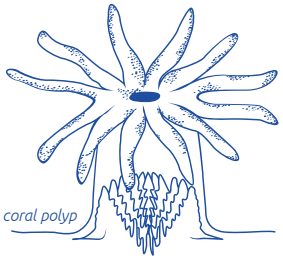
Information sheets for fishing communities #30

Coral bleaching



Bleaching branch coral

Bleaching in
a colony-forming hard coral

Bleached soft coral

Corals and coral reefs

Corals are marine invertebrates and are closely related to jellyfish and sea anemones. Corals can be generally categorised into two types: hard corals and soft corals. Almost all corals are colonial organisms, being composed of numerous genetically identical individual animals called *polyps*. Some, such as some mushroom corals, however, are solitary. Hard coral polyps produce a skeleton composed of calcium carbonate to strengthen and protect them. The individual polyps sit in cup-shaped depressions called *corallites*. Soft corals produce miniscule, spiny skeletal elements called *sclerites* to support their bodies. The Indo-Pacific is the planet's 'hot-spot' of coral biodiversity – approximately 75% of the world's estimated 800 species of hard corals are found in the region, with species richness being highest in the west and gradually declining towards the east.

Many species of both hard and soft corals have a symbiotic relationship with single-celled microscopic organisms called *zooxanthellae* that live inside their tissues. This relationship is mutually beneficial in that zooxanthellae provide oxygen and food to corals through photosynthesis, and in turn gain shelter and protection from predators by living inside the coral. It is estimated that zooxanthellae can provide up to 90% of a coral's energy requirements. Zooxanthellae also provide the unique and beautiful colours observed in corals. Most hard corals form reef-building colonies of various shapes and sizes, ranging from encrusting colonies to leaf-like or massive coral colonies that may be more than several metres in diameter and consisting of millions of individual coral polyps. These living constructions form the basis of coral reefs. Coral reefs are among the planet's most diverse and valuable ecosystems, and provide a key source of food and livelihood for millions of people around the world. Coral reefs provide habitat, spawning and nursery grounds for economically important fishes and invertebrates, and key services such as shelter for coastal communities and ecosystems from waves and storm surges, and are a source of new medicines. Coral reefs ecosystem are, however, fragile and face many threats to their survival, including overfishing, destructive fishing practices, pollution, and climate change through warming ocean temperatures and ocean acidification.

What is coral bleaching?

Coral bleaching is caused by environmental stress when the symbiotic relationship between the coral polyp and the zooxanthellae breaks down, resulting in the coral and zooxanthellae separating. Without the zooxanthellae, the coral polyps become transparent, exposing the coral's calcareous skeleton. While most bleached corals appear bright white (hence the term 'bleached'), bleached corals can also appear in shades of blue, yellow or pink. Once a coral is bleached, it struggles to survive without the energy provided by the zooxanthellae. In some instances, corals are able to regain the zooxanthellae and return to their usual colour if conditions return to normal, although they may suffer from decreased growth and reproduction, and increased susceptibility to disease. If the environmental stress continues, however, bleached corals can eventually die and may become overgrown by algae.

Healthy and bleached solitary corals

What causes coral bleaching?

The most common cause of coral bleaching is thermal stress, and in particular that from elevated seawater temperatures. Because corals live close to their thermal limits, a sustained increase of only 1–2°C above the mean summer temperature over several weeks can trigger a bleaching event. Localised influxes of cooler or fresh water, such as upwelling events for from floods, and poor water quality from sediments or pollutants, can also induce coral bleaching. Under severe conditions, other organisms that contain zooxanthellae, such as giant clams, can also bleach.

#30 Coral bleaching

Coral bleaching, ENSO and climate change

Mass coral bleaching events are commonly associated with strong El Niño Southern Oscillation (ENSO) cycles. ENSO is a somewhat periodic, naturally occurring phenomenon that involves fluctuating seawater temperatures in the Pacific. The ENSO cycle has three phases: ENSO neutral, El Niño and La Niña. In the ENSO neutral phase, tradewinds blow east to west over the surface of the Pacific Ocean, bringing warm, moist air and warmer surface waters towards the western Pacific, while keeping the central Pacific relatively cool. During the El Niño phase, tradewinds that move across the water weaken, with warm water 'sloshing' towards the central and eastern Pacific, resulting in severe coral bleaching across the region. The third phase, La Niña acts to strengthen neutral conditions, such that stronger trade windst push water towards the western Pacific, where it pools and warms, often resulting in heavy coral bleaching in the western-most Pacific Island countries and territories, such as Palau and the Federated States of Micronesia. The strong ENSO of 1997–1998 resulted in massive coral bleaching and extensive coral mortality worldwide. During the 2015–2016 El Niño, severe coral bleaching was observed throughout the Pacific Islands region. With recent models suggesting that extreme El Niño events are likely to become more frequent under climate change, an increase in the frequency and severity of coral bleaching events is expected across the Pacific Islands region in the future. If coral bleaching events occur more frequently than corals can recover, increased coral mortality and declines in coral cover will result.

Effects on fisheries

Loss of corals through coral bleaching can have many negative effects on fisheries in the region. Coral bleaching can result in declines in reef community biodiversity and the abundance of individual species, largely through the loss of their food source and declines in the structural complexity of reef habitats. Increased loss of corals through coral bleaching and subsequent overgrowth of algae may also increase the incidence of ciguatera fish poisoning in the region. Ciguatera fish poisoning is caused by toxic phytoplankton that reside on algae, such as those of the genus *Gambierdiscus*. These toxic algae are eaten by small grazing fish and invertebrates, which in turn are eaten by larger fish, with the toxins they contain concentrating up the food chain. People eating ciguatoxic fish may experience numbness, muscle pains, nausea and, in extreme cases, death may occur through respiratory failure.



Management measures to aid coral recovery in times of bleaching

Because they are the result of large-scale climate processes, mass coral bleaching events are largely unpreventable. However, there are several strategies that communities can do at the local level to limit the effects of bleaching and support coral recovery after a bleaching event, including:

1) **maintaining healthy water catchments to reduce additional stress on corals** through good land-management practices, such as maintaining vegetation cover on slopes and around rivers and streams; maintaining good water quality by controlling pollution from sewage, chemicals and waste; and prohibiting activities that damage corals, such as careless anchoring of boats;

2) **reducing fishing pressure on affected reefs**, and in particular regulating harvests of herbivorous fishes and invertebrates. Herbivores play an important role in preventing algae from overgrowing corals and occupying substrate for coral recruitment. Options for maintaining good numbers of herbivores include imposing size limits; spatial and temporal closures during and after bleaching events; protecting spawning aggregation sites and nursery grounds; and gear restrictions, such as bans on night-time spearfishing.

Options for maintaining food security for coastal communities in times of coral bleaching include:

- → **Shifting fishing pressure from reef species to species that are less affected by coral bleaching or are less important for reef recovery, such as nearshore pelagic or small pelagic fishes, by deploying fish aggregating devices (FADs);**
- → **Extending the shelf life of fish catches so surplus catches can be stockpiled, particularly in the lead up to, and during, El Niño events when coral bleaching is most likely to occur, and primarily through training in traditional methods for smoke curing, salting and drying large catches of both small and large pelagic fish; and**
- → **Undertaking pond aquaculture, including freshwater species in land-based systems, or salt-tolerant species, such as milkfish, in atoll locations, to provide an alternate source of protein.**

Report it!

Coral bleaching events in the Pacific are often poorly reported. To ensure they are documented, and that appropriate action can be taken, communities should report coral bleaching events to their local fisheries agency. Monitoring programmes could be established to determine the extent and severity of bleaching, and recovery of affected reefs. For more information on setting up a monitoring programme, contact SPC's Coastal Fisheries Programme (cfpinfo@spc.int).

This information sheet has been produced by SPC (**www.spc.int**) in collaboration with the LMMA Network (**www.lmmanetwork.org**) to assist people working with fishing communities in providing advice on appropriate fisheries management options. Please refer to guide book for an explanation of terms used in this information sheet. Photos: John Beasley, Pauline Bosserelle and Johanna Johson.

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Improving the practice of marine conservation
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