Star Bulletin
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SECTION F

HAWAII'S CORAL REEF

CRADLE of LIFE

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People pose the greatest threat to this delicate marine ecosystem

EVERYBODY'S HEARD about the value of rainforests.

How they house countless undiscovered creatures, foods, plants and medicines — maybe even the cure for cancer.

The same can be said of coral reefs.

Only 2 percent of the world's oceans houses coral reefs, but in that small area teems a staggering diversity of life. And the coral reefs of Hawaii are home for the majority of coral found in U.S. waters.

Hawaii's reefs are home to more than 40 species of reef-building coral and more than 5,000 marine species. One in four of Hawaii's reef plants and animals are found nowhere else in the world.

The most pristine reefs are in the uninhabited and protected Northwestern Hawaiian Islands. The decline of reef ecosystems in the main Hawaiian Islands shows clearly that, as in the rainforest, the biggest threat to the coral reef's delicate web of life is — humans.

Scientific research conducted in Hawaii has made clear that:

>> Overfishing upsets the natural balance among reef inhabitants.

>> Marine debris, discarded fishing nets and anchors damage coral.

>> Dirt and pollution from land development can weaken or kill coral.

>> Fertilizer runoff and sewage can cause overgrowth of algae, particularly aggressive, non-native species that kill coral and compete with native limu.

>> Careless divers, snorkelers and boaters can damage the reef.

>> Global warming is raising sea temperatures and contributing to coral bleaching — the die-off of the symbiotic algae that live inside many coral animals.

>> Observations of coral disease are increasing.

"In Hawaii, more than 1.2 million people live within three miles of living coral reef," Dave Guilko, a state Division of Aquatic Resources coral reef scientist. "On Oahu, Maui and at Kailua-Kona, you have some of the largest human populations so near major coral in the Pacific, if not the world," he said.

Coral reefs provide food and habitat for many fish and invertebrates. They buffer the islands from storms and create the break for our famous waves.

A majority of island residents spend time on Hawaii's reefs, beaches and nearshore waters, according to a survey by the Hawaii Coral Reef Initiative Research Program.

Survey respondents from 1,600 households said they are worried about the increasing pressure on beach and reef areas from development, pollution and overfishing. Some mentioned that Hawaii would be just like the mainland if it weren't for the reef and beach areas.

"My husband, a lot of times he'll leave work early to just surf, especially if he's having a bad day. He comes out of the water and feels rejuvenated. He's able to push all that stress away just being there," one respondent said.

Respondents said they want stricter enforcement of existing rules to protect Hawaii's reefs, new rules as needed and restricting activities at biologically important areas.

Earlier research by the University of Hawaii-based research program estimated that Hawaii's reefs generate $364 million a year. But the full value of their worth can't be calculated.

DOS AND DON'TS TO PROTECT THE CORAL

>> **Do enjoy live coral in the ocean.** But don't touch it, rub against it, walk on it or drop anchor on it. Whether hundreds of years old or just getting established, the living part of coral is on its outer surface — the very portion of it that people are most likely to disturb. Research shows that being stepped on nine times can kill a coral.

>> **Do clean your boat hull regularly.** Many of the aquatic invasive species in Hawaii, which can overgrow and harm native species, hitched a ride here from faraway ports on boat hulls or in ballast water. That's also how they get from one place to another in-state. Cleaning boating equipment (including anchors, chains and ladders) and dive gear keeps the damage from spreading. Be sure to dispose of what you clean off in a rubbish bin.

>> **Do observe fishing regulations.** Take only what you need; comply with rules about when and where to fish; and obey the size limits. The rules are designed to allow fish to reproduce.

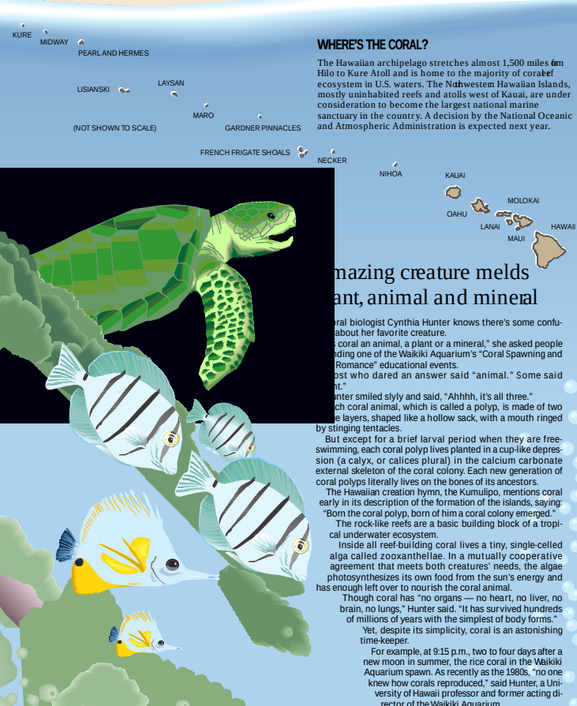
>> **Do get involved in waterfront cleanups and ocean monitoring.** Every piece of trash removed from a beach is a piece that won't be back in the ocean with the next storm. And trained volunteers who participate in periodic surveys of reef life help scientists track the health of coral reef ecosystems.

>> **Don't take coral home.** State law prohibits the breaking, damaging or taking any stony coral from Hawaii waters, including reef and mushroom corals. It's also illegal to sell any stony coral native to the Hawaiian Islands. First violations are subject to a fine of up to $1,000 and/or 30 days in jail, plus up to $1,000 per specimen taken illegally. Penalties increase for subsequent violations.

>> **Don't dump aquarium water.** No aquarium water or creatures should go into streams, storm drains or the ocean. Flush water down a toilet and bury the rest.

>> **Don't leave fishing equipment in the ocean.** Abandoned fishing lines and nets can entangle and kill marine mammals, sea turtles and fish. These "ghost nets" and debris can also damage coral reefs.

Sources: The state Division of Aquatic Resources, the Hawaii Coral Reef Initiative Research Program, Associated Press.



WHERE'S THE CORAL?

The Hawaiian archipelago stretches almost 1,500 miles from Hilo to Kure Atoll and is home to the majority of coral reef ecosystem in U.S. waters. The Northwestern Hawaiian Islands, mostly uninhabited reefs and atolls west of Kauai, are under consideration to become the largest national marine sanctuary in the country. A decision by the National Oceanic and Atmospheric Administration is expected next year.

HAWAII'S DOMINANT CORALS

The three corals depicted here are the most frequently seen in the Main Hawaiian Islands. The common English name is given, followed by the Hawaiian name and the scientific name.

1. Lobe coral
   Pohaku puna / Porites lobata
   Forms encrusting or massive forms in the intertidal zone to depths of more than 30 feet. Long, narrow cracks often found on colonies are produced by a type of shrimp. Live colonies range in color from yellowish-brown and sometimes blue.
2. Finger coral
   Ko'a / Porites compressa
   Most common in wave protected areas in shallow or deeper reef slopes to depths of about 150 feet. It has many growth forms, but all of these show some sort of fingerlike branching. Color of live colonies ranges from light brown to light yellowish-green.
3. Cauliflower or rose coral
   Ko'a / Pocillopora meandrina
   Prefers wave-agitated environments, and is found at depths down to about 150 feet. Colonies form heads about 10 to 20 inches in diameter. Branches are heavy and leaf-like, and fork bluntly near the ends. Color of living colonies ranges from brown to pink.

CREATURES OF THE REEF

The marine creatures shown in this illustration are but a fraction of the more than 5,000 species that inhabit Hawaii waters. One in four of Hawaii marine species are found nowhere else in the world. The animals here were selected as representative of those that casual divers and snorkelers in the main Hawaiian Islands are likely to see.

4. Green sea turtle
   Honu / Chelonia mydas
5. Convict tang
   Manini / Acanthurus triostegus
6. Long-nosed butterflyfish
   Lauwiliwilinukunuku'oi'oi / Forcipiger longirostris
7. Soldierfish (Mempachi)
   'U'u / Myripristis amaena
8. Whitemouth moray eel
   Puhi 'oni'o / Gymnothorax meleagris
9. Banded coral shrimp
   'Opae huna / Stenopus hispidus
10. Featherduster worm
    Kio 'po'apo'ai / Sabellastarte spectabilis
11. Needle-spined urchin
    Wana/ Echinostrephus aciculatus
12. Banded spiny lobster
    'Ula / Panulirus marginatus
13. Bullethead parrotfish
    Uhu / Chlorurus sordidus

Not shown to scale or in terms of their location in relation to other species.

mazing creature melds ant, animal and mineral

oral biologist Cynthia Hunter knows there's some confu- about her favorite creature.

coral an animal, a plant or a mineral," she asked people ding one of the Waikiki Aquarium's "Coral Spawning and Romance" educational events.

ost who dared an answer said "animal." Some said t."

nter smiled slyly and said, "Ahhhh, it's all three."

ch coral animal, which is called a polyp, is made of two e layers, shaped like a hollow sack, with a mouth ringed by stinging tentacles.

But except for a brief larval period when they are free-swimming, each coral polyp lives planted in a cup-like depression (a calyx, or calices plural) in the calcium carbonate external skeleton of the coral colony. Each new generation of coral polyps literally lives on the bones of its ancestors.

The Hawaiian creation hymn, the Kumulipo, mentions coral early in its description of the formation of the islands, saying: "Born the coral polyp, born of him a coral colony emerged."

The rock-like reefs are a basic building block of a tropical underwater ecosystem.

Inside all reef-building coral lives a tiny, single-celled alga called zooxanthellae. In a mutually cooperative agreement that meets both creatures' needs, the algae photosynthesizes its own food from the sun's energy and has enough left over to nourish the coral animal.

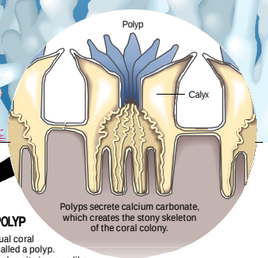
Though coral has "no organs — no heart, no liver, no brain, no lungs," Hunter said. "It has survived hundreds of millions of years with the simplest of body forms."

Yet, despite its simplicity, coral is an astonishing time-keeper.

For example, at 9:15 p.m., two to four days after a new moon in summer, the rice coral in the Waikiki Aquarium spawn. As recently as the 1980s, "no one knew how corals reproduced," said Hunter, a University of Hawaii professor and former acting director of the Waikiki Aquarium.

Hunter is among scientists who — over the past 25 years — have discerned down to the day and hour, when to expect coral spawning events for all of Hawaii's major coral species.

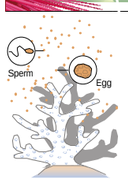
Hunter said she still finds: "These simple creatures are infinitely fascinating!"



CORAL POLYP

An individual coral animal is called a polyp. Each live polyp sits in a cup-like depression called a calyx. Polyps, which close up look like tiny anemones, form the outer living layer of a coral colony.

Sources: Waikiki Aquarium and Department of Land and Natural Resources, Division of Aquatic Resources.



BASIC LIFE CYCLE OF CORAL

Most coral can reproduce both sexually and asexually. Asexual reproduction comes from budding, when an individual coral branches out to form a new animal, or when a piece of coral breaks off and starts to grow on its own. In both cases, the new animal is genetically identical to the original. How coral reproduces sexually:

Depending on the species, eggs and sperm may come from separate male and female coral animals, or from hermaphroditic animals that produce both eggs and sperm. Eggs are buoyant and fertilization often occurs in surface waters.

A fertilized egg has a larval stage, during which it is free-swimming. The free-swimming coral larvae are called planula.

The planula finds a suitable place to attach itself to a firm surface and grow into a polyp. Many eggs, sperm and larvae are eaten by other marine life before they get to this stage.

A young coral colony may grow by asexual budding for years before spawning. Mature coral spawn — releasing eggs and sperm — at precise times of the day or night and seasons of the year that are specific to its species. Many coral seem to time their spawning by phases of the moon. If eggs and sperm weren't released into the ocean at the same time, they would have little chance of finding each other.

TO LEARN MORE ON THE NET

>> CORAL REEF OUTREACH NETWORK: www.hawaiireef.org
>> CORAL REEF CONSERVATION PROGRAM OF THE NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION: www.coralreef.noaa.gov
>> NOAA-PACIFIC ISLANDS FISHERIES SCIENCE CENTER'S CORAL REEF ECOSYSTEM DIVISION: www.pifsc.noaa.gov/cred
>> WAIKIKI AQUARIUM: www.waquarium.org
>> HAWAII CORAL REEF INITIATIVE: www.hawaii.edu/ssri/hcri/index.htm
>> U.S. FISH & WILDLIFE SERVICE'S PACIFIC ISLAND REFUGES: www.fws.gov/pacificislands/wnwr/nwrindex.html
>> REEF CHECK: www.reefcheck.org
>> HAWAII CORAL REEF NETWORK: www.coralreef network.com
>> NORTHWESTERN HAWAIIAN ISLANDS CORAL REEF ECOSYSTEM RESERVE: hawaiireef.noaa.gov