The Fisheries Profile of Gigantes Islands, Carles, Philippines and Notes on its Scallop Fishery History

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ABSTRACT

This study is the first report on the fisheries industry in Gigantes Islands, Carles, Philippines, highlighting its scallop fishery. Focused group discussions were done in North and South Gigantes Islands on January 2014 to provide estimates of yield, fishing pressure and other fishery parameters, which can be primarily used to manage the resources. Information on fishing gear types used, fishing seasonality, and estimated catches were gathered. Gigantes is exposed to fishing pressure of 8,811.9 trips km^{-2} yr^{-1}, which is much higher compared to other larger local fishing grounds in the Philippines. The total estimated annual catch of North Gigantes is 9,941.2 MT and 6,479.6 MT for South Gigantes. Compressor diving targeting scallops and the oysters contributed about half of the total estimated annual catch, landing a total of 8,473.5 MT. This high record of catch landings may already dictate that the current extraction rates should no longer be increased.

KEYWORDS

Sustainable fishery, fishing gears, *Spondylus* spp., *Chlamys* spp., compressor diving

INTRODUCTION

Fishing is a major livelihood for millions of people from coastal and rural areas in the Philippines. However, capture fisheries no longer yield their potential harvest as a result of overfishing and destructive harvesting methods. Among the heavily fished resources, invertebrates such as bivalves are the most vulnerable to overfishing because they generally inhabit shallow water and are sedentary making them easy to collect (Thorpe et al. 2000). A declining estimated annual catch of *Paphia undulata* was reported in Hinigaran, Negros Occidental from 1,356.3 MT in 1995 (Agasen et al. 1998) to 755.2 MT in 2008 (Villarta and del Norte-Campos 2010). In Asid Gulf, Masbate, scallop harvesting was reported to be unregulated (Soliman and Dioneda 2004). This underlines the urgent need for biological research to support sound fisheries management especially for those resources that are not yet depleted.

Gigantes Islands occupy a 5 km^2 area in the northwest corner of the Visayan Sea. Their waters are one of the most productive fishing grounds in the country, where small-scale fisheries contribute a large percentage to the fish catch (Hermes et al. 2004). During the southwest monsoon, fishers from other coastal villages in neighboring islands (i.e. Cebu and Masbate) move to Gigantes Islands, where fishing boats are protected against strong winds (Zayas and dela Peña 2012). The Gigantes Islands are also well known for their rich bivalve fishery, specifically for scallops and spiny oysters, however information on specific resources is limited. A recent study has been published on the ecology and reproductive biology of *Chlamys senatoria nobilis*, which is one of the commercially valued scallop from Gigantes (Manalo et al. 2016).

The unusually high abundance of bivalves in the area is likely the result of massive recruitment. Hence, guarding against recruitment failure is key to sustaining high production. Manalo et al. (2016) reported that the major spawning peak of the highly fished scallops is between December and February, with a minor peak between May and June. Understanding such processes related to recruitment provide vital information on what to guard against.

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There is a similarly rich bivalve fishery across Jintotolo Channel and the Asid Gulf in southwest Masbate, just north of Gigantes, where exploitation of scallops was reported to collapse in 1999 after two years of harvesting (Soliman and Dioneda 2004).

Scallops are of high delectable and economic importance. Several species of scallops including *Bractechlamys vexillum*, *Chlamys macassarensis* and *Chlamys senatoria*, and spiny oyster species like *Spondylus barbatus* and *S. squamosa*, among others, are caught in large volumes in the Gigantes Islands by compressor diving at depths ranging from approximately 6-8 m. They are landed whole with shells, and processed by hand for their adductor muscles mainly for export. The gonads and other visceral organs of the scallops are removed from the adductor muscles and are set aside to be used as bait for hook and lines. Some of the catch are locally consumed in households or beach resorts around the islands which were sold, shell-on, for 70-80 Php per kilo. Like the typical setting in the country (Campos et al. 1994), the fishermen sell all their harvest to a middleman at a minimal cost, who then sells the scallops to buyers at the municipal center in mainland Carles.

Initial interviews with local fishermen showed a perception that bivalve catches have been declining for years, hence, the fishery needs to be managed properly to avoid stock depletion, although there is no data to verify this. As a first step, this study aims to provide a fisheries profile of the Gigantes Islands with particular insights on the scallop and spiny oyster fisheries. At the same time, this study attempts to describe and reconstruct some aspects of the history of the scallop fishery in Gigantes in relation to their fishing practices. Results generated from this study will provide baseline information for management plan formulation and for further studies on these resources on the island.

MATERIALS AND METHODS

Information on fisheries were gathered through two sets of Focused Group Discussions (FGD) conducted one for each in North and South Gigantes Islands (Figure 1) in 13 January 2014. The FGD allows data verification through active discussion with and among participants from the local community (Campos and Castillo 2007). This is an attempt to describe the fisheries profile and estimate fishery resource exploitation in Gigantes Islands to allow initial management interventions. North Gigantes is composed of only two *barangays*, Granada and Asluman, with 989 households both with a total population of 5894 (Philippine Statistics Authority 2010). South Gigantes, similarly, has two barangays (Gabi and Lantangan) composed of 968 households both with a total population of 10,334 (Philippine Statistics Authority 2010). No hard data is available as to how many individuals depend on fisheries for a living. In each set of FGD, 16-20 respondents from

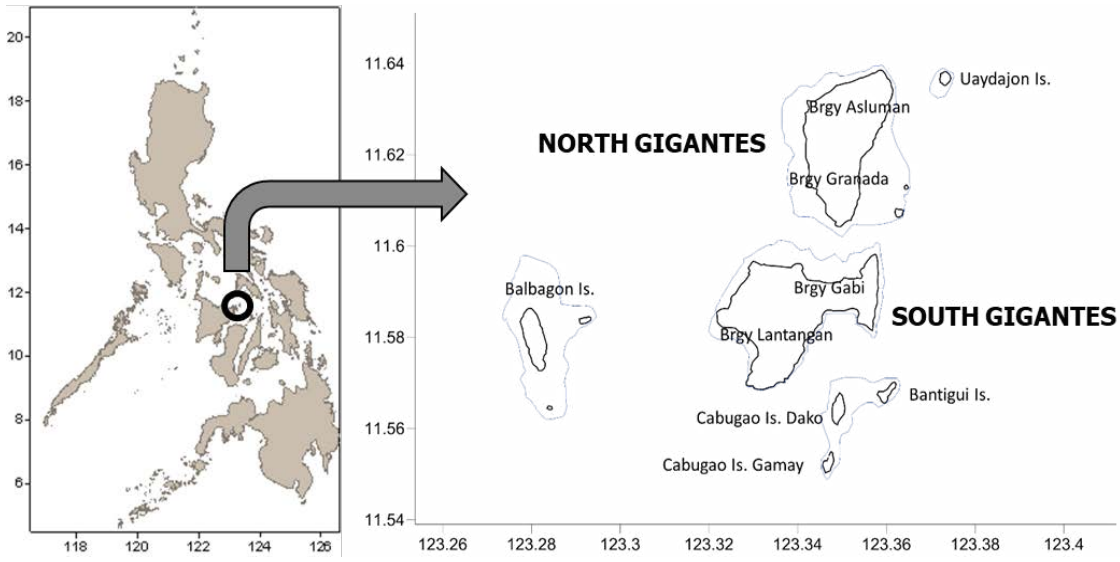

Figure 1. Map of Gigantes Islands, Carles, Iloilo, Philippines. North Gigantes is composed of Barangays Asluman and Granada. South Gigantes is composed of Barangays Gabi and Lantangan.

the two barangays in each island participated. Though the number of respondents is a small proportion of the total population, the respondents chosen are presumed to know about the area's fishery situation which will yield a credible and robust extraction of information. Participants were mostly fishers, their wives, and a few *barangay* officials, were invited to participate in the FGD (Campos and Castillo 2007; Zayas and dela Peña 2012). The respondents were chosen by the *barangay* officials or fisheries officer in the areas, which follows the methods of Campos and Castillo (2007). These representatives were expected to know about the fishing operations in Gigantes, where, fishing is typically done by men/husbands/sons and money management is done by women/wives (Zayas and dela Peña 2012). Questions and subsequent discussions focused on fishery catches, fishing gear used, fishing frequency (number of fishing trips in a year), area, and season. Information provided were considered valid when all or most of the participants agreed. For catch rate which is usually a range of values, asking the fishers of what and how much they caught the previous night and the night before greatly helped in narrowing the range. In instances when the range of values was narrow, the median value was used. The outputs of the activity are summarized in the form of a catch matrix providing estimates of total annual capture fisheries production from estimates of fishing effort (number of gear units and fishing frequency) and catch rates of each gear type, fishing area distribution maps, and fishing calendars. The formulae used to derive fishing frequency and production estimates and explanations as to how the maps and calendars were constructed are as follows:

a. Fishing frequency:
   = *no. of fishing days in a month x no. of fishing months in a year x no. of fishers*

   (note: for gears composed of more than 1 fisher per trip i.e. compressor diving, number of fishers is considered only as one as they all belong to one trip)

b. Estimated annual catch (EAC) by gear:
   = *catch rate (kg/trip) x no. of gear units x no. of fishing days per month x no. of fishing days in a year*

c. Total EAC:
   = *sum of all EACs from each gear type*

d. The fishing area distribution maps which show where most fishing operations are done and where target species are caught or are concentrated were constructed by manually putting in the symbols of the different gear types in the map of Gigantes Islands. In this map, areas where operations were more frequent are marked with two or more symbols

e. The fishing calendar shows the seasonality in the use of the various fishing gear types which may also depict the availability and peak season (high catch rates) of the target species. This was constructed using the information on the identified fishing months in a year and the peak season of each gear.

Although the interviews revealed daily operations for compressor diving, computation of the annual production was based on 25 days per month to avoid overestimation, since weather conditions may affect fishing activities on the island. The number of fishing days/month was based on enumerator data, which are daily records of compressor catch. The FGD was done on January 2014, and could be a reflection of the catches in 2013. Catches of scallops and spiny oysters were reported as raw weights, which include shells, meat and other visceral organs. This study also attempts to reconstruct the history of the scallop fishery in Gigantes based on the FGD and a separate written survey with guided questions on 60 respondents for supplemental information.

RESULTS

Background of the Scallop Fishery in Gigantes

According to interviews, the scallop spawning season in Gigantes, as perceived by the locals, is during the cold months from October to February, and gonads appear to be largest and mature in the months of December to February. In January, scallops of 1.5 inch size begin to appear, which can be those that were spawned in the earlier part of the season. Local fishers used to have a regulation in catch, where they only harvested 2.5 inch sized-scallops. However, because of the continued market demand and as scallop stocks continue to decline, buyers started accepting scallops of less than the regulated size. This scenario has caused great concern regarding the sustainability of these resources and the possible impacts on the stock.

Many of the invertebrate populations in the

Philippines are overexploited, and the habitats that sustain them are degraded by fishing activities. The 1980's (around 1985-87) was the peak of the scallop fishery and export in Gigantes Islands allowing them to take out likely 2 tons of this shellfish per day per *barangay* or village. Approximately 10 – 20 groups of three to five compressor divers harvested scallops. They spent roughly 2 – 4 hours underwater for scallop collection. Around 1995, fishing pressure increased to about 50 groups of divers. Because of this increase in fishing intensity, each *barangay* was only able to collect 0.5 – 1 ton of scallops per day. Compressor catches only landed dominant species of scallops, such as *Chlamys macassarensis* and *C. senatoria nobilis*. However, there was an eight-year decimation of the scallop population from years 1992 – 2000. During this time, compressor divers resorted to harvesting the spiny oysters, *Spondylus* spp., which remained abundant as scallops continued to reduce in number. The locals had to study how *Spondylus* spp. can be marketed, then was later on allowed for export in year 2000.

In the 1980's, scallops were distributed around both north and south of Gigantes. Scallops nowadays are more concentrated around Uaydajon in the north. There were several reasons for the decline in the scallop stocks in Gigantes that came out in the interviews. Cyanide fishers from adjacent islands became rampant inside and outside of the municipal waters of Carles. Commercial fisheries expanded their activities into deeper water. The highly destructive Danish seine, whose operations were just strictly banned in Philippine fishing grounds in October 2013 despite the Fisheries Administrative Order in 2000 (BFAR 2000), also harvested the adult population of scallops in deeper water as bycatch. This fishing gear was operated by fishers from neighboring municipalities and islands. Local fishers can only dive as deep as 60 feet using the compressor when weather permits. Consequently, they complain of the loss of the adult scallop stock in deeper water, which they presume would replenish the supply in shallower water.

General Fisheries Profile

Overall, there were more fishing gear units operated by North Gigantes fishers than in South Gigantes (Table 1). A total of eighteen (18) fishing gear types with a total number of 2,110 units was noted in North Gigantes, while twenty (21) fishing gear types with 1,231 units were noted in South Gigantes. Overall, the common and most dominant fishing gear types include the squid trap (24.5%), gleaning (15.9%), hook and line with floater (13.5%), and compressor diving (8.1%). The purse seine was only operated in the North, while the encircling net, drift gill net, troll line, and trawl were only operated in the South.

Generally, the number of fishing gear units used to target squid contributed 60.6% in North Gigantes. These include the squid trap, multiple hook and line, squid jig, hook and line with floater, and troll line. In North Gigantes, the squid trap alone showed a contribution of 32.2%, which is only slightly lower than the total contribution of all gears types targeting squid in the South (34.5%). The hook and line with floater also showed a high contribution in the North (17.5%).

Nets contributed 11.0% in the South, and they exceeded those in the North with 6.9% contribution. Among the nets, the crab gill nets were largely used in both islands composing 3.7% of the fishing gear units in the North Gigantes and 6.5% in the South. Among the miscellaneous fishing gears and methods, gleaning was the most important for both islands with a contribution of 14.2% and 18.7% in North and South Gigantes, respectively.

Fishing Gear Calendar/ Seasonality

Tables 2 and 3 show the fishing calendar of fishing gear types used in North and South Gigantes Islands, respectively. The arrows refer to months of operation, while the shading refers to months with highest catch rates. In both islands, most gear types are used year round. For most gear types, seasonality in catch rates is not well defined, although for some, like compressor diving for scallops, catches peak during the northeast monsoon in the North and summer months in South Gigantes.

For most of the gears, fishing is year-round except for some that are seasonally used. The set gill net (*pukot pambulaw*), which catches small pelagic fish such as *Rastrelliger* sp. (Family Scombridae), has different seasonality between the two islands. This gear is only used during the summer months (May – July) in the North, but fishing in the South extends from May to December. Cuttlefish traps are also seasonal and are only deployed from May to December in the North and only during the northeast monsoon in the South. The drive-in net has similar seasonality between islands. Gleaning is year-round in the South, but it is only done in December in the

Table 1. Fishing methods, gear types, and number of units used in North and South Gigantes Islands, Carles. Fishing gears with * are used mainly to catch squid. **No. of units for traps refers to the number of boats operating traps. Overall dominance refers to the total percent contribution of each fishing gear and activities over their total number in both North and South Gigantes.

Fishing gears and methods		No. of Gear Units				Overall Dominance (%)
English Name	Local Name	North	%	South	%	
Nets						
Crab gill net	Pukot pangkasag	79	3.74	80	6.50	4.76
Set gill net	Pukot pambulaw	64	3.03	20	1.62	2.51
Encircling net	Pukot yabyab			30	2.44	0.90
Drift gill net	Pukot pamo			2	0.16	0.06
Drive-in net	Pukot pambalo	3	0.14	4	0.32	0.21
Seines and Trawls						
Purse seine	Pukot pantulingan	2	0.09			0.06
Trawl	Trawl			2	0.16	0.06
Traps						
Fish trap	Bobo isda	75	3.55	19	1.54	2.81
Crab trap	Bobo kasag	3	0.14	50	4.06	1.59
Cuttlefish trap	Bobo kalambutan	20	0.95	6	0.49	0.78
Squid trap*	Bobo nokos	680	32.23	140	11.37	**24.54**
Line						
Bottom set longline	Kitang	72	3.41	23	1.87	2.84
Hook & line	Panapli	21	1.00	40	3.25	1.83
Hook & line	Pandimano			16	1.30	0.48
Multiple hook & line*	Lagulo	3	0.14	65	5.28	2.04
Squid jig*	Lukon-lukon	200	9.48			5.99
Hook & line w/ floater*	Pataw-pataw	370	17.54	80	6.50	**13.47**
Troll line*	Panibid			60	4.87	1.80
Squid jig*	Tina-tina	25	1.18	80	6.50	3.14
Others						
Gleaning	Kinhas	300	14.22	230	18.68	**15.86**
Spearfishing (day)	Pamana mano-mano (day)	5	0.24	60	4.87	1.95
Spearfishing (night)	Pamana compressor (night)	31	1.47	112	9.10	4.28
Compressor dive						
Compressor dive	Compressor fishing (scallop)	157	7.44	112	9.10	**8.05**
	TOTAL	2110	100	1231	100	100

North. The crab trap and fish trap in the North had high catch rates from January to May, but not remarkable in the South. Compressor diving for shellfish in North Gigantes peaks during the northeast monsoon months (December - May), while compressor diving operations are confined within the summer months (March – May) in the South.

Gear Map

Figure 2 shows consolidated gear maps of major fishing gears used to catch target species such as scallop, squid, crab, and fish in North and South Gigantes, respectively. Figure 2A shows three distinct fishing areas for scallops in Gigantes. Scallops were exploited in the small islands of Balbagon in the far west and Cabugao Is. in the south. The fishing ground for scallops was largest in the eastern portion of North Gigantes extending up to the north. Figure 2B shows the fishing areas of three major fishing gears that target squid. Squid trap operations were scattered offshore north of Gigantes at depths of approximately 60m, while squid jig was operated mainly nearshore and concentrated mainly around North Gigantes and Cabugao Islands. Hook and line and troll line were deployed in slightly deeper water and were operated ubiquitously, but were more common on the eastern side of Gigantes down to Cabugao Island. Fishing gears that target crabs (Figure 2C) were distributed

Table 2. Fishing calendar of the various gear types and other fishing methods in North Gigantes Is., Carles, Iloilo. Months highlighted with gray color indicate months with high catch rates (peak season).

Fishing Gears and Methods			
English Name	Local Name	Fishing mos/yr	J F M A M J Ju A S O N D
Bottom set longline	Kitang	12	
Compressor dive	Compressor fishing (scallop)	12	
Crab gill net	Pukot pangkasag	12	
Crab trap	Bobo kasag	12	
Cuttlefish trap	Bobo kalambutan	8	
Drive-in net	Pukot pambalo	5	
Fish trap	Bobo isda (*Timing*)	12	
Gleaning	Kinhas	1	
Hook & line	Panapli	12	
Hook & line w/ floater	Pataw-pataw	12	
Multiple hook & line	Lagulo	2	
Purse seine	Pukot pantulingan	4	
Set gill net	Pukot pambulaw	3	
Spearfishing (day)	Pamana manomano (day)	12	
Spearfishing (night)	Pamana compressor (night)	12	
Squid jig 1	Lukon-lukon	12	
Squid jig 2	Tina-tina	12	
Squid trap	Bobo nokos	12	

Table 3. Fishing calendar of the various gear types and other fishing methods in South Gigantes Is., Carles, Iloilo. Months highlighted with gray color indicate months with high catch rates (peak season).

Fishing Gears and Methods			
English Name	Local Name	Fishing mos/yr	J F M A M J Ju A S O N D
Bottom set longline	Kitang	12	
Compressor dive	Compressor fishing (scallop)	12	
Crab gill net	Pukot pangkasag	12	
Crab trap	Bobo kasag	12	
Cuttlefish trap	Bobo kalambutan	3	
Drift gill net	Pukot pamo	7	
Drive-in net	Pukot pambalo	5	
Encircling net	Pukot yabyab	5	
Fish trap	Bobo isda (*Timing*)	12	
Gleaning	Kinhas	12	
Hook & line 1	Panapli	12	
Hook & line 2	Pandimano	12	
Hook & line w/ floater	Pataw-pataw	12	
Multiple hook & line	Lagulo	12	
Set gill net	Pukot pambulaw	7	
Spearfishing (day)	Pamana mano-mano (day)	12	
Spearfishing (night)	Pamana compressor (night)	12	
Squid jig	Tina-tina	3	
Squid trap	Bobo nokos	12	
Trawl	Trawl	12	
Troll line	Panibid	12	

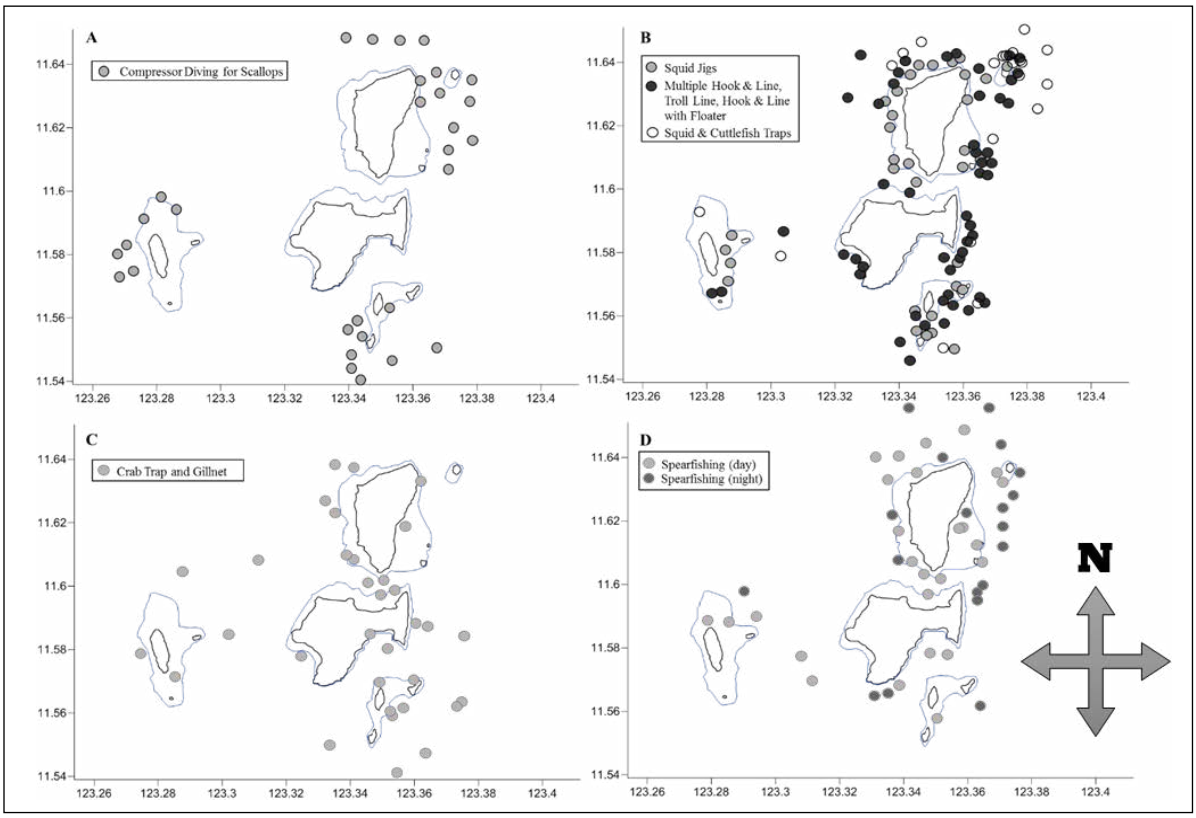

Figure 2. The fishing areas for each major target species (A.scallop, B.squid, C.crab and D. fish) with corresponding fishing gears operated in Gigantes Islands with information based on interviews conducted in January 2014.

fairly well around the islands of Gigantes. Daytime spearfishing (Figure 2D) were more concentrated around North Gigantes exploiting the deep water along Asluman and the area between Gabi and Granada, while nighttime spearfishing were concentrated along the right shoreline of North Gigantes.

Other minor fishing gears have unclear patterns of distribution to determine specific fishing areas, however, some gears show an obvious zoning such as the purse seine being operated offshore to catch pelagic fish, and gleaning was operated nearshore during low tide.

Estimated Catch Contribution Per Gear

The estimated annual catch of the entire Gigantes Islands amounted to 16,420.8 MT (Figure 3), with North Gigantes contributing 9,941.2 MT and 6,479.6 MT for South Gigantes. The compressor operations dominated in both islands and comprised more than half of the annual catch (51.6%). This is followed by traps contributing 17.5% (2,869.0 MT). Traps were composed mainly of squid and cuttlefish traps which contributed 11.4% to the total annual catch. Lines (annual catch: 2,373.5 MT, 14.5%) were dominated by the hook and line with floater which also targeted squid (1,114.2 MT, 6.8%), and the bottom set longline which mainly targeted pelagic fish (730.8 MT, 4.5%). All the rest, contributed less than 10% to the total catch. The purse seine and the trawl were less dominant, and were only operated in North and South Gigantes, respectively.

Approximately 50% of Gigantes' yield is contributed by compressor diving (53.3 MT km^{-2}), which mainly catches scallops and spiny oysters (Table 4). Compressor diving alone registered an estimated annual catch of 8,473.5 MT of scallops and spiny oysters in both North and South Gigantes Islands, with a catch rate of 3.8 kg $fisher^{-1}$ day^{-1} (Table 4). This value is one magnitude lower than that of Peru which registered 12,300 MT of scallops in 2010 (Brown 2011). Though Gigantes has a lower value, its estimated annual catch is more comparable with the Peruvian scallops than its adjacent fishing ground, Asid Gulf, Masbate. Soliman and Dioneda (2004) only reported catches of the dominant species of scallops, *Chlamys funebris*, *C. senatoria nobilis*, and

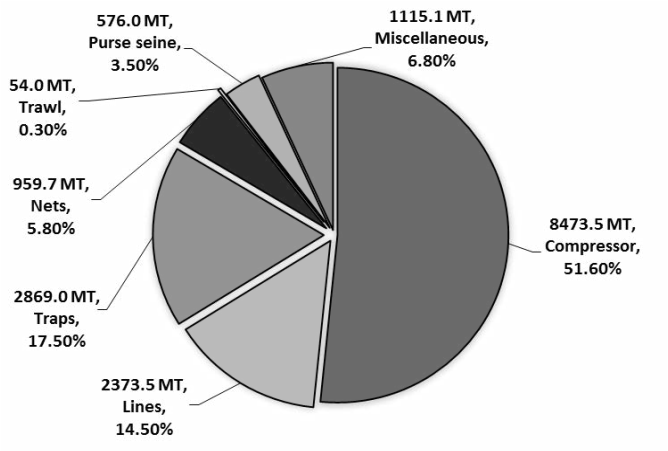

Figure 3. Estimated annual catch of North and South Gigantes Islands, Carles, Iloilo, Philippines. Values are catches in metric tons and values in percent are the contribution of each fishing gear and activities to the total fishery.

Table 4. Summary of fishery parameters for Gigantes Islands, Carles, Iloilo based on monitoring in January 2014. The same fishery parameters were measured in other local fishing grounds around the Visayan region (Concepcion, Talibon, and Palompon) in 2013.

Fishery Parameters	N & S Gigantes	Gigantes Overall Compressor Dive	Concepcion, Iloilo (*Campos 2013*)	Talibon, Bohol (*Campos 2013*)	Palompon, Leyte (*Campos 2013*)
	This Study				
Total Est. Annual Catch (MT)	16,420.8	8,473.5	9,192.5	3,149.5	1,643.7
Total no. of fishing trips	910,050.0	80,700.0	809,616.2	501,788.9	409,789.4
Total no. of fishers	5,341.0	1,076.0	9,527.0	3,092.0	2,572.0
Est. area of fishing ground (km^2)	159.0	159.0	284.5	251.4	43.4
Yield (MT/km^{-2})	103.3	53.3	32.3	12.5	37.9
Fishing pressure ($trips/km^{-2}/yr^{-1}$)	8,811.9	1,514.3	2,845.8	9,442.2	1,996.0
Fisher density ($fishers/km^{-2}$)	51.7	20.2	33.5	12.3	59.3
Ave. no. fishing day/yr^{-1}	260.7	300.0	150.3	277.4	201.0
Est mean catch rate ($kg/fisher^{-1}per\ day^{-1}$)	6.6	3.8	6.4	3.7	3.2

Decatopecten striatus, which registered 1,100 MT. This huge difference may be, however, due to the heavy shells of *Spondylus* spp. which have already been harvested in large volumes in 2013, according to the FGD.

DISCUSSION

Several fishing gears are operated in Gigantes Islands, and there has been a perceived increase in the number of gear units and operators in the islands through the years. The fishery resources caught in the islands include fish, shells, crabs, lobsters, sea cucumber, cuttlefish and squid. Squids could be naturally abundant in Gigantes because of such catch production that supports this fishery. Several types of fishing gears that target squids are being used by local fishers, which indicates that squid is a major target species in Gigantes, particularly in the North where approximately 60% (Table 1) of the gear types were used for squid fishing.

Among the miscellaneous fishing gears, gleaning for shellfish, such as *Scapharca inaequivalvis*, is one

of the major activities of fishers, housewives and children. Spearfishing was more regularly used by South Gigantes fishers (14.0%). Spearfishing was done manually during the day and by compressor diving during the night. Spearfishing at nighttime was operated mainly in deeper water off the east coast of North Gigantes (Figure 2D).

The operation of crab trap and gill net is scattered around Gigantes with no definite pattern (Figure 2C). South Gigantes fishers operated the crab trap and gill net exhaustively around the southern part of Gigantes including Balbagon. Conversely, the deployment of these gears was limited and less exhaustive for North Gigantes fishers. Crab traps were only deployed close to North Gigantes' shoreline. It is, therefore, imperative to suggest that crabs were more abundant in the southern portion of Gigantes and that the fishers favor the exploitation of the crab fishery all year round.

Compressor diving is one of the major fishing methods in both major islands. It is generally used to collect shellfish like scallops and spiny oysters. However, fishermen may simultaneously catch large fish while diving for shellfish when they come across them. In North Gigantes, a high number of compressor units (n=157) were being operated to catch scallops and spiny oysters (Table 1). This is, to some extent, comparable to the compressor units (n=112) operated in the South. This could probably indicate richer scallop fishing grounds around North Gigantes. The establishment of a marine sanctuary between Uaydajon and Brgy. Asluman (Figure 1) could have also contributed to the high production of this resource in North Gigantes. According to the FGDs, one compressor unit is brought out to sea with 4 – 6 fishermen on-board a 7-9 m motorized boat. Two to three divers collect shellfish underwater, and the others operate the compressor and assist in other boat tasks.

The seasonality in catch rates for the compressor diving reveals a pattern, where catches peaked during the northeast monsoon (December – March) for fishers from the North and immediately after (March – May) for those from the South (Tables 2 and 3), which may be a reflection of resource abundance and fishermen's preference for a resource to exploit. Manalo et al. (2016) reported a major spawning peak for *Chlamys senatoria* between November – February, which coincides with an abundance of large, sexually mature scallops that can be harvested and sold. It is apparent that the fishers from the North focus more on scallop fishing during the spawning period (Table 2), while fishers from the South increase effort on compressor diving for scallops just immediately after the spawning season (Table 3). It is likely that the South fishers focus on other fishery resource, such as squids as shown also in Table 3.

Table 4 summarizes the overall fishery parameters for Gigantes Islands, with highlights on compressor diving. Gigantes was estimated to have 159 km^2 fishing ground, with a relatively high overall estimated catch of 16,420.8 MT per year. Fishing pressure in Gigantes water is four times higher than that reported in an adjacent fishing ground in Concepcion, Iloilo. However, this may be due to the larger fishing ground in Concepcion of 284.5 km^2. Gigantes recorded a yield of 103.3 MT km^{-2}, which is one of the highest reports in the Philippines. This value is also much higher than those reported in other fishing grounds in the Visayas such as Concepcion, Iloilo (32.3 MT km^{-2}), Palompon, Leyte (37.9 MT km^{-2}) and Talibon, Bohol (12.5 MT km^{-2}) (Campos 2013). Gigantes demonstrates very high production which could be driven by constant presence of gyres and certain hydrographic features. It is suggested that these features result to its outstanding productivity, although consistently exposed to high fishing pressure. Gigantes Islands, which has a relatively smaller fishing ground seems to be highly fished with a fishing density of 51.7 fishers km^{-2} (Table 4). However, the annual catch is still comparable with the highly productive fishing grounds in the Philippines, such as mentioned in Table 4 (Campos 2013).

CONCLUSION

Gigantes Islands exhibits a nominally higher fisheries production based on the estimated annual catch compared to other fishing grounds in the Visayan Sea (Table 4), and 50% of this is contributed by compressor diving. Although the fishing effort of Gigantes Islands was comparable with that of other Visayan Sea fishing grounds, especially Concepcion, its estimated catch is still one magnitude higher (Table 4). A variety of commercially important fishery resources are exploited, such as crabs, squids, fish, and other mollusks, and most of them are fished out all-year-round. The fishing grounds for these fishery resources are fairly widespread, however, most of them are concentrated around North Gigantes and the small islets south of South Gigantes. Despite

this high production, fishers still consider a decline in the fishery stocks of Gigantes corresponding with shifts into different resources. For instance, fishers opt to collect spiny oysters rather than scallops during the off spawning peak seasons. Scallops and spiny oysters thrive in areas of different substrates, sandy-muddy and rocky, respectively (Caddy 1989; Skoglund and Mulliner 1996). Hence, the difference in the seasonality of scallop harvesting between the two islands could be mainly due to the availability of resources. However, this practice is possibly worthy since the scallop stocks are allowed to grow for the rest of the year until the next spawning/harvest season. This is probably an example of a small-scale boom and bust fishery. However, it is important to note how long scallops become sexually mature after recruitment, though they have been reported to be sexually mature at approximately 5 cm (Manalo et al. 2016). On the other hand, Gigantes possibly possesses important hydrographic processes, such as gyres that are likely to retain larvae and recruits of different species. The establishment of the marine sanctuary in North Gigantes may also have a positive effect on the sustainability of the coastal fisheries of Gigantes (De Guzman 2004).

Unsustained and unregulated fishing of scallops in the Asid Gulf, Masbate was also reported to result to the collapse of scallop stocks and 1999 (Soliman and Dioneda 2004), and was able to recover around the same time in Gigantes in 2001 - 2005. It is notable that the bulk of fishery in Gigantes Island is concentrated on scallop and spiny oyster harvesting. With high fishing pressure, these resources maybe depleted and eventually collapse if left unmanaged. This is applicable to other exploited fisheries in Gigantes. Thus, it is necessary to formulate a sound management plan for resource sustainability. In order to do this, reproductive studies should be done on fish and invertebrate fishery resources to determine the minimum size limit of catch to allow them to spawn first before they are harvested. Information on spawning frequency and behavior can lead to understanding if spawning is restricted to specific defined periods. Identifying major months of spawning will provide window to focus management on. Knowledge of locations of spawning and spat settlement is also important, then protection is also an option allowing them to spawn and grow out of their vulnerable juvenile stage.

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