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Issues on the different coastal and marine resources in Dumanquillas Bay, Zamboanga Peninsula, Mindanao, Philippines

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Abstract: Philippines, as an archipelago with almost 80% territory is water, is endowed with rich coastal and marine resources which are considered vital for ecological, social and economic activities. Unraveling the potentials of this natural wealth is a challenge due to peace and order problems. Existing security threats results to lack of information on the existing resources that can be managed and utilized. An inventory of coastal and marine resources in major bays in Mindanao will provide information that is necessary for better resource management. In this study, respondents from Kumalarang, Zamboanga del Sur had identified three major resources in Dumanquillas Bay, Zamboanga Peninsula, Mindanao, Philippines. These include mangrove, seagrass and fishery resources. Of the mangrove resource, only 12 species were identified by the respondents constituting 66% of the true mangroves found in the whole Dumanquillas Bay and 26% of the 47 true mangroves and associated species found in the Philippines. Diversity was significantly lower compared to other parts of the country. Mangroves in Dumanquillas followed a distinct zonation pattern with *Sonneratia alba* and *Avicennia* species dominating seaward while *Rhizophora, Bruguieria* and *Lumnitzera* species dominating landward zone. Of the fishery resource, 40 species of fish were identified by the respondents as most common species caught by fisherfolks. These constitute 85% of the 46 species of fish caught from Dumanquillas bay. *Apogonichthyoides brevicaudatus* and *Aurigequula fasciata* were commonly identifiedEighteen (18) species of mollusks and seven (7) species of crustaceans were also identified resources in the bay. The seagrass communities were among the most exploited resurce in Dumanquillas Bay as shown by the remaining three (3) hectares of seagrass beds in Village Bualan dominated with *Enhalus acoroides* implying that the area is highly degraded or completely altered as this species was noted for its resistance to high levels of siltation. This study has shown that without proper management of resources, the bay will suffer from overexploitation. It is recommended that proper management of the area is needed.

Key words: Coastal and marine resources; Dumanquillas Bay; Zamboanga Peninsula; Philippines

1. Introduction

Philippines, as an archipelago, are composed of a wide range of territorial waters with a total of about 220 million hectares of marine area, including 200-mile exclusive economic zone (Camacho et al., 2001). The country's coastal and marine resources which are approximately seven times bigger than its land resource contain the most complex and diverse yet biologically and economically productive ecological systems in the world (White and Trinidad, 1998). As part of the Indo-West-Pacific region, Philippines have been recognized as the world's epi-center of marine biodiversity (Carpenter and Springer, 2004; Fishbase, 2006; Springsteen and Leobrera 1986). Although, Philippine coastal and marine biodiversity is relatively well-known, there still remain undiscovered marine resources. This is because the Philippines geographic distribution is so fragmented resulting to difficulty in assessing the biodiversity of the entire region. With global trend of massive extinction due to unsustainable and indiscriminate utilization of resources which does also happening in the country, many species have become extinct without even know their existence. The inaccessibility of the many islands due to unstable peace and order has aggravated the situation.

One of the richest fishing grounds in Western Mindanao. The Dumanquillas bay in Zamboanga Peninsula is considered a rich coastal and marine ecosystems home to different valuable and commercially important species of fish and other marine organisms. The bay is a spawning ground of anchovies and juveniles of sardinela species. The bay has become a threatened resource since the municipality of Kumalarang has utilized an estimated area of 2,859.09 hectares for fishpens (BFAR-Provincial Fisheries Office, Zamboanga del Sur) of which 700 hectares are in operation and 565.70 hectares are currently abandoned (DBPLS GMP, 2015-2019). To protecthe bay and its natural resources for overexploitation, it was proclaimed as

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a protected landscape and seascape by virtue of Presidential Proclamation No. 158 in 1999. Despite being a protected area, Dumanquillas bay is continuously threatened due to mass conversion of mangroves into aquaculture ponds, pollution, and sedimentation, destructive and indiscriminate use of illegal methods of resource utilization. Lack of information of the resources of the bay may also have contributed to the poor management of the area. The current study of making an inventory of coastal and marine resources was aimed to provide updated scientific information which could be the basis in management and conservation of the resources found in the coastal areas of the bay (Walters, 1998; Jin, 2002; Jin, 2003; White and Trinidad, 1998) uniquely suited for various activities that cater diverse human needs such as for food, employment, energy, transport, recreation and others (UNDIESA/UNEP, 1984; FAO, 2000; Munoz, 2002; Espejo-Hermes, 2004; Luna et al., 2004). Since coastal areas are not just biologically and ecologically important but also play a significant role in the economy of any country as it serve as focal points for many developmental activities such as tourism, trade, and industrial production, the information that are generated in this study will be a good contribution for its proper management.

2. Materials and method

2.1. Study area

This study was conducted insix coastal villagesvillage of Bualan, Gusom, Poblacion, Picanan, Diplo and Boyugan West at the coastal stretch of Kumalarang, Zamboanga del Sur, a major municipality of Dumanquillas Bay. Dumanquillas bay encompasses a total of 29,662.98 hectares with a core zone area of 25,948 hectares and 3,714.984 hectares allocated as buffer zone. The bay was proclaimed a protected landscape and seascape by virtue of Presidential Proclamation No. 158 in the year 1999 by former Philippine president Joseph E. Estrada. The bay was situated in between the provinces of Zamboanga del Sur and Zamboanga Sibuguey, with a latitude and longitude of 7.668095° and 123.113173°, respectively (Fig. 1). The bay is managed by a Protected Area Management Board (PAMB), National Government Agencies (NGAs), other government agencies (OGAs), Non-government Organizations (NGOs), academe, and various stakeholders. The board is chaired by the Regional Director of the Department of Environment and Natural Resources (DENR), Region IX and is directly supervised by the Protected Area Superintendent (PASu).

2.2. Sampling design

This study employed a multi-method research design such as semi-structured interview (SSI) (McCracken et al., 1988; Sajise et al., 1990; Pido et al., 1996), focus group discussion (FGD) and Key informants interviews (KII) to obtain detailed information on the different coastal and marine resources present in the bay. Prior to the interview, a market survey was done where digital images of fish and other marine lives were taken to be presented to the respondents for identification and source verification.

Fig. 1: Shows the location of the study sites. In set is the map of the Philippines and map of Zamboanga peninsula.

An actual habitat survey following the standard technique used by Mendoza and Alaura (2001) was also done to describe the structure of mangrove ecosystems in the area. A transect of 100 meters was laid perpendicular to the shoreline until to the last mangrove stand with 10x10 meter plot having an interval of 10-50 meters. All mangrove species (trees, saplings and seedlings) that fall inside the quadrat were listed and counted. The girth at breast height estimated at 1.3 meters (GBH) of all trees in the quadrat was determined using the tailor's measuring tape. There were three sampling sites representing the most productive coastal area in Kumalarang. These were Bualan, Boyugan and Gusom with three quadrats each having a total of nine quadrats. Observations were also done to note some important features of the different coastal and marine resources in the area including threats as well as conservation and management schemes present in the area. Geographic Coordinates were also taken to determine the exact location of the different coastal and marine resources for future monitoring purposes.

2.3. Sample size

A total of 140 fisherfolk respondents were interviewed from June 4 to June 21, 2015. They were chosen using a simple random sampling method which considered only 10% of the household population in each coastal village whose heads of the family were solely or partly dependent on fishing as source of livelihood (Table 1).

2.4. Data analytical method

This study employed descriptive statistics in the analysis of data which comprised the calculation of the percentage, relative frequency, relative density and relative dominance. Taxonomic classification and identification of fish and other marine species such as mollusks and cephalopods were based on the

illustrations and sample specimen available at http://www.fishbase.org;http://www.discoverlife.org; http://www.sealifebase.org and http://www.marinespecies.org while mangrove and associated species were identified using the Mangrove Management Handbook by Melana et al. (2000). Sample digital images from the field which were positively identified by the respondents were brought to MSU-IIT, Biological Sciences Laboratory for further verification.

Table 1: Shows the number of respondents per village

Coastal Villages	Total No. of Household	Total No. of Household that are Fishers	10% of the Total Household that are Fishers
Bualan	210	210	21
Poblacion	1,300	50	5
Diplo	711	30	3
Picanan	649	649	65
Boyugan West	303	303	30
Gusom	160	160	16
Total	3,333	1,402	140

3. Results and discussions

3.1. Mangrove community structure

In this study, 12 species of true mangroves belonging to six families were identified by the respondents (Table 2). This constituted 66% of the 18 true mangrove species found in the whole Dumanquillas bay (DBPLS GMP 2015-2019). Family *Rhizophoraceae* has five (5) species such as *Rhizophora apiculata, Rhizopora mocrunata, Bruguieria sexangula, Bruguiera parviflora and Ceriops tagal.* This was followed by Families of *Avicenniaceae* and *Combretaceae* with two representatives each such as *Avicennia alba, Avicennia lanata* and *Lumnitzera littorea, Lumnitzera recemosa* respectively while the rest are having one representative each. The existing data was significantly lower than previous reported (Mendoza and Alaura, 1998; Melana et al., 2000; Primavera et al. (2004). There were also two mangrove associated species identified by the respondents from Gusom comprising of Malabago (*Hibiscus tiliaceus*) and Talisay (*Terminalia catappa*). These trees were known as beach forest species and commonly dominating along beach areas. Nipa or *Nypa fruticans* was also recognized by 17 or 12.14% of the respondents as one of the most important components of the estuarine environment.

Actual habitat survey of mangroves revealed that mangrove stand in Kumalarang occurred only as patches or strip along the coastline while others were scattered along riverbanks. Extensive mangrove stands were found in thevillages of Bualan and Boyugan West consisted mostly of *Sonneratia alba* and *Avicennia species* known as natural colonizers and thrive in areas directly facing the sea (Sneadaker & Sneadaker, 1984; Primavera and Esteban, 2008) usually from rocky to sandy-muddy substrate (Calumpong &Menez, 1997).

Table 2: List of mangrove species in Dumanquilas Bay in the coast of Kumalarang, Zamboanga del Sur

Family Name	Local Name	Scientific Name
Avicenniaceae		
	Bungalon puti	*Avicennia alba*
	Piyape	*Avicennia lanata*
Combretaceae		
	Tambo-tambo	*Lumnitzera littorea*
	Kulasi	*Lumnitzera racemosa*
Meliaceae		
	Tabigi	*Xylocarpus granatum*
Myrsinaceae		
	Saging-saging	*Aegerias corniculatum*
Rhizophoraceae		
	Bakawan-babae	*Rhizophora mucronata*
	Bakawan-lalaki	*Rhizophora apiculata*
	Tungog	*Ceriops tagal*
	Putotan	*Bruguiera sexangula*
	Langaray	*Bruguiera parviflora*
Sonneratia		
	Pagatpat	*Sonneratia alba*

The villages of Poblacion and Diplo had mangrove which appeared only strips along the riverbanks with some matured trees of *Rhizophora apiculata* and *Rhizophora mucronata.* In muddy, reverine areas of the village of Gusom, *Aegerias corniculatum* (Fig 2) was frequently obaerved with some mangrove-associated species like *Hibiscus tiliaceus* and *Terminalia catappa.*

Fig. 2: Species of Saging-saging or *Aegerias corniculatum* highlighting its banana-like fruit

While most of the mangroves were just forming a narrow strip along the coastline, distinct mangrove zonation was observed. *Sonneratia alba* and *Avicennia species* dominate seaward while *Rhizophora, Bruguieria and Lumnitzera* in association with the *Nypa fruticans*dominated the landward zone specifically in the brackish water of the village of Bualan. The results is similar to the mangrove zonation pattern of Mendoza and Alaura (1998) in Samar Island, Philippines butcontradicted the findings of Tomlinson (1986) who reported that *Lumitzera racemosa* is resistant to saline condition.

The standard survey of mangrove habitat further revealed that out of the 12 true mangrove species identified by the respondents, only seven species fall within the quadrats of the three sampling sites having only four species for each quadrat (Fig. 3). Of the seven identified species, *Sonneratia alba* or pagatpat was the most dominant, dense and frequently occurring mangrove species in the three sites. Although quadrat 1 of Gusom was mostly dominated with *A. corniculatum*, however in terms of basal area, *S. alba* yielded higher relative dominance. Mangroves in Bualan and Boyugan West were also dominated with *S. alba* (pagatpat). *S. alba* got also the highest number of seedlings and samplings followed by *A. corniculatum* and *A. lanata* while of the three sites, the village of Bualan got the highest number of seedlings and saplings (Fig. 4).

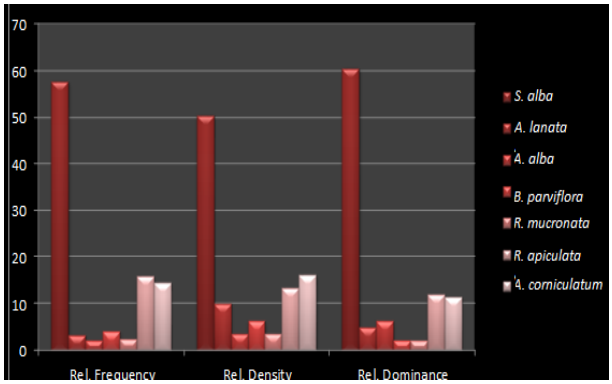

Fig. 3: Shows the relative frequency, density and dominance of mangroves species in the coast of Kumalarang, Zamboanga del Sur

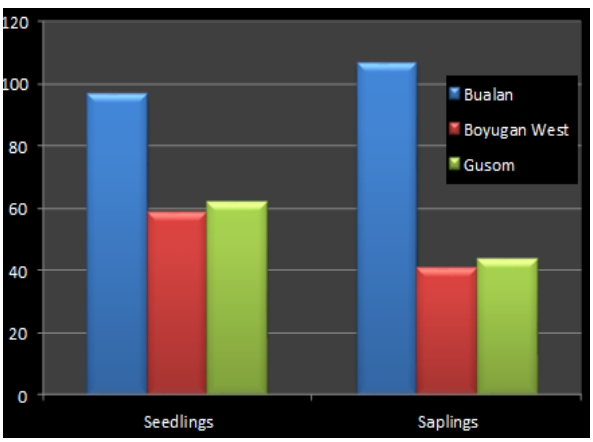

Fig. 4: Shows the number of seedlings and saplings in the three sampling sites.

3.2. Fish community and structure

Dumanquillas bay boasted a variety of fishery and marine resources as a source of food and livelihood for the surrounding coastal population. The bay has 46 types of commercial fishes (DBPLS-GMP, 2015-2019) commonly caught from their municipal waters (Table 3). The data revealed that of the 40 species identified by the respondents *Apogonichthyoides brevicaudatus* and *Aurigequula fasciata* are the most common species.

The coastal waters of Kumalarang were also abundant of malacofaunal species. The muddy to silty substrate had become favorable habitat for various species of shells. In this study, the respondents were able to identify a total of 18 species of mollusks belonged to 11 families (Table 4). Nine (9) species belonged to Class Bivalvia, six (6) species belonged to Class Gastropoda and three (3) species under Class Cephalopoda. There were also seven (7) species of crustaceans identified. According to respondents, the presence of heavy siltation and sedimentation in the area provided better opportunities for gleaners. This was mainly because many species of shelled mollusks such as *Lingula unguris, Mytella falcate, Placuna spp. Anadara uropigimelana, Crassotrea iredalei and Katelysia hiantina* thrived abundantly in the area. These species constituted large fraction of the gleaners' daily catch. However according to interview, many species of shelled mollusks were no longer found in the area such as giant clams locally known as "t*aklobo"*, helmet shells or *"budyong"* and many others. In fact, they shared that some of the species such as species under Families of Strombidae and Valutidae can only be seen in the deeper parts of the bay where there were seagrasses and coral reefs thriving mostly, in the municipal waters of Lapuyan and Buug. These species were sold in the market at higher prices.

Of the 25 species of mollusks and crustaceans, only seven species can be caught in the mangrove area, eight species can be found from seagrass beds, and ten can only be bought in the market. It was also revealed that none of the species can be derived from the coral reef areas since according to respondents their coral reefs were already damaged and no longer productive. They added that sometimes they went to neighboring municipalities to fish usually in Lapuyan, Buug and Malanggas to fish reef species of fish.

3.3. Seagrass community structure

Seagrass communities make significant contributions to coastal productivity as it physically help to reduce wave and current energy (DBPLS-GMP, 2015-2019). It also helps to filter suspended sediment from the water and stabilizes the substrate (Fonseca and Cahalan, 1992; Fonseca et al., 1982). However, seagrasses are also among the most neglected marine resources due to lack of understanding on its ecological and economic values.

Table 3: Shows the common species of fish caught by fishers of Kumalarang from Dumanquillas Bay

Scientific Name	Frequency(n=140)	Percentage (P=f/n*100)	Rank
Apogonichthyoides brevicaudatus	98	70	1.5
Balistapus undulates (Park, 1797)	26	19	31
Tylosurus acus melanotus (Bleeker, 1850)	21	15	34
Pterocaesio marri (Schultz, 1953)	76	54	18
Pterocaesio randalli (Carpenter, 1987)	54	39	26
Carangoides ciliarus (Rüppell, 1830)	57	41	23.5
Scomberoides tala (Cuvier, 1832)	67	48	20
Atule mate (Cuvier, 1853)	90	64	10.5
Chanos chanos	99	71	7.5
Oreochromis miloticus (Linnaeus, 1758)	88	63	12
Clarias batrachus (Linnaeus, 1758)	5	4	38
Sardinella aurita (Valenciennes, 1847)	110	79	5
Anodontostoma chacunda (Hamilton, 1822)	99	71	7.5
Dussumieria acuta (Valenciennes, 1847)	57	41	23.5
Encrasicholina oligobranchus (Wongratana, 1983)	123	88	4
Oxycheilinus diagramma (Lacepéde, 1801)	23	16	35.6
Cheilo inermis (Forskål, 1775)	33	24	30
Cheilinus trilobatus (Lacepéde, 1809)	59	42	21.5
Aurigequula fasciata (Lacepéde, 1803)	137	98	1.5
Gazza minuta (Bloch, 1795)	91	65	9
Photopectoralis bindus (Valenciennes, 1835)	101	72	6
Lutjanus fulviflamma (Forskål, 1775)	78	56	15.5
Chelon macrolepis (Smith, 1846)	80	57	14
Parupeneus indicus (Shaw, 1803)	25	18	32
Nemipterus bathybius (Snyder, 1911)	78	56	15.5
Nemipterus virgatus (Houttuyn, 1782)	56	40	25
Stegastes fasciolatus (Ogilby, 1889)	24	17	33
Priacanthus macracanthus (Cuvier, 1829)	76	54	18
Cetoscarus bicolor (Ruppell, 1829)	45	32	28.5
Epinephelus trimaculatus (Valenciennes, 1828)	90	64	10.5
Siganus canaliculatus (Park, 1797)	134	96	3
Siganus punctatus (Schneider & Forster, 1801)	45	32	28.5
Siganus vermiculatus (Valencinnes, 1835)	50	36	27
Sillaginopodys chondropus (Bleeker, 1849)	75	54	18
Liachirus melanospilos (Bleeker, 1854)	3	2	39
Synodus intermedius (Spix and Agassiz, 1829)	12	9	37
Synodus variegatus Lacepéde, 1803	23	16	35.5
Terapon jarbua (Forskål, 1775)	59	42	21.5
Terapon theraps (Cuvier, 1829)	84	60	13

Table 4: Shows the list of Molluskan and crustaceans species found in major ecosystems of Dumanquillas Bay in Kumalarang, Zamboanga del Sur.

Bivalves				
Scientific Name	Mangrove	Seagrass Beds	Coral Reef	Sold in Stalls
Placuna placenta (Gmelin, 1791)		+		
Placuna epphipium (Philipsson, 1788)		+		
Anadara uropigimelana (Bory de Saint-Vincent, 1827)		+		
Polymesoda erosa (Solander, 1786)	+			
Lingula unguris		+		
*Codakia tigerina (*Linnaeus, 1758				+
Mytella falcate (Orbigny, 1846)		+		
Cassostrea iredalei (Faustino, 1932)	+	+		
Grafarium tumidum (Röding, 1798)				+
Katelysia hiantina (Lamarck, 1818)		+		
Gastropods				
Terebralia palustris (Linnaeus, 1767)	+			
Telescopium telecospium (Linnaeus, 1758)	+			
Lambis lambis (Linnaeus, 1758)				+
Strombus canarium (Linnaeus, 1758)				+
Cymbiola vespertilio (Linnaeus, 1758)				+
Sepia officinales (Linnaeus, 1758)				+
Crustaceans				

Charybdis feriatus (Linnaeus, 1758)				+
Portunus pelagicus (Linnaeus, 1758)				+
Scylla serrate (Forskålm 1775)	+			
Scylla olivacea (Herbst, 1796)	+			
Metapenaeus ensis (De Haan, 1844)		+		
Penaeus monodon (Frabicus, 1798	+	+		
Macrobrachium rosenbergii (De Man, 1879)	+			
	7	8	0	10

In this study, respondents were not knowledgeable on the species of seagrass existing in the area. Majority of them revealed that most of their seagrasses vanished due to heavy siltation and sedimentation brought by massive conversion of mangroves into culture ponds, log ponds and even human settlements. Respondents of the village of Bualan recalled that in early 1980s, their coastal waters had a long stretch of seagrass beds. But after large portion of mangroves were converted into aquaculture ponds, seagrass beds were deposited with mud. They added that the long operation of the Philippine Capital Promoters, Inc. in the area had partly contributed to the disappearance of seagrasses. The General Management Plan of Dumanquillas bay recorded only one species of seagrass in an estimated area of only three hectares, the *Enhalus acoroides* species which can be found in the coastal waters of the village of Bualan. The marine waters of Kumalarang are categorized as highly degraded or completely altered. This was confirmed in the FGD conducted at the village of Bualan. Respondents revealed that way back 1950s coastal waters of Kumalarang were abundant with seagrasses but since the operation of Philippine Capital Promoters, Inc, the seagrass communities have deteriorated along with other resources such as mangrove and coral reefs. They shared that long ago, large ships that carry logs to be exported to Japan can duct at Cabug Island and barges can navigate the rivers into their log ponds to get logs. At present, the rivers and the entire coastal stretch of Kumalarang is getting shallower with turbid water due to heavy siltation and sedimentation (Fig. 5.) caused by extensive logging operations in the upland, conversion of mangroves into fishponds and improper establishment of shallow coral fish pens or *bunsod*.

4. Summary

The coastal waters of Kumalarang, Zamboanga del Sur, which once had become abundant with natural resources, are now become barren and unproductive. In this study, there were only three major natural resources such as mangrove, seagrass and fishery resources had been described.

The mangrove resource is composed of 12 species of true mangroves belonging to six families were identified by the respondents Although sparsely distributed and usually forming like a strip along riverbanks and in the coastline, mangrove in this area followed the same mangrove zonation pattern of Mendoza and Alaura (1998) in Samar Island, Philippines..

Dumanquillas bay is also abundant with fishery resources. A total of 40 species of fish belonging to 27 families were identified by the respondents. The bay is also rich of juvenile species of *Sardinella* which occurs once in every two years or once a year. Aside from fishes, malacofaunal species is also abundant in the bay. In this study, the respondents were able to identify a total of 18 species of mollusks with 11 families' \and seven (7) species of crustaceans.

Fig. 5: A shows parade of shallow coral fish weirs established few meters from Cabug Island which was proclaimed as a fish sanctuary. B shows an island of mud deposited at the center of the former seagrass beds of Village Bualan which can only be seen during low tide

Though, there is a little portion of the area occupied by seagrasses but it only consisted of around three (3) hectares dominated by only one species. Large portion of seagrass beds in the area were vanished due to heavy siltation and sedimentation due to a long history of anthropogenic activities. Apart from seagrass beds, coral reefs were also extremely affected by siltation and

sedimentation and other human-induced activities such as pollution, extractive resource utilization, destructive and illegal activities including cyanide and dynamite fishing, trawl, push nets and others.

5. Conclusion

Dumanquillas Bay has relatively diverse coastal and marine ecosystems that host exceptional number of biodiversity - the main reason why it is declared as a marine protected area in 1999 with the purpose to protect, conserve, preserve and sustainably manage the remaining natural resources for the benefits of both present and future generations. However, the present condition of the Dumanquillas signifies ineffective management of the bay since extractive yet haphazard utilization of the resources still exist in the area.

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