CONSERVATION OF BIODIVERSITY IN WETLANDS AND MARINE AREAS OF THE PHILIPPINES

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ABSTRACT

The conservation of biodiversity in mangrove forests and coral reefs of the Philippines is reviewed. Current estimates of remaining mangrove forest in the Philippines is less than 100,000 ha, less than a fifth of the area reported in the early 1900s. The marine area occupied by coral reefs has been estimated at 2,500,000 ha. Less than 30% of several hundred reef sites surveyed nationwide have live coral cover of 50% or more. The remaining mangrove forest and good coral reefs as well as their biodiversity have been the object of protection and management by government, non-government agencies, local communities and academe since the mid-1970s, as indicated by the large number of protected areas (500+) reported at this time. However, it is estimated that these marine protected areas (including no-take marine reserves) do not probably exceed 100,000 ha indicating the enormity of the task of protection that lies ahead. The paper discusses the research findings on the present status of resources in mangroves and coral reefs and their implications for management.

Introduction

Two ecosystems or habitat types, which are mainly tropical in distribution, are the subject of this paper. These are mangroves and coral reefs. Mangroves and shallow coral reefs less than six m in depth at low tides (coral reefs extend to deeper marine waters) are classified as wetlands according to the Ramsar Convention (Articles 1.1 and 2.1). Mangroves are part of the estuarine wetland system (Barbier et al. 1997; Shine & de Klemm, 1999).

In many coastal areas of the Philippines, mangroves and coral reefs occur near each other. Mangroves occupy the land fringes and coral reefs the shallow areas seaward from mangroves. Mangroves are adapted to bays and estuaries fully or partially protected from strong wind or wave action. Another habitat type, sea grass bed, may also be found in close proximity to mangroves and coral reefs. These three habitat types exchange nutrients and marine organisms, such as fish (Fortes, 1994; Poovachiranon & Satapopoomin, 1994; Calumpong and Serate, 1994; Pacalioga, 1994; de Leon et al. 1994). Only mangrove and coral reef conservation will be discussed in this paper.
Status of Philippine mangroves

Studies on the mangroves of the ASEAN region prior to 1994 have been reviewed by a number of authors (Wilkinson et al. 1994). A critical discussion of these reviews is presented here.

Mangrove forest and vegetation

The actual area of mangrove forest in the Philippines is not certainly known. In 1986, the area of Philippine mangroves was placed at about 88,000 ha (Fortes, 1988), much reduced from the estimated 500,000 ha in the 1920s. Calumpong (1994) estimated that the Rhizophora-dominated mangrove is less than 70,000 ha, which is probably closer to the truth.

The number of mangrove tree species is 20–25 (Fortes, 1988). But according to both Arroyo (1977) and Fernando and Pancho (1980), as cited in Calumpong (1994), the number is 50. Japar (1994) reported a total of 96 species of plants in Philippine mangroves, of which 31 are exclusive (I interpret as primary) mangrove species. The discrepancy in estimates of number of tree species is probably due to the exclusion or inclusion of species that are considered beach species by other authors. For example, Barringtonia, Ipomoea, and Xylocarpus are listed as mangrove species by Arroyo and by Fernando and Pancho, but they are considered seashore species by Merrill (1945). No reports on the density of primary mangrove species are available. Based on field observations, in highly disturbed and secondary mangrove forests, representatives of certain families no longer exist (e.g. Xylocarpus spp. in the Family Meliaceae). The exclusive use of Rhizophora spp. in reforestation projects has resulted in areas of pure stands of these species. This practice may have exacerbated the spread of animal pest species (e.g. isopods) that burrow through the stems of young mangrove seedlings, causing death of the plants.

Mangrove primary production

Singh et al. (1994) reviewed the function of mangroves as nursery and feeding grounds for fishery species and quoted Gomez’ 1988 study of the production and transport of organic matter in mangrove-dominated estuaries; which produced a large amount of litter, 1,930 g dry wt/m² yr. De Leon et al. (1992) reported that 37.7–61.8% of leaf litter from Rhizophora in Bais Bay is retained in the mangrove forest. This confirms the conclusion of Boto et al. (1991) that 46% of the mangrove primary productivity in Australia are exported to coastal waters.

Fishery production

Sasekumar et al. (1994) summarized FAO statistics on mangrove-dependent finfish landing in the Philippines during the four-year period 1988–1991 and gave the mean as 199,673 tons (range 188,758–216,012). Chong et al. (1994) reported that annual penaeid prawn landings in the Philippines showed a yearly downward trend
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from 41,613 tons in 1986 to 15,149 tons in 1991. This and other lines of evidence showed that this decline was due to overfishing.

**Land vertebrate biodiversity**

The land vertebrates in Philippine mangroves have been listed by Low *et al.* (1994) as composing of three lizards, four snakes, two crocodiles, many birds, including migratory and shore birds, and one wild pig. This list of non-bird species is incomplete. And includes one species that does not enter salt water (*Hydrosaurus postulatus*) and one species that may only be occasionally found in brackish water (*Crocodylus mindorensis*). These two reptile species should be excluded. This list must be revised, to include species that have been recorded in mangroves (pers. obs.), as follows: the frog *Rana cancrivora*; the lizards *Gehyra mutilata*, *Lepidodactylus lugubris*, *Emoia atrocostata*, *Varanus salvator*, and *Mabuya multifasciata* (rare in mangroves); the snakes *Acrochordus granulatus*, *Boiga dendrophila*, *Hurria rhynchops*, and *Naja naja* (probably rare in mangroves); the macaque *Macaca fascicularis*; the fruit bats *Acerodon leucotis* and *Acerodon jubatus*; and the wild pigs *Sus* spp., which certainly occupy mangrove areas of isolated small islands.

Fruit bats of the genus *Acerodon* roost on mangrove trees. There are many birds occurring in mangroves, and the list of Low *et al.* (1994) is incomplete. Many species of migratory birds actually feed along the edges of mangrove forests, but resident species feed and nest within the forest, including herons, kingfishers, tailor birds, flycatchers, etc. These are the species that break the stillness inside primary mangrove forests. Smaller species of fruit bats feed on mangrove fruits and flowers and so do some bird species from the lowland forest. One must remember that up to the 1930s and 1940s, the mangrove forest was continuous with the lowland or dipterocarp and montane forests on many islands of the country.

**Invertebrate biodiversity**

Philippine mangroves abound in shells and crustaceans, both groups collectively called shellfish. Several penaeid crustacean species inhabit mangroves. Several species are economically important Alcala (1979) and Alcala and Alcazar (1984) gave a list of molluscan shells and their values gathered from mangroves of Bais Bay, Negros Oriental, and Calumpong and Luchavez (1997) summarized studies, physical and biological, on the marine resources of the bay. Some of the most sought-after edible shells occur in mangroves, *Geloina* and *Phacoides*. Crabs of the genera *Uca*, *Sesarma* and *Cardisoma* and certain sea cucumbers occur in mangroves. The mudcrabs *Scylla serrata* and *S. oceanica* are found in mangroves, which serve as nursery habitats for them. Large species of shipworm *Teredo* burrow in decaying logs. Many species of molluscs inhabit mangroves (including replanted areas) and supply food and income to local communities (e.g., Bohol). Sipunculid and polychaete worms and oysters abound in mangroves as Zakaria and Sasekumar (1994) have reported for Malaysian mangroves.
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Fish and fishery species

Japar et al. (1994) listed the species of fish reported from Philippine mangroves as belonging to 56 families, 86 genera and 173 species, with most species belonging to Gobiidae, Mugilidae, Lutjanidae, Carangidae, Siganidae, Ambassidae, Apogonidae, Sciaenidae, Gerreidae, and Ariidae. Not all of these species can be caught in any one locality due to local environmental factors and also especially due to the deterioration of the mangrove environment. For example, De la Paz and Aragones (1985, as cited in Calumpong, 1994) listed 104 fish species from the mangroves of Pagbilao, Quezon. The nursery function of mangroves is well known. Juveniles of pelagic and coral reef fish and crustaceans, including the mud crab Scylla serrata and species of penaeid prawns are nursed in mangroves.

Mangrove forest protection in the Philippines

There are only few protected mangrove areas in the Philippines. One of the first areas to be protected is the Pagbilao Forest Reserve in Pagbilao, Quezon Province established by the Forest Research Institute in 1975. The Talabong Mangrove Forest Reserve is small (200 ha) and has been protected by a local government unit, the City of Bais, Negros Oriental since the mid-1980s. On some islands of Palawan, primary mangroves exist. These are provided limited protection by local government units.

Since the early 1990s, cutting of mangrove trees and conversion of mangrove forest into fishponds have been stopped by the Department of Environment and Natural Resources (DENR). However, reports indicate that removal of mangrove trees is still going on in some parts of the country, such as the Sulu Archipelago. A program on mangrove tree planting by local communities and non-government organizations has also been in effect for 20 years, with concentration on the species of Rhizophora. These groups are issued a document called Certificate of Stewardship Contract, whereby they are allowed to harvest some of the trees in exchange for protection of the planted trees (see Atmadja et al., 1994; pers. obs.). In mid-1993, the DENR established the Coastal Environment Program, which included conservation of mangroves, coral reefs and threatened marine species.

Many non-government organizations have been active in preserving remnants of mangrove forests, mostly secondary, as fish sanctuaries and in reforestation of denuded coastal areas, but these are generally small areas. Low et al. (1994) listed 20 protected mangrove areas in the Philippines. The Philippine sites include Tubbataha Reef National Marine Park, which are 33,000 ha in area. The list should excluded Tubbataha which does not have mangroves, and the total protected area is only about 3,000 ha. If Rhizophora plantations protected by local government units and non-government agencies estimated at 2,000 ha on Palawan and associated islands, Mindanao, Bohol and other larger islands, the total area would be 5,000 ha. This is about 7% of the estimated 70,000 ha of primary and secondary mangrove forest remaining in the Philippines. This estimate gives an idea of the extent of the
conservation effort needed to ensure the survival of the mangrove forest in the Philippines. Mangrove reforestation that includes species other than Rhizophora is needed to conserve the aquatic and terrestrial biodiversity in mangroves and to maintain the productivity of shallow marine waters.

One of the conservation programs of government should be conversion of unproductive fishponds back to mangrove areas. The estimate of Calumpong (1994) of fishponds in 1998 is 200,000 ha. Probably 40-50% of this area is not productive and is better off reconverted to mangrove forest. In fact, elsewhere (Alcala in press), I have argued that fish can be better cultured in protected bays and estuaries rather than in mangroves, and by utilizing open, but protected marine waters, the pressure on mangroves can be lifted.

The existing programs of protection and reforestation should be implemented fully, and efforts at local sites by government and private groups must be strengthened and supported by national agencies charged with the responsibility of mangrove conservation.

**Status of Philippine coral reefs**

*Research on coral reefs*

Taxonomic studies on Philippine corals were started by Faustino and Nemenzo in the 1920s (Nemenzo, 1981). The initiative for coral reef studies was made by the Marine Sciences Center (now the Marine Science Institute) of the University of the Philippines (Diliman) under the leadership of Dr. Edgardo D. Gomez, its first director, in 1976. Scientific and public attention has been focused on coral reefs since the holding of the 4th International Coral Reef Symposium in Manila in 1981; in the Proceedings of this Symposium were published a number of papers dealing with Philippine coral reefs (Gomez et al. 1981). The pace of research and publication of coral reef papers have increased in the succeeding years as a result of the work of a few academic institutions and regional groups, notably the ASEAN-Australia marine science program in mid-1980s to mid-1990s (Wilkinson et al. 1994). In the 1990s, more international organizations participated in coral reef research.

The latest review of coral reef research in the Philippines is that by Gomez et al. (1994). Based on this report, only 30.5% of 742 sites surveyed as of 1991 had good to excellent live coral cover. From the initial surveys of coral cover began in the 1970s, studies have progressed to include distribution of corals and fish, recovery from physical damage by natural and human-induced factors (see Gomez et al. 1994), behavior of fish in protected and fished areas as a result of fishing pressure and changes in density and biomass as a result of protection (Alcala & Russ, 1990; Russ & Alcala, 1998). Such studies showed the effects of marine reserves and may be viewed as having direct practical value to fishermen in terms of enhanced fish yield. Much effort is being focused now on marine protected areas as tools for
fishery management and biodiversity conservation. At the present time, marine protected areas in the Philippines need scientific monitoring. Because of the utility function of marine protected areas (as a result of spillover effect), monitoring activities will likely be a major research activity in the future. Among the scientific problems needed to be resolved is the movement of fish larvae from sources to sinks. The findings of such research are required for the establishment of a rational system of marine protected areas.

Coral reef fish

Alino (1994) summarized the patterns of distribution of reef-associated fish communities in the ASEAN region. He found higher numbers of demersal fish species in the Philippines-Indonesia area than in the continental areas. A total of 354 species in 38 families was recorded from Philippine reefs, the highest record for both species and families among the five ASEAN countries (Thailand, Malaysia, Singapore, Indonesia and the Philippines). The Philippines lacks fish taxonomists who can determine the taxonomic status of existing populations.

Other coral reef animals

The diversity of marine organisms other than fish in coral reefs has not been reviewed. It is known that the Philippines is in the center of marine biodiversity (Briggs, 1974). About 400 species of scleractinian or reef-forming corals are found in the Philippines. The Philippines also leads in the number of species of marine mollusks and probably in other marine invertebrate groups as well. However, no recent studies have been done to quantify how much of the rich biodiversity has been lost. Based on our observations, a considerable number of species are no longer common or even observed in reefs, and it is assumed they have been over-collected. A good example is the family of giant clams, of which seven out of the eight species known in the Indo-West Pacific region used to be abundant in Philippine coral reefs. At present, all seven species, except one small, burrowing species, are found in small numbers. Populations of three species (Tridacna gigas, T. derasa, and Hippopus porcellanus) are either extinct or critically endangered (Alcala, in press). T. gigas from Australia was imported into the country to serve as broodstock for a breeding program and juveniles produced at the hatchery of Bolinao Laboratory, University of the Philippines have been used to stock certain coral reefs in the country. Another laboratory, Silliman Marine Laboratory, has an ongoing program of restocking protected coral reefs with other species of giant clams hatched and reared in the laboratory.

Coral reef protection and management

The results of observations by divers and marine biologists indicated destruction of many coral reefs in the country. Public awareness of degradation of the marine environment increased. The Marine Laboratory, Silliman University, launched the first active coral reef protection program in 1974, with the establishment of Sumilon
Marine Reserve, off southern Cebu Island (Alcala, 1980, 1981). After this event, small marine reserves or fish sanctuaries were established in Negros Oriental, Negros Occidental, Bohol, Siquijor, Zamboanga, Mindanao, and Palawan in the 1980s (pers. obs.). The number of marine reserves increased in number during the 1990s with the increase in the number of non-government organizations and local government units concerned with the protection of natural resources. Many coastal resource management projects incorporate marine sanctuaries as tools for fishery enhancement. No-take marine reserves are now accepted worldwide as an effective tool for conservation of fishery stocks and marine biodiversity (e.g. Roberts & Polunin; 1993; Russ & Alcala, 1998). Marine protected areas form a significant part of the National Integrated Protected Areas System (NIPAS). There are probably more than 100 such areas in the Philippines today. However, most of them do not have management plans and are not properly monitored.

Despite the continuous effort at establishing marine protected areas since the mid-1970s, only a small area of Philippine reefs is being protected at the present time. The total coral reef area of the Philippines is 2,500,000 ha, and probably not more than 50,000 ha (2%) is protected, mostly by local governments and local communities (pers. obs.). This indicates that a great deal of effort needs to be spent on coral reef protection and management.

The reef sites with substantial areas include the Tubbataha Reef National Marine Park (33,000 ha), and Carbin and Macahulum reefs combined (1,000 ha.). The other protected areas range from less than 50 ha to a couple of hundred ha.

References


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(Note: Citations for 1994 in the present paper refer to papers published in these Proceedings.)