Beneath the tsunami waves

Diver beside a massive coral which has been dislodged by the tsunami waves near Phi Phi Island.

Niphon Phongsuwan

The tsunami waves that struck South and South-east Asia on 26 December 2004 claimed the lives of over 280,000 people and displaced a further 1.1 million, wreaking havoc along the coastlines of Indonesia, Thailand, India and Sri Lanka. On shore, the scale of the human tragedy was almost indescribable. But what had happened to the marine environments so crucial to these communities? Coral reefs, mangroves and seagrass beds border the coastlines of all the affected countries, and initial expectations were of serious damage, particularly to coral reefs.

One of the affected coastlines was the Andaman Sea coast of Thailand on the eastern edge of the Indian Ocean, where much of the mainland, and many offshore islands, have fringing reefs. Over the last 27 years I have been monitoring coral reefs around Phuket Island in the Andaman Sea with colleagues at Phuket Marine Biological Center (PMBC). The Thais have also studied reefs along the 700km coastline of western Thailand. Together, we have built up extensive databases of information about the biological and physical aspects of these reefs. We quickly realised these would let us accurately measure change on reefs affected by the tsunami.

The Thai Department of Marine and Coastal Resources acted swiftly, mounting a rapid assessment survey, which started work four days after the tsunami struck. Teams of government and university scientists visited 174 reef sites to make preliminary surveys. Surprisingly, 105 sites were unaffected or showed very little damage, 16 showed moderate damage, and only 23 were severely damaged. Niphon Phongsuwan (my collaborator at

The Asian tsunami left Thai coral reefs surprisingly unscathed, reports Barbara Brown.

Want to know more?
There is a research paper on this topic in the journal *Current Biology*, vol. 15, pp1926–1930.
The Global Coral Reef Monitoring Network recently produced a book called *Status of Coral Reefs in Tsunami Affected Countries: 2005*, see www.gcrmn.org/ for details.

PMBC) and I then picked from our database 18 locations that had been regularly monitored up to 2004. We revisited these in February and March 2005 and surveyed the coral communities in detail. The results confirmed the findings of the earlier rapid assessment. Only four of these long-term monitoring sites showed marked reductions in coral cover (of between 4 and 16 per cent). At these sites, some branching corals had been broken and others corals were overturned or had been smothered by sediments and coral rubble. The worst damage was in shallow waters.

Overall, remarkably few of Thailand's reefs were harmed by the tsunami waves. The greatest effects were along the northern-most coastline and its offshore islands, where tsunami waves were probably about 10m high. Certain sites in the southern provinces (for example Phi Phi Island) were also badly damaged. Here, the waves were around 5m high. Shallow reefs on exposed islands and shorelines took the greatest impact, and the amount of damage was clearly related to the level of exposure to the waves, the depth of the surrounding sea, and the height of water over the reef. Other researchers found similar effects on tsunami-affected reefs at other sites in the Andaman Sea, namely in north-west Sumatra, and the Andamans and Nicobars. The Mergui Archipelago, off the Myanmar coast, where wave heights were much lower than along the northern coastline of Thailand, seems to have escaped relatively unscathed.

Even for damaged reefs, the prognosis for recovery is good. Natural regeneration will probably mean they recover within the next 10 years. My earlier work has shown that boulder-like corals (termed massive corals), which dominate reefs in the area, grow very rapidly here compared to other places around the world. And we know the reefs have recovered rapidly after damage from previous storm surges. It also helps that coral reefs on the west coast of Thailand are in very good condition, with relatively high coral cover and lots of juvenile corals successfully settling onto the reefs at the end of their free-living larval stage.

Niphon Phongsuwan

Branching coral with central section broken off by the force of the waves.

Rising sea temperatures—the result of global warming—are perhaps most likely to delay recovery. Reefs are very susceptible to combinations of high temperatures and strong sunlight, which 'bleach' corals. Their colour changes as they lose the single-celled algae that usually live within them, and which are vital to the corals' well-being. Severe bleaching can kill coral, and reefs in other parts of the world have deteriorated after bleaching events caused by warm waters. Although Thai waters are getting warmer at about 0.14°C per decade, Thai reefs haven't suffered much bleaching since 1991 and 1995. Nonetheless, corals that bleach but then survive grow less quickly and reproduce less, so even low-level bleaching may slow recovery.

Luckily for Thailand, many shallow water corals in the Andaman Sea are well adapted to environmental stresses, because they are regularly exposed during low tides. But many thousands, maybe millions, of these shallow water coral colonies died in early 2005, not because of the tsunami, but because of the Sumatran earthquake itself. The damage happened not in Thailand, but in nearby north-west Sumatra, and the Andaman and Nicobar Islands, where the earthquake lifted many thousands of square kilometres of reef-flat up by 1.5–2m, leaving corals permanently high and dry. We can tell from local geology that reefs have been lifted up like this in the past. But this time, the threat of global warming means losing this gene pool of adaptable corals could be a real blow for the other reefs in the region. It's possible that the irreversible effects of the earthquake will yet prove much worse for reefs in the Andaman Sea than the tsunami waves.

Barbara Brown is Editor in Chief of the journal Coral Reefs *and is attached to the School of Biology, University of Newcastle upon Tyne. Her postal address is West Briscoe, Baldersdale, Barnard Castle, Co Durham DL12 9UP, email: ProfBarbaraBrown@aol.com.* *NERC funded the surveys reported here through its urgency grant scheme.*