



Economic value of a large marine ecosystem: Danajon double barrier reef, Philippines



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1. Introduction

The Danajon double barrier reef (Fig. 1) is the only double barrier reef in the Philippines formed over the last 6000 years and one of only three such sites in the Indo-Pacific region (Pichon, 1977). The double barrier developed as a result of unique tidal currents and/or resumption of subsidence after the outer barrier was formed (Grobe et al., 1985). It covers a total area of 272 km² (27,200 ha) with a total coastline of 699 km, spanning 17 municipalities in four provinces and two administrative regions. It accounts for over one percent (1%) of the total area of coral reefs of the Philippines which is estimated at 27,000 km² (Christie et al., 2006). This unique coastal environment is identified as a priority area for the conservation of reef fishes, corals, mangroves and molluscs (Green et al., 2004).

Located off northern Bohol Island, Danajon double barrier reef consists of three large reefs, clusters of small reefs and about 40 small islands. The outer barrier reefs and slopes contain the most prolific coral growth while the inner reefs and lagoons are more turbid and have less coral growth. In 2004, 211 hard coral species were recorded (Calumpong, 2004) and the presence of a variety of

sharks and rays as well as a large population of seahorses were also reported (Christie et al., 2006). Danajon also hosts significant mangrove forest cover with over 2000 ha of *Rhizophora* sp. The area also serves as important feeding and roosting grounds of over 20 bird species during July to November, one of which is the IUCN-listed threatened species Chinese egret (*Egretta eulophotes*) (Perennou et al. 1994).

The condition of the coral reef reflects the extent of habitat degradation in Danajon as evidenced by low living coral cover despite high coral diversity in the area. Fish biomass is also very low suggesting that the general status of the area is degraded and overfished (Calumpong, 2005; Armada et al., 2009; Lucas, 2010). It is likewise considered a critical resource area especially for fishing, as it sustains the livelihood of around 5000 fishers in the commercial sector and over 125,000 full-time municipal small-scale fishers. The management of Danajon is difficult because of a generally large, poor population, which is highly reliant on fishery resources. Over 60% of coastal habitats in northwestern Bohol live below the poverty line of USD 120 per month (Green et al. 2004). Population densities on outlying islands are unusually high with most people heavily reliant on marine resources. The poverty and density of fisher population drives many fishers to use destructive, unsustainable and illegal fishing practices.

A number of coastal resource management projects have been initiated largely at the inner reefs of the Danajon double barrier reef either by local communities or government agencies such as the Department of Environment and Natural Resources (DENR) and the Bureau of Fisheries and Aquatic Resources (BFAR) of the Department of Agriculture (DA) in partnership with nongovernment organizations or special programs such as the Fisheries Improved for Sustainable Harvest (FISH), and Project Seahorse Foundation. There are more than 30 small marine protected areas (MPAs) including seven strict nature reserves and three protected seascapes (Green et al. 2002). A local initiative on mangrove reforestation in one of the islands has caught international attention for its size. As Amper (2004) discussed, the initiative of mangrove planting came from the residents themselves and was later supported by the DENR. The 487-hectare mangrove area has not only protected the island from storm waves and strong winds, and provided a spawning area for

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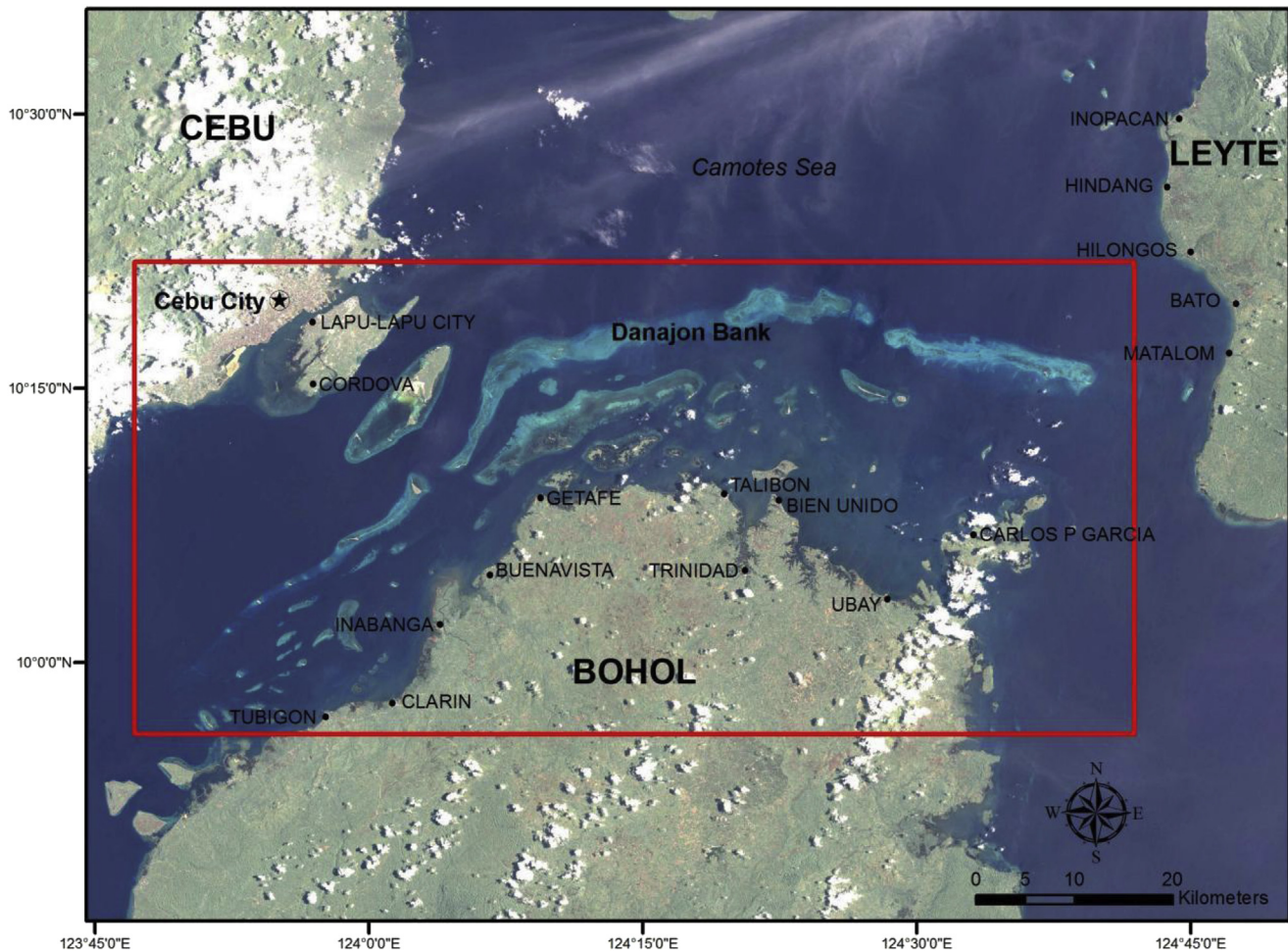


Fig. 1. Danajon Bank double barrier reef area.

fish and other marine creatures, but also brought eco-tourists.

The outer Danajon reef is largely outside any active management effort. Previous efforts at integrating the initiatives of different provinces and municipalities/cities surrounding Danajon have not succeeded. The Cebu-Leyte-Bohol-Southern Leyte Management Council initiatives in 2002 and 2009 have not progressed beyond the signing of the Memorandum of Agreement.

Historically in the Danajon Bank area, each municipality operated quite autonomously and not in a coordinated manner with the neighboring municipalities. Given the number of fishers and mobility of fishers, without coordination among all the local governments covering the Danajon area, the potential for managing the fishing effort and curbing the illegal and destructive fishing was very poor. As governance interventions were refined and improved in the area, it was realized that the entire area needed to be treated as a common management unit and that the primary municipalities needed to form a management cluster and adopt common management guidelines and policies. They also needed to coordinate their efforts to stop illegal fishing because of fisher mobility. This cluster approach also involved engaging large numbers of local stakeholders in order to raise awareness and to get the buy-in of the communities towards a common cause of protecting and restoring the Danajon Bank coral reef and fisheries. This process has also made it possible to set aside more marine protected areas to help restore the coral reef habitat with active community support.

In 2011, the Danajon Bank Marine Park Project, was initiated as

the first collaborative large-scale marine protected area in the Philippines. The Danajon Bank Marine Park Project aimed to accomplish the following outputs: i) establish a Danajon Bank Marine Park Governance Framework; ii) establish the Bien Unido Double Barrier Marine Park, a large-scale marine protected area within the outer reef of the Danajon Bank to restore marine habitats and address overexploitation of fish stocks; and iii) enhance livelihood options through secure food sources, and tourism-related economic opportunities.

As a first step towards accomplishing these goals, the project sought to compile and analyze baseline information on biophysical, socio-economic, institutional, policy and governance conditions of Danajon. This was aimed at contributing towards the formulation of the Governance Framework Plan for Danajon double barrier reef.

This study will estimate the economic values of the marine ecosystems comprising the Danajon reef (Fig. 1) area under present conditions and the future values of economic benefits and costs among stakeholders in the fishing and tourism industry. The objectives of this study are:

1. To calculate the use values attributed to the direct utilization of ecosystem services provided by the Danajon reefs; and
2. To estimate an appropriate diver visitation fee based on a willingness-to-pay valuation.

The Danajon reef area is a capital good acquiring value to the

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