Coral reef decline: The need for protection

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Coral reefs are among the most productive and diverse ecosystems on Earth (Connell, 1978), They are critically important in supporting a vast biological diversity and genetic library for future generations (Moberg & Folke 1999). They provide goods, services and livelihoods for a vast number of people: seafood products, raw materials for medicines, jewellery and curio trade, live fish and coral for aquarium, recreational activities, building materials and (critically) coastal protection against wave action (Kuhlmann 1988, Gomez et al. 1994, Done et al. 1996, Moberg & Folke 1999). Furthermore they provide biotic services such as spawning, breeding, nursery, and feeding grounds for a wide range of organisms (Moberg & Folke 1999). They also fulfil biogeochemical functions such as nitrogen fixation in nutrient poor environments, act as sinks for carbon dioxide over geological time scales and are also found to have a significant role in the world's calcium balance (Kuhlmann 1988, Hallock 1997).

Over one hundred countries have coastlines with coral reefs. In many of these countries a large portion of the coastal population depend on coral reefs for part of their livelihood and/or their protein intake (McAllister 1988, Salvat 1992, White & Vogt 2000). It has been calculated that one square kilometre of growing reef could support over three hundred people if no other protein sources were available (Jennings & Polunin 1996). The particular importance of coral in developing countries, notably in southeast Asia, has been highlighted by Connell (1978) and Cesar et al. (2003).

Threats facing coral reefs

Unfortunately many uses of coral reefs are unsustainable, and are leading to serious reef decline (Richmond 1993, Weber 1993, Bryant et al. 1998). Deterioration of reefs has been linked to a number of causes: overharvesting of reef organisms, habitat destruction by destructive fishing methods (e.g blasting), uncontrolled tourism activities, pollution, diseases, oil extraction and global climate change (McAllister 1988, Wilkinson and Buddemeier 1994, Roberts 1995, Dulvy et al. 1995, White & Vogt 2000, Jackson et al. 2001, Wilkinson, 2004). This deterioration poses a major threat for the livelihood of millions of people, with a likely impact on their sources of income. McAllister (1988) has estimated that damage to reefs in Philippines has led to the loss of at least 100,000 fishermen's jobs. Furthermore anthropogenic impacts on coral reefs can have far extended consequences on adjacent ecosystems such as mangroves, sea-grass beds and the open ocean (Moberg & Folke 1999).

Coral reefs seem to be resilient to natural disturbances occurring periodically such as typhoons and predator outbreaks (Connell 1978), often recovering in 10 to 30 years after the disturbance (Lourey et al. 2000, Salvat 2002). However, such 're-establishment' does not mean a return to the original coral species composition as recovery of slow-growing species can take centuries (Lourey et al. 2000). However, persistent and chronic anthropogenic disturbance appear to be more damaging to coral reefs (Richmond 1993, Hughes 1994, Connell et al. 1997). A poor recovery of reef system has been observed when affected by natural disturbances, if they have previously been exposed to persistent human disruptions (Brown 1997).

Reef decline in the Philippines

In a landmark study of Philippine reef health in 1981, Gomez et al. documented reef decline over a period of twenty years. They found that the percentage of reef with coral cover greater than one quarter dropped from 68% to 26% over the course of their investigation (Bruno &

Selig 2007). Studying the Central Visayas, these findings were confirmed by Liza Eisma-Osorio et al. (2009) who reported that no sites were found to be in 'excellent' condition and that 75% of the reefs had poor coral cover (less than 25% living coral cover substrate). In a broader investigation, Bruno & Selig (2007) compiled and analysed a coral cover database of 2667 Indo-Pacific coral reefs and reported that average Indo-Pacific coral cover declined from 42.5% in 1980s to 22.1% by 2003. This represented an average annual cover loss of approximately 1% or 1. 5 km^2.

The protection that coral reefs provide the coastline from currents, waves, and storms is particularly relevant for the Philippines where an average of 20 typhoons hit the country each year (Gomez et al. 1994, Velasco & Cabanilla, 2003). It is also coral reefs that provide the white coral sand characteristic of tropical islands shores, which is doubtless one of the main attractions in beach tourism (Richmond 1993, Moberg & Folke 1999).

It is known that illegal and destructive fishing are a common practice in the Philippines. Blast fishing is particularly widespread (Pauly et al., 1989). Alcala & Gomez (1979) suggested that it may take up to 40 years to recover to just 50% of the live coral cover in areas effected by blast fishing.

All of this highlights the urgent need of reef conservation plans/policies and their implementation and enforcement in the country.

Combating reef decline

To face coral reef decline several studies highlight the need for baseline assessment, fish population and reef conditions monitoring. This will provide accurate data for the creation of efficient marine reserves, conservation policies and the creation or improvement of management plans (Gomez et al. 1994, Mosquera et al. 2000, Lourey et al. 2000, Christie et al. 2002, Bruno & Selig 2007). Cuthill (2000) effectively reported that without accurate monitoring data, it is difficult to determine the impact of human or natural influences on the marine environment and how to respond accordingly.

Such data are also required to describe to coastal communities the condition of their environment and to highlight the need for their participation in management policies (White &Vogt 2000). This is especially relevant for the Philippines as the country consist of more than 7000 islands, most of them having extensive coral reefs known to be under stress and suffering from poor management and/or destruction (White & Vogt 2000).

Several studies and meta-analyses provide evidence of the positive effect of marine reserve on many organisms (Mosquera et al. 2000, White & Vugt 2000 Côté et al. 2001, Halpern 2003, Samoilys et al. 2007). As an example, Samoilys et al. (2007) surveyed changes in fish populations in Bilang-Bilangan marine reserve (central Philippines) and a control site over 7 years found that mean densities ranged from 5 (±4 sd) fish per 250 m^2 at the control site (outside the reserve) to 36 (±40 sd) fish per 250 m^2 inside the reserve. They reported that reserve effects were most evident on top-trophic level fish and coral health indicator species. They also noted that significant positive effects appeared to be dependent on good levels of enforcement and compliance, highlighting the importance of the enforcement of fishing bans.

Furthermore, in a meta-analysis compiling 12 studies across the world, Mosquera et al (2000) demonstrated that fish were 3.7 times more abundant inside reserves compared to non-reserve areas. They reported that this result was mostly due to the increase in species otherwise targeted by fisheries and noticed a significant heterogeneity among species.

Other factors influencing successful protection efforts

White & Vugt (2000) reported successful examples of reef conservation in the provinces of Negros Oriental, Batangas and the Tubbataha Reef National Marine Park where significant areas of reefs are legally protected. They concluded that intensive education programs (providing the initial understanding of why a program is needed), co-operation among all relevant stakeholders and community participation are considered as key elements of sustainable reef management. In areas where the community was informed and participated in the surveys, the results were better in the long term. Verheij et al. (2004) highlighted the importance of local community involvement in interpreting collected datasets and reported that it clearly improved marine sanctuary management.

Another element leading to successful conversation programs includes visible and immediate results of the management efforts. White et al. (1994) reported that only observable results will sustain a program for the long term. Furthermore local residents must understand how a management program will solve a problem they perceive as important. They need to see a direct connection between a physically disturbed coral reef habitat and decreased fish catches otherwise they will not take action to protect the reef.

Finally it is important for coastal management projects to consider links among all participants: fishermen, community leaders, stakeholders, town mayor and council, private business and government organisations (White & Vugt 2000).

Conclusion

The environmental, social, and economic significance of coral reefs is well documented and impossible to deny. Unfortunately they face major threats, most of them due to human activities. Their significant decline highlights the urgent need for more attention and further protection. Scientific studies have shown that marine reserves with suitable management and enforcement policies have positive effects on fish populations and the health of coral reefs. They have also demonstrated that the involvement of the local community is a important factor for the success of marine reserves and protection strategies. We have in our hands the tools and elements to implement effective protection, it is dependent upon us to put in the required effort and commitment.

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