

## Marine park with whale shark and adjacent to sardine fishery

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**Abstract.** The aim of balance between conservation and capture fishery is understood yet elusive. In a coastal town in the Philippines, Donsol, considered the "whale shark capital of the world", its coast also supports a commercial sardine fishery. A portion of its coastal waters has been declared a marine conservation park while most of it is still open to fishing. An assessment of the sardine fishery showed high exploitation rate. Bottom-set and drift gillnets are the major sustenance fishing gears. Commercial fishing vessels operating purse seine were also reported in the area. Regarding the whale shark or *Butanding* ecotourism, tourism officers perceived warming of coastal waters which they observed to have affected whale shark occurrence. Whale shark and sardines appeared swimming along the same path in coastal waters because they both feed on zooplankton. Small-scale fishers revealed that they intentionally avoid whale sharks while fishing because their nets and boats can be destroyed when the large fish swim at them. They contend it is the large fishing vessels that can potentially hurt whale shark when hit by their boats. The local government assisted by an international NGO has been pursuing measures to protect the largest fish and the fishers through an integrated marine resource management program.

**Key words:** Ecotourism, Donsol, Assessment, Whale Shark, Sardine

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### Introduction

The Donsol Marine Conservation Park (DMCP) in Bicol Region (southern Luzon, Philippines) is a especially unique marine protected area. The Donsol coast supports a commercial sardine fishery. Sardines are a commercially valuable raw material for canned fishery products. The coast is also home to whale shark *Rhincodon typus* locally known as "Butanding", the largest fish in the sea. Because of the high frequency and regularity with which the large fish occurs in its coast during summer (March to May), Donsol is considered the "whale shark capital of the world". The marine park houses a good diversity of coral reefs, reef fishes and mangroves. For the town's local economy, sustenance capture fishery contributes Php54M (Soliman, 2004) while whale shark ecotourism is valued at Php7M (Padilla, 2005) and recently Php100M (DMTO, 2011). Crucial challenge for resource managers of the place is protecting and maintaining these resources integrally over long-term. Enjoining the broadest people support is necessary for achieving success toward this aim.

In the Philippines, the role of local government units (i.e., LGU at village and town/city levels) in coastal resources management is indispensable primarily because the local government has the legal mandate. LGUs are in the vicinity of coastal resources to be protected and they have direct contact with coastal stakeholders from whom true concern for

protective management must first be encouraged. The legal status of the DMCP has been enacted through passage of a town ordinance. Mainly, the rationale for establishing the DMCP rests on the twin objectives of sustaining its coastal capture fisheries and increasing the network of protection for whale sharks and coastal habitats (MCP-MC, 2006). During the planning phase for the park, these have been the key considerations the stakeholders recognized the plan must contain. There is also concern on the spatial overlap between the fishing ground for sardine and the areas where whale shark aggregations occur because fishing boat propellers can potentially hurt the large fish. Harmonizing marine park conservation and ecotourism with capture fishery present a singular challenge to local governance of marine resources.

The paper discusses the status of the DMCP based from fishery and coastal habitat assessments. Together with the high occurrence frequency of whale shark, these assessments provided the biological bases for establishing the marine park. Resource utilization issues derived from a community-level vulnerability assessment (VA) are discussed with emphasis on interaction between sardine fishery and whale shark. Finally, the results of stakeholder evaluation of the DMCP governance effectiveness are discussed including recommended actions to sustain its management.

## Material and Methods

### Coastal Habitat Studies and Fishery Assessment

The coast of Donsol (12°53.18"N, 123°36.51"E; 12°59.10"N, 123°28.56"E; total area = 360.28 km<sup>2</sup>) is bordered by 11 villages from Ogod in the south to Sta Cruz in the north covering a coastal length of 20 km (Fig. 1). Coastal fishery assessment in 2004 covered municipal fishing gear inventory, catch and fish landing surveys. Commercial fishing vessels were not able to be surveyed because the crews were not allowed to be interviewed. FISAT (Ver. 1.2.2) was used to estimate exploitation rate vis-à-vis yield-per-recruit indices for *Sardinella lemuru*. Coastal habitat survey in 2007 involved line-intercept transect survey for corals and underwater visual census of reef fishes along the transects for corals (English et al., 1994).

### Community-level Vulnerability Assessment

A survey on the perceived vulnerability of whale shark to climate change stressors was conducted to 45 *Butanding* Interaction Officers (BIO). The questionnaire consisted of five areas namely socio-demographic data of BIO, general knowledge and awareness to CC, BIO observed manifestation of CC in Donsol coast, perceived impacts of CC to whale shark and recommended actions for the local government and concerned agencies to address negative impacts of CC. Responses were scaled from 1 through 5, where 1 is equivalent to lowest level of awareness, occurrence or agreement, and 5 is equivalent to the highest.

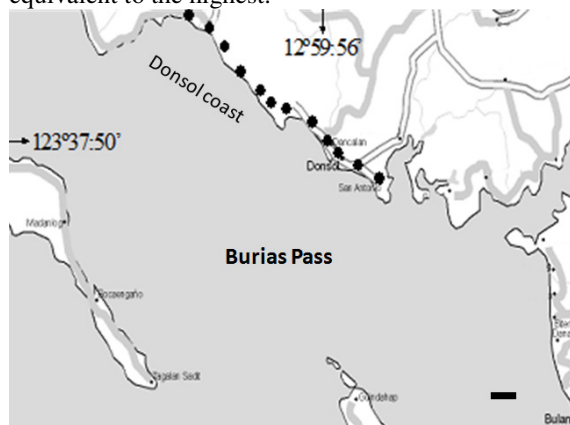


Figure 1: Burias Pass along Southern Luzon, Philippines, showing the coast of Donsol, Sorsogon and indicating location of the 12 fishery monitoring sites (shaded circles along the coast); along the coast were 11 stations for coastal habitat assessment; scale = 1 km.

Pearson correlation analysis examined the strength of association between variables. The findings from the survey-workshop and assessment of biological information on the coral reef ecosystem were presented before the Donsol *Sangguniang Bayan* or local government council for legal adoption.

### Stakeholders Evaluation of the DMCP

The evaluation used a two-pronged paradigm covering MPA governance and biological indicators (Fig. 2). The governance goals were defined using specific indicators (adapted from Pomeroy et al., 2004) consistent with the prevailing local management environment. Findings of the coastal assessment provided biological indicators.

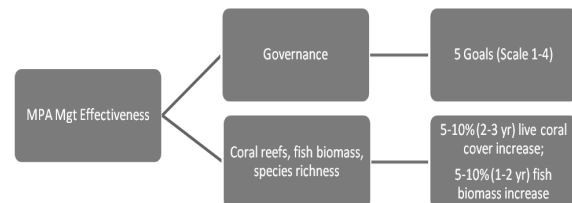


Figure 2: Paradigm of the evaluation for management effectiveness of the DMCP.

A workshop of stakeholder-representatives (n = 20) in the town (i.e., fishers, town executives, teachers, youth sector representatives, women sector representatives, policemen, businessmen) was held to administer the survey on evaluation of governance for the MCP. The survey form and its administration were conducted in Filipino and Bicol languages. Each participant was asked to respond to a series of 20 questions using a scaled response of 1 through 4. The scale 1 means “Mostly No”, 2 “No”, 3 “Yes” and 4 “Mostly Yes”. Further, it was explained that scaled rating has four levels and percent equivalents namely 1 (0-25%), 2 (26-50%), 3 (51-75%) and 4 (76-100%).

## Results

### Coral reefs and coral reef fishes

Of the 12 stations for coral reef assessment, seven were in “good” live coral cover (LCC) condition (50–74.9%), three in “fair” (25-49.9%), one in “poor” (0-24.9%) and one in “excellent” (75–100%). The general condition of the coral reefs of Donsol is “good” with an average LCC of 50.21%.

Fifty-eight species of reef fishes belonging to 14 families were found. Pomacentridae has the highest number of species with 30, Chaetodontidae with 6 species, Apogonidae with 5 and Labridae with 5, and Serranidae with 3. Eleven other families have 1 species each. Most of the species found were zooplankton feeders indicating abundance of zooplankton which can explain the high frequency of the large zooplankton-feeding *Butanding*.

Most of the reef fishes are not commercially important. Relative to fish biomass (g-250m<sup>-1</sup>), all stations in Catundulan Point (i.e., Catundulan and Tinanogan) have higher values (2,646.43) compared to those obtained in San Rafael (1,313.21) and the Sta. Cruz-San Rafael border (1,593.41). This can be

attributed to the presence of an approximately one kilometer stretch of coral reef formation in Catundulan Point that is not present in the other stations. The total reef area in Catundulan and San Rafael is about 400 hectares. The stations showed close live coral cover values but the areal extent of reefs in Catundulan is largest, a critical factor influencing reef fish abundance.

#### *Total catch and species composition*

The catches from Donsol coast consisting mainly of sardines and mackerels are caught by a multiplicity of gears dominated by drift-gillnets and bottom-set gillnets of various sub-types. Catches by sustenance gears from its coast yielded an annual harvest of 1350.89 t. Drift-gillnets, locally called *Barangay*, *Largarete* and *Palutang*, account for 68.2% of the total annual production. Bottom-set gillnets, locally called *Patitig sa gilid* and *Patitig sa lawod* and *Palubog*, catch 17.29% and the remaining 3% is shared by lines, seines, and traps. The *Law-law* (*S. lemuru*) and *Buraw* (*Rastrelliger kanagurta*) constituted 44.32% and 27.31%, respectively, of the total fishery harvest. The analytic assessment of *S. lemuru* stock revealed its high exploitation ( $E = 0.68$ ) which is beyond the exploitation level to generate maximum sustainable yield.

#### *DMCP governance effectiveness*

Effective management structures and strategies, and stakeholder participation categories showed the highest mean values of about 80% among the six governance categories. The lowest values were on management plan compliance and conflict management with 76-77%. However, all six categories did not differ significantly (F-test<sub>0.05</sub>).

In terms of level of community support, the mean of the factors on logistics, co-management empowerment and people's willingness to comply with sustainable management registered 78%. The factors that showed the highest values were on the existence of management plan (88%), ordinance (89%) and harmonization of ordinance with local arrangements (86%). Individually, all 21 factors in the five goals did not differ significantly (F-test<sub>0.05</sub>).

The existence of a management plan was positively correlated with clear and acceptable ordinance ( $r=0.60$ ). The existence of an ordinance was directly correlated with its clarity and acceptability ( $r=0.65$ ), existence of management council ( $r=0.64$ ), harmonization of ordinance with local as well as national and international arrangements ( $r=0.74$ ). The compatibility of the ordinance with local informal arrangements was positively correlated with its clarity and acceptability ( $r=0.65$ ), recognition of local government system

( $r=0.70$ ), periodic monitoring ( $r=0.56$ ), and improvement of surveillance and monitoring ( $r=0.60$ ). Logistical and manpower supports were positively correlated with clarity and acceptability of ordinance ( $r=0.67$ ) and the improved enforcement or application of pertinent laws ( $r=0.42$ ).

#### *Coastal climate change VA for whale shark*

The respondents have at least five years experience as BIO. BIOs are government-accredited personnel who accompany tourists who, for a minimal fee, can interact briefly with the "largest fish in the world". Forty-five percent of them observed decrease in whale shark sightings in the period 2008-2011; 30% increase and 25% no change in annual sightings. Majority (67%) also noted more small whale sharks during the interaction with guests. Most of them (96%) noticed coral bleaching in the coast. Many (62%) observed warming of coastal waters which have negatively affected whale shark occurrence frequency. But SST data obtained (<http://aprdc.soest.hawaii.edu>) indicated cooling of waters in the area. Most of them (96%) agreed to the possibility of capture fishery interacting with whale shark that may lead to hurting and disturbing the large fish particularly large vessels for commercial fishing. Compliance to the whale shark interaction guidelines and strictly prohibiting commercial fishing are their two most important recommendations.

#### **Discussion**

Findings of the coastal habitat and fishery assessments together with the importance of whale shark to ecotourism provided the biological basis for declaring the DMCP (MCP-MC, 2006). High extraction rate of fish stocks along the coastal waters necessitates implementation of fishing effort regulation (TFT-FM, 2006). The local government is mandated to implement this regulation but it admits it is difficult to achieve with high level of compliance. Legal declaration of the MCP (total area = 313 hectares) through the local ordinance indirectly regulates fishing effort by spatially limiting fishing area, although the park is only about 1% of the total area of Donsol coast.

The condition of coral reefs (50.21% LCC) in Donsol is comparable with those in well-managed marine fishery reserves and sanctuaries in Bicol Region with LCC range of 30-63% (Soliman and Mendoza, 2000). Live cover is also higher than in the two marine protected areas close to Donsol namely Marilag in Prieto Diaz (33.02%) and Bantigui in Pilar (34.98%) in the same province of which both have "fair" (26-50%) cover. However, the entire coast of Donsol may not be a good site for touristic diving because reefs are not extensive, water is turbid and

current is strong except along the 1-km stretch of coral community in Catundulan Point and San Rafael but both were declared fish sanctuaries within the DMCP so diving is prohibited.

Species richness of coral reef fishes increased from 58 in 2007 to 71 in 2010 (Mendoza, et al., 2010). Reef fish biomass also significantly increased by more than 400% in Catundulan and 600-700% in San Rafael during the same period. However, there was mean LCC decrease of 11% in the sites surveyed. The decrease in Catundulan was from 48% cover to 39%, while it was from 55% to 41% in San Rafael. The large decrease in Catundulan was due to reduction of soft coral cover, although there was 2% increase in hard coral cover in the site. In San Rafael, there was a decrease of 7% hard and 1% soft coral cover. The decrease could be due to high siltation observed in the place.

The estimated annual fishery production from Donsol municipal waters is 1,350.89 t. Annual extraction rate is 3.75 t-km<sup>-2</sup> (coastal area of 260.28 km<sup>2</sup>). This is significantly lower than extraction rates in nearby areas. In Bantigue Point of the adjacent town Pilar, Sorsogon, the extraction rate was estimated at 22.63 t-km<sup>-2</sup>-yr<sup>-1</sup> (Soliman et al., 2001). In the nearby Sorsogon Bay, the annual fishery production was 21.8 t-km<sup>-2</sup> (Cinco, 1996). The estimates of annual extraction rate in two areas in Sorsogon are about 5-6 times higher than the estimate obtained in Donsol municipal waters. One major reason proposed by majority of the sectoral stakeholder-representatives is the non-representation of catches from large commercial fishing vessels reportedly operating in the area.

During the presentation of the fishery assessment results before local government officials and the fishery aquatic resource management councils of Donsol, the high incidence of commercial vessels fishing within the municipal waters was raised by both groups. In these meetings, it was estimated that there are about 22 *pangulong* or purse-seiners that fish inside the municipal waters every year, at a frequency of about 15-20 trips-month<sup>-1</sup>. Assuming there are 10 *pangulong*, operating 10 trips-month<sup>-1</sup> and catching 100 tubs-trip<sup>-1</sup> (50 kg-tub<sup>-1</sup>), the annual harvest estimate is 500 t/month. Purse seine catches of 150-200 tubs-trip<sup>-1</sup> were revealed by crew members of large fishing vessels. The estimate of purse seine harvest for 3 months is more than the annual municipal fisheries production.

Drift and bottom-set gill-nets are operated using motorized banca equipped with 16-hp gasoline engine or large diesel engines. Larger diesel engines are used to operate purse seines. The propeller of these types of boat can potentially hurt whale shark when they pass on top of the fish. Scars along the dorsal side

especially in the caudal fin of whale shark are commonly due to predator attacks and propeller strikes (Speed et al., 2008). In Donsol, touching of the whale shark, flash photography and swimming toward the animal significantly affect its response behaviour (Quiros, 2007). If the latter events can disturb the fish, propeller strikes can cause more disturbance and even harm. For the large vessels, this is on top of the issue of incursion into municipal waters by commercial fishing vessels prohibited under existing Philippine laws. A national fishery administrative order passed in 1998 penalizes wounding and killing the whale shark in the course of fishing for other fish species. The order protects the fish from harmful fishery interactions, which intuitively expands spatial protection for the fish outside of the marine park. BIOs opined that strictly enforcing the prohibition of commercial fishing vessels to operate in municipal waters is the best way to avoid such fishery interaction. They also admit that since there is only 60% compliance to the guidelines by BIOs, they will exert maximum effort among their ranks to achieve 100% compliance.

The decline in whale shark frequency observed by BIOs in the last 4 season-years was corroborated with actual sightings (D. David, pers com). In 2008 through 2011, total whale sharks sighted were 276, 457, 312 and 179, respectively (Fig. 3). Mean annual SST (27.75±0.29 SD) was generally declining during this period. Within a season (Jan-June), that revealed

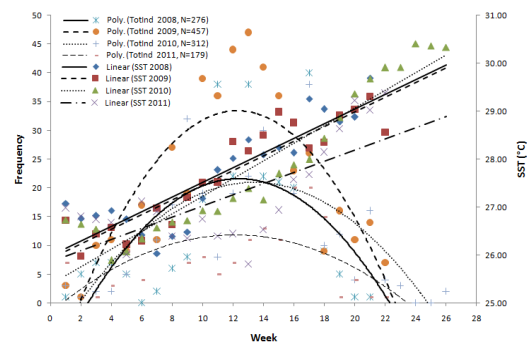


Figure 3: Whale shark sighting frequency and SST along the study site.

increasing weekly SST for all years (Fig. 3), sightings peaked in April and May. Highest sightings in various years were 20, 38 and 47-week<sup>-1</sup> in April (2009, 2010 & 2011) and 40-week<sup>-1</sup> in May (2008). The inter-year decline in sightings was correlated with annual SST (r=0.64), which is opposite BIOs' observation that warming resulted to the decline of whale shark frequency.

The mean factor rating for DMCP governance effectiveness was 78% or equivalent to an adjectival phrase of "close to the low end of the highest rating".

Highest values are in the effective management structure and strategies. The strength of the MCP management is in its management structure and strategies, although individually, the existence of the ordinance gave the highest affirmation from the stakeholders. The strength in management structure indicates the MCP is still in the phase of organizational development. The council has been in operation for only 3-4 years.

The highest factor rating given to existence of enabling ordinance could be due to the process involved and agreements achieved that led to the legal declaration of the MCP. There was a legitimization process from the village to town levels. Before the passage of the municipal ordinance declaring the MCP, a covenant was passed by the local government executives, village captains, officials of the fishery aquatic resource management council officials, fishers, media representatives, provincial fishery officers, and officials from the eco-tourism industry in Donsol. There is a strong base of support both at the village and municipal levels. There was also a joint village resolution from three villages adjacent to the proposed MCP site urging the town's legislative body to pass an MCP ordinance. There is premium in comprehensive consultation before establishing a management structure and formulating ordinance to legalize its existence (White et al., 2006).

In summary, the DMCP protects the portion of Donsol coast with the best condition of coral reefs. Coral cover is fair and its extent is small. This and the national order prohibiting whale shark from being wounded or killed due to fishing operations expand the spatial extent within which the huge fish are protected against undesirable fishery interactions. Compliance to whale shark ecotourism guidelines is an effective internal mechanism to minimize impact to the large fish. Commercial fishing operations can harm whale sharks. Achieving successful management of the DMCP requires a broad base of support from the community.

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