POSTED 22 JANUARY 2009

Going, going, gone green?

On Jan. 6, in one of his final acts as president, George W. Bush established marine reserves within 50 miles of low-lying Pacific islands and reefs that are the farthest-flung U.S. territories. The new reserves, covering 195,274 square miles, will prohibit oil drilling, tourism and commercial fishing.

Even the conservative press thought Bush was playing to history when he painted a green stripe across the closing days of an administration that was seldom keen on environmental protection. The Economist, for example, pointed to some inconvenient facts about reef preservation:

> *"The departing president is presumably thinking of his legacy, as he may now at least claim to have done some environmental good for the seas. Less happily, the changing global climate is already doing great damage. A report this week suggests that the growth of coral on the Great Barrier Reef, off Australia, has slowed by 13 percent since 1990. Marine scientists attribute this to the fact that the ocean is increasingly acidic, as a side-effect of rising CO_2 levels in the atmosphere." (Read our coverage of ocean acidification).*

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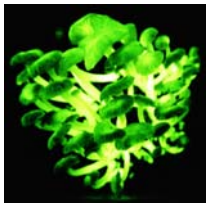

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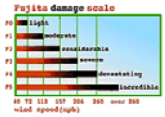

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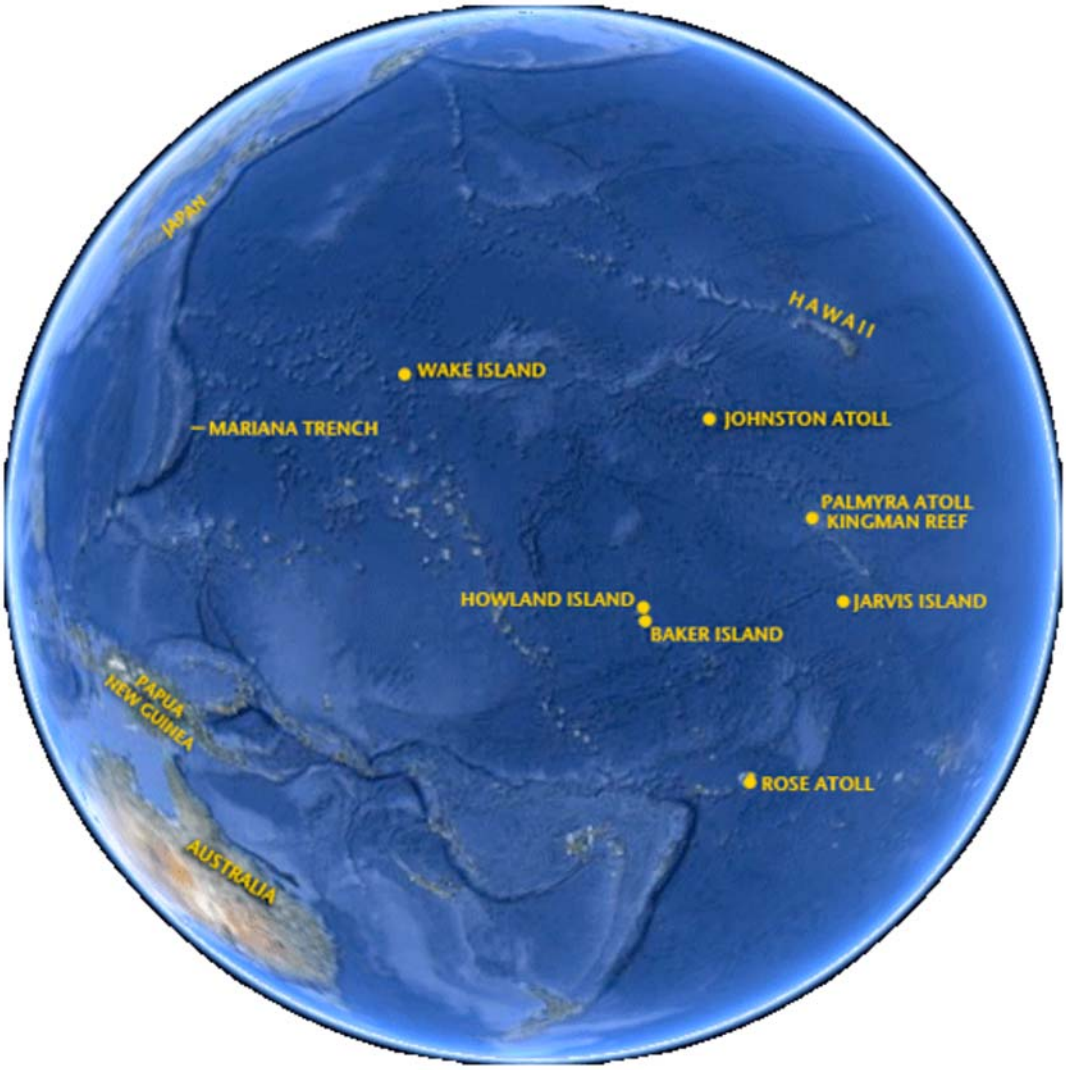


Three giant new reserves will protect oceans within 50 miles of the marked islands, atolls and reefs.

In 2006, Bush surprised environmentalists by establishing the 140,000 square-mile Papahānaumokuākea Marine National Monument northwest of the Hawaiian Islands. Bush's recent, last-minute act of conservation echoed by outgoing President Bill Clinton's 2001 ban on roadbuilding in about 90,000 square miles of national forests. While that ban is still under litigation, the Pacific reserves are less controversial, simply because they are so remote and virtually unpopulated. The three reserves were established to protect ocean that is home to a vast range of birds, clams, corals and fish:

MARIANAS TRENCH MARINE NATIONAL MONUMENT
protects a coral reef ecosystem on some of the westernmost U.S. territory. These waters are home to more than 300 species of stony corals and the 11,000 meter-deep Marianas Trench, the deepest place on Earth. Twenty-one active submarine volcanoes support life in severe conditions that may resemble the birthplace of life on Earth.

With enough endurance to stay aloft for over a week, the great frigate bird could be an argument for an aerial national monument over the Marianas! Deep beneath the water, hydrothermal vents pump super-heated water into frigid darkness. Some of the bizarre creatures around the vents survive without getting energy from sunlight, even through the food

chain. Instead, they get energy from chemicals in the hot water.

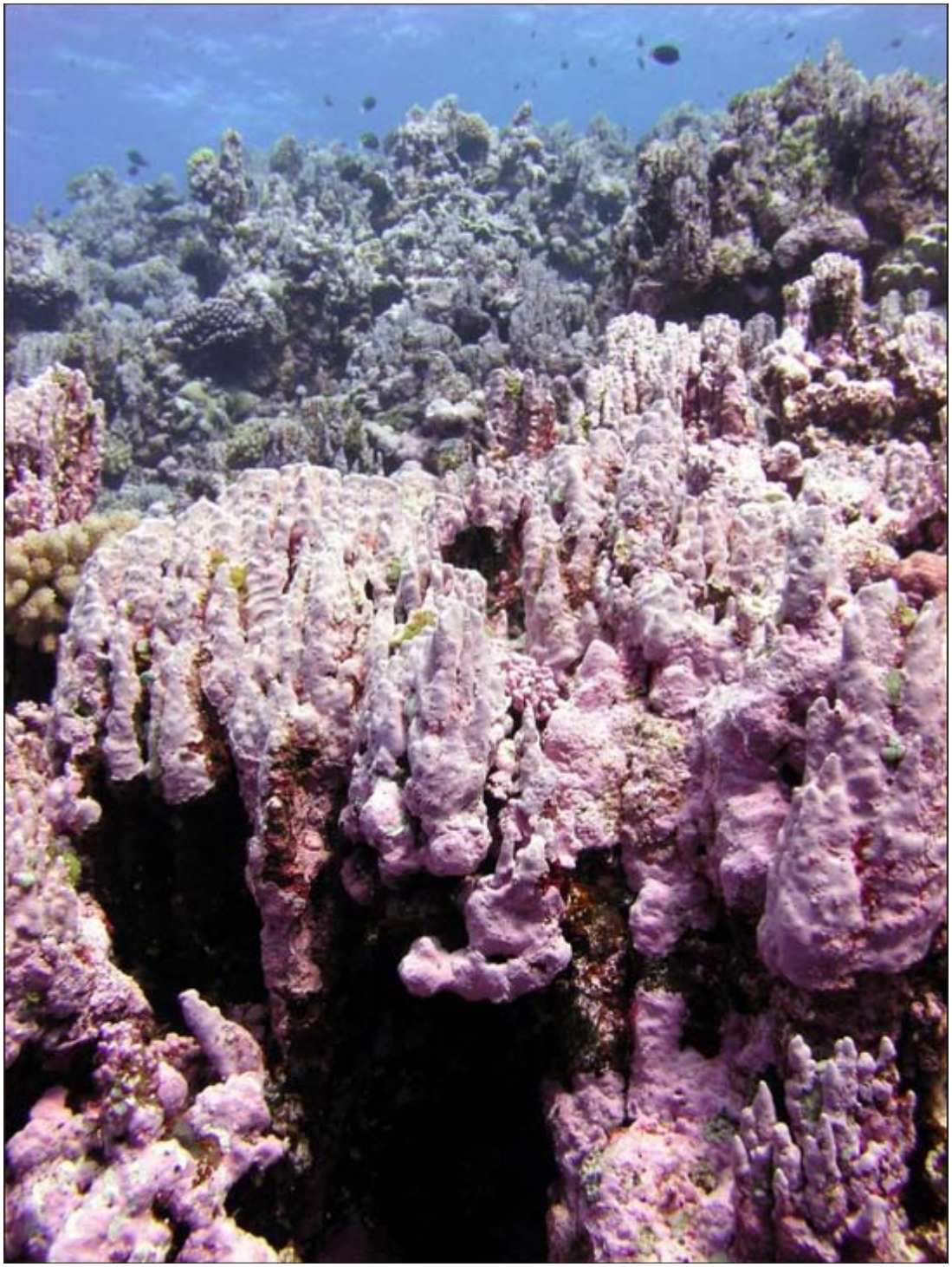
Photo: NOAA

ROSE ATOLL MARINE NATIONAL MONUMENT

protects a pristine coral reef ecosystem around a remote part of American Samoa that is home to many declining species, including reef sharks and giant clams. Threatened species of nesting petrels, shearwaters and terns nest on shore.

Rose Atoll was named for the dense packs of bubblegum-colored coralline algae stuck along its outer slopes. Members of this algae family are common on almost any rocky intertidal shore in many parts of the world.

Photo: US Fish and Wildlife Service



PACIFIC REMOTE ISLANDS MARINE NATIONAL MONUMENT
protects threatened, endangered or depleted species in pristine coral reefs around Kingman Reef, Palmyra Atoll, Howland, Baker, and Jarvis Islands, Johnston Atoll, and Wake Island. Residents include green and hawksbill turtles, pearl oysters, giant clams, reef sharks, coconut crabs, groupers, Napoleon wrasse, Bumphead parrotfish and dolphins. Coral skeletons at the islands record millions of years of climatic history, offering an opportunity to conduct climate research near the equator, far from immediate human disturbance.

This Hawksbill sea turtle has an appetite for typically toxic sponges (some have a higher silicon content than your motherboard), but that's not why it's endangered — chalk that up to a delicious taste. Turtles and sponges around Palmyra Atoll are part of an interdependent ecosystem with matchless diversity in the central Pacific.

Photo: Twilight Zone Expedition Team 2007, NOAA-OE

With all this conservation activity, it only seems logical to ask:

Do marine reserves actually preserve biodiversity?

There are 1 2 pages in this feature plus a bibliography and credits page

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In praise of protection

Protecting the ocean is a younger concept than protecting habitat on land. Australia set up one of the first marine reserves in 1975, when it established the Great Barrier Reef Marine Park on the world's largest reef, in the Coral Sea. That was 85 years after the United States set aside Yosemite, the first National Park.

Like terrestrial parks, marine reserves are designed to preserve habitat and biodiversity, and nothing works better in the ocean, says Daniel Pauly, professor of fisheries and zoology at the University of British Columbia. "They maintain those ecosystems in which the biodiversity emerged. Therefore they are what biodiversity needs, nothing else can be as effective as setting up protected areas."

Coral reefs are a subject of feverish concern because they are considered the rain forests of the ocean, home to innumerable marine creatures, including finfish, shellfish and other invertebrates. Coral itself is a symbiotic relationship: photosynthetic algae provide nutrition in return for shelter from the animal that makes their stony structure.

Coral reefs are suffering many insults, including overfishing, global warming and epidemics, says Pauly. "Coral cover, especially in the Caribbean, but also in the Pacific, is going to hell. Having large marine protected areas is like putting money into the bank."

Photo: NOAA

White tip reef shark under a ledge in the northwest Hawaiian reserve. Sharks and other large fish are common on most reefs throughout the Northwestern Hawaiian Islands, one of the rare marine ecosystems still dominated by apex predators.

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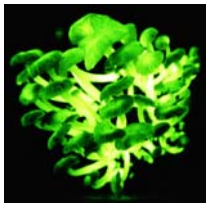

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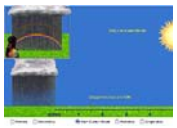

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A shark in our midst?

In studying the ecological health of reefs and other waters, researchers have increasingly focused on top predators - the sharks, tuna and groupers that regulate prey populations. But vegetarian fish are also important, says Terry Hughes of the Centre of Excellence for Coral Reef Studies at James Cook University in Australia. "The loss of herbivores such as parrotfish through over-exploitation can result in destructive blooms of seaweed that replace corals."

Overall, both top predators and herbivores "are critically important to the overall ecology and dynamics of reefs, yet they are typically very depleted," Hughes wrote via email. "No-take refuges [where fishing is banned] are one tool that can help to re-build and maintain stocks of fished species."

Studies confirm that marine protected areas help over-exploited fish to rebound, Hughes wrote. "Recovery of depleted stocks can be fast or slow, depending obviously on a range of issues (for example, just how depleted they are, the supply of [young] recruits, the species' growth rate and the effectiveness of the refuge). In the Philippines, 25 years of protection has seen a six-fold increase in biomass of predatory fishes. In Australia, there has been an immediate increase in fish biomass since the Great Barrier Reef was re-zoned in 2004. Typically, the biomass of targeted species is three to five times greater inside no-take zones compared to adjacent fished areas."

Photo: Chika

Shallow coral reefs thrive around the perimeter of Wake Island, in the new Pacific reserves. These waters support 323 types of fish, including large populations of the globally depleted Napoleon wrasse, several species of sharks, and large schools of bumphead parrotfish.

A good neighbor

The benefits of reserves can also extend beyond their borders: Fish that spawn and mature inside a reserve often swim out to unprotected waters and can be caught by people who cannot fish inside the reserve.

Marine reserves also promote survival through evolutionary adaptation, says Pauly, who notes that ocean creatures must change or perish along with a changing environment. "In the face of challenges like global warming and acidification, having a high biomass is the basis for adaptation for these animals. For adaptation, you need variability, and you have greater variation in large populations. If you only have a few fish, they cannot adapt because they do not have the genetic variability."

the bigger picture

Reserves of all sizes face threats that cannot be blocked by a simple reserve boundary or even a good enforcement plan:

EXOTIC-SPECIES PROBLEMS

Marine reserves can be over-run by exotic species, as Anthony Ricciardi of McGill University wrote in Science in 2006 (see #1 in the bibliography): "Severe impacts of invasive algae and pathogens have been documented, and cases involving other organisms continue to accrue. In recent years, an octocoral from the western Atlantic and a sponge from Indonesia have been overgrowing and killing native corals in Hawaii. Similarly, a stony coral from the Indo-Pacific has begun to foul reefs off Florida and Brazil." (More on octocorals and on invasive species.)

GLOBAL PROBLEMS

Non-living forces can also breach the borders of a marine reserve. As Stephen C. Jameson of Coral Seas observed in Science, "some of the most important pervasive global anthropogenic stressors on coral ... penetrate Marine Protected Area boundaries via terrestrial, atmospheric, and oceanic avenues. These include increasing sea surface temperatures and associated coral bleaching, contagious coral disease, and potential ocean acidification."

SOCIAL PROBLEMS

Although most experts prefer large reserves to small ones, a 2006 study found small community marine reserves were actually more effective at conserving fish. The explanation can be found in social factors, wrote the Nature Conservancy's Peter Kareiv: "It seems that the best managers of fisheries are the poorer communities that depend upon fish for their own food source, compared to wealthier communities [and national governments] that exploit fisheries for economic gains and may not reside in close proximity to the managed areas" (see #2 in the bibliography). "Marine protected areas are not the silver bullet solution for every situation and for every community," Kareiv wrote. "One cannot achieve conservation that is at odds with the people."

Photo: NOAA

Fishing can damage marine reserves by removing top predators, or simply by dragging nets along the bottom. A "purse seine" is a fine net that snags every fish above a certain size. But does banning commercial fishing from reserves just transfer fishing pressure elsewhere?

Although local support can be critical, that is not a problem in the new Pacific reserves, Pauly says. "Local participation is not very relevant here, these are areas with minimum populations, so this was really a low-hanging fruit" in terms of marine conservation. However, he says poaching by international fleets bent on catching tuna or sharks could be troublesome in the deep regions of the new reserves.

The challenges of preserving marine biodiversity are much greater in the Caribbean's fast-declining reefs, Pauly says, because "you would have to displace people." Only in the United States, Australia and a few other countries can reefs be protected without much population displacement, Pauly adds. In the meantime, lovers of coral, sharks and tropical fish can thank George W. Bush for his last-minute decision to place a federal umbrella over large parts of the Pacific Ocean.

Reef-reading in our bibliography!

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