

**THE PHILIPPINE REEF AND RAINFOREST PROJECT:
AN INTEGRATED APPROACH TO ESTABLISHING MARINE PROTECTED AREAS.¹**

**Gerardo L. Ledesma[†], Maria Beger^{†2}, Gillian Goby[†], Alastair R. Harborne[‡],
Peter S. Raines[‡]**

[†] **Philippine Reef and Rainforest Conservation Foundation Inc.**, Door 3, Monfort Building, Mandalagan, Bacolod City 6100, Negros Occidental, Philippines

[‡] **Coral Cay Conservation**, 154 Clapham Park Rd, London SW4 7DE, UK

ABSTRACT

The Philippine Reef and Rainforest Project (PRRP) is a collaborative project between the Philippine Reef and Rainforest Conservation Foundation Inc. (PRRCFI), a non-stock, non-profit organisation based in Negros Occidental, and Coral Cay Conservation (CCC), a British non-profit organisation. Since 1995, the PRRP has provided technical and community organisational assistance to establish a community-driven marine reserve and wildlife sanctuary at Danjungan Island (Negros Occidental).

Danjungan Island has been found to support a rich marine and terrestrial biodiversity and its reefs are of particular socio-economic value to local subsistence fisherfolk. The PRRP has proved successful and the Danjungan Island Marine Reserve and Wildlife Sanctuary was established in 1998. The key elements of the PRRP have been (i) acquiring the rights of ownership to Danjungan Island via an international fund raising scheme (ii) establishing an extensive database on the marine resources of the area (iii) utilising a simple zoning scheme for sustainable resource use and (iv) conservation education and alternative livelihood schemes for the local community.

Following the success of the PRRP, it has been broadened to provide technical assistance for a comprehensive and systematic survey of coastal marine resources throughout southern Negros, under the Southern Negros Coastal Development Programme. The PRRP has also been extended to provide similar support to the Palawan Council for Sustainable Development for surveys of reefs and forest within Taytay Bay (Palawan).

INTRODUCTION

The tropical forests and coral reefs of the Philippines are of vital importance both ecologically and economically. However, logging and agricultural development, caused by

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² Corresponding author: ccc@coralcay.demon.co.uk

rapid economic and population growth has seriously depleted the forests. Similarly, the countries' coral reef ecosystems have been adversely affected by a range of anthropogenic activities including over-fishing, destructive fishing, sedimentation, eutrophication and pollution. These impacts, which have resulted in a rapid decline in reef health, represent substantial long- and short-term threats to the ecological balance of reef ecosystems.

Effective management, including conservation of coral reefs and tropical forests, requires a holistic and multi-sectorial approach. This is often a highly technical and costly process which many developing countries cannot adequately afford. With appropriate training, non-scientifically trained, self-financing volunteer divers have been shown to be able to provide useful data for coastal zone management at little or no cost to the host country. This technique has been pioneered and successfully applied by Coral Cay Conservation (CCC), a British non-profit organisation.

The Philippines Reef and Rainforest Project (PRRP) was established by the Philippine Reef and Rainforest Conservation Foundation Inc. in collaboration with CCC and the World Land Trust in 1995 to address the problems of reef and forest destruction. The main aim of the PRRP was to protect Danjungan Island via a community-driven reserve in order to protect the reefal resources, increase fish catches and provide income from nature based tourism. Founding such a project was imperative since Danjungan Island was known to be one of the few remaining intact tropical islands with rich fringing coral reef and rainforest in the province of Negros Occidental (Figure 1). Core components of the PRRP have been to acquire ownership of the island and collect data on the status of coral reefs around the island. The project simultaneously aimed to establish environmental awareness programmes involving the active participation of local communities.

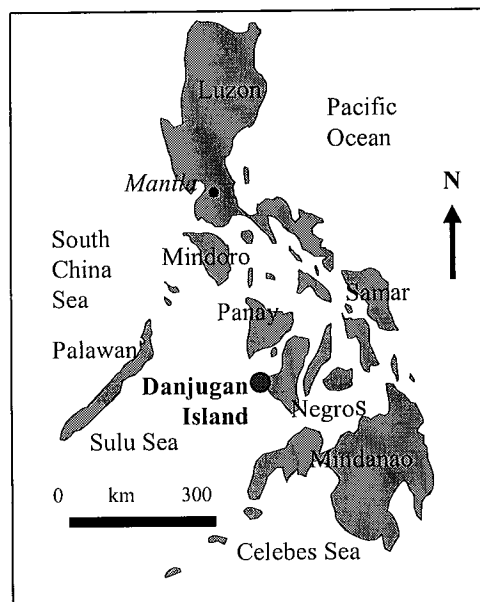


Figure 1. Map of the Philippines indicating location of Danjungan Island.

METHODOLOGY

Purchase of Danjugan Island

Danjungan Island is a small island of approximately 43 hectares, measuring approximately 1.5 km in length and 0.5 km in width. The island rises to a height of 80 m and is covered in rich tropical forest. The island lies in the Sulu Sea adjacent to Negros Occidental (Brgy. Bulata, Cauayan) in the central Visayas region of the Philippines.

A core component of the PRRP has been to acquire the rights of ownership to the island via an international fund raising scheme in order to provide long-term stability for the reserve.

* more Gerry.

Coral reef assessment

The principle aims of the baseline marine surveys carried out around Danjugan Island were: to describe the topography and habitat types of the reefs; collect basic oceanographic data; assess the extent of anthropogenic disturbance to the reefs and combine survey data with remotely sensed imagery to create an accurate habitat map. In order to achieve these aims, the PRRP utilised the standard baseline survey technique developed by CCC for the rapid assessment of biological and physical characteristics of reefal communities by trained volunteer divers (Harborne *et al.*, 1996) and acquired RoxAnn side scan sonar imagery of the area. All surveys were co-ordinated by a qualified Project Scientist to ensure accurate and efficient data collection.

Volunteer training

Prior to assisting with data acquisition, CCC volunteers are required to undertake an intensive eight day training course in marine life identification and survey techniques. The training programme includes assessments of volunteers identification skills and their competence at undertaking reef surveys. Assessments are in the form of written tests to determine the level of competence of each volunteer in marine life identification. Only those volunteers who pass the assessments satisfactorily are permitted to gather data. Lectures and practical exercises include a general introduction to coral reef ecology and more specifically hard corals, invertebrates, marine fauna and fish.

Baseline reef surveys

The CCC transect survey method uses a series of plot-less transects, perpendicular to the reef, starting at a depth of 28 m and terminating at the reef crest to map zonation across a reef profile (CCC, 1995). The positions of the transects are fixed using a Global Positioning System (GPS). Benthic and fish surveys are focused on a pre-selected number of species and standardised life forms that are either abundant, easily identifiable or ecologically or commercially important.

During the course of each transect survey, divers may traverse two or more apparently discrete habitat types, based upon obvious gross geo-morphological or biological differences. The data gathered from each habitat type are recorded separately for subsequent analysis. Data collected are transferred to recording forms prior to incorporation into CCC's database.

Habitat map preparation

For the preparation of baseline habitat maps, remotely sensed imagery is overlaid with the benthic and habitat data gathered from the transects. CCC has collaborated with the SeaMap Research Group (University of Newcastle, UK) to use a RoxAnn side scan sonar to acquire appropriate imagery.

Capacity building and conservation education

*Gerry please expand/ rewrite

Conservation education and capability building are an integral part of the PRRP. Conservation education is important in raising the understanding and awareness of a particular environment and inter-linked environmental and socio-economic processes. Alternative livelihood skills are also an important component of the project since this diversifies community income and reduces pressure on the marine and terrestrial resources. For example, local fishermen are trained in SCUBA diving and marine ecology.

The PRRFCI have a Senior Community Organiser and a Alternative Livelihood Extension Officer who are working with the local community.

Regular Children's Marine and Wildlife Camps are organised on Danjungan Island. The curriculum for these camps incorporates an introduction to the marine and forest ecosystems, snorkelling, trekking, basic nature conservation, games and workshops and a pledge to mother earth.

Establishment of the Danjungan Island Marine Reserve and Wildlife Sanctuary

The PRRP aimed to utilise habitat maps and additional scientific data on reef health and motile organisms (e.g. fish) to identify management schemes, location and extent of the planned Danjungan Island Marine Reserve and Wildlife Sanctuary and future monitoring needs. Data collected by CCC volunteers formed the scientific basis for management recommendations and the identification of sanctuary zones in accordance with the IUCN standard ecological criteria for selecting protected areas (Salm and Clark, 1989):

1. Large variety and richness of ecosystems, habitats, communities and species.

2. High degree of naturalness and representative of the native flora and fauna.
3. Habitat for species possibly previously not reported in this region.
4. Naturally productive area with particular socio-economic value to the local community.
5. Threatened by both natural and anthropogenic impacts. Of particular concern is the indirect effects from terrestrial based human activities.

The integrated approach for the establishment of the sanctuary on Danjungan Island aimed to combine scientifically validated recommendations for sustainable management with community involvement, including conservation education, acquisition of new skills and alternative incomes for local fisherfolk.

RESULTS

Purchase of Danjungan Island

Danjungan Island was bought by the PRRP in 1997/ 8? with the aid of a bridging loan which is currently being repaid.

*expand- Gerry

Coral reef assessment

Baseline reef surveys

A total of 51 full survey transects were completed on the fringing reefs around Danjungan Island and adjacent reefs. These transects comprised a total of 119 dives. The data collected were analysed to identify discrete habitat types around Danjungan Island, using multivariate and univariate techniques. Establishing the location of different habitats was important in order to include an example of each within a sanctuary zone for maximising biodiversity protection.

The benthic and substratum data were analysed via cluster analysis, based on the Bray-Curtis similarity coefficient, within PRIMER (Plymouth Routines in Multivariate Ecological Research) software. This analysis produced a dendrogram grouping sites with similar biological and physical composition, which are assumed to constitute a distinct habitat type. The analysis of PRRP data gave four distinct clusters at a Bray-Curtis similarity of 48%. These clusters represent four different habitat types with discrete species assemblages and substratum composition.

Habitat type 1 contained a diverse and abundant assemblage of scleractinians, dominated by Non- *Acropora* hard corals, and was located mainly on the eastern reef of Danjungan Island. A combination of Non-*Acropora* and *Acropora* hard corals and soft corals characterised ***Habitat type 2***, most of which was situated on the north and southern end of the island.

Habitat type 3 was comprised primarily of a sand and rock substratum with scattered Non-*Acropora* and *Acropora* corals and was located mainly on the western side on Danjungan Island. **Habitat type 4** was dominated by branching *Acropora* coral life forms, and was principally located on the adjacent patch-reefs.

Univariate analysis of the fish community showed that whilst most commercially exploited fisheries species and groups were present in the four main habitat types, their body size and abundance was low. However, the presence of small size classes of commercially important fish species indicate that the fisheries adjacent to Danjungan Island have the potential to recover.

The data on physical parameters demonstrated a generally good horizontal underwater visibility and weak currents. The underwater anthropogenic impacts were dominated by broken coral. A relatively high amount of surface activity was recorded, most of which was artisanal fishing.

The reefs around Danjungan Island were found to support a high biodiversity and appear to be in good condition relative to many other reefs of the Philippines. It is possible that Danjungan Island's reefs rate among the most diverse small reefs in the world (Fenner, pers. comm.). Approximately 250 scleractinians and hydrocorals (representing 72 genera) and approximately 400 species of fish have been recorded. In addition, 43 genera of macroalgae, four genera of blue-green algae and seven genera of seagrasses have been identified. There are a small number of animals which damage coral, such as Crown-of-Thorns (*Acanthaster planci*) seastars or *Drupella* snails, indicating good reef health.

Habitat map preparation

A preliminary habitat map has been prepared by unsupervised classification of the RoxAnn image. A detailed habitat map combining the remote image and the characteristics and locations of habitat types identified from data collected by PRRP volunteers is in preparation.

Capacity building and community conservation education

*Gerry please expand/rewrite

In many of the PRRP conservation education workshops, such as marine and wildlife camps, local communities were made aware of the significance of preserving the coastal zone's natural wealth for future generations. The PRRFCI Senior Community Organiser and a Alternative Livelihood Extension Officer worked together with the local community on educational and capacity building programmes. A large number of former fishermen have been trained in a number of skills, including SCUBA diving, operation of compressors and speedboats and marine ecology and species identification.

A large pool of educational material has been produced and disseminated, for example an educational poster “Life On The Coral Reef”, informing about life on the reef and its threats. A comic-booklet “Ang Aton Nga Coral Reef” was produced in the local language and has been applied in both schools and Children’s Marine and Wildlife Camps.

Children’s Marine and Wildlife Camps were conducted on Danjungan Island on an annual basis. They were made available to children from both rural schools (e.g. Bulata) and urban schools (e.g. Manila).

The Danjungan Island Marine Reserve and Wildlife Sanctuary

The community- based Danjungan Island Marine Reserve and Wildlife Sanctuary was established in 1998. The integrated approach for its establishment ensured both the integration of scientific data and the inclusion of the local community into the decision making process. Local fishermen fully support the initiative and have been supported to develop new skills and alternative ways of generating income.

The extensive scientific survey data supported the rationale for the protection of Danjungan Island and its reefs. This protection was recommended and established via the implementation of a marine reserve and a zoning scheme for the sustainable utilisation of the island's biological and physical resources (Harborne *et al.*, 1996). It includes three areas for special protection, designated as Special Management Areas (SMA's; Figure 2).

Within the boundaries of the reserve all activities have been monitored and regulated by a community based management committee. The entire marine habitat within the reserve is protected by a total ban on destructive or unsustainable fishing practices. A regulated fishery will be permitted within the boundaries of the reserve but excluded from within the SMA's. Anchoring within the reserve will be prohibited and mooring buoys will be established throughout the reserve. The boundaries and the position of the SMA's will be designated by buoys.

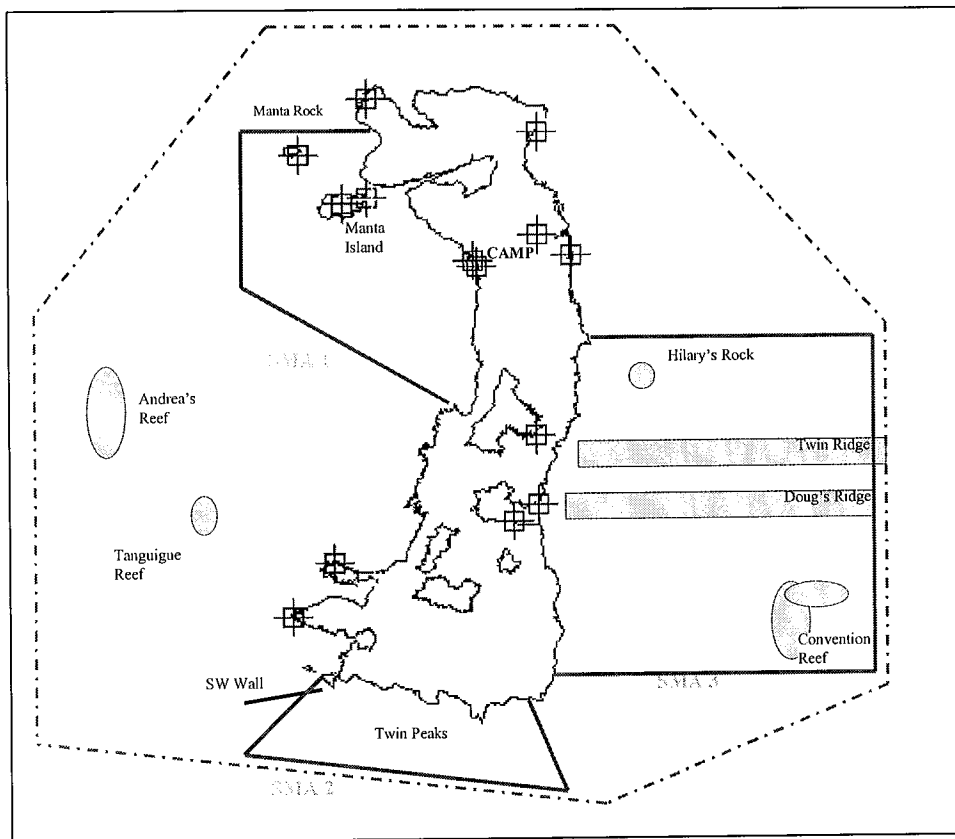


Figure 2. The recommended boundaries for the Danjungan Island Marine Reserve and Wildlife Sanctuary (-----) and Special Management Areas (—————). Crosses represent ground control points.

In contrast to many reserves in the Philippines, the PRRP surveys have allowed management decisions to be based on scientifically valid criteria. The rationale for locating the SMA's is summarised below.

SMA 1

The reefs within SMA1 are topographically rich, thus providing a variety of ecological niches, which maximises the biodiversity that is protected. It includes "Convention Reef" with possibly the greatest percentage of coral cover around Danjungan Island and "Hilary's Rock", which is formed by a relatively rare coral (*Pavona clavus*). The area supports a large number of other coral, fish and invertebrate species.

SMA 2

SMA 2 incorporates the south west wall which supports a very high diversity of corals (Fenner, pers. comm.), including the rare *Pavona xarifae*. The fish community in this area supported an unusually high number of large fish before the advent of spearfishing (Lizares, pers. comm.). It is likely this community will recover if given protection from fishing.

SMA 3

SMA 3 protects a representative part of the extensive seagrass habitat close to the western shore. Small sharks have been recorded in this SMA, particularly over the seagrass bed, possibly indicating a nursery area. It includes an unusually extensive area of *Montipora digitata* in shallow water and large colonies of the rare *Acropora monticulosa*. SMA 3 offers protection to the most accessible snorkelling area on Danjungan Island, which is important for education purposes.

The SMA's as strict no-fishing zones protect the most important fish families around Danjungan Island, including Lutjanidae, Caesionidae, Haemulidae, Serranidae, Carangidae and Scaridae. Although these fish often utilise greater ranges than the size of the SMA's, the direct fishing pressure has been removed from the fish stocks and important nursing and feeding habitats are included within the SMA's. Some of the commercially important species are pelagic (Carangidae, Caesionidae) and thus can be protected within any no-fishing area.

FUTURE RESEARCH

Monitoring at Danjungan Island

Following the designation of the reserve, a number of on-going monitoring studies have been developed and initiated around Danjungan Island to monitor its efficacy. These include a fish population study, a sedimentation study and a coral bleaching study.

Fish population monitoring study

In the fish population study, CCC aim to quantitatively assess and monitor the population (numbers and sizes) of commercially important target fish at permanent monitoring sites inside and outside protected (no-fishing areas) using surveys at regular time intervals. The data will be used to compare the fish stocks and populations of commercially exploited fish groups and species inside and outside the no-fishing zones of the SMA's.

This survey will also incorporate a census of commercially important vertebrates (lobsters, conch and clams). The benthic community will be assessed annually using the CCC baseline technique and complimented by a full quantitative monitoring programme.

Sedimentation study

Increased sedimentation on a reef ecosystem usually has a negative influence since heavy layers of sediment can smother corals preventing them from both active and passive feeding. Suspended sediment reduces water clarity, which in turn can affect the photosynthetic capacity of corals due to diminished light levels. A sedimentation study was

initiated to monitor the impacts of the recently constructed Negros Occidental coastal road upon the reefs around Danjugan Island and the surrounding mainland coastline. Sediment levels are measured using sediment traps located around Danjugan Island and the adjacent mainland coastline, which are collected at regular intervals. Preliminary results suggest that the road development may have increased sedimentation in the area.

Coral bleaching study

Corals live in symbiosis with microscopic algae, known as zooxanthellae. The term “coral bleaching” is used when these zooxanthellae, which contain colour pigments, are expelled and thus the corals appear white or “bleached”. Bleaching occurs where corals become stressed because of increased water temperature and solar radiation and may lead to colony mortality.

During the 1998 world-wide bleaching event, the first evidence of large scale bleaching on Danjugan Island was observed in August. To monitor the results of this bleaching event, a series of permanent quadrats were placed on the reef around Danjugan Islands at a range of depth. Each quadrat was mapped and the percentage of bleaching was recorded. Under water photographs were also taken as a permanent record.

Data showed significant bleaching and many colonies were covered in filamentous algae indicating coral death. All surveys and observations are being continued to monitor further development of affected areas. Herbivorous fishes, urchins, holothurians, molluscs have been recorded feeding on this algal overgrowth and this grazing affords the potential for the reef to regenerate via recruitment. At Danjugan Island, recruitment may be further enhanced by the establishment of the SMA's.

Project extensions

The success of the PRRP at Danjugan Island has led to an expansion of the project in Negros and also a new site in North Palawan. In Negros the PRRP has led to the establishment of the Southern Negros Coastal Development Programme (SNCDP). In Palawan the Taytay Bay Conservation Project (TBCP) has been initiated.

Southern Negros Coastal Development Project

The SNCDP covers four municipalities and aims to rehabilitate forests, provide protection to coastal resources, strengthen capacity to enforce environmental laws, provide alternative livelihoods to fishing communities and enact legislation to promote marine and terrestrial resource protection. Through an extension of the PRRP, CCC has agreed to provide technical assistance for resource assessment within the SNCDP area over a period of five years from 1997 until 2002. CCC has already conducted baseline survey work of the reefs and lagoons within each of the four municipalities.

Taytay Bay Conservation Project

In 1997, CCC and the PRRCFI developed the TBCP in collaboration with the Palawan Council for Sustainable Development. Based on Cagdanao Island, the primary aims of the project are to harness the skills and resources of the participating organisations to provide baseline and monitoring data, training opportunities and environmental awareness programmes to facilitate an integrated approach to conservation in Taytay Bay. Phase 1 of the TBCP was carried out in September 1998 by CCC volunteers and staff from the University of Essex (UK). It is expected that a permanent base for the TBCP will be established in spring 1999.

CONCLUSIONS

Since 1995, the PRRP has successfully facilitated the establishment of the Danjugan Marine Reserve and Wildlife Sanctuary. A core component of this work has been the collection of scientifically valid data by PRRP volunteers and field science staff. The database, in conjunction with community conservation education and workshops, has allowed management initiatives to be based on specific criteria and stakeholder input. This integrated approach is a model for the establishment of other marine reserves in the Philippines.

The Special Management Area's within the reserve aim to provide protection to important coral reef habitats and to act as a reproductive pool, nursing ground and sanctuary for fish stocks. The efficacy of the SMA's is currently being monitored and the data will be used to adapt management recommendations as necessary, again based on scientific criteria. Furthermore, the boundaries of the SMA's have been accepted by the local community which is vitally important to the success of the reserve. The local community will also be responsible for monitoring reserve regulations.

Although the PRRP was originally established to protect the marine resources of the Danjugan Island, its success has led to other proposed reserves in both Negros Occidental and Palawan. This principal of a successful local scale project expanding to regional level is unusual in the Philippines and should be considered by coastal managers aiming to establish a network of reserves. Such an approach also achieved the need to generate stakeholder support since the SNCDP was proposed by local government and communities, rather than by the PRRP.

The PRRP is constantly being refined and expanded and future plans include building a training and education centre in Bulata. This centre will teach coastal communities marine conservation, alternative livelihood, sustainable agriculture, arts and crafts and sustainable development. The long-term aim is to create a model community in Bulata for similar projects elsewhere.

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