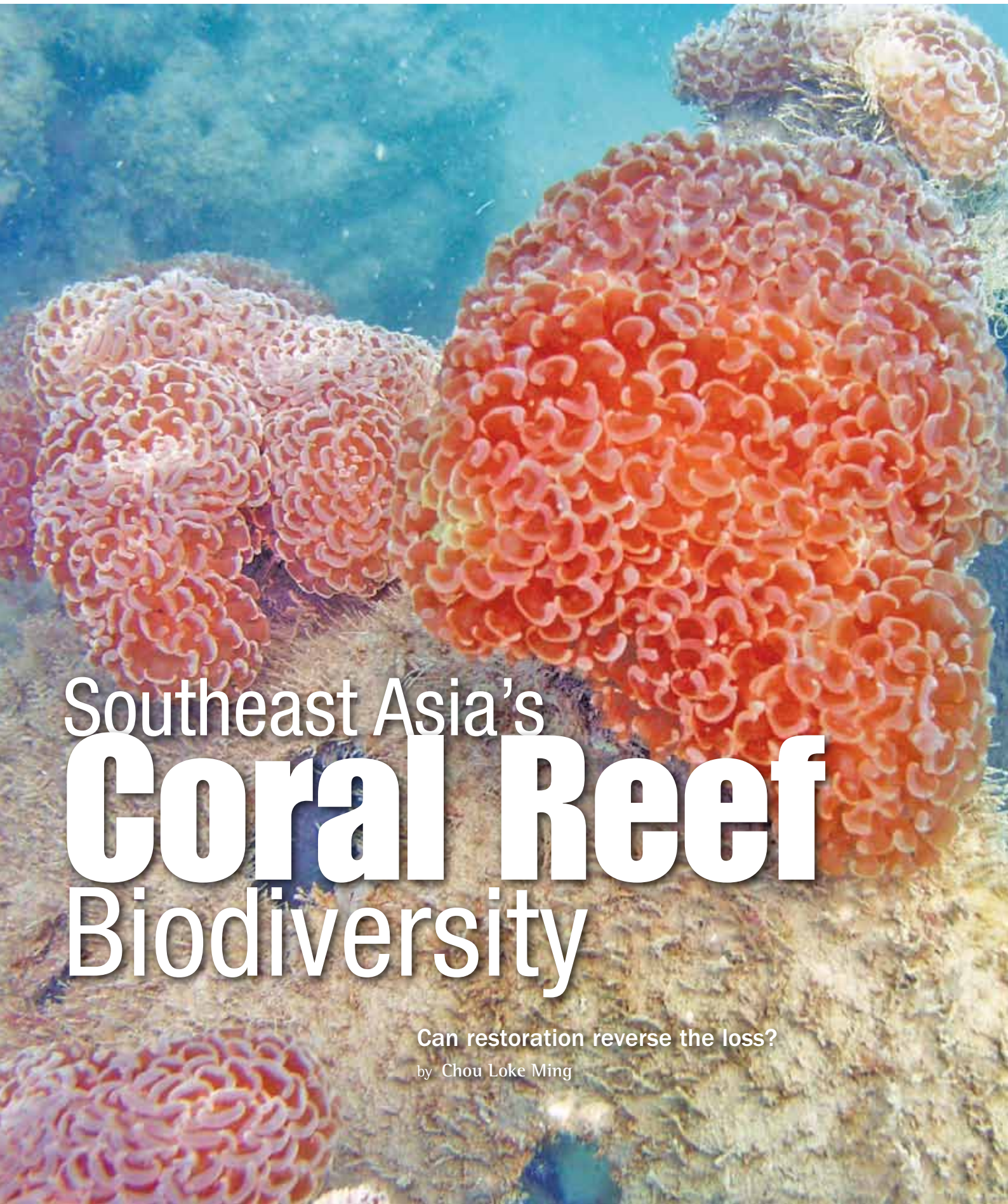

Southeast Asia's Coral Reef Biodiversity

Can restoration reverse the loss?

by Chou Loke Ming

Transplants of Euphyllia coral growing well after attachment to a fibreglass substrate.

Southeast Asia has the undisputed position of being the global centre of coral reef biodiversity but such significance is not fully appreciated by many, judging from the rapid degradation of its reefs. While SEA's seas occupy only 2.5 percent of earth's ocean surface, one-third of the world's coral reefs are packed into it. The region's dynamic economic expansion and rapid population growth however, adds tremendous pressures and poses a huge threat to the vibrant ecosystem.

SEA's coral reefs support species richness at levels greater than anywhere else on earth. The global centre of hard coral diversity, with more than 70 genera, lies around eastern Indonesia, east Malaysia, the Philippines and Papua New Guinea – popularly referred to as the 'coral triangle'. Throughout the rest of SEA, over 50 hard coral genera are found. The reef ecosystem also supports a high diversity of associated plant and animal species, including invertebrates such as molluscs and crustaceans.

As is expected of a region hosting the richest reef biodiversity, many species are endemic to the region and do not occur elsewhere. . It is a common pattern for species richness to decline with increasing distance from the region, and this is the case for many species, notably corals and reef fishes. The pomacentrid fish species (widely associated with reefs) for example, as well as hard coral species, exemplify such a pattern.

The Value of Reef Biodiversity

Why is reef biodiversity important? Firstly, SEA is endowed with the world's richest marine biodiversity (Figure 1) and this gives the region a unique position. Secondly, 70 percent of the region's population lives in the coastal area and depend on reef systems to a great extent, using it as their natural living resource. Reefs provide them with essential goods and services. For example, reef-related fisheries contribute the most to total marine fisheries of the region compared to elsewhere in the world and fish is the main protein source for SEA's coastal population.

On an estimate, individuals gain only a net benefit of USD121,000 for every square kilometre of Indonesia's reefs that they mine. The net loss to society however, adds up to a whooping estimate of USD834,000. This amounts from USD93,600 in fisheries value, USD12,000 - 260,000 in coastal protection value, USD2,900 - 481,000 in tourism value, and unknown costs due to lost food security and biodiversity. Clearly, the cost to society heavily outweighs the profit made by a few individuals who only gain by destroying the ecosystem. An economic analysis of the coral reef of the world's third largest atoll –Taka Bone Rate in South Sulawesi – valued the fisheries resources up to USD12 million per year. From this analysis, it is clear that the benefit from coral mining is only monetary and short-termed. The effects however, will be felt for generations to come.

As an endowed centre for marine biodiversity, more studies are required to document the numerous species that remain

undiscovered. Even till today, new species are being discovered and there is little doubt that the region possesses a rich genetic bank with a great potential for the discovery of natural bioactive chemicals.

Why is Restoration Needed?

Conservationists maintain quite correctly that coral reefs should be effectively managed to ensure sustainable use. However, there is little opportunity for this ideal approach in the real world. Many reefs have been degraded leaving two options available. Leave them as they are with the hope that they recover naturally, or do something to speed the recovery process. For many reefs, degradation has been too severe and even with late management to halt the impacts, natural recovery may be too slow and ineffective. Restoration efforts can give these reefs a better chance as it hastens the pace of recovery.

The cure is always more expensive than the prevention and reef restoration is by no means a cheap alternative. It also has its limitations. Since corals grow slowly, reef restoration is on the whole a slow process, too slow for the comfort or patience of managers and funding agencies used to more instant results. Still, there are others who feel that restoration should be implemented quickly and widely, barring the uncertainty and cost. As a result, all manner of restoration techniques are being attempted, many of which are without proper scientific assessment of their efficacy or claims. Reef restoration in the region started in the later part of the last century and has expanded greatly in recent years.

The variety and scale of effort varies tremendously, covering habitat modification, coral transplantation and natural recruitment. Some of these interventions involve large structures designed to facilitate natural colonization of reef-related species, while others use simpler and less costly approaches that are suitable for coastal community involvement. Singapore's setting offers interesting challenges to reef restoration and techniques used have to take into account the high sediment level. Still, natural recruitment, growth and survival of coral transplants on prepared substrates have shown promising results (Figure 2). The science of reef restoration is still new and many questions remain unanswered. This has resulted in many different attempts throughout the region using a wide variety of techniques with varying results.

Reef restoration will continue to have an increasingly important role and efforts are likely to expand. However, viable approaches and technologies are in relatively early stages of development, and in most cases are currently difficult to implement over large spatial scales. Levels of understanding are still largely based on personal experiences. To overcome these difficulties, two major international projects were initiated in 2004 in the region to address the unanswered scientific questions that will be of most help to reef managers.

The first is the Coral Reef Targeted Research and Capacity Building for Management project implemented through the World Bank/Global Environment Facility. One of its six research components deals with reef restoration and focuses on long-term efficacy and cost-effectiveness of restoration interventions, larval recruitment and coral transplantation. Most of the research is conducted in the Philippines and Palau. The other is the European Commission project "Developing ubiquitous restoration practices for Indo-Pacific coral reefs". This project investigates reef restoration techniques that are suitable for replication across the region and different environmental conditions. Investigations are being conducted in Philippines, Thailand and Singapore.

Both projects, together with further lessons from present in-country reef restoration activities should increase our understanding of the lessons learnt from restoration, reduce the guesswork and make reef restoration more effective. Restoration is an inevitable intervention that can assist degraded reefs to recover. The approach is a poor alternative to effective management, but unavoidable if something is to be done to help degraded reefs recover.

Interesting lessons are emerging from all these attempts and a sharing of information, together with regular synthesis of what works where, when and why will help to improve reef restoration strategies and techniques that will provide a lifeline to SEA's troubled reefs. The sharing of experiences will address information gaps and improve the region's capability in reef restoration. It is also noteworthy that reef restoration has increased the awareness of coastal communities on the value of reef management and offers ample opportunities for direct community involvement. Despite limitations, restoration can assist with the recovery of the region's rich reef biodiversity.

Professor Chou Loke Ming, a marine biologist from the Department of Biological Sciences focused his research on coral reef restoration during the last 4 years. He was involved with both, the European Commission and the World Bank/GEF projects mentioned in the article. Locally, he collaborated with NParks to establish Singapore's first coral nursery and with TMSI in a project to introduce reef life to seawalls.

Figure 1. Southeast Asia's coral reefs are known for their rich biodiversity.