out-of-sight wild life in an alien environment. How do people know what is normal? In an ever-fluctuating environment, how can we discover what causes the changes in nature that we experience? How can we tell if fishing and other consumptive uses of the sea are sustainable? Traditionally, we measured what we took from the sea, and sometimes recorded how much effort we expended to take it, e.g., number of boats or traps or days fishing. We then used landings and catch rates as indications of population change. We assumed that exploited populations remained the same if landings and catch rates were unchanged. This was somewhat akin to managing a bank account by monitoring the checks written, but never recording the

Figure 3. Twice a day the tide falls in Cabrillo National Monument, San Diego, California, opening a window on the sea for people of all ages to explore nature, and in protected parks to discover how the coast used to be when their grandparents first saw it. Photo by G.E. Davis, © 2006 G.E. Davis & Associates.

deposits and assuming there were reserves to balance the account.

During the 20th century, fishing in the ocean continued virtually everywhere technology provided access. The U.S. National Marine Protected Area Center inventoried managed areas in U.S. waters and determined that even with 1,688 marine protected areas, 99.9% of U.S. territorial waters were still available for fishing in 2008.[3] As boats got larger and faster, more remote areas were lost as *de facto* refugia, sources of replenishment. Any hope of sustaining exploited populations rested on fishery constraints exercised through limits on fishing seasons, gear, fish sizes, quotas, and bag limits. In the oceans, no systems of fully protected areas emerged as they did on land to serve as benchmarks by which human behavior could be assessed.

What happened?

After decades of research and monitoring, it became clear that fishery resources in parks were in the same depleted condition as those outside parks. Controlling fishery take with state regulations and protecting habitats and water quality in parks were insufficient to assure sustained populations and intact ecosystems. Park fisheries collapsed widely, from tropical Florida and the Virgin Islands to temperate seas in California and Alaska. Opportunities were lost to benefit from fishing, to otherwise enjoy unimpaired wild life, and to learn the effects of fishing on ecosystems.

When Jack Randall, a professor at the University of Miami, needed specimens for his pioneering biological surveys and studies of Virgin Islands National Park and Buck Island Reef National Monument in the 1950s and 1960s, he could spear dozens of large groupers and snappers any day. He collected hundreds of big fish. Local fishermen could feed their families and meet fresh seafood demands of local resorts using traditional woven arrowhead traps to catch big predatory fish. Snorkeling in shallow water, they caught spiny lobster and conch. Fifty years later, fish traps catch only small herbivores. Mature conch and lobster are rarely seen, even in deep water, and resorts import frozen seafood from afar. Now, teams of scientists surveying fish populations in Virgin Islands National Park search for weeks to find a single small grouper.[4] Even though the baseline had already shifted substantially downward from Jack Randall's experience 30 years before the current studies began, monitoring fish abundance and size in the park over the past 20 years revealed continued declines. Traditional artisanal fishing eventually removed most large reef predators and grazers, allowing algae to increase and compete with corals for light and space. Environmental stress on reef-building corals reached critical limits when ecological effects of fishing down the food pyramid combined with impacts of increased sediments and nutrients in runoff from human-altered local watersheds (Figure 4). The increased stress appears to have impaired the corals' immune systems and made them more sensitive to global forces, such as warming sea temperatures. This, in turn, increased the corals' susceptibility to previously unknown diseases. Warm water in 2005 caused nearly 50% of reef corals at park study sites to die, some directly from thermal stress and others from subsequent diseases months later.[5] A cascade of these interdependent stress factors further diminished reef resilience to normal hurricane disturbances, exacerbating an already precarious situation for park reefs. Hundreds

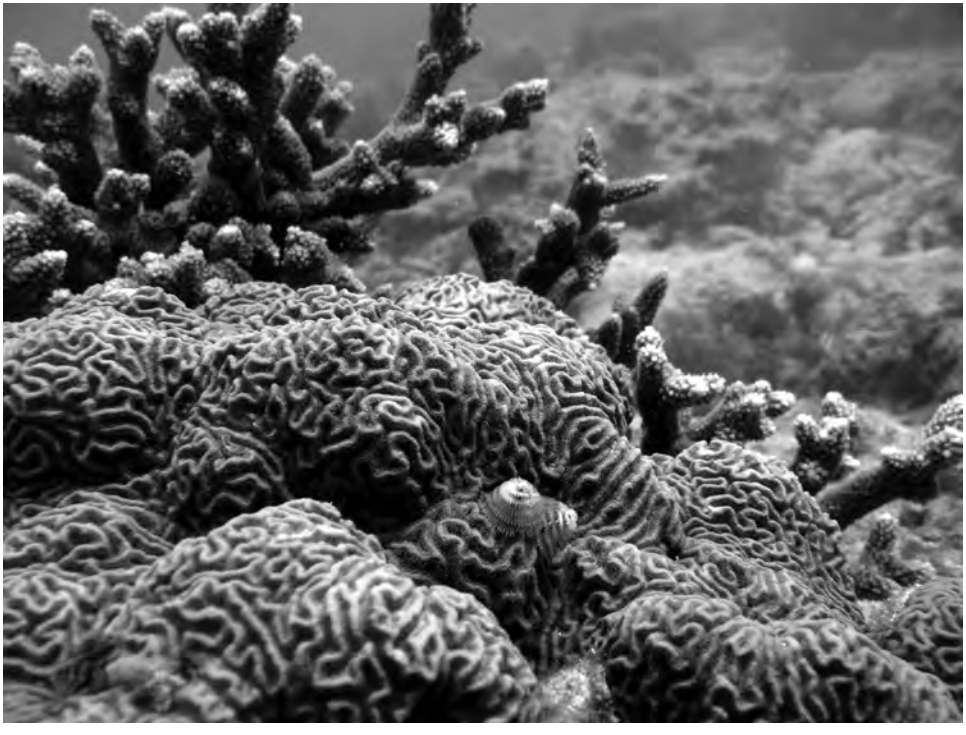


Figure 4. Clearly impairment of sea life in parks has reached critical levels when major reef-building corals, such as elkhorn (*Acropora palmate*) and staghorn (*A. cervicornis*), and one-time mainstays of commercial fisheries, such as white abalone, *Haliotis sorenseni,* approach extinction and appear on threatened and endangered species lists. Photo by G.E. Davis, © 2008 G.E. Davis & Associates.

of species of park wild life depend exclusively on these reefs for food, shelter, and other life essentials. Two major western Atlantic reef-building corals, elkhorn and staghorn (*Acropora palmata* and *A. cervicornis*), were designated "threatened" under the U. S. Endangered Species Act in 2006.[6] The coral reef chain of life is stretched dangerously thin in Virgin Islands parks, with many links poised to fail.

When Everglades National Park was authorized in 1934, Florida Bay and the other ocean waters of the park were true wilderness (634,000 acres), difficult to penetrate and seen only by the heartiest adventurers. By the 1970s the ocean parts of the park had become a battleground crisscrossed with boat tracks; the park was losing 1,000 tons of fish, crabs, and lobster every year to fishing.[7] Fishermen competed with eagles and crocodiles and with one another for what all believed to be diminishing resources. While nearly everyone agreed resources were declining, none knew what caused the declines or when they began. Lacking historical data, I interviewed experienced fishers in an attempt to find a pattern of environmental events to help explain the deteriorating conditions. No patterns emerged. No connections among hurricanes, real estate development, pollution, boat traffic, agriculture, human population growth, park regulations, or other events matched the onset of the

declines all interviewees could so vividly recall. The only pattern I found was that the declines seemed to begin, on average, 11 years after the interviewee arrived in South Florida. Apparently, it took people 11 years to notice a shift from their personal baseline.

Eventually, professional fishing guides in the Florida Keys petitioned the park to take remedial actions, specifically requesting prohibition of commercial fishing. NPS lacked sufficient ecological knowledge to deal with the underlying causes of this situation. Therefore the park addressed only a symptom of the stress, competition among users—nature, sport fishers, and commercial fishers—and reallocated the available resources to nature and sport fishers. The park banned commercial fishing, introduced daily bag limits for sport fishers, protected stone crabs and spiny lobster, and closed sensitive crocodile nesting areas. These actions delayed the inevitable for 20 years. Decades of altered watershed conditions eventually combined with physical habitat damage and loss of ecological integrity from fishing to push Florida Bay into a new community state more conducive to algae and bacteria than bonefish and tarpon, and helped precipitate a multibillion-dollar restoration program.[8] Delay born of denial and ignorance can be expensive.

Hard by Miami, Florida, to the north, Biscayne National Park affords habitat protection to 173,000 acres of unbroken mangrove shoreline, tropical lagoon, seagrass beds, shallow patch reefs, and outer coral reef tract, in addition to the northernmost Florida Keys. Commercial and sport fishing of all kinds have been major activities in the park since Biscayne's inception in 1968. Fishing activities have been managed by the state of Florida, while the park monitored fishery take and resource conditions. In the mid-1970s Florida established a spiny lobster sanctuary in the park's bay waters to protect juvenile lobsters from fishing-induced injuries and mortality, complemented today by similar lobster reserves in Everglades and Dry Tortugas national parks.[9] Reef fisheries in South Florida, including in the park, have been under tremendous pressure for the past 50 years. Recreational boat registrations in the region are now nearly five times what they were when the park was established. Park fisheries show the strain with signs of impairment. An independent analysis in 2002 designed to explore alternative park management strategies revealed that 70% of exploited species in the park were much smaller and overfished, meaning their spawning capacity was reduced by more than 70%. For example, black grouper were 60% smaller and had lost 95% of their spawning potential. Investigators also indicated that traditional fishery regulations, e.g., sizes and seasons, were not likely to restore or to sustain fishing as it had been in the past.[10]

Patterns of fishery over-exploitation, serial depletion, and cascading ecosystem shifts are not limited to warm-water parks. Giant kelp forests dominate the cool waters of Channel Islands National Park, off California's southern coast. Often described as rainforests in the sea, these highly productive communities are home to more than 1,000 species. When the park was expanded in 1980 from the 1938 national monument boundaries, it was widely recognized as the last, best place in the region to fish and to see wild life. The park was at the core of California's most valuable fisheries, including abalone, spiny lobster, red sea urchin, market squid, and a wide variety of

fin fish, including more than 50 species of rockfish (Scorpaenidae), California sheephead, and lingcod. After more than 20 years of national park protection, 80% of the kelp forest was gone; all five abalone fisheries had collapsed serially, with one species (*Haliotis sorenseni*) now on the federal endangered species list; and several rockfish fisheries were closed to prevent population collapses.[11] Reduction of large predators and grazers left smaller species, e.g., purple sea urchins, brittle stars, and sea cucumbers, without competition, which allowed their populations to increase rapidly and over-graze kelp forests. Without kelp to provide food and shelter, the entire community shifted to bare rock reef. The small grazer populations, now stressed from lack of food, died back as a result of disease, initiating a series of abnormal boom and bust cycles triggered by natural El Niño events.[12] A similar story is unfolding in the remote vastness of Glacier Bay National Park and Preserve in Alaska, where salmon and crab fisheries are struggling and park ecosystems are stressed on more than 600,000 acres of submerged lands.[13]

Hope on the horizon

The untested assumptions that ocean vastness and species-based fishing rules would sustain populations were wrong. As an unintended consequence, 90% of the world's populations of large fishes have been depleted to critical levels, fisheries have collapsed, and wild life populations have been destabilized and threatened with extirpation while some species face extinction.[14] Not only has fishing reduced populations, it selectively reduced or removed higher trophic levels from systems. This "fishing down the food chain" initiated additional ecological consequences that cascaded through ecosystems, altering system states from diverse, complex, resilient, and stable to simple, chaotic, and less productive. Clearly, it is time for a change in our approach to ocean conservation.

On land, people around the world have set aside portions of landscapes as national parks and other designations as wild places. These systems of protected areas, as the places most insulated from human perturbation, complement species-based conservation strategies and serve as:

- Benchmarks, dynamic standards, to define normal conditions and ecological integrity (resilience, biodiversity conservation, and historical fidelity);
- Sources of replenishment—for both nature and human spiritual values (recreation);
- Foundations of education—stories to tell and lessons to learn about nature;
- Common ground that facilitates diverse cultures living together peacefully; and
- Means to sustain options for future generations to connect with their heritage.

Protecting wild life in analogous designated ocean areas to obtain these values has yet to be tried. Although special places in the ocean were included in coastal parks and refuges early in the 20th century, system-wide, place-based conservation first arrived in the ocean in the 1970s, a full century after Yellowstone National Park ushered in modern place-based, landscape-scale conservation of terrestrial ecosystems. Pioneering efforts in systemic place-based ocean conservation include the 1975 Great Barrier Reef Marine Park Authority in Australia, and the Marine Protection, Research, and Sanctuaries Act of 1972 (MPRSA, P.L.

92-532) in the USA which authorized multiple-use national marine sanctuaries. Nevertheless, these early efforts still did not prohibit fishing in the "protected" areas. Today, the major U.S. systems of marine protected areas, such as national marine sanctuaries, wildlife refuges, national parks, and estuarine research reserves, still do not categorically prohibit taking of fish, shellfish, or plants.

Protection of wild life in special ocean places has increased only incrementally for the last 50 years. At first, small places were set aside to allow swimmers safe havens from boats and fishing gear. Places like the underwater trails in Trunk Bay and Buck Island in the U. S. Virgin Islands broke new ground in the 1950s when they protected fish, lobster, conch, and whelk along the trails so visitors could see coral reef inhabitants. These truly protected zones were generally limited to areas of 10–15 acres. As SCUBA diving became popular in the 1960s and 1970s, a few slightly larger areas, 30–50 acres, were protected in state parks like John Pennekamp in Florida and Point Lobos in California to give divers a chance to experience nature and to separate spearfishing from other divers and swimmers.

In a few places, people explored protected areas as nurseries for exploited species or gathering sites for mass spawning. During the 1970s in Florida, a series of spiny lobster, stone crab, and conch refuges were established to protect spawning stocks or juveniles. This helped to rebuild and sustain those popular fisheries, but did little to ensure ecosystem health. However, these species-based, fishery-driven efforts did demonstrate the potential value of national parks as sources of replenishment and benchmarks for evaluating fishery management. Today these refuges in Biscayne, Dry Tortugas, and Everglades national parks continue to contribute significantly to the success of Florida's valuable invertebrate fisheries.

Recent lessons from fully protected reserves

Where fishing mortality has been reduced, benefits to exploited populations and ecosystems in parks accrued quicker and more dramatically than expected. When the Great Barrier Reef Marine Park was authorized in 1975, only 5% of the park was off-limits to fishing, and because of the park's size and remoteness, just 5% of the reef was accessible to day visitors. Today, faster boats make 95% of the reef accessible to day-trippers and a third of the park now protects wild life from fishing. The response of newly protected coral trout surprised everyone: in two years trout numbers in reserves went up 36–64%, yet did not change in nearby fished zones.[15] Just three years after implementing no-take marine reserves covering nearly 140,000 acres at Dry Tortugas, Florida, scientists found significantly greater fish abundances and larger fish in the reserves.[16] In the five years since a network of 10 no-take marine reserves covering a total of 111,276 acres around the California Channel Islands was implemented in 2003, kelp forests have expanded more in reserves than outside, fish and invertebrate species exploited by fishing had greater population densities and sizes in reserves than outside, while species not taken by fishing remained the same inside and outside reserves.[17]

As park fisheries collapsed and ecosystems shifted from complex and productive to simple and barren, opposition to new management strategies softened. Larger areas in parks (thousands of acres rather

than tens of acres) were set aside from fishing to aid in resource recovery and to rebuild lost fishing opportunities. These new reserves revealed amazing resiliency of ocean ecosystems, from the coral reefs in Great Barrier Reef Marine Park, Dry Tortugas National Park, and Florida Keys National Marine Sanctuary, to the giant kelp forests in Channel Islands National Park and Channel Islands National Marine Sanctuary. The consequences of protecting ocean wild life in parts of parks and sanctuaries are now much clearer. Places in which all wild life is protected from human exploitation recover and sustain their ecological integrity, stability, and beauty. The capacity for self-renewal quickly returns in such places. They begin to contribute to regional environmental well-being. The question we must now confront is, "Why should fishing continue in special 'protected' places like national parks?"

Time for a change

> How can you tell how it used to be
> when there's nothin' left to see?
> *Jimmy Buffett, "Prince of Tides"*

Over the past century, well-intentioned, but ill-informed, fishing activities inadvertently altered the integrity, stability, and beauty of ocean wild life in national parks. It is time to change those uninformed policies and practices to incorporate new information on the widespread effects of fishing on both exploited species and ocean ecosystems, and to use recent experiences with fully protected marine reserves to improve design of ocean parks. Just as wildfire and predator "control" policies and practices in national parks changed with new information in the 20th century, fishing in ocean parks needs to change in the 21st century while critical elements of ocean park ecosystems remain extant.

I find four basic tenets of park stewardship useful to structure the needed changes:

1. Know and understand how park ecosystems work;
2. Restore impaired elements of park ecosystems and design new functional systems;
3. Protect parks and mitigate threats to their integrity, stability, and capacity for self-renewal; and
4. Connect people emotionally to parks and spark public interest to learn about nature.

Know and understand. Until we understand better how ocean park ecosystems work, stewardship will, in effect, be limited to treating symptoms of stress reactively. Greater ecological understanding will permit proactive reductions in the causes of stress, thereby reducing costs and improving the likelihood of successful treatment and prevention of additional losses. Investments in more knowledge will yield dividends in better, faster, and cheaper stewardship. Knowledge of ocean parks pales in comparison with that of land-locked parks.

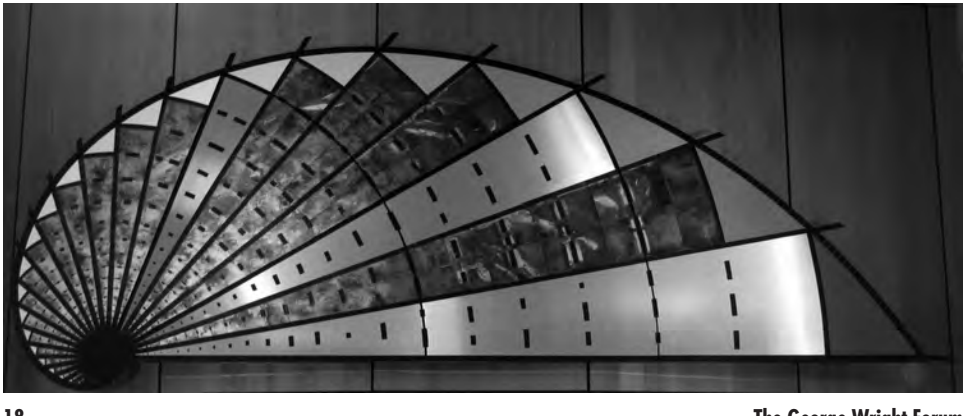
Restore and design. Fixing broken parts of parks has become a core mission for park stewards. Setting goals for desired future conditions based on former conditions is fraught with uncertainty, and may well be impossible when species have been lost. The 20th-century concept of ecological restoration that looked backward to set future goals is shifting into a new forward-looking paradigm that recognizes the need to design future systems using available remnants of the past. With increasingly pervasive human effects on global environmental forces, design seems inevitable. How-

ever, the designs will be constrained heavily by conspicuous limits of human control on outcomes and future conditions. Living with such limits will be a major challenge for humans in the 21st century. Parks will likely be some of the easiest and cheapest places to learn those lessons.

Protect and mitigate. Fully protecting all wild life in ocean parks is essential to comply with the 1916 National Park Service Organic Act and to make the parks whole. Annually removing thousands of tons of fish, invertebrates, and plants remains the greatest threat to ocean park integrity, stability, and capacity for self-renewal, i.e., environmental health.

Connect and educate. The public needs to feel connected to out-of-sight, out-of-mind, seemingly alien life forms in the sea, and understand that people are also interdependent parts of ocean communities. If they do not, essential parts of ocean parks will be lost forever. With such losses, people everywhere will be forced to forego opportunities for sustained human health and well-being. I believe compiling scientific facts and information about wild life in the sea is, by itself, insufficient to spark public interest and light the fires of education. We need artists to join the fray, as they did in the 19th century. Painters inspired by the Hudson River School conveyed the grandeur of western landscapes to an American populace confined to the eastern seaboard by limited transportation and communication technologies. The artists created sweeping tableaux on huge canvasses that still hang in the halls of Congress, the White House, and museums in eastern cities. These artistic renderings of nature inspired Americans to join in an expression of their best idea—a system of special places protected so that all could enjoy the nation's shared heritage (Figure 5). Today's technologies afford even more capacity to touch diverse audiences and inspire them to take the next steps to effectively sustain and extend the park system into ocean realms. Indeed, Jean-Michel Cousteau's beautiful and moving film *Voyage to Kure* triggered President Bush's recent decision to establish Papahanaumokuakea Marine National

Figure 5. People have used abalone (large marine snails, *Haliotis* spp.), for food, utensils, and jewelry for thousands of years. This wall-sized, stylized shell in Nanaimo, British Columbia, symbolizes the powerful bonds people forge between art and nature. Photo by G.E. Davis, © 2007 G.E. Davis & Associates.



Monument, with encouragement by straight talk from Sylvia Earle and other ocean advocates.[18]

Today, we labor under a tyranny of diluted words and euphemisms. Special places labeled "national parks," "sanctuaries," and "refuges" do not offer protection, sanctuary, or refuge for wild life. We describe taking and exploitation of ocean park wild life as "harvest" as if a crop were planted, tended, and gathered. Fish killed and removed from parks are labeled "landings," and fish taken from the sea become "yield" as if they were interest on an investment we made. We must acknowledge we are at the end of millennia of human "hunting and gathering" in the sea, and begin to recognize that the future is one of stewardship in which we invest, tend, and care for wild life in the sea. Those special places we recognize as critical to preserving our shared ocean heritage should be first among equals.

Recovery is still possible

National parks in the sea reside at the confluence of human interests with coastal watersheds and the ocean. Understanding ocean ecosystems gives people hope for rebuilding depleted resources; for restoring integrity, stability, and beauty of degraded ecosystems; and for returning capacity for self-renewal to intact ecosystems. Just as returning wild wolves to Yellowstone National Park restored ecological integrity, when fishing was curtailed in existing marine protected areas, populations of fish and invertebrates rebounded swiftly. This positive and hopeful response to protection has been witnessed and documented carefully in many places, including Australia's Great Barrier Reef Marine Park, in Florida's Dry Tortugas National Park and Florida Keys National Marine Sanctuary, and in California's Channel Islands National Park and Channel Islands National Marine Sanctuary. The ecological concepts are now well known and tested. The current challenge is applying what is known to policy and practice through political processes.

Inspire the next generation to do more

I know from personal experience that fishing can forge powerful, life-long bonds to nature. Perhaps the greatest challenge facing ocean park stewards today is engaging sport fishing communities to search for new strategies that will restore and sustain integrity, productivity, and capacity for self-renewal of ocean parks. People in these communities have the greatest potential for understanding what is at risk and the values to be gained by changing current human behavior in the sea. Yet continued denial that sport fishing contributes to deteriorating conditions of ocean park resources will doom timely restoration efforts politically and result in Pyrrhic victories when remedial actions are finally taken, too little and too late.

To preserve options for future generations of humans to enjoy unimpaired wild life in ocean national parks (Figure 6), we must now: (1) care for all wild life in existing ocean parks by extending the same protections national parks afford life on land to life in the sea; (2) make coastal parks ecologically whole by adding submerged lands adjacent to coastal watersheds in those places where park boundaries stop at the water line or reach less than a mile from shore, effectively denying park wild life access to critical habitat; and (3) join efforts of the national park system, NOAA sanctuaries and estuarine research reserves, the U.S. Fish & Wildlife Service national wild-

Figure 6. Coastal waters offer park visitors access to explore alien realms and to discover nature on their own terms in ways that are difficult to imagine on land. Photo by G.E. Davis, © 2006 G.E. Davis & Associates.

life refuge system, states, territories, and tribes to design and implement a cooperative national system of marine protected areas that builds on existing sites and fills the gaps in biogeographic and functional designations needed to meet the nation's needs.

Endnotes

1. National Park System Advisory Board, *Rethinking the National Parks for the 21st Century,* J.H. Franklin, chair (Washington, D.C.: National Geographic Society, 2001).
2. J.D. Varley and P. Schullery, "Yellowstone Lake and Its Cutthroat Trout," in *Science and Ecosystem Management in the National Parks,* W.L. Halvorson and G.E. Davis, eds. (Tucson: University of Arizona Press. 1996), pp. 49–73; W. Jennings, "Florida Keys Tarpon," *Fly Fisherman* (2008), on-line at http://flyfisherman.com/florida/wjfloridatarpon/index.html; L.D. Zeidberg, W.M. Hamner, N.P. Nezlin, and A. Henry, "The Fishery for California Market Squid (*Loligo opalescens*) (Cephalopoda: Myopsida), from 1981 through 2003," *Fishery Bulletin* 104 (2006), pp. 46–59.
3. National Marine Protected Areas Center, *The State of U.S. Marine Managed Areas: West Coast,* L. Wooninck and R. Grober-Dunsmore, eds. (Silver Spring, Md.: NOAA, 2008).

On-line at http://mpa.gov/helpful_resources/inventoryfiles/wcoast_mma_report-0608.pdf.

4. A. Friedlander and J. Beets, *Temporal Trends in Reef Fish Assemblages inside Virgin Islands National Park and around St. John, U.S. Virgin Islands, 1988–2006,* NOAA Technical Memorandum NOS NCCOS 70 (2008).
5. J. Miller, R. Waara, E, Muller, and C. Rogers, "Coral Bleaching and Disease Combine to Cause Extensive Mortality on Reefs in U.S. Virgin Islands," *Coral Reefs* 25 (2006), p. 418.
6. See www.nmfs.noaa.gov/pr/species/invertebrates/elkhorncoral.htm.
7. G.E. Davis, "Fishery Management Conflicts in Everglades National Park," In *Marine Recreational Fisheries, Proceedings of the Seventh Annual Marine Recreational Fisheries Symposium, Fort Lauderdale, Florida, May 10–11, 1982,* R.H. Stroud, ed. (Washington, D.C.: Sport Fishing Institute,) pp. 65–75; G.E. Davis, *An Assessment of Fishery Management Options in Everglades National Park, Florida,* National Park Service South Florida Research Center Technical Report T-523 (1979).
8. J.W. Fourqurean and M.B. Robblee, "Florida Bay: A History of Recent Ecological Changes—Estuaries," in SeaGrant Florida, *Florida Bay Science Conference Proceedings* 22:2B (1999), 345–357, on-line at www.floridabay.org/pub/conf_proceedings/index.shtml; Committee on Independent Scientific Review of Everglades Restoration Progress (CISRERP), National Research Council of the National Academies, *Progress toward Restoring the Everglades: The First Biennial Review, 2006* (published 2007), on-line at www.evergladesplan.org/index.aspx.
9. G.E. Davis, "Spiny Lobsters as Flagship Species for Marine Ecosystems," *Wings* (fall 2004), pp. 16–19. (Published by the Xerces Society.)
10. J.S. Ault, S.G. Smith, G.A. Meester, J. Luo, and J.A. Bohnsack, *Site Characterization for Biscayne National Park: Assessment of Fisheries and Habitats,* NOAA Technical Memorandum NMFS-SEFSC-468 (2001).
11. G.E. Davis, P. L. Haaker, and D.V. Richards, "The Perilous Condition of White Abalone, *Haliotis sorenseni,*" *Journal of Shellfish Research* 17:3 (1998), pp. 871–875.
12. M.D. Behrens and K.D. Lafferty, *Effects of Marine Reserves and Urchin Disease on Southern California Rocky Reef Communities,* Marine Ecology Progress Series 279 (2004), pp. 129–139; Davis et al, "The Perilous Condition of White Abalone," pp. 871–875.
13. For a brief history of Glacier Bay fisheries issues, see www.nps.gov/archive/glba/indepth/learn/preserve/issues/fish/history.htm.
14. D. Pauly, V. Christensen, J. Dalsgaard, R. Froese, and F. Torres, Jr., "Fishing Down Marine Food Webs," *Science* 279 (1998), pp. 860–863; J.B.C. Jackson et al., "Historical Overfishing and the Recent Collapse of Coastal Ecosystems," *Science* 293 (2001), pp. 629–638; V. Christensen et al., "Hundred-year Decline of North Atlantic Predatory Fishes," *Fish and Fisheries* 4 (2003), pp. 1–24; R.A. Myers and B. Worm, "Rapid Worldwide Depletion of Predatory Fish Communities," *Nature* 423 (2003), pp. 280–283.
15. G.R. Russ, A.J. Cheal, A.M. Dolman, M.J. Emslie, R.D. Evans, I. Miller, H. Sweatman,

and D.H. Williamson, "Rapid Increase in Fish Numbers Follows Creation of World's Largest Marine Reserve Network," *Current Biology* 18 (June 24, 2008), pp. R514–R515.

16. J.S. Ault, S.G. Smith, J.A. Bohnsack, J. Luo, D.E. Harper, and D.B. McClellan, "Building Sustainable Fisheries in Florida's Coral Reef Ecosystem: Positive Signs in the Dry Tortugas," *Bulletin of Marine Science* 78:3 (2006), pp. 633–654.
17. California Department of Fish and Game, Partnership for Interdisciplinary Studies of Coastal Oceans, Channel Islands National Marine Sanctuary, and Channel Islands National Park, *Channel Islands Marine Protected Areas: First 5 Years of Monitoring* (2008).
18. At the June 6, 2006, signing of the national monument proclamation, President Bush said, "I think the American people will understand better about why I made the decision I made when they see the movie that Jean-Michel has produced." See www.whitehouse.gov/news/releases/2006/06/20060615-6.html.

Gary E. Davis recently retired from the U.S. National Park Service after a long and distinguished career as a marine scientist. He is also a past president of the George Wright Society.

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