

Assessing Tsunami Damage to Indian Ocean MPAs: Efforts Underway to Find Answers Amid Chaos

The Indian Ocean tsunami on 26 December 2004 brought catastrophic human suffering to coastal communities in South and Southeast Asia. It also affected many marine ecosystems in the region, through broken coral reefs, sedimentation, and piling of debris, among other impacts. Efforts are underway region-wide to assess the undersea damage from the disaster, including effects on MPAs.

Such efforts have not been easy. Tsunami damage to research vessels has delayed surveys in some areas, while scientists elsewhere have had to develop assessment methods on the fly, unprepared for a rare tsunami event in the region. This month, *MPA News* examines some of the assessment efforts so far and what lessons they may hold for MPA practitioners.

Thailand: Measuring coral damage, repairing reefs

Following the tsunami, the government of Thailand moved swiftly to initiate assessments of the disaster's impact on its marine ecosystems. With diving and other marine tourism accounting for a significant portion of national revenue, government officials were eager to measure how the tsunami had affected its marine national parks, which were closed to visitation following the disaster.

By 30 December, government and university researchers were dispatched to collect preliminary data on impacts to sandy areas, rocky shores, mangroves, and coral reefs. A week later, the Thai Department of Marine Natural Resources and senior scientists used these preliminary data to develop an underwater survey protocol for more intensive assessments. The protocol has since been distributed to eight universities and dozens of volunteer divers nationwide, who have used it to collect data on the extent of damage, types of coral affected, and other indicators.

Biologist Suchana Chavanich of Chulalongkorn University (Thailand) was part of the preliminary survey group and also participated in follow-up research trips. Her work focused on the coral-laden Ko Similan Marine National Park, a popular destination for dive tourists and a site she had surveyed previously as part of

normal research. In her surveys since the tsunami, Chavanich observed a range of impacts. Some coral reefs had been heavily damaged — even as deep as 90 feet — while others appeared unaffected. Similarly, some beaches and seafloor areas had lost sand, while others had gained it: she observed that a significant amount of sand was missing from one seafloor site 100 feet below sea level.

The assessment effort has been essential to grasping the damage to Thailand's marine resources. However, Chavanich warns that the protocol is imperfect and may result in inaccurate damage estimates. She points out, for example, that it offers no rigorous method for measuring the percentage of coral damage, aside from relying on divers' best estimates. Furthermore, she says, the protocol requires no prior familiarity with a survey site, thus making it difficult in some circumstances for surveyors to tell whether a coral died before the tsunami, such as from prior bleaching.

"I think these are big problems," she says. The committee that created the survey protocol has said that an error factor of up to 25% between damage estimates and real damage would be acceptable, although Chavanich says the estimates may be off by more. She says one survey team estimated 80% tsunami damage in an area with which her own survey group was familiar; her group, surveying afterward, estimated only 30% tsunami damage.

Although the lower figure still is cause for concern, Chavanich says that at least the impacts to coral in Thailand do not appear to be as severe as first feared. She says the effects have been greater on the tourism industry, where offices and tourist lodgings in most of the marine

Impacts of tsunami on marine ecosystems

A tsunami can damage marine ecosystems via (A) its initial surge and (B) the ensuing backwash, the latter of which may carry sediments and debris from land. The sediments and debris can smother and scrape seafloor habitats, such as coral, while introducing toxins and disease agents to the ecosystem.

The physical forces of a tsunami are powerful enough to alter river mouths or cause meter-wide coral boulders to tumble across the seafloor. In the Seychelles, the repeated draining and refilling of shallow bays over the course of 26 December exposed reefs there to direct sun and rain — elements they may not have experienced in more than a century, say experts.

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national parks were destroyed. “This is the peak tourist season, which ends in April,” she says. “It may take two to three months to build even temporary buildings.”

While repairs to the tourist infrastructure are underway, so are efforts to repair broken and smothered corals. From 19-24 January, 140 volunteer divers worked in Ko Similan to uncover smothered sea fans, table corals, and other reef structures and re-set them in the seafloor. Henry Aruffo, director of the Coral Reef Institute, a research and education organization in nearby Phuket, was a participant. “A significant percentage of the larger coral species still had a majority of corals alive,” he says. He expects survival rates for corals that were completely buried in sand to be 20-50%, whereas broken but not buried corals could have 80% survival rates.

The sites for repair work were selected in part based on results of the intensive assessments: the sites with greatest damage were repaired first. “At whatever rate the corals survive — and we will monitor survival in the future — repopulation of the reefs will occur much faster than if the corals had been left unrepaired,” says Aruffo.

Standardizing the long-term monitoring of tsunami effects region-wide

What Thailand did in facilitating a national damage-assessment campaign, an international project is aiming to do for the entire Indian Ocean. Led by regional and global coral-research institutions, the project has produced a draft set of guidelines for rapid assessment and monitoring, to be finalized within the next several weeks. The guidelines were assembled from a range of sources, including a technical manual for post-disaster environmental assessment in the Caribbean (see box on opposite page, “Importance of conducting surveys prior to disasters”). The project is led by the Global Coral Reef Monitoring Network (GCRMN), the International Coral Reef Initiative (ICRI), the International Society for Reef Studies (ISRS), and CORDIO, an international research program created to respond to coral reef degradation in the Indian Ocean.

The draft guidelines are available for viewing at http://www.unep-wcmc.org/latenews/emergency/tsunami_2004. The document is intended to serve two purposes: to assist field teams and monitoring programs to collect relevant tsunami data, and to promote comparisons of data from local to national and regional levels. By standardizing such surveys, says David Obura of Kenya-based CORDIO, the resulting datasets and reports will be comparable in the next months and years — the timescale he believes will be necessary for accurate analysis.

“Direct biological impacts of the tsunami, I think, can be estimated reasonably accurately within three to four months’ time, and probably quite well after a year — not so much by having more accurate surveys but by having the chance to visit more sites,” says Obura.

“However, there may be longer term repercussions that will need several years of monitoring, such as the loss of structures used as cues for fish-spawning aggregations. It’s hard to know. Also, the extreme damage on land may have very strong impacts on the recovery of reefs: changed river mouths and underground streams, mobile debris persistent over multiple years, or trapping of waste sludge or other materials into depressions on reefs.”

The draft guidelines, he says, are not so much a list but a set of recommendations on key variables and indicators to measure, and how to conduct sampling at different levels of expertise. “Because people have used a variety of monitoring techniques in the past, and to maximize compatibility with past surveys, users will be urged to use a strategy similar to their past ones, while also trying to cover broad areas and make their results compatible with others’,” says Obura.

The guidelines are fairly comprehensive, with tips on site selection, data units, damage indicators, data management, and even how best to use photo/video equipment, among other information. The authors state two “critical rules” to follow when sampling within a given area:

- (1) Always use the same methodology, so that data can be compared; and
- (2) Do not pre-select areas to sample (such as selecting only areas with maximum damage), as this biases the damage assessment.

Karenne Tun, Southeast Asia regional coordinator for GCRMN, says the guidelines when finalized will be distributed to practitioners throughout the Indian Ocean. “GCRMN and ICRI will publish regular updates on the impacts, and will produce a more detailed report in the second half of 2005 for global release,” says Tun. “There are also plans to publish several papers on the socioeconomic and ecological effects of the tsunami on coastal communities.”

Sri Lanka: Assessing coral reefs and the protective role of MPAs

The draft guidelines mentioned above have already been tested in Sri Lanka as part of post-tsunami reef assessments there. Jerker Tamelander, South Asia regional coordinator for CORDIO, GCRMN, and the IUCN Regional Marine Programme, applied the methodology in rapid assessments of six sites, including a no-take MPA — Hikkaduwa National Park. The sites were selected due to their inclusion in an existing reef-monitoring program under Sri Lanka’s National Aquatic Resources Research and Development Agency (NARA).

“These sites are the only locations where we have good baseline information, so they were natural ‘first stops’,” says Tamelander. “While they consist of similar reef types, they have slightly different characteristics in terms of their exposure and whether inner lagoons or outer

More resources on tsunami

IUCN Information Paper: “Recovery from the Indian Ocean Tsunami - Guidance for Ecosystem Rehabilitation Incorporating Livelihoods Concerns” http://www.iucn.org/info_and_news/press/tsunami-guidance-info.pdf

IUCN Tsunami Response <http://www.iucn.org/tsunami/>

UNEP Tsunami Response <http://www.unep.org/tsunami/>

WorldFish Center <http://www.worldfishcenter.org/>

ReefBase Tsunami Impacts <http://www.reefbase.org/Tsunami.asp>

slopes, or both, are sampled. Given the patchiness of the damage from the tsunami, it is important to sample broadly, covering many different sites and a lot of area at each site." Seagrass beds and beaches in association with the reefs are also being sampled, he says, as well as mangroves where they occur. Other assessment teams are examining terrestrial systems like broader mangrove, coastal dune, and wetland areas.


The results of the rapid assessment suggest the protected status of 0.45-km² Hikkaduwa National Park may have fostered resilience to the tsunami. Whereas non-protected sites on the same coast of Sri Lanka experienced moderate to high losses in fish abundance following the disaster, Hikkaduwa exhibited little change in such abundance, which had been high prior to the tsunami. The limited impact on fish was despite the tsunami-caused deposit of large quantities of debris on the Hikkaduwa reef: textiles, tree branches, parts of boats, and other materials. (Volunteer divers cleaned the Hikkaduwa reef lagoon in late January, and will return to clean fringing reef areas.) The assessment is available online in PDF format at <http://www.nara.ac.lk/RAP%201st%20report%20FINAL1.pdf>.

Although Tamelander is cautious about attributing Hikkaduwa's apparent resilience to its status as an MPA, he says it is generally acknowledged that healthier ecosystems are better able to dissipate wave energy, withstand stress, and recover from damage than degraded ones. "Marine and coastal protected areas will serve as a good comparison with surrounding unprotected areas on tsunami impacts," he says. The other sites in the Sri Lanka reef survey have all experienced fishing pressure in recent years, including from blast-

fishing and other destructive techniques. (Most of the sites, including Hikkaduwa, had also suffered heavily from a 1998 bleaching event and were at various stages of recovery prior to the tsunami, in terms of coral and fish diversity.)

Tamelander says more research is needed before concluding that the protected status of Hikkaduwa kept it safer in the disaster. "The problem is that the energy with which the tsunami struck different areas varies, influenced by such factors as bathymetry and shore profile," he says. "So comparisons between different locations need to be made carefully." Studies already underway by NARA are analyzing such oceanographic factors, and may yield findings by mid-2005. Tamelander says the studies could provide important information for policy development, as well as for the general population. "It should be noted that promoting healthy coastal ecosystems will provide physical protection from a range of other calamities as well, including cyclones and climate change effects," he says.

As elsewhere throughout the Indian Ocean, fishing communities of coastal Sri Lanka were devastated by the tsunami. The Sri Lankan government is building replacement fishing vessels and trying to resurrect the industry, which could take years, say officials.

Tamelander says that in rebuilding livelihoods, it will be important to ensure sustainability as well, avoiding a return to the past situation of overcapacity and rampant destructive fishing practices. "This will take a concerted effort from government, the conservation community, and other stakeholders," he says. "It will also emphasize the need for development of sound and realistic alternative livelihood options." 

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Importance of conducting surveys prior to disasters

Although not prone to tsunamis, the Caribbean Sea annually experiences several hurricanes that cause destruction to terrestrial and marine ecosystems. In 2003, the Environment and Sustainable Development Unit of the Organization of Eastern Caribbean Countries (OECS) published a technical manual for member states to use in post-disaster rapid environmental assessment. The two-volume manual — adapted recently as part of draft guidelines for post-tsunami assessments in the Indian Ocean — was applied on a trial basis in Grenada following Hurricane Ivan in 2004.

George Sammy of Ecoengineering Caribbean Limited authored the manual for OECS and says its basic principles are applicable to most small-island developing states worldwide. Among the most important principles is disaster preparedness, he says, including the mapping of natural assets like coral reefs, seagrass beds, and mangrove forests. Such mapping not only serves as a control for post-disaster

assessments of damage, but also may be useful in litigation following various human-caused disasters, such as oil spills.

"The basic finding of the Grenada trial last year was that the assembly of pre-disaster information on environmental assets is important if values are to be placed on the damage," says Sammy. "Although mitigation-related aspects of the manual can be applied without pre-disaster information, the usefulness of the manual in valuing damage is compromised if there is no reliable pre-disaster information." The *Manual for Post-Disaster Rapid Environmental Assessment* is online at <http://www.oecs.org/esdu>.

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Scientists: UK Should Set Aside 30% of Waters as No-Take Reserves

A total of 30% of UK marine waters should be placed off-limits to commercial fishing to protect ocean habitats and save threatened fish species, according to a report by Britain's Royal Commission on Environmental Pollution (RCEP), an independent body that provides non-binding advice to the UK government. Calling for "radical change" in UK fisheries management, the report also proposes introduction of a marine zoning system, a ban on deep-sea trawling in UK waters, and reduction of UK fishing capacity, as well as payments to fishermen to ease their adjustment to a network of marine reserves.

The report incorporated submissions from 90 organizations and individuals, as well as a review of MPA research from around the world.

Fishing industry reaction to the RCEP report has been negative. Among the complaints is that the closures would apply only to UK fishermen due to the structure

of EU common fisheries policy, making the closures essentially meaningless. RCEP Chair Tom Blundell acknowledges that changes in EU law are necessary to require equal application of the closures to all EU fishermen, and notes the report calls for such changes. "Solely excluding UK vessels would be pointless as all UK offshore waters are fished by other European Community nations," he says.

The 420-page report *Turning the Tide: Addressing the Impact of Fisheries on the Marine Environment* and a 30-page summary are available online at <http://www.rcep.org.uk/fishreport.htm>. 

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Opinion on percentage-based targets: Tom Blundell, Royal Commission on Environmental Protection

The Royal Commission on Environmental Protection (RCEP) has called for 30% of all UK waters to be set aside as no-take areas. Arguments for and against such percentage-based targets have been made before by others (*MPA News* 3:11 and 1:8). Below, *MPA News* speaks with RCEP Chair Tom Blundell about the politics and potential implementation of these targets:

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MPA News: Among those who favor establishing more marine reserves, there is disagreement over whether setting percentage-based targets for reserves is a useful strategy politically. Many advocates say it provides a valuable target for planning processes. Others say it needlessly inflames opposition to reserves from fishermen before planning has yet begun, and that the eventual size of no-take zones should be based on local ecological and economic factors, not a broad goal. What was the RCEP's view on this dilemma?

Blundell: Whatever percentage figure is attached to environmental protection measures, it will be an area of some policy debate, as has been the case in previous RCEP recommendations, such as the commission's call for a 60% reduction in UK carbon dioxide emissions. However, if there are to be benefits in terms of protecting marine ecosystems and conserving fisheries, then it is clear that there is sufficient evidence that at least 20% must be protected from fishing as a minimum level. To allow for uncertainty in

studies worldwide of the percentage requiring protection — findings of which have ranged from 20-50% — we recommended a precautionary level of 30%. As fishers are only one set of stakeholders involved in the planning process, it would be counterproductive to solely pander to this interest group. The government needs to be clear about its intentions to the wider set of stakeholders — the general public — that their interests are being represented. Hence a percentage figure is required.

MPA News: The report calls for 30% of all UK waters to be set aside as reserves, as opposed to setting aside a uniform percentage of each marine bioregion or habitat type. Why did the RCEP decide on its recommendation, which could result in less than 30% of some bioregions being protected?

Blundell: It is part of the RCEP recommendations that every bioregion should be sufficiently represented within a fully protected ecological coherent network of marine nature reserves. However, although sufficient information is already available for biotypes for the Irish Sea, there is insufficient information for the rest of UK territorial waters. The RCEP set the percentage in the realization that as more data become available, it will be possible to develop a more sophisticated system of spatial planning at the regional sea level, but that it was necessary to have a baseline of 30% of the total Exclusive Economic Zone in terms of policy development and legislation at this stage.

Notes & News

Fuel spill kills birds in Alaskan MPA

The grounding of a bulk freighter on 8 December 2004 off the coast of Alaska (US) has resulted in the spill of an estimated 225,000 gallons (850,000 liters) of fuel oil into nearshore waters of the Alaska Maritime National Wildlife Refuge, or AMNWR. At least 35 miles (56 km) of shoreline have suffered some form of oiling, with more than 10 miles (16 km) coated with a thick, brown layer of oil and tar balls, now undergoing cleanup. Field crews have collected more than 1500 dead seabirds and documented extensive scavenging of oiled carcasses by eagles and foxes.

The Singaporean-owned M/V *Selendang Ayu*, which split into two pieces following the grounding, also spilled most of its 66,000-ton cargo of soybeans, which the ship had been transporting from the US to China. Anne Morkill, deputy refuge manager for AMNWR, says the soybeans appear to be smothering intertidal life. "Field crews have discovered a substantial kill of marine invertebrates washing up in the soybean surf line," she says.

The 20,000-km² AMNWR, which includes many islands of the Aleutian archipelago and surrounding waters, is home to 40 million seabirds, representing more than 30 species. Federal and state agencies involved in responding to the spill are collecting data on a range of factors — such as distribution of species at risk, scavenging rates, spill-drift patterns, and sediment samples — to determine the spill's impacts. Morkill says additional studies may be initiated later this year to determine effects of residual oil during seabird-breeding and salmon-spawning seasons. The official spill-response website, with photos, daily situation reports, and incident action plans, is at http://www.state.ak.us/dec/spar/perp/response/sum_fy05/041207201/041207201_index.htm.

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Great Barrier Reef, Florida Keys to partner on reef resilience program

MPA officials from Australia and the US have launched a partnership to maintain and improve the resilience of coral reefs to environmental stressors, such as climate change and pollution. Announced 2 December 2004, the partnership will focus on the Great Barrier Reef Marine Park in Australia and the Florida Keys National Marine Sanctuary (FKNMS) in the US, and will involve coordination of scientific research and joint development of management techniques.

Paul Marshall, manager of the Climate Change Response Program for the Great Barrier Reef Marine Park Authority (GBRMPA), says the program will address the challenges involved in converting the concept of reef resilience to management. "Coral reef resilience is emerging as an important framework for adaptive reef management in the face of global and local pressures," says Marshall. "But the science of resilience is relatively new, and its role in guiding coral reef management is still poorly understood."

He says GBRMPA and FKNMS, with their combined expertise in science-based management of reefs, will work first to identify resilience factors that play a role in the long-term health of reefs, then use this knowledge to develop management strategies. "Both of these MPAs have experienced the far-reaching effects of coral bleaching, and share concerns about the cumulative impacts of climate change, degraded water quality, and other stressors," says Marshall. "Both agencies also recognize the value of sharing and comparing experiences in attempting to address the management challenges facing their reefs." GBRMPA and FKNMS have collaborated before, most recently to produce *A Reef Manager's Guide to Coral Bleaching*, to be published later this year. The accumulated knowledge gained from the reef-resilience partnership will be shared among other MPAs and practitioners in the global coral reef community, says Marshall.

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IUCN releases guide to governing Mediterranean Sea, including MPAs

The IUCN Centre for Mediterranean Cooperation has released a CD-ROM and associated website with information on legal aspects of governing the Mediterranean Sea outside of national waters, including the designation of MPAs on the Mediterranean high seas. Much of the information on MPAs — including background papers, presentations, and contact information for experts — is from a workshop on high-seas MPAs held in Málaga, Spain, in January 2003. The CD-ROM and website contain information in English and French, as well as some documents in Spanish. The website is <http://iucn.org/places/medoffice/CDGovernance/index.html>.

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Symposium on MPA financing to be held this month

A symposium on the financing and benefits of MPAs will occur 28 February – 4 March in Loreto, Mexico. Hosted by the North American Marine Protected Areas Network (NAMPAN), the symposium will examine creative financing methods and successful models for long-term economic sustainability, as well as consider the socioeconomic and ecological benefits provided by MPAs.

NAMPAN is coordinated by the North American Free Trade Agreement (NAFTA) Commission for Environmental Cooperation (CEC), in partnership with the Comisión Nacional de Áreas Naturales Protegidas (CONANP) in Mexico; Parks Canada and Fisheries and Oceans Canada; and the National Oceanic and Atmospheric Administration (NOAA) in the US.

For more information on the symposium, e-mail Hans Herrmann, CEC biodiversity program head, at hherrmann@cec.org. More information on NAMPAN is online at http://www.cec.org/programs_projects/conserv_biodiv/project/index.cfm?projectID=19&varlan=english.

MPA congress to feature speakers from around world

More than 600 abstracts for presentations have been submitted to the first International Marine Protected Areas Congress (IMPAC1), to be held 23-27 October 2005 in Geelong, Victoria, Australia. The review of these abstracts is nearly complete, and the final congress program will be chosen from several hundred second-stage abstracts to be invited soon.

IMPAC1 program coordinator Jon Day says organizers have received expressions of interest from 65 countries. "It is expected the congress program will reflect this international interest with presentations from around the globe — a truly international conference," he says. Day is director of conservation for the Great Barrier Reef Marine Park Authority, which is co-hosting the congress with the IUCN World Commission on Protected Areas and Parks Victoria. IMPAC1 is intended to be the first of a series of international conferences on improving MPA planning and management.

Congress organizers are seeking to raise funds to assist delegates who would otherwise be unable to attend, particularly those from developing nations. Institutions interested in providing funding assistance should contact Simon Monk of ASN Events at sm@asnevents.net.au. More information on the congress is available on the IMPAC1 website at <http://www.impaccongress.org>.

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conference calendar, searchable back issues, and more

Letter to the Editor

Dear MPA News:

In light of your article on invasive species (*MPA News* 6:6), it is worth noting that marine protected areas, if not planned carefully, could unintentionally enhance populations of such introduced species. As a case in point, federal no-take zones now under consideration to restore stocks of deepwater reef fishes off the Atlantic coast of the southeastern US could benefit populations of the introduced Pacific red lionfish, whose areas of maximum abundance in the region coincide with several sites proposed for bottom-fishing prohibitions by the (US) South Atlantic Fishery Management Council.

One of the objectives of the proposed no-bottom-fishing zones is to protect areas where multiple species spawn at various times of the year. Some of the proposed sites contain spawning grounds for more than 20 species of native reef fishes. It is likely, however, that conditions at these sites also favor spawning in red lionfish; in fact, there is substantial evidence of spawning by this species in the region.

This presents a conundrum for fishery managers. In management's effort to protect native deepwater reef fishes, populations of an invasive species might benefit, including enhancement of spawning success and recruitment to other reefs downstream. Because this venomous species probably has few predators in its post-settlement stage on Atlantic reefs, it is likely to compete with the species that managers want to protect, and may further contribute to declining populations. It is known that red lionfish eat small fishes and decapod crustaceans that are important prey for native fishes in the region, and are likely to affect diversity of assemblages of those species and their prey, predators, and competitors.

Management agencies should consider locating MPAs that are outside of the current range of the red lionfish; at this point in time, there are still areas with little overlap between the target fishery stocks and the invasive species. Otherwise, managers should consider allowing managed harvest of red lionfish within MPAs should such closures be implemented. The nine proposed sites, some with nearby alternatives (14 total sites), will be offered for public comment in mid-2005, with possible implementation by mid-2006.

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