SPILL-OVER EFFECTS OF A COMMUNITY-BASED MARINE PROTECTED AREA: THE CASE OF THE DANJUGAN ISLAND MARINE RESERVES AND SANCTUARIES

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ABSTRACT

The Philippine Reef and Rainforest Project (PRRP) began in 1995 as a collaborative project between the Philippine-based NGO, the Philippine Reef and Rainforest Conservation Foundation Inc. (PRRCFI), and the UK-based NGO, Coral Cay Conservation (CCC). The initial aims of the project were to gather information on the natural resources of Danjugan Island, facilitate training in scientific survey techniques and eco-tourism related professions, and to provide comprehensive coral reef education to schools and local communities. The results of scientific surveys carried out by CCC volunteers and PRRCFI staff between 1995 and 1999 led to the establishment of the Danjugan Island Marine Reserve and Sanctuaries (DIMRS) as a statutory marine reserve under the Philippine provincial law in February 2000. Interest in the reserve has filtered through to communities beyond Danjugan and the work expanded to mainland Negros to survey two further municipalities through another project, the Southern Negros Coastal Development Project (SNCDP), between 1998 and 2001.

The positive influence of the DIMRS has led local barangays to develop their own voluntary marine reserves with the technical assistance of PRRCFI staff. Dive surveys in southern municipalities between 1998 and 2001 have provided information on four more proposed marine reserves. Effective long-term community-based education and training, coupled with the provision of alternative livelihood capacity, has resulted in the success of the project

near to source, at Danjugan Island, and within the municipality of Cauayan, Negros Occidental. However, the impact of the overall project is reduced in areas further to the south of Negros Occidental as a likely result of limited resources.

Introduction

The development of networks of marine protected areas has increasingly been recognized as key to the successful implementation of coral reef conservation (Christie *et al.*, 2002; Roberts, 2000; Roberts and Hawkins, 2000) and reef fisheries management (Ward *et al.*, 2001; Roberts and Polunin, 1991; Russ and Alcala, 1989 and 1996 a and b). With the increasing populations of Philippine coastal communities and the growing use of destructive fishing practices (White and Vogt, 2000), the need is greater than ever to conserve the remaining healthy coral reef areas.

Although the Philippines is well known for its coral reef biodiversity, with well over 490 species of hard coral described from the archipelago (Chou, 1998), this is tempered by the fact that only 5% of Philippine reefs remain in pristine condition (Licuanan and Gomez, 2000). Many near-shore Philippine reefs have not only suffered the effects of over-fishing, but also sediment run-off caused by deforestation (Heaney and Regalado, 1998; Hodgson, 1993, 1997). Heaney and Regalado (1998) also documented that the rise in development of the sugar-cane industry has pushed many subsistence farmers to the coasts, which is likely to have resulted in further pressure on coral reefs. Negros Occidental is typical of this situation. The conversion of considerable portions of the countryside to sugarcane farms meant the destruction of original forest cover (causing sedimentation) and the consequent contamination of adjacent fringing reefs by chemical fertilizers (via river run-off). In a recent study by Grimes (2001) carried out at Danjugan Island, nutrient levels for dissolved phosphates appeared to be at 'threshold' levels (Bell, 1992), which

could potentially result in increased algal growth and thereby a shift from coral to algal dominated communities.

However, there is hope as the Philippines is recognized as one of the leading countries in community-based coastal zone management in South East Asia (Rivera and Newkirk, 1997; Uychiaoco *et al.*, 2000), and has been cited for model approaches to managing coral reefs (Christie *et al.*, 2002; White and Deguit, 2000). Indeed, the second International Tropical Marine Ecosystem Management Symposium held recently in Manila (March 2003) gave details of many successful case-study projects in the Philippines (e.g., Trono *et al.*, 2003).

The Danjugan Island Marine Reserve and Sanctuaries (DIMRS) was established under a provincial ordinance in February 2000 as a result of work carried out by the Philippine Reef and Rainforest Project (PRRP). The PRRP began in 1995 with the aims of conserving reef and coastal resources, improving the understanding of coastal environmental issues, and alleviating poverty (Ledesma *et al.*, 1998). The project was facilitated by the Philippine Reef and Rainforest Conservation Foundation Inc. (PRRCFI) which worked with the local community, local government, and international collaborators.

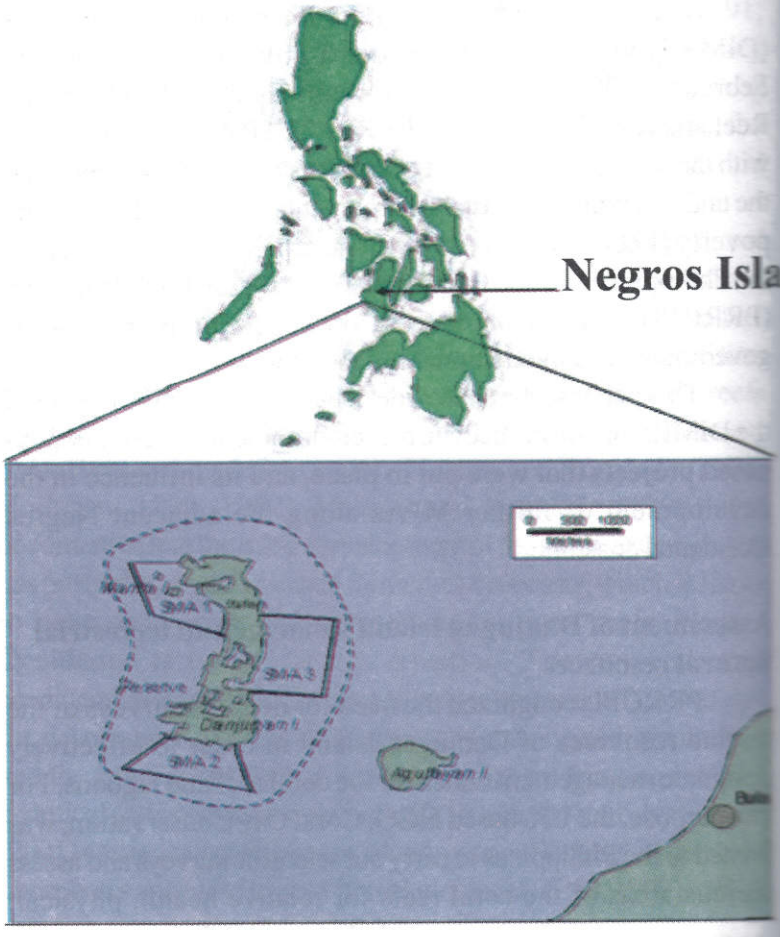
This paper seeks to provide details of the relative impact of the DIMRS on the immediate reef environment, the community-based projects that were put in place, and its influence in the development of further MPAs along the adjacent Negros Occidental coastline.

Assessment of Danjugan Island's marine and terrestrial natural resources

PRRCFI recognized the need for detailed surveys of the marine resources of Danjugan Island in order to effectively designate management zones for the coral reef and lagoons. For this purpose, the UK-based NGO, Coral Cay Conservation, was invited to the Philippines to carry out scientific surveys and assess various areas of the coral reefs for relative health, physical,

oceanographic, and anthropogenic impacts. Coral Cay Conservation baseline (Mumby and Harborne, 1999; Mumby *et al.*, 1995) and Reef Check (Solandt *et al.*, 2001a; Hodgson, 1997) survey methods were used to provide data.[1] SCUBA Surveys and discussions with local fishermen provided the baseline data for selecting three distinct Special Management Areas (fish sanctuaries) around Danjugan Island (Fig. 1).

Figure 1. The location of Danjugan Island Marine Reserve and Sanctuaries (DIMRS). The boundary of the reserve is represented by the dotted line, where permits are needed to fish and extract other resources. The boundary of the three Special Management Areas (fish sanctuaries) are shown by the solid lines.



Further survey work and collaboration with the SEAMAP group from the University of Newcastle resulted in a habitat map (White *et al.*, 2003). A number of maps were generated from acoustic surveys (using RoxAnn sonar) which yielded information on distribution and extent of marine habitats. From this information, maps of substratum distribution were published and validated by the transect data from volunteer surveys. An example of one of the maps describing three broad habitats is presented here (Fig. 2, next page). More detailed maps with five and seven described habitats were also produced to help facilitate management and zoning of the reserve.

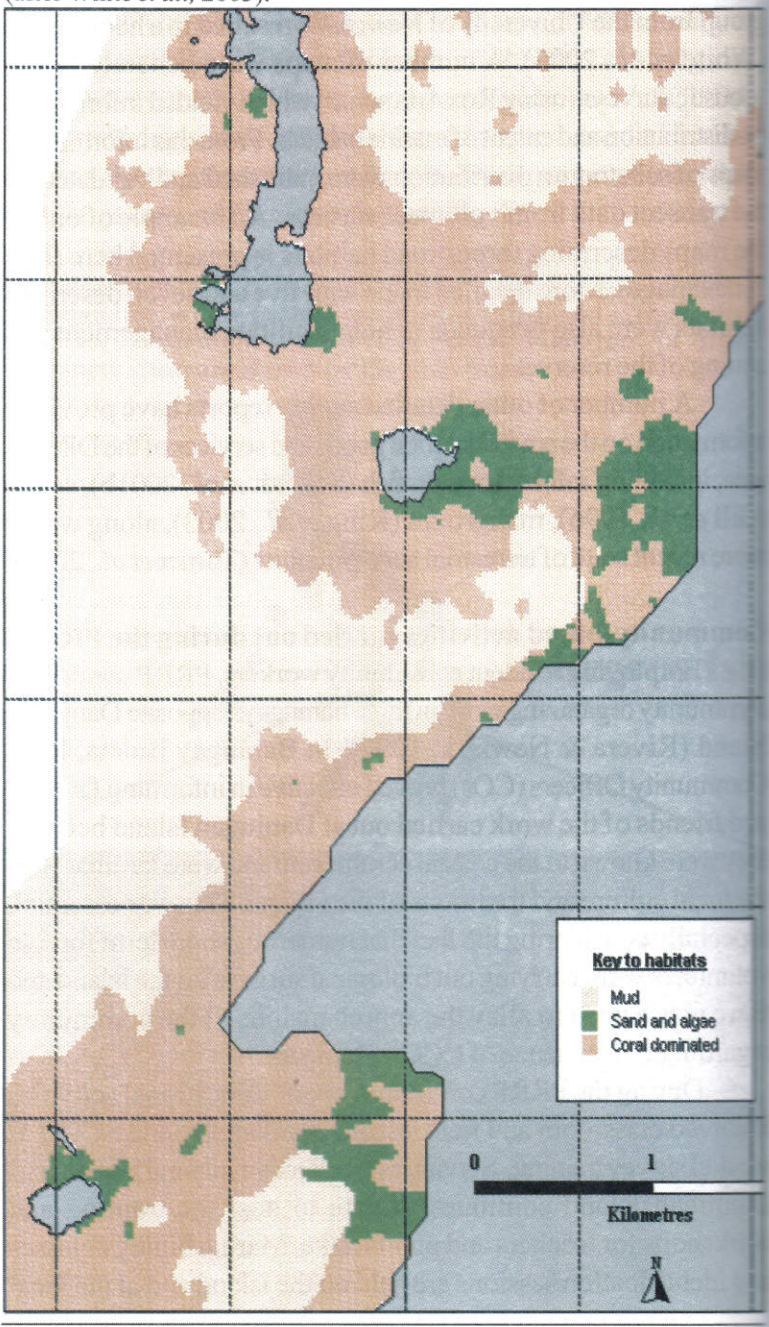
A number of other detailed survey reports have provided information on the environmental goods and services of the DIMRS area, including information on fish (Solandt *et al.*, 2001b), corals (Gill *et al.*, 1996), mangroves (King *et al.*, 2003), along with a more recent suite of terrestrial survey reports (Turner *et al.*, 2002).

Community-based activities carried out during the PRRP

Employing resident community workers, PRRP conducted community organizing work in three barangays opposite Danjugan Island (Rivera & Newkirk, 1997). In Barangay Bulata, local Community Officers (COs) proved effective in informing families and friends of the work carried out at Danjugan Island because they were known to the coastal community and were familiar with the local culture and traditions of the village. This was essential, especially considering the fact that numerous short-term foreign volunteers were carrying out biological surveys on the island and there was a need to allay the apprehensions of the community regarding the presence of CCC volunteers.

During the PRRP community work, educational activities involved classroom and field lessons, workshops, and SCUBA/ snorkel survey training. Serving as an effective 'natural laboratory,' Danjugan Island continues to date to host the training and workshops for teachers and pupils alike. Marine biology classes and identification sessions are held on the island and at the local

Figure 2. Habitat map of Danjugan Island (at top of map), and adjacent Negros coastline showing the distribution of three different marine habitats (after White *et al.*, 2003).



school in Bulata where a marine mural was painted on the school wall. Since most Filipino children seldom get the opportunity to see underwater life, taking the pupils reef snorkeling and on guided walks through the local mangrove could already stimulate conservation awareness. Teacher-training sessions were also carried out on the island to enable schools to introduce local marine wildlife to their classroom lessons.

Participation in coastal clean-up, mangrove growing, and planting and turtle tagging has led the local community to feel a sense of 'ownership' over the local marine resources and encouraged them to engage in other marine conservation activities. A mangrove multi-species nursery project was developed in one of the lagoons of the island to provide seedlings for the adjacent coastal area that had been stripped of natural mangrove vegetation.

About 15 local people were trained in SCUBA use and participated in the CCC-led 'Skills Development Programs.' This activity provided effective integration between the CCC-volunteer science program and PRRCFI community-based resource assessment training. A number of Filipino divers have been trained to PADI Dive Master level and taught detailed coral and fish surveying (reef monitoring abilities) skills. Currently, they constitute the local pool of experts who monitor the effectiveness of the DIMRS and provide information about the benefits of sustainable resource use to other members of the coastal community.

Both the volunteer-driven approach to both the PRRCFI-led community-based training and the CCC-led resource surveys have resulted in the formation of a sustainable Community-Based Coastal Resource Management (CBCRM) program within and around Danjugan Island and the adjoining coast. While many similar projects often collapsed after the withdrawal of funding agencies and personnel, the PRRP's volunteer-driven approach has enabled the project to thrive. The 'built-in' respect for the environment engendered within the community through volunteerism has led to long-term stability within the ecosystem.

Alternative livelihood mechanisms at Danjugan Island

To take pressure off the reef fishery, alternative income was also introduced as an important component of the PRRP. The main alternative livelihood schemes in Bulata centered around two projects: mud crab (*Scylla* spp.) farming, and pig-raising. The mud crab project required a penned area of mangroves to be developed as habitat for adult crabs on the coastal mainland just to the north of Bulata village. Consequently, juvenile mangroves were planted at this site to provide the necessary habitat for the project. These mangrove juveniles originated from trees reared at one of the lagoons on Danjugan Island, thereby leaving the natural mangrove community of the area unaffected. Juvenile crabs were grown from larval stock in one of the lagoons of Danjugan Island and subsequently transferred to the coastal enclosure where they were grown on to marketable size.

However, the mud crab project was not altogether successful because the crabs needed a much larger natural territory area per crab than was originally anticipated by the project. Attempts to set up higher than natural stocking densities on an area approximately $100m^2$ x $100m^2$ only caused crabs, which are highly territorial, to escape from the crowded enclosure through the mesh net. Moreover, with overhead cost proving too high and fieldwork requiring intensive labor, this project was not economically worthwhile.

The pig-raising project focused on fattening and breeding of animals within the village and surrounding areas. Unlike the mud crab project, the expansion of the already present pig-fattening project was more successful mainly because this was already an existing industry within the village before the start of the project and as such, many members of the community already knew the methods and pitfalls of this activity.

Other complementary alternative income schemes were weaving products from pandanus palms (*Pandanus* spp.), production of banana chips, and waste utilization schemes. The

only issue was to convince fishermen to switch entirely to this livelihood.

Spill-over effects of the DIMRS on the surrounding communities

The influence of the PRRCFI/CCC partnership on the successful development of protected areas has inspired local mainland communities to develop their own voluntary fish sanctuaries. The first community to approach PRRCFI was Elihan, located to the South of Bulata (Fig. 3). A small area of coastal reef was identified as a suitable site for a voluntarily-managed fish sanctuary to be managed by the community members themselves. The unique biological features of the Elihan fish sanctuary include many young coral colonies (corals less than 5cm diameter) at areas further offshore (control site 1), and much higher numbers of recruits than reefs located adjacent to Bulata town (control site 2) (Figure 3 + 4, next page). Detailed CCC volunteer surveys also showed that the shallow waters of the bay south of Binigsian Point were dominated by silt and sandy habitats. At the more exposed headland of Binigsian Point, current and wave action is stronger, which is likely to result in higher cover of hard substrate and live corals (at the proposed Elihan fish sanctuary). High coral cover is correlated with, and intrinsically linked to, greater reef fish biomass as it provides greater niche variation and habitat per unit surface area (Roberts and Ormond, 1987) to support fish in greater densities. It is precisely for these reasons that Elihan was chosen as a fish sanctuary (Figure 3).

Barangay Inayauan, located north of Bulata, also sought assistance from PRRCFI to establish a fish sanctuary (Fig. 5). Dives carried out by PRRCFI and CCC scientists (TD and JLS in January 2001), however, deemed the area inappropriate for the establishment of a reserve at the time, as the influence of sedimentation was considerable from a nearby river mouth, while coral cover and fish biomass were minimal.

Figure 3. Location of voluntary fish sanctuary at Elihan (Elihan MPA), and two other control sites surveyed during Reef Check dives in 1999.

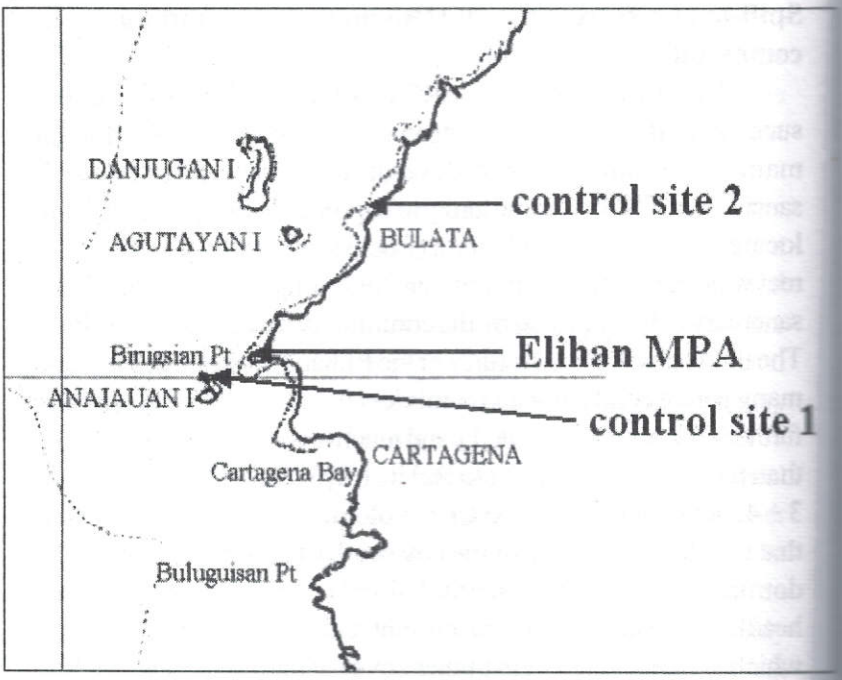
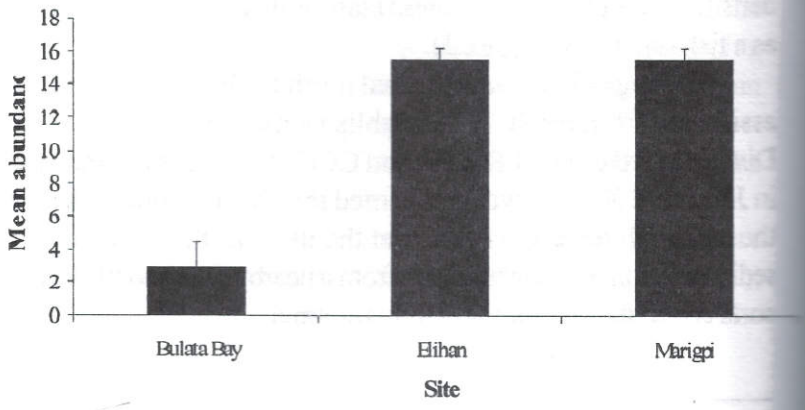


Figure 4. Mean abundance of coral recruits at control site 2 (Bulata Bay), control site 1 (Marigpi), and at the location of the voluntary fish sanctuary (Elihan).



The development of the Southern Negros Coastal Development Programme - Poverty Alleviation and Community Education

The success of the Philippine Reef and Rainforest Project at Danjugan Island in establishing a community-managed marine reserve, coupled with interest from local communities and the support of Governor Rafael Coscolluela of the Province of Negros Occidental, led to the development of the Southern Negros Coastal Development Programme (SNCDP). This provincial program was implemented to carry out scientific reef surveys and community-based training in communities further to the south of Danjugan as well as in the other southern municipalities of Negros Occidental.

In line with the objectives of SNCDP (Table 1), PRRCFI established, led, and coordinated a program called PACE (Poverty Alleviation and Conservation Education). PACE facilitated a modular approach to coastal management and conservation through education and community work aimed at developing alternative livelihoods. PACE was initially funded by a grant from the British Partnership Program (BPP) over a three-year period (1997- 1999) following a joint application from PRRCFI and CCC. PACE aimed to make the communities appreciate their natural resources and to establish the foundation for the sustainable use of these resources through research, education, organization, and skills development.

Activities under PACE started in 1997 when a two-month coral reef assessment pilot project was carried out by CCC in Campomanes Bay (Figure 5+6). From July 1998 until January 1999 the CCC survey project was permanently based in Campomanes Bay where both coral reef assessments and community work took place (Solandt *et al.*, 2002) between Sipalay and northern Nabulao Bay (Fig. 5). Underwater surveys showed that the area of fringing reef to the northern mouth of Campomanes Bay had high coral diversity and has since been recommended for MPA status (Solandt *et al.*, 2002; Beger and

Figure 5. Southern Negros Occidental coastline from the municipality of Cauayan in the north to the municipality of Hinoba-an in the south. Location of all MPAs (statutory, voluntary or proposed) as discussed in this paper is as follows: 1 – DIMRS (statutory); 2 – Elihan (voluntary); 3 – Campomanes Bay (proposed); 4 – Nabulao Bay patch reef (proposed); 5 – Catmon Point (proposed); 6 – Palm Reef (proposed).

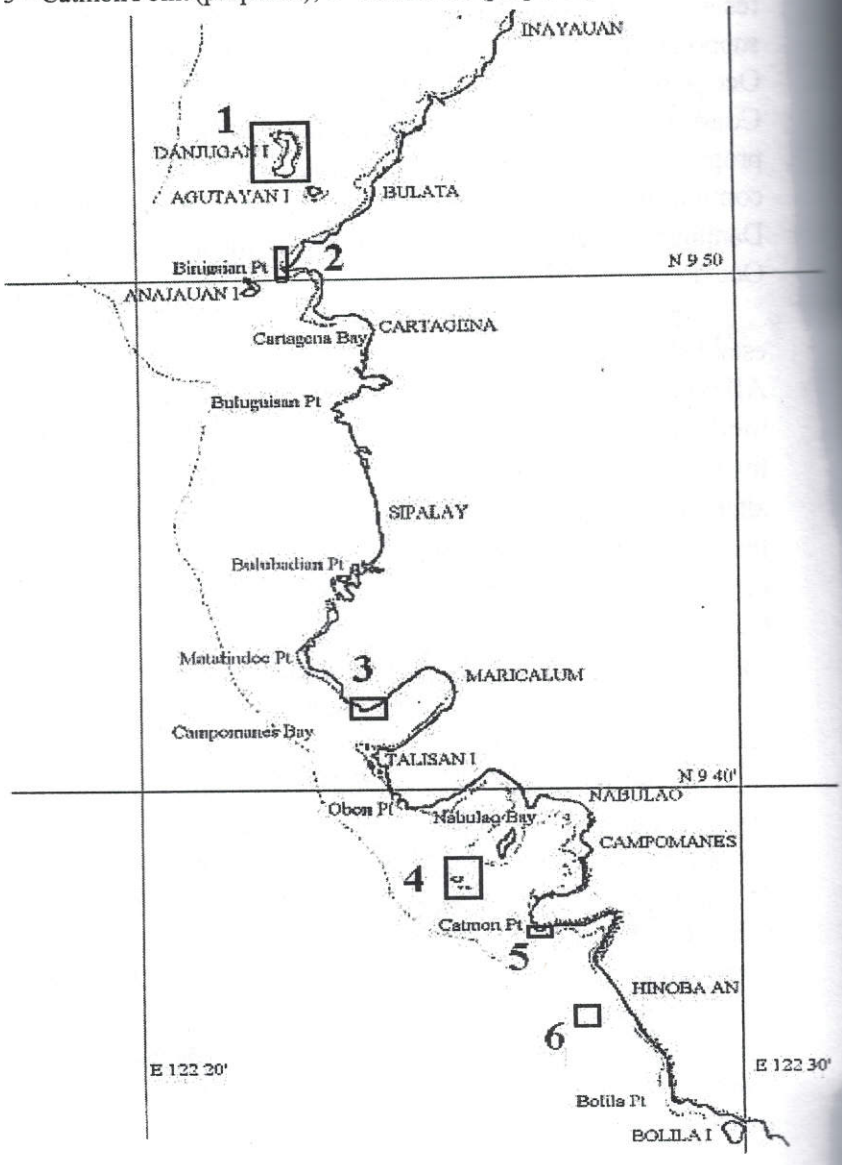
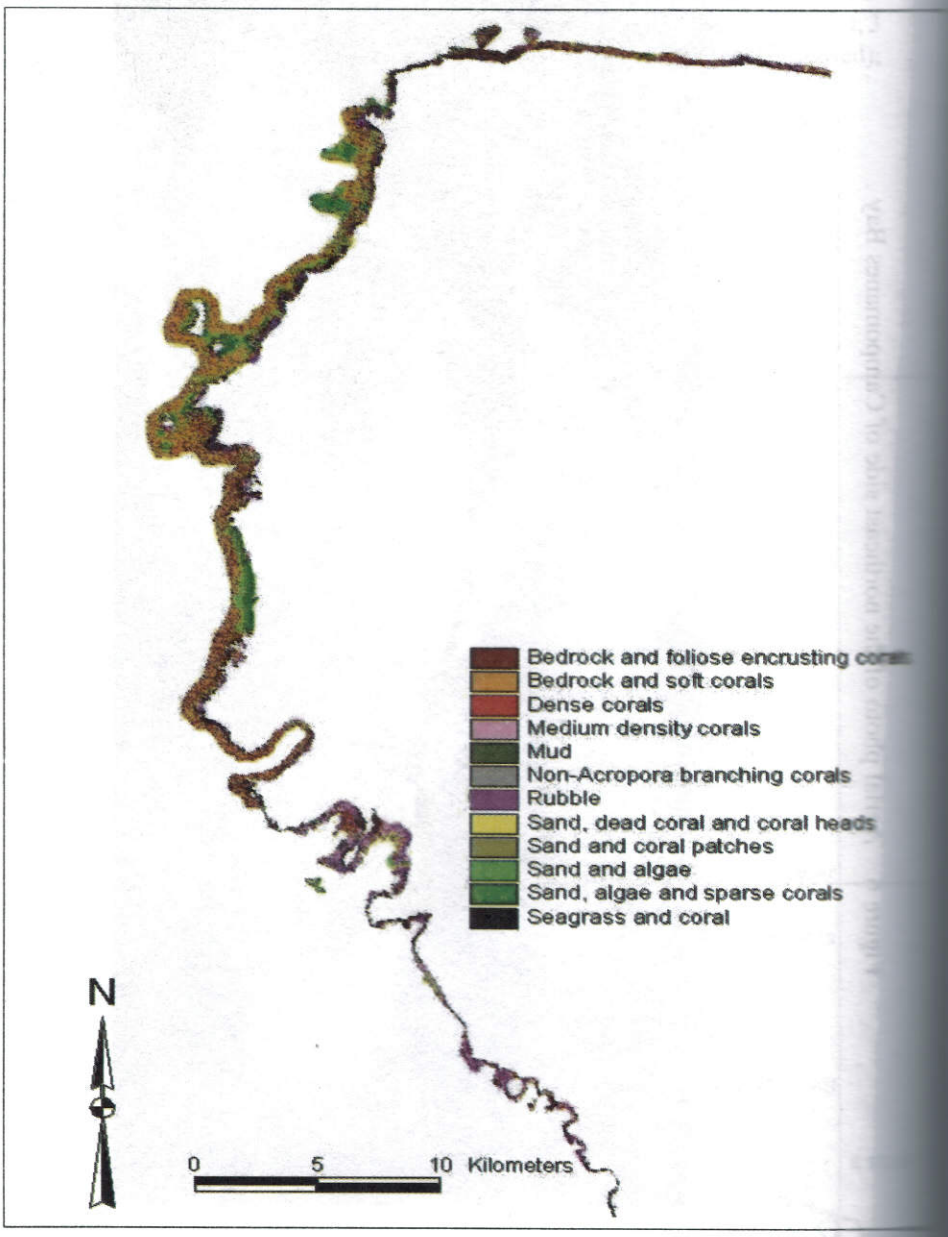


Figure 6. Aerial photo of the northeast side of Campomanes Bay .

Figure 7. Habitat map of South-West Negros developed through resource assessment surveys carried out by CCC/PRRCFI divers, and the University of Leicester (Stephen 2000). (Refer to Figure 5 for town names.)



Harborne, 2000; Dacles *et al.*, 2000) (Fig. 5). PRRCFI community workers were based in Maricalum (adjacent to Campomanes Bay) and Sipalay from where they carried out community-based training in the area.

When all reefs had been surveyed between Danjugan Island and northern Nabulao Bay, activities then moved south to the town of Hinoba-an (2000-2001). Further surveys from this base camp identified three more sites which merited protected area status: Nabulao Bay Patch Reef, Palm Reef, and Catmon Point (Fig. 5). Local agricultural officers from Hinoba-an municipal offices were trained in the use of SCUBA and reef-monitoring techniques at the Hinoba-an base camp.

The initial stages of the SNCDP project carried out baseline resource assessment surveys, training of local communities, and the development of school partnership projects. As a direct result of the scientific investigations, coastal management recommendations have since been presented to the local community via the Mayor's office of the municipalities of Sipalay and Hinoba-an respectively. These reports recommended at least 5 potential sites to be designated as Marine Protected Areas for Sipalay (Dacles *et al.*, 2000), and Hinoba-an (Solandt *et al.*, 2001c) reefs. The aim of this proposal was to establish a chain of marine reserves in three municipalities in Southern Negros (see Fig. 5).

Lessons learned and challenges ahead

The principal successes of the project were the publication of four key reports recommending the development of Marine Protected Areas in the municipalities of Sipalay and Hinoba-an for the purpose of providing a network of protected areas which will benefit genetic flow and larval transfer of reef fish and invertebrates between different coastal areas (Beger and Harborne, 2000; Dacles *et al.*, 2000; Solandt *et al.*, 2001b; Solandt *et al.*, 2002).

Monitoring quadrats and Reef Check surveys were laid at two of the southern-most sites in the municipality of Hinoba-an, Catmon Point, and Palm Reef, and the coordinates of these quadrats have been noted for future repeat monitoring by local communities.

Around 2500 UK-based and hundreds of Philippine volunteers and staff have contributed to the success of the survey project along the coast. As a result, a habitat map which shows areas of high coral cover at different locations along the Negros Occidental coast (Fig. 7) was also developed between CCC/ PRRCFI in collaboration with the University of Leicester (Stephens, 2000).

As a result of community training at CCC base camps in Campomanes Bay and Hinoba-an, local fishermen and employees of local government offices have been introduced to CCC survey methodologies, and trained in the identification of reef flora and fauna (fish, invertebrates, algae, and coral). (Table 1). SNCDP program staff visited local schools and invited children from both Sipalay and Hinoba-an to visit Danjugan Island and to participate in educational camps. Formal meetings between PRRCFI, CCC, and municipal staff have led to an ingrained sense of responsibility for the marine environment at municipal level in the south of Negros. However, it will take more time and effort to carry this process through to action on the ground such as has been the case for communities like Elihan and Bulata.

Notes

[1] It is beyond the scope of this paper to go into detailed descriptions of methodology - please see Mumby and Harborne, 1999; Mumby *et al.*, 1995; Solandt *et al.*, 2002)

Table 1. Main aims, objectives and anticipated outputs of the Poverty Alleviation and Community Education (PACE) programme in line with the Southern Negros Coastal Development Programme (SNCDP), and its achievements thus far with regard to all areas described in this paper (after Beger and Harborne, 2000).

		ACHIEVED AT:		
AIM	OBJECTIVE	DIMRS	ELIHAN	SNCDP
➲ Resource assessment coral reefs.	❶ Undertake a scientific survey of target coral reefs.	Yes	Yes	Yes
	❷ Conduct preliminary human impact assessment studies.	Yes	Yes	Yes
	❸ Establish a baseline database.	Yes	Yes	Yes
	❹ Provide management tools and recommendations for the establishment of marine reserves and sanctuaries.	Yes	Yes	Yes
➲ Resource assessment and restoration mangroves.	❶ Undertake a scientific survey of mangroves.	Yes	No	No
	❷ Re – establish mangroves in coastal areas.	Yes	No	No
➲ Environ-mental Monitoring.	❶ Establish and validate a monitoring program within the project area.	Yes	Yes	Yes
➲ Training and conservation education.	❶ Provide coral reef ecology and SCUBA training for local counterparts and CCC volunteers.	Yes	No	Yes
	❷ Heighten awareness of marine and coastal resources, their use and protection.	Yes	Yes	Yes
➲ Community organization and alternative livelihood.	❶ Provide organizational training for local communities.	Yes	No	No
	❷ Organize environmental activities with local and CCC volunteer groups.	Yes	Yes	No
	❸ Develop a sense of community stewardship in monitoring and managing the coastal zone.	Yes	Yes	No
	❹ Develop alternative livelihood projects.	Yes	No	No
➲ Resource management.	❶ Establish community based coastal zone management plan.	Yes	No	No
	❷ Establish a chain of marine reserves in three municipalities: • Hinoba-an • Sipalay • Cauayan	N/A	N/A	No
	❸ Community based and controlled nature tourism.	Yes	No	No

References

Beger, M. and A.R. Harborne (2000). The Southern Negros Coastal Development Programme. Summary Report to the Municipality of Sipalay. Technical Report, Coral Cay Conservation, London.

Bell, P.R.F. (1992). Eutrophication and Coral Reefs - Some examples in the Great Barrier Reefs Lagoon. Water Resources. 5: 553-568.

Chou, L.M. (1998). Status of Southeast Asian Coral Reefs. *In* C.R. Wilkinson, (Ed). Status of coral reefs of the world: 1998. Australian Institute of Marine Science, Townsville, Australia.

Christie, P., A. White, and A. C. Alcala, A. (2002). Starting point or solution? Community-based marine-protected areas in the Philippines. Journal of Environmental Management. 66: 441-454.

Dacles, T., M. Beger, and G. L. Ledesma (2000). Recommendations for location and level of protection of marine protected areas in the municipality of Sipalay. CCC/PRRCFI technical report presented to the Mayor of Sipalay, Coral Cay Conservation, London. 17 pp.

Gill, A., A. Harborne, P. S. Raines, and J. Ridley (1996). Danjugan Island marine reserve – Preliminary report to the Philippine Reef and Rainforest Conservation Foundation Inc. CCC Technical report, Coral Cay Conservation, London. 39pp.

Grimes, A.J. (2001). A summary biogeochemical report of the shallow fringing reefs of Bulata and Danjugan Island. Msc thesis, University of Plymouth. 35pp.

Heaney, R.L. and J. C. Regalado (1998). Vanishing treasures of the Philippine rain forest. The Field Museum, Chicago, Illinois, USA. 88pp.

Hodgson, G. (1997). Resource use: Conflicts and management solutions. *In* Life and death of coral reefs. C. Birkeland (Ed.). Chapman and Hall, London. Chapter 17: 386-409.

Hodgson, G. (1993). Sedimentation damage to reef corals. *In* R.N. Ginsberg (Ed.). Proceedings of the colloquium and forum on global aspects of coral reefs: Health, hazards and history. Pages 520-525. Rosenstiel School of Marine and Atmospheric Sciences, University of Miami, 420 pp.

King, T., C. Turner, T. Dacles, J-L. Solandt, and P. S. Raines (2002). The mangrove communities of Danjugan Island, Negros Occidental, Philippines. Silliman Journal 43(1): 153-167.

Ledesma, G.L., M. Beger, G. Goby, A. R. Harborne, and P. S. Raines (1998). The Philippine Reef and Rainforest Project: An integrated approach to establishing marine protected areas. The Symposium on Marine Biodiversity in the Visayas and Mindanao, Iloilo, Philippines.

Licuanan, W.Y. and E.D. Gomez (2000). Philippine coral reefs, reef fishes and associated fisheries. Status and recommendations to improve their management. Global Coral Reef Monitoring Network Report.

Mumby, P.J. and A.R. Harborne (1999). Development of a systematic classification scheme of marine habitats to facilitate regional management and mapping of Caribbean coral reefs. Biological Conservation 8: 155-163.

Mumby, P.J., A.R. Harborne, P.S. Raines, and J.M. Ridley (1995). A critical assessment of data derived from Coral Cay Conservation volunteers. Bulletin of Marine Science. 56: 737-751.

Rivera, R. and G. F. Newkirk (1997). Power from the people: A documentation of non-governmental organizations' experience in Community-based Coastal Resource Management in the Philippines Ocean and Coastal Management. 36: 97-120.

Roberts, C.M. and N. V. C. Polunin (1991). Are marine reserves effective in management of reef fisheries? Reviews in Fish Biology and Fisheries. 1: 65-91.

Roberts, C.M. (2000). Selecting marine reserve locations: Optimality versus optimism. Bulletin of Marine Science. 66(3): 581-592.

Roberts, C.M. and J.P. Hawkins (2000). Fully protected marine reserves: A guide. *WWF endangered Sea Campaign*. 1250 24th St., NW, Washington, USA. 131pp.

Roberts, C.M. and R.F.G. Ormond (1987). Habitat complexity and coral reef fish diversity and abundance on Red Sea fringing reefs. Marine Ecology Progress Series. 41: 1-8.

Russ, G.R. and A. C. Alcala (1996a). Marine reserves: Rates and patterns of recovery and decline of large predatory fish. Ecological applications. 6(3): 947-961.

Russ, G.R. and A. C. Alcala (1996b). Do marine reserves export adult fish biomass? Evidence from Apo Island, Central Philippines. Marine Ecology Progress Series. 132: 1-9.

Russ, G.R. and A.C. Alcala (1989). Effects of intense fishing pressure on an assemblage of coral reef fishes. Marine Ecology Progress Series. 56: 13-27.

Solandt, J-L., Cadbury, S., Raines, P.S., and G. L. Ledesma (2002). An assessment of subtidal surveys carried out at Campomanes Bay, Negros Occidental. CCC Technical Report submitted to PRRCFI, Coral Cay Conservation, London. 93 pp.

Solandt, J-L., J. Slater, M. Beger, and A. R. Harborne (2001a). Danjugan Island, Negros Occidental, Philippines: Reef Check Report 1997 - 1999. Danjugan Island Survey Summary Report #4 to the Philippine

Reef and Rainforest Conservation Foundation Inc., Coral Cay Conservation, London. 25pp.

Solandt, J-L., M. Beger, and A.R. Harborne (2001b). Reef fish populations around Danjugan Island, Negros Occidental, Philippines. Danjugan Island Survey Summary Report #3 to the Philippine Reef and Rainforest Conservation Foundation Inc., Coral Cay Conservation, London. 32 pp.

Solandt, J-L., M. Beger, and T. Dacles (2001c). Preliminary recommendations for the location of marine protected areas in the Municipality of Hinoba-an. CCC/PRRCFI Technical report presented to the mayor of Hinoba-an, Coral Cay Conservation, London. 13pp.

Stephens, I. (2000). Remote sensing of tropical coasts. Msc thesis, University of Leicester, UK. 115pp.

Trono, R.R., G. L. Ledesma, J. Lizaris, J. Comley, S. Harding, J-L. Solandt, and P.S. Raines (2003). The Mabini-Tingloy Marine Biodiversity Conservation Project – A collaborative approach to marine environmental protection. Proceedings of the 2nd International Marine Ecosystem Management Symposium, Manila, Philippines.

Turner, C., T. King, R. O'Malley, M. Cummings, and P. S. Raines (2002). Danjugan Island biodiversity survey (terrestrial). CCC Technical Report to PRRCFI, Coral Cay Conservation, London. 79pp.

Uychiaoco, A.J., P. M. Alino, and A.L. Dantis (2000). Initiatives in Philippine coastal management. An overview. Coastal Management. 28: 55-63.

Ward, T.J., D. Heineman, and N. Evans (2001). The role of marine reserves as fisheries management tools: A review of concepts, evidence and international experience. Bureau of Rural Science, Canberra, Australia. 192pp.

White, A.T. and E. Deguit (2000). Philippine community-based coastal management: Evolution and challenges. Intercoast. 6-31.

White, A.T. and H.P. Vogt (2000). Philippine coral reefs under threat: Lessons learned after 25 years of community-based reef conservation. Marine Pollution Bulletin. 40(6): 537-550.

White, W.H., A. R. Harborne, I. S. Sotheran, R. Walton, and R. L. Foster-Smith (2003). Using an acoustic ground discrimination system to map coral reef benthic classes. International Journal of Remote Sensing. 24 (13): 2641-2660.