

# ***Danajon Bank Double Barrier Reef:***

**A Unique Resource in Peril**

*The sustainable use and management of Danajon Banks's coastal and fisheries resources is critical not only to its coastal communities but also to the whole Central Visayas region.*

**T**he Danajon Bank or Double Barrier Reef, located off northern Bohol Island, is the only double barrier reef in the Philippines and is 1 of only 3 such sites in the Indo-Pacific (Pichon, 1977). The reef is spread across almost 130 km and consists of 3 large reefs. Caubyan is the largest covering about 143 km<sup>2</sup>. There are 5 smaller reefs in the northern outer region and 1 other large

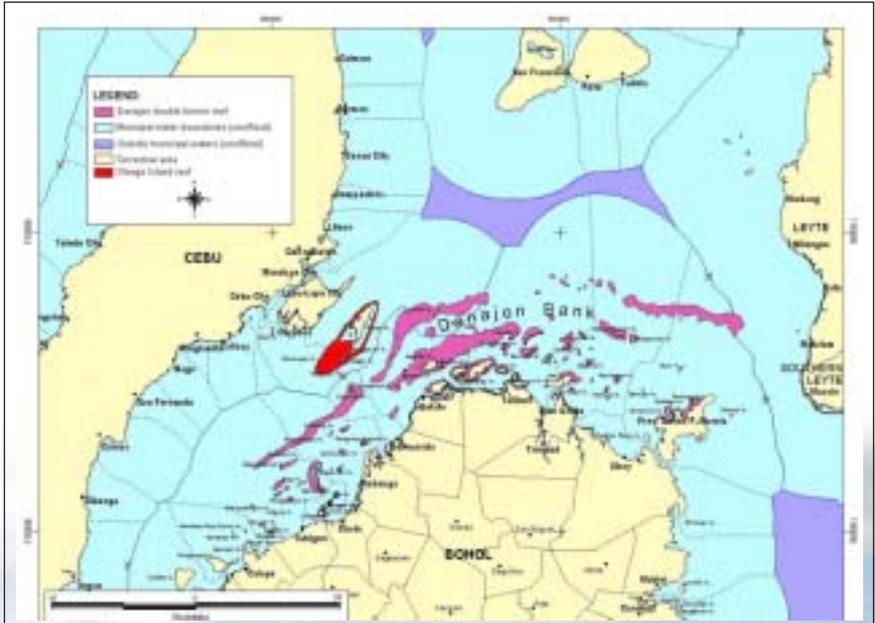
reef, Calitubas, in the inner region. The overall area of the Danajon Bank is 272 km<sup>2</sup> with an aggregate coastline of 699 km including 40 islands. The Danajon Bank makes up over 1% of the total area of coral reef of the Philippines (estimated at 27,000 km<sup>2</sup>).

Sixteen municipalities and 1 city include the Danajon Bank within their area of jurisdiction, within 4 provinces and 2 regions. In Region 7, 10 municipalities belong to Bohol and 2 to Cebu. In Region 8, 4 municipalities belong to Leyte and 1 city to Southern Leyte. The shoreline of all 16 municipalities and 1 city covers 699 kms. Ten National Integrated Protected Area System (NIPAS) sites occur within these seascapes (Green *et al.*, 2002). To date, 60 community and municipal-based marine protected areas (MPAs) have been established within the area in various stages of protection and management. The Fisheries Improved for Sustainable Harvest (FISH) Project activities focus on 4 Bohol municipalities with jurisdiction on the Danajon Bank.

**Municipalities with jurisdiction over the Danajon Bank**

Province	Municipality	Shoreline kms
Bohol	Tubigon	28
	Clarin	29
	Inabanga	62
	Buenavista	32
	Getafe	77
	Bien Unido*	45
	Trinidad	8
	Ubay*	61
	Pres. Carlos P. Garcia*	76
	Talibon*	86
Cebu	Lapu-Lapu City	112
	Cordova	21
Leyte	Matalom	14
	Bato	4
	Hilongos	12
	Hindang	7
Southern Leyte	Maasin City	25
<b>Total</b>		<b>699</b>

\*Focal area municipalities of the FISH Project



Map of jurisdiction over Danajon Double Barrier Reef, FISH Project 2005.

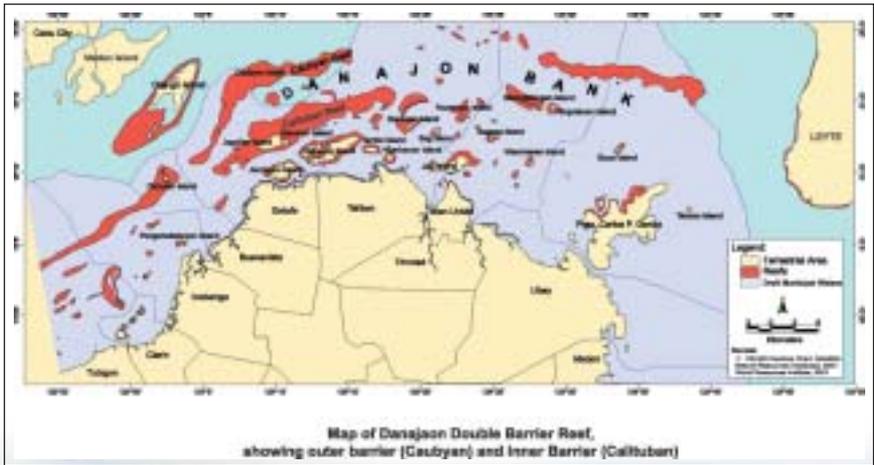
## ***Location and Significance***

Danajon Bank is one of the few documented double barrier reefs in the world and is a very rare geological formation. Located off the northwest coast of Bohol, it comprises two sets of large coral reefs that formed offshore on a submarine ridge due to a combination of favorable tidal currents and coral growth in the area. It is believed that the reefs were formed over the last 6000 years.

Danajon's double barrier reef is a larger and better-defined structure than other known double barrier reefs in the world. The outer reef lies 11 km offshore, and is composed of several units up to 23 km long each. The inner barrier is 2 km wide and separated from the littoral by an inshore channel 28 m deep at most.



Stuart J. Green



The Philippines has been recently recognized as the “center of the center of marine shore fish biodiversity” in the world, with the peak of marine biodiversity as occurring in the central Philippine Islands (Carpenter and Springer, 2005). It is likely that given its location in Central Philippines, the Danajon Bank area has been historically an evolutionary source of fish and coral species in the Philippines (Christie *et. al.*, 2005).

***“Center of the center of marine shore fish biodiversity.”***

Danajon Bank has a high degree of diversity in its marine flora and fauna. Its location inside an “inland” sea (the Camotes Sea) contributes to endemism within the high diversity of fish, coral and other invertebrates and algae species. The large reef structure, relatively protected from strong currents and storms encourages a wide variety of micro-habitats to flourish inside and adjacent to the reef lagoons and slopes. Its location also protects it from strong monsoon winds and heavy oceanic swells.

Overall, the Bank is a most important source for biodiversity and a large breeding area for many species of finfish, shellfish and invertebrates. It is also a critical pathway of the Asian southward bird migratory route.

Danajon Bank plays a major role in the fishing industry of the Province of Bohol. About 54% of the fishers, 44% of the non-motorized boats and 62% of the motorcrafts of the entire province



are found in the 9 coastal municipalities bounding the Danajon Bank. In addition, it is a critical fishing ground for fishers from Cebu, Leyte, and Southern Leyte who have for many generations relied on fishing in the area for their subsistence and livelihood.

## ***Coastal Resources: Status and Threats***

### **Coral Reefs, mangroves and seagrass**

Danajon Bank has approximately 270 sq km of coral reefs whose productivity could be worth US\$ 8 million per year if managed well (Christie *et. al.*, 2005). The area surrounding the double barrier reef is composed of coral reefs, mangroves and seagrass habitats in shallow and relatively well-protected waters. Highly productive, it is home to a vast array

***Historically,  
the Bank is the  
most habitat-  
rich fisheries  
ecosystem of  
Central Visayas,  
having the  
largest areas  
of both coral  
reefs and  
mangroves  
in the region.***

of commercially valuable reef fishes, shellfish, crustaceans and invertebrates such as sea cucumbers and sea urchins. Its extensive seagrass beds are nursery and feeding grounds for various species of rabbitfish (Siganids) and sea horses, while its mangroves are spawning habitats for crustaceans, shrimps and various fishes. A survey



***Unfortunately, over the years, the Danajon Bank area has been subjected to extremely high fishing pressure, largely through illegal and destructive fishing methods. The area was also a magnet for live fish as well as tropical aquarium trades. Use of cyanide and compressors are widespread, and so are dynamite fishing, trawl fishing and the use of fine mesh nets.***

conducted in 2004 show that the area's coral diversity is high, with 211 hard coral species (205 scleractinian in 15 families and 6 non-scleractinian in 4 families) inhabiting Danajon Bank (Calumpong, Silliman University, 2004).

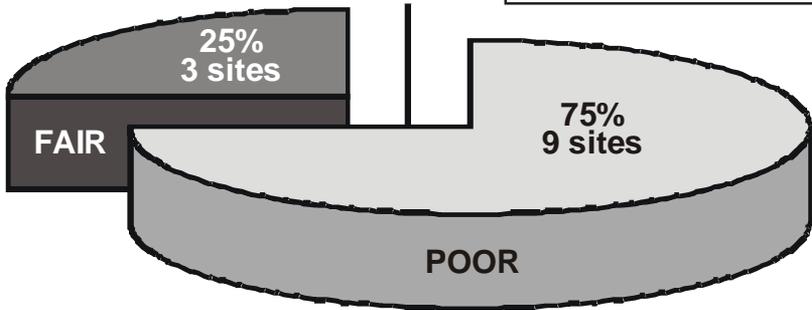
Danajon Bank is rich in mangrove habitats found mostly in the coastal areas of Getafe to Calape, with significant patches along the coastlines of Talibon and Bien Unido. Mangroves cover an area of 5,250 ha and fishponds in mangrove areas cover 4,750 ha. The Danajon area also contains one of Southeast Asia's largest human-made mangrove forest in Banacon Island with over 2,000 ha of *Rhizophora* spp (Green *et. al.*, 2004).

Another critical fish habitat in Danajon Bank are its extensive seagrass beds that serve as feeding grounds and nursery areas for bottom-dwelling marine organisms including various species of rabbitfish, mollusks, seahorses,

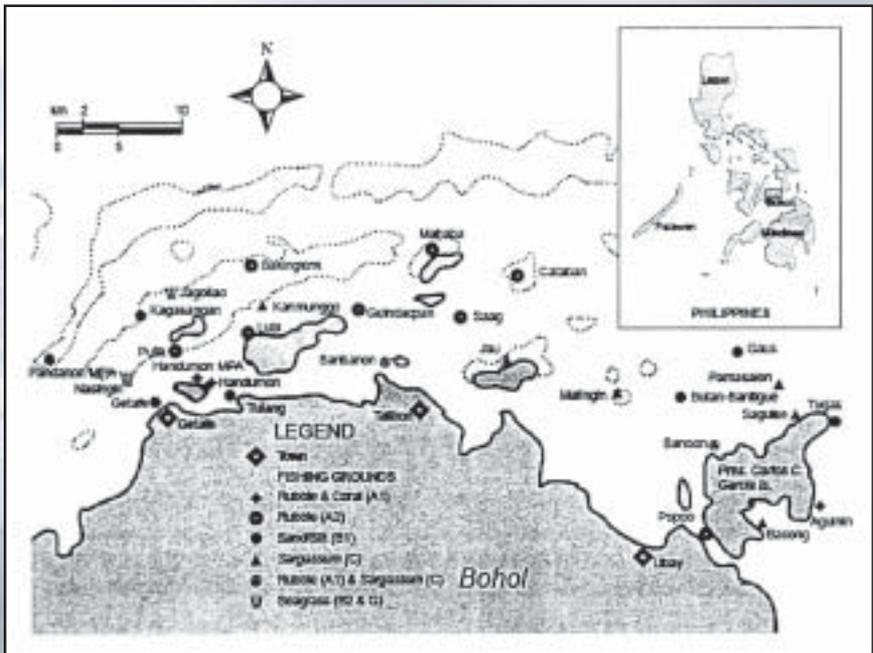
sea cucumbers and sea urchins. Almost all species of sea grass that occur in the Philippines are represented, although currently, fish fauna in the sea grass beds are quite sparse and consisting mostly of juveniles.

In a 1995 survey of northern Bohol, it was determined that dynamite fishing was the preferred method of fishing in the area because it yielded the highest average catch of 17.5 kg per person per hour (ADB *et. al.*, 2003). Since that time, fish catch, even with the use of dynamite has considerably dwindled because of the absence of fish and the destruction of its habitats. The use of dynamite and cyanide has severely degraded the area's reefs with

Fair: 25% - 49% live hard coral cover  
 Poor: 0 - 25% live hard coral cover



**Status of live hard coral cover in Danajon Bank coral reefs in 2004**  
 (Calumpang, 2004).



**Benthic conditions on 28 near-shore reef fishing grounds** (Marcus *et al.* in press).

current living coral cover standing at less than 25% (Fish Project 2005.). This finding show that living coral cover had decreased in 2004 from the mean cover of 29.5 per cent when compared to a similar survey conducted in 1996 (Reboton and Luchavez 2002).



Recent study of 28 near-shore, reef fishing grounds also found benthic conditions in Danajon to be in poor condition with 32% rubble, 28% sand or silt, 9% dead coral and only 12% live coral (Marcus *et. al.*, in press).

The study also observed that presently, the macro invertebrate fauna of the sample sites were poor in diversity and density. Only a few sites had economically important species of sea urchins, sea cucumbers, mollusks and crabs.

In addition to fishing-related disturbances, the overall reef condition is also degraded due to the following: 1) sediment accumulation, prohibiting coral and seagrass regrowth; 2) high population density within Danajon's island communities which has led to conversion of more land for settlements, agriculture and landfills for waste disposals resulting to increased pollution load in the area; and 3) removal of mangroves and their conversion to other uses that have exacerbated sedimentation and terrestrial run-offs, the loss of critical nursery habitats as well as shoreline resilience to erosion and storms.

A final threat to these habitats is the poverty of northern Bohol and surrounding provinces. Over 60 percent of the coastal inhabitants of northwestern Bohol live below the poverty line of P6,000 per month driving fishers to catch smaller fish and to use more efficient but destructive fishing methods (Green *et. al.*, 2002).

## ***Fishery Resources: Status and Threats***

Given its varied habitats of coral reefs, mangroves and seagrass beds, Danajon Bank harbors various species of finfish, shellfish, crustacean and invertebrates. These include reef fishes such as grouper (*pugawo*) and snapper (*maya-maya*) and small pelagics such as scads, roundscads and bullet tunas. Among the invertebrates that abound in the area are blue crabs, shrimps, squids and sea cucumbers. Seagrass-associated fish such as siganids or rabbitfish also inhabit the area as well as anchovies and garfish.

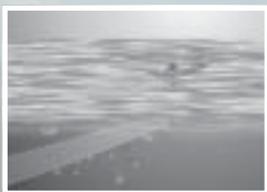
Danajon Bank has been subjected to extremely high fishing pressure, largely through illegal as well as destructive fishing

**The most common gears were the crab gillnet (*panglambay*), simple hook and line (*pasol*), squid troll (*ulang-ulang*), bottom-set gillnet (*palugdang*), spear fishing (*pamana*), drift gillnet (*palutaw*), multiple handline (*bira-bira*), bottom-set gillnet longline (*palangre*), fish corral (*bungsod*), crab liftnet (*sapyaw*) and crab pot (*panggal*).**

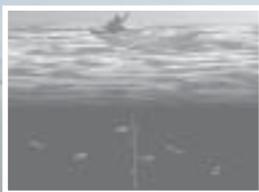
methods. Fisheries outside of the shallow reef areas are also heavily exploited by a combination of small-scale locally based fishers and commercial fishing boats that fish illegally inside municipal waters.

It is reported that there are approximately a total of 17,693 fishers in the municipalities of the Bohol side of Danajon Bank. Of these, 5,083 or 43.5% fish with non-motorized boats, while 5,557 or 62.1% fish with motorized boats (Green, 2004). A partial inventory of fishing gears conducted by the FISH Project in 2004 showed that there were about 5,000 fishing gear units in the four municipalities of the FISH focal area belonging to at least 20 generic types and 44 specific types.

Trawl survey conducted by the FISH Project in 2004 showed



Bottom-set gillnet (*panglambay*)



Multiple handline (*bira-bira*)



Bottom-set longline (*palangre*)



Fish corral (*bungsod*)



Crab pot (*panggal*)

a very low demersal biomass density of 0.44 t/sq km for the Danajon Bank, which is more or less the same as the demersal biomass density estimated for Manila Bay in 1992-1993 (Armada, 1994). The catch as shown in this survey is composed mainly of low valued species such as the slipmoutns (*potpot*), puffer fish (*butete*), flat head (*sunugan*), goatfish (*timbangnan*) and cardinalfish (*moong, pangan*), species of fish that may be considered trash fish two decades ago (FISH Project, 2004).

The results of bottom-set longline (*palangre*) survey conducted by the FISH Project also showed a very low catch rate in Danajon Bank with 4.77 kg per fishing operation despite the 1000 number of hooks used in the area. The catch was dominated by the crescent perch (*bugaong*), emperor (*katambak*) and threadfin bream (*lagaw*). High valued fishes such as the grouper (*pugawo*) and snapper (*maya-maya*) were not well represented in the catch. The catch and effort monitoring conducted likewise showed very low catch rates of many fishing gear types.

***The following are Danajon Bank's most important fisheries problems/issues as identified by municipal fishers in a coastal law enforcement assessment workshop conducted by the FISH Project in 2004:***

- 1. Commercial fishing in municipal waters***
- 2. Use of trawl (palakaya), danish seines (liba-liba, hulbot-hulbot)***
- 3. Dynamite/blast fishing***
- 4. Use of compressor (hookah) and cyanide***
- 5. Use of fine mesh nets***
- 6. Collection of corals***
- 7. Mangrove cutting/ conversion into other uses***
- 8. Marine sand quarrying/ mining***
- 9. Increasing pollution***

## **Socio- Economic Context**

Fishing communities are among the poorest and most marginalized in the Philippines. It is reported that over 60 percent of the country's coastal inhabitants live below the poverty line of Php 6,000 per month for a family of 5-6 members. Danajon Bank's coastal communities are no exception.



Approximately 50% of the population of Northwest Bohol is engaged in fishing, with only 5% of coastal inhabitants owning agricultural land (Calumpong *et. al.*, 1997). In some instances as in the island of Hingotanan, seaweed farming has brought some relative prosperity to its island residents. Not everyone in the other island communities are into seaweed growing however, with a good number continuing to engage in illegal and destructive fishing practices as their means of maximizing the sea's bounty.

As such, with a rapidly growing population, limited livelihood options and degraded marine resources, economic diversification is a key dimension to the sustainable development of Danajon Bank communities.

### ***A difficult situation...***

- *In 1997, the average monthly income from fishing was Php1,830 per month*
- *In 1997, over 60 percent of the coastal inhabitants lived below the poverty line of Php6,000 per month for a family of 5-6 members*
- *Current annual growth rate is 2.85%*
- *Population projected to double in 28 years*
- *Since 1990, the coastal population in Region 7 has increased 24.7% and Bohol's population has grown by 19.5% (NSO 2001).*

## ***Past and Current Management Interventions***

A variety of management efforts have been initiated in the past and a few are ongoing in the Danajon Bank area. NGOs/donor supported projects that have worked with selected municipalities include:

- Haribon Foundation through its Project Seahorse Pamanaka sa Pilipinas
- Project Seahorse Foundation (now independent from Haribon)
- Local Government Development Foundation (LOGODEF)
- Feed the Children
- Coastal Resource Management Project (CRMP) of USAID
- Bohol Environmental Management Office (BEMO)
- Japan International Cooperation Agency (JICA)
- Southeast Asian Fisheries Development Center (SEAFDEC)
- Community-Based Resource Management Program of the Department of Finance (DOF) and the World Bank

Support from these various donor-funded projects/NGOs resulted in coastal resource management initiatives such as activation of POs, resource assessment activities, development of CRM plans, formulation of comprehensive fishery ordinances, the establishment of marine protected areas/marine sanctuaries, coastal law enforcement, activation of Fisheries and Aquatic Resource Management Councils (FARMCs) and introduction of livelihood projects.

However, currently, majority of the approximately 27 small MPAs legally established in the area, are not effectively managed or implemented, and have not resulted in much beneficial impact in terms of protecting habitats or sensitive species. In addition, law enforcement against illegal fishing has been inconsistent and sporadic.

In 2002, a technical working group was formed to study the best structure to operationalize the Danajon Bank Protection and Conservation Inter Province Growth Quadrangle. A memorandum of agreement creating the Cebu-Leyte-Bohol-Southern Leyte (CeLeBoSoLe) Council and technical working group for the management and conservation of Danajon Bank was signed among the Governors (except Cebu), mayors (except Lapu-lapu City) and

representatives of other concerned government agencies (BFAR, PNP Maritime Group, PCG, DENR, NEDA, DILG, and the Office of the President for Central Visayas.

The agreement was a land mark initiative as it recognized the unique importance of Danajon Bank and affirmed the collective commitments of the signatory parties to pursue an ecosystem-based management program. If operationalized, the Council offers promise of an effective conduit and system for future coordination and integrated conservation activities for Danajon Bank and its surrounding areas. It is critical that Cebu Province and Lapu-lapu City participate in the council since many fishers on Danajon Bank come from Cebu, particularly the Mactan and Olango group of islands.

### **Opportunities for the sustainable management of Danajon Bank's coastal and fishery resources**

Overall, research and information point to the need to ban all illegal fishing methods and gears from the area and to implement/enforce appropriate fishery laws and ordinances. This entails the strengthening of local enforcement capabilities to strictly regulate or prohibit the use of active fishing gears such as beach seines (*baling*), Danish seine (*liba-liba*), round haul seine (*lawag*) and baby trawl (*palakaya*) in municipal waters.

The need for such regulation is particularly true in the case of *lawag*, or round haul seine which is used to catch anchovies (*bolinao*). The size composition of *bolinao* caught by *lawag* is comparable to other fishing gears. However, the problem arises when *lawag* starts to catch other species of fish that grow bigger. It is clear that the use of *lawag* only becomes destructive when fishers start catching the juveniles and early stages of other species of fish. For *lawag* and other similar gears, it must be very specific as to the time/season when it is allowed or prohibited.

The sustainable use and management of Danajon Bank's coastal and fisheries resources is critical not only to its coastal communities but also to the whole Central Visayas region. Among the strategies that are needed to directly manage the fisheries resources of the area through the various LGUs and other institutions include:

1. Effective law enforcement to curtail illegal fishing practices.

2. More and improved marine protected areas (MPAs)/ sanctuaries covering sufficient areas to protect habitat and fish populations, as well as spawning aggregations and to support an increase in biomass of fish from improved reproduction, larval dispersal and biomass export from sanctuaries.
3. Establishment of use zones through municipal ordinances that allocate areas according to local user rights for specific uses such as MPAs, fish and/or seaweed culture, tourism and recreation uses, navigation channels and landing areas and other use zones as appropriate.
4. Protection and reforestation of mangroves to prevent further soil erosion and habitat degradation.
5. Foreshore management to prevent further encroachment of human settlements into mangrove areas and reef habitats and beaches to prevent increasing pollution and sedimentation.
6. Registration and licensing of fishers to allow them to use specified gear in agreed zones on or off the reef.
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8. Species-specific fisheries management plans and ordinances that address overexploitation of blue crabs, siganids and selected target reef fish and invertebrates species.
9. Delineation and enforcement of municipal water boundaries.
10. Assistance in alternative livelihoods that are environment friendly such as seaweeds, mariculture of selected fish species, marine tourism and other land-based options in the islands.
11. Other strategies that are generated through localized planning and are acceptable to the stakeholders.

Danajon Bank's unique geological double barrier reef formation and high marine biodiversity has great potential for ecotourism, but only and if it's ecological condition is first significantly improved.

Ultimately, the area requires strengthened institutions that enable coordination of the various actions of the LGUs so that the overall integrity of the Danajon environment is stabilized and enhanced.

Indeed, it will redound to everyone's benefit to rehabilitate the coastal and fisheries resources of Danajon Bank.

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The FISH Project is an initiative of the Government of the Philippines, implemented in partnership with the Department of Agriculture-Bureau of Fisheries and Aquatic Resources, national government agencies, local government units, and other stakeholders, funded by the United States Agency for International Development, and managed by

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