

The purpose of this "Coral Reef Conservation Guide for the Military" is to create awareness and outline procedures militaries should use to ensure safe and environmentally responsible behavior in and around coral reefs. Coral reefs are important for environmental, economic, recreational and strategic reasons. They are both beautiful and fragile resources which must be treated with respect. This guide is intended to help military forces conduct their operations in these sensitive areas while minimizing the potential for adverse impacts to coral reefs.

Guide Authors: P. S. Lobel and L. M. Kerr. Photographs are copyrighted by P. S. Lobel (1998)



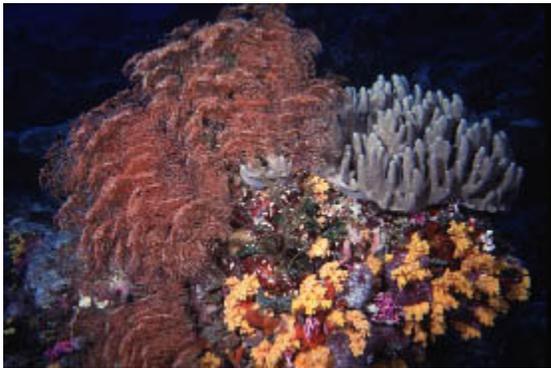
Caribbean reef

What is a Coral Reef ?

Corals are living animals. Their skeleton is the carbonate structure that constitutes what is commonly named reefs. The Caribbean corals in this photo are reef building stony corals. ▶



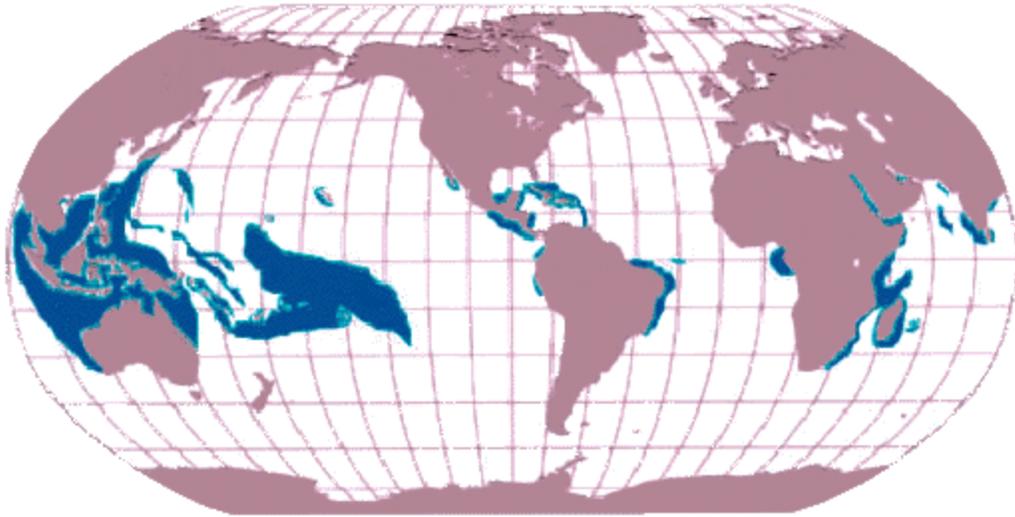
The coral reef is a prime example of rich biodiversity. Reefs, themselves, are composed of algae, corals and many amazing varieties of plants and animals both microscopic and large. Reef surfaces swarm with fishes and tiny crustacea, abundant mollusks, and worms. There are, of course, many more tiny animals and plants living secretly in reef crevices and deep holes that human visitors rarely see. Many of these tiny organisms, like rain forest insects, are still scientifically unknown, and no one has yet accurately estimated the total numbers of different species living on reefs



◀ *The coral reef is much more than just corals. It includes a vast assemblage of living organisms including all forms of plants, animals and microbial life whose survival is intimately intertwined and directly affected by water and habitat quality. This photo shows a Palauan assemblage of soft corals, sponges, algae and more.*

We do know, however, that parts of the reef ecosystem depend upon one another and that the reef ecosystem depends upon neighboring systems. For example, reef herbivores, such as the long-spined sea urchin, consume algae that might otherwise smother living corals. The larval stages of many reef animals drift as plankton in the open ocean, and there are also reef connections to sea grass meadows, sand flats, intertidal zones, and mangrove swamps. Thus, the complex web of reef life intertwines with the larger lattice of Earth's biodiversity. Coral reefs are linked to other habitats such as mangrove swamps and seagrass meadows not only by geography but also by biology. These three distinctive habitats provide shelter and food to many of the same species that often migrate between these habitats as they grow and feed. Mangroves and seagrass habitats function as nursery grounds for many of the same fishes and invertebrates we see as adults on coral reefs.

Why is Coral Reef Conservation Important to the Military ?



US Military Installations near reefs include;

Pacific Ocean: Hawaii (Hickam AFB & Pearl Harbor; Kaneohe Bay), Johnston Atoll, Wake Atoll, Kwajalein Atoll, Guam

Atlantic Ocean: Key West, Panama City, Florida, Puerto Rico, Virgin Islands, Cuba

Indian Ocean: Diego Garcia

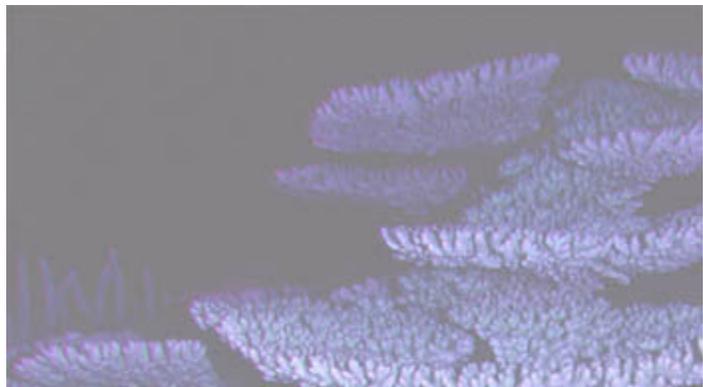
Under Superfund, E. O. 12580, the Secretary of the Department of Defense is designated as a Natural Resource Trustee.

Coral reef conservation is a part of biodiversity conservation which is the foundation of sensible military natural resource management.

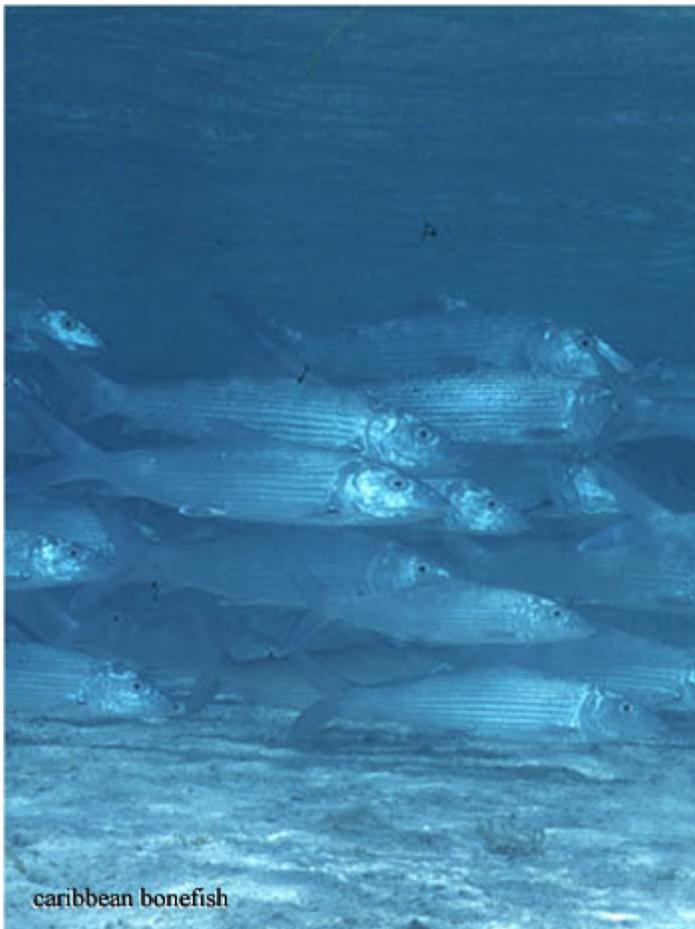
- Helps maintain natural landscapes for realistic military training, now and in the future.
- Helps DoD protect water resources, endangered species and other important resources.
- Contributes to national security by helping maintain the natural resources, especially fisheries, upon which this country's strength depends.
- Provides public relations benefit because people want good stewardship of their natural resources.
- Enhances quality of life for military personnel.

Department of Defense Policy Statement on Coral Reefs

The Department of Defense (DoD) recognizes coral reefs and related endemic ecosystems (mangroves and sea grass beds) as biologically rich and diverse habitats and gives a high priority



to their protection. Along with other nations in the International Coral Reef Initiative, including Japan, Australia, Jamaica, France, the United Kingdom, and the Philippines, the United States is developing a coordinated strategy for coral reef research and management world-wide. The major goal of DoD's involvement is effective and long-term conservation, through the development of management policies and procedures for coral reefs held in trust by the U.S. military world-wide in a manner consistent with the balance of interests reflected in the 1982 United Nations Convention on the Law of the Sea (LOS Convention). DoD, in cooperation with designated co-trustees, will identify important reef areas held in trust by the U.S. military, develop management guidelines and policies to enhance protection of these coral reef ecosystems, and initiate long-term monitoring efforts to determine the health of these ecosystems over time. Furthermore, DoD will ensure that actions in proximity to coral reefs will be consistent with United States' rights and obligations under the LOS Convention, DoD mission requirements, and conform to host nation agreements.



caribbean bonefish

What is DoD Policy on Coral Reef Conservation?

DoD's 1994 "Ecosystem Management Policy Directive," issued by the Deputy Under Secretary of Defense (Environmental Security), articulates the biodiversity conservation policy embraced by the DoD and the military departments. The goal is to:

"Maintain and improve the sustainability and native biological diversity of terrestrial and aquatic, including marine, ecosystems while supporting human needs, including the DoD mission."

DoD Environmental Conservation Instruction

This instruction, signed in 1996, lays out specific management tactics to achieve conservation goals

"Maintain or restore remaining native

ecosystem types across their natural

range of variation".

- *"Maintain or reestablish viable populations of all native species in areas of natural habitat, when practicable."*
- *"Maintain evolutionary and ecological processes, such as disturbance regimes, hydrological processes, and nutrient cycles."*
- *"Manage over sufficiently long time periods to allow for changing system dynamics."*
- *"Plan to accommodate human use as necessary."*

Coral Reef Biodiversity



Pea-sized plankton



Soft Coral, Palau



Caribbean Seahorse



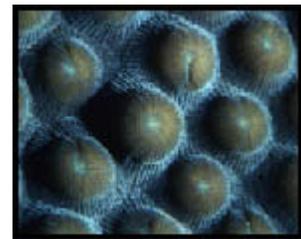
Pacific green sea turtle



Pacific bottlenose dolphins



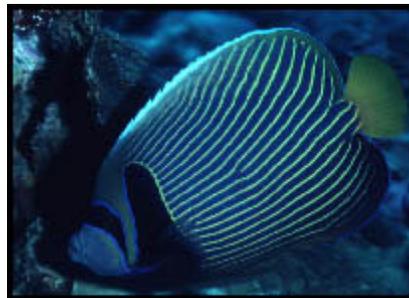
Open coral polyp feeding



Closed coral polyp



Christmas tree worm



Emperor Angelfish, South Pacific



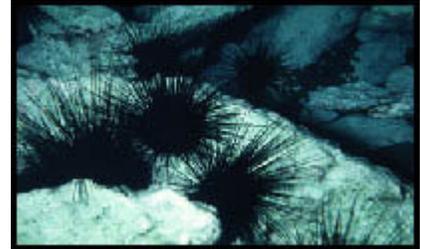
South Pacific feather duster colonial worms



Fishes on a Palua reef



Hawaiian octopus



Spiny sea urchins

Why are Coral Reefs Important?



Johnston Island, barrier reef in foreground



Johnston Atoll Chemical Agent Demilitarization System (JACADS). Coral reef monitoring program supported by the Army, Air Force, Coast Guard, Defense Special Weapons Agency, Office of Naval Research and DoD's Legacy Resource Management Program

- Important economic resource from fisheries, ecotourism and water sports recreation.
- Major source of nutrition for tropical coastal populations.
- Physically protects shorelines from erosion and wave damage.
- Reef organisms have potential as sources of new medicines
- Militarily important as strategic sites, land in the middle of vast oceans.



Yellowfin tuna and Wahoo caught off Johnston Atoll



Wake Atoll



Pearl Harbor and Hickam AFB



Coral reef at Enewetak Atoll, former nuclear test site.

The International Coral Reef Initiative (ICRI) is a partnership of nations and

organizations seeking to implement Chapter 17 of Agenda 21 and other International Convention and Agreements for the benefit of coral reef ecosystems.

U.S. National Laws & Policy

Key legislation concerning reefs includes:

- National Environmental Policy Act of 1970
- Clean Water Act of 1977
- River & Harbor Act of 1899- Aids to Navigation
- Endangered Species Act of 1973 as amended 1978
- Coastal Zone Management Act of 1972
- Marine Protection Research and Sanctuaries Act of 1972 - ocean disposal
- Marine Mammal Protection Act 1972
- Migratory Bird Treaty Act of 1918
- Coastal Barrier Resources Act of 1982



Natural causes of coral mortality



Coral bleaching results when corals are stressed by extrinsic factors and lose their symbiotic zooxanthellae. This may result in the colony death.



Siltation and sediment can smother and kill live coral. Storms can stir up bottom sediments and increase river runoff naturally. Siltation can also result from construction site runoff when erosion barriers are missing and from sewer effluents.

This microalgal infestation called blackband disease is killing this coral. There are several



natural diseases that kill coral. The challenge in environmental management is to determine when such disease manifestations are naturally occurring or due to anthropogenic stresses, such as pollution.



The crown-of-thorns seastar consumes live coral leaving a path of dead white coral skeleton. Sometimes underwater surveys reveal areas of reef with dead patches. Unless observers are careful in determining the cause, feeding scars from the crown-of-thorns can be misinterpreted as coral bleaching due to pollution or unusually warm water temperatures.

Activities with the Potential for Adverse Ecological Impacts on Coral Reefs

Military Exercises and Training

- Excessive noise
- Explosions
- Oil & fuel spillage
- Wreckage & debris
- Breakage of reef structure



Daily Operational Procedures

Construction & dredging causing siltation
Waste management

- chemicals including solvents, bleaches, detergents
- discarded plastic bags are mistaken for food by sea turtles causing death
- discarded cigarette filters are mistaken for food by fishes causing death
- batteries tossed overboard dissolve releasing toxic chemicals
- sewage; solid wastes; oily wastes
- shading due to docks and barges
- storm water runoff

Personnel Activities

- Recreational water sports
- Souvenir harvesting of live shells and coral
- Scuba divers grabbing, scraping and dragging gear on live coral
- Anchors and chains



Accidental Species Introductions

- Exotic species can be transported in ship's bilge water or aircraft cargo
- Some animals and plants hitch rides by attaching onto hulls, barges, buoys and other favorable surfaces
- Pest species sneak into cargo
- Agricultural pests can be transported in fruits and potted plants

Environmental scars and chemicals leave distinct tracers of the impact's original source

Organize a Plan for Sound Environmental Behavior

The purpose is to allow operations to continue, but to make the least impact on the reef as possible.

Planning criteria

- Know the resource: species inventories and distributions in mapped habitats.
- Involve stakeholders early in the process.
- Involve all interested parties: trainers, natural resource managers, engineers, and biologists.
- Define roles and responsibilities using an adaptive flexible framework that concentrates on results.

- Define measures of performance: including changes in the distribution and abundance of species and priority natural communities; identify key indicator species and specify assessment methodology.
- Develop a site specific Integrated Natural Resources Management Plan (INRMP) using the best scientific advice available.

Mitigation Strategies

- Obtain reference materials for area specific details of local species especially toxic and poisonous ones.
- Educate key personnel and trainers about the site.
- Educate personnel involved in recreational activities.
- Avoid sensitive ecological areas.
- Eliminate ocean disposal.

Pre/Post activity assessments & monitoring

- Use the best science to understand local species and ecological processes and to develop the monitoring plan; coordinate review with national natural resource trustee agencies and other interested parties.
- Monitor to identify and assess impacts.
- Assess actions after training.

For technical assistance contact the office of the Deputy Under Secretary of Defense (Environmental Security, Conservation), 3400 Defense Pentagon, Washington DC 20301



◀ Diver using full face mask with communications collects sediment samples next to old 55 gal. drums.

Lagoon reef, Johnston Atoll.

▶ Diver pulling underwater radiation detector developed by Boston University, the Defense Special Weapons Agency and the Office of Naval Research. Lagoon, Johnston Atoll.



Health and Safety Concerns

Danger from reef animals

- ciguatera - toxin in edible fishes
- exposure to sea wasps, scorpionfish, stingrays, sharks & eels
- some colorful seashells have a poisonous sting, such as cone shells - don't touch or remove



Grey reef shark



Lionfish with poisonous spines



*Fireworm raises white bristles
burning to touch*



Cone shells can sting



*Jellyfish stinging tentacles can be
several feet long*



Eels bite fingers poking in the reef



*Tropical snappers and other large reef
fishes may have ciguatera and are
poisonous to eat*

Danger from reef environments

- waves and swells can sweep swimmers and boats over reefs
- tidal currents can change quickly - caution anchoring
- swimmers and divers can be injured by the sharp jagged surfaces of reefs.



Stingrays have a sharp venomous tail spine

"Sustaining our Nation's military training and testing lands through ecosystem management is among the most important of DoD's environmental goals. As a critical element of ecosystem management, biodiversity conservation contributes directly to military readiness. Biodiversity helps us to achieve military readiness in harmony with nature."

*Sherri W. Goodman,
Deputy Under Secretary of Defense (Environmental Security)*