

Coral reefs and society—finding a balance?

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The Aceh province of Indonesia lies at the western extreme of the island of Sumatra. Its location was tragically brought to global attention on 26 December 2004 when the most devastating tsunami in human history swept across the Indian Ocean. Aceh's densely populated coastline and its proximity to the earthquake's epicentre resulted in an estimated 167,000 lives lost in the province alone, and a fractured people and economy that became a focus for humanitarian aid in the subsequent years. Six articles in this issue of *Oryx* describe a confluence of science and society, and conservation and development, in projects focused on marine livelihoods and coastal communities in Aceh after the tsunami. They demonstrate how these dualities are complementary and necessary sides of the same coin, and show the potential for good governance of resource use on coral reefs.

Rudi et al. (2012) set the scene by describing the biological diversity of this little-studied area where the Indian and Pacific Oceans meet. Its remoteness and marginalized cultures have left it neglected in many ways, with attention having been focused on Wallace's Line in west-central Indonesia, the core of what is now dubbed the Coral Triangle—the epicentre of tropical marine biodiversity globally. However, species diversity of corals in Aceh rivals that in the core of the Coral Triangle, a result of faunal mixing between the Indian and Pacific Oceans. With Aceh as a focal point for the six countries that share the Andaman Sea (Indonesia, Thailand, Malaysia, Myanmar, India and Australia), Rudi et al. argue for a regional initiative for the conservation of the reefs in this little known part of the world.

Marine science, focused on coral reef conservation and local fishery management, has grown in Aceh over the last decade (Campbell et al., 2012). One of the findings of this work is the demonstration of a traditional institution of over 300 years duration, the *Panglima Laot*, which has as its purpose the reduction of conflict between fishers. Meeting many of the criteria for indigenous institutions that remain relevant in modernizing societies (Ostrom, 2009; Cinner et al., 2012), it has recently focused on reducing the use of large nets that cause damage to reefs and to fish populations. Because larger nets tend to be owned by wealthier individuals this has had the effect of maintaining access to fishing for small-scale fishers using less destructive gears. Having survived decades of both colonialism and centralized control the *Panglima Laot* has retained significant

credibility among the coastal communities and is now emerging as an effective institution in the co-management of fisheries, as a partner to regional government.

However, this institution was hit hard by the tsunami. Wilson & Linkie (2012) describe how a third of *Panglima Laot* leaders lost their lives to the tsunami, representing a massive loss of traditional knowledge and community institutions. In response, as part of a broader programme of rebuilding social institutions, the surviving *Panglima Laot* participated in an indigenous knowledge mapping project to rebuild capacity for ensuring safety at sea and for boats to avoid hazardous shallows and reefs. By focusing on safety of fishermen, the project strengthened and helped rebuild the province-wide network of *Panglima Laot*, with the additional benefits of reducing physical impacts of boats and nets in shallow reef areas, thus reducing damage to the reefs.

A perspective on combining environmental benefits (reef restoration) with economic stimulation (ecotourism) is described by Fadli et al. (2012) through an artificial reef project derived from post-tsunami support for environmental rehabilitation. With coral reef decline a serious concern to both tourism and fishing communities, the project involved a dive centre interested in tourism growth and the local community interested in casual employment as well as improved fisheries. However, transplanted corals were just as vulnerable to background threats as other corals, and all died during a bleaching event in 2010. Although unsuccessful in terms of restoration, this was a valuable learning opportunity (about coral and reef growth and the problem of threats) and the artificial reefs nevertheless succeeded as a tourist attraction, stimulating the local economy.

More deeply embedded in the mainstream socio-economy, Novriyanto et al. (2012) describe a revolving fund providing access to microcredit, to assist different sectors within the community in improving their income. The project focused firstly on building the institutional framework, with local representatives, to manage lending and repayment of funds. Farming, clothes making and fishing groups had access to the fund, with the *Panglima Laot* playing a role not just in the fisher groups but in strengthening the functioning of the local committee overseeing the funds. The revolving fund did not focus on conservation objectives but many of the beneficiaries interpreted conservation as a subtext of the project, resulting in increased awareness and commitment to conservation amongst them.

Finally, the cohesiveness of local institutions in Aceh is illustrated in the description by Syakur et al. (2012) of a province-wide marine protected area planning exercise,

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combining data-driven spatial analysis and broad-based stakeholder consultation. The consultations resulted in selection of the option that included the greatest expansion of area under protection: an additional 60,000 ha in 23 locally-managed marine areas.

The lessons from these studies in Aceh are of great relevance to other regions where environmental management is grappling with conflicting pressures from economic and social spheres. Many parts of the world are gravitating towards partnerships with civil society in the management of natural resources, following the early lead of Pacific island cultures but now also evident in Africa, South America and other parts of Asia. Mature and credible local governance institutions are essential for maintaining a local identity and resilience in the face of larger scale pressures—whether from centralized government or globalization, the good intentions of donors and external organizations, or natural disasters and tragedies such as the Indian Ocean tsunami. Supportive partners and larger scale governance systems are of course critically important but experience has shown time and again that people unable or unwilling to help one another often cannot benefit in a meaningful or sustainable way from external aid or charity. An additional key ingredient in the projects described in these six articles is the attention of the NGOs and foreign partners involved: although they have a strong focus on conservation of biodiversity they sought to achieve this through first establishing the social and humanitarian foundations necessary to build local ownership. Where many aid and rehabilitation programmes focused on centrally and donor planned interventions with large budgets, those highlighted in this issue sought to rebuild social institutions devastated by the tsunami, on small budgets.

These studies also demonstrate the essence of what is described as a social-ecological system. Reflecting the growing realization that protecting the environment is more often than not about managing people, these articles focus on the social sphere more than the ecological. Thus, coral and fish health are fundamentally influenced by governance regimes (promoting small vs large nets), reducing physical damage from fishing is achieved by focusing on the safety of fishermen (avoiding hazardous waters), and increased awareness of and compliance with fishery regulations results from social and financial support (micro-credit). The resilience of the Aceh community, with well-planned and adequate but not excessive foreign assistance, is amply demonstrated. While many other challenges surely persist, the social fabric of the Aceh community, signified by the *Panglima Laot* and its ability to serve multiple functions, appears to be a fundamental property that may help the province emerge from the devastation of the tsunami, become a fully productive and sustainable province in Indonesia, and perhaps be newly recognized as a centre of diversity at the confluence of the Indian and Pacific Oceans.

A final word is appropriate following the conclusion of the quadrennial International Coral Reef Symposium (ICRS, 2012) in July 2012. Scientists and reef managers are struggling to discover to what extent coral reefs may survive the combined effects of climate change (especially warming and ocean acidification) and globalization of local impacts (fishing, pollution and habitat loss). The timing of an opinion piece in the *New York Times* (Bradbury, 2012) claiming that coral reefs are a lost cause, essentially zombie ecosystems producing next-to-zero goods and services to dependent societies and with no hope of survival, is highly damaging to the material, financial and ethical commitments that people such as those described in this issue on Aceh have a right to expect from the global community. Coral reefs will assuredly be different in the mid- to long-term compared to how they were before humanity's footprint covered the globe. But they may yet hold some surprises, perhaps with yet unknown resilience and adaptive capacity, and we may be able to steer them towards a trajectory of clean and sustainably productive communities of algae, invertebrates and fish that will continue to support societies such as the coastal communities of Aceh.

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