The Philippine Journal of Fisheries 25 (1): 136-155 January-June 2018
DOI 10.31398/tpjf/25.1.2017C0011

Status of Leyte Gulf Fisheries CYs 2001-2011

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ABSTRACT

Leyte Gulf is among the major fishing grounds in the Philippines with a shelf area of 13, 147 km^2 covering the islands of Samar and Leyte. For this reason, it was chosen as the study area in Eastern Visayas under the National Stock Assessment Program (NSAP) which aims to assess the status of fisheries resources. This paper presents the fishery stock assessment results from CY 2001-2011.

The annual fish catch from 2001-2011 showed a declining trend. The lowest was in 2008 with 12, 483.52 MT while the highest was in 2003 with 26,367.32 MT. The municipal fisheries had a high catch contribution except in 2001 where commercial catch was higher by 30%.

Thirty eight (38) types of fishing gears were identified operating in Leyte Gulf. Danish seine (commercial, DSC) had the highest yield in the commercial fisheries sector while for the municipal fisheries sector it was gillnet (GN). The highest catch of DSC was observed in 2004 (4,243.30 MT) and the lowest in 2010 (1,203.05 MT). The highest catch per unit of effort (CPUE) for DSC was in 2004 (288.66 kg/boat landings) and the lowest was in 2010 (167.09 kg/boat landings). For GN, the highest catch and CPUE were in 2004 (3, 010.72 MT) and 2003 (8.27 kg/boat landings) respectively; while the lowest in catch and CPUE were in 2001 (339.37 MT, 4.05 kg/boat landings).

The top ten (10) species caught belong to the families Leiognathidae, Carangidae, Nemipteridae, Scombridae, Gerreidae, Engraulidae, Mullidae, Synodontidae, Clupeidae, and Portunidae. The selected five (5) major stocks, which are *Rastrelliger kanagurta, Leiognathus bindus, Gazza minuta, Selar crumenophthalmus,* and *Nemipterus hexodon* were mostly abundant in the second half of the year. The percentage of catch at which they were caught before their length at maturity were as follows: 60% for *R. kanagurta,* 85% for *L. bindus*, 13% for *G. minuta,* 45% for *S. crumenophthalmus*, and 51% for *N. hexodon.*

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Received: 25 April 2017
Accepted: 1 September2017

Keywords: *Stock assessment, Leyte Gulf fisheries, population parameters, exploitation values*

1. INTRODUCTION

Leyte Gulf is situated in the central eastern part of the Philippines, having a shelf area of 13,147 km^2 (Silvestre 1986) covering the islands of Samar and Leyte including San Pedro Bay. It has an average depth of 38 fathoms in the central gulf and 8 fathoms in the bay. The bottom of the gulf is sandy muddy with indications of coral growth on the 15-fathom contour along the northwest coast (Warfel and Manacop 1949, cited in Edralin et al. 1992). It is characterized as multi-gear and multi-species fisheries which make it difficult to manage.

It is observable that the fisheries in the Philippines are declining, as the trends in the catch are declining. This situation is also happening in Leyte Gulf. Realizing this need to properly manage our fishery resources, a regular data collection was conducted by the Bureau of Fisheries and Aquatic Resources (BFAR) through a project called National Stock Assessment Program (NSAP), conceptualized and implemented in 1998. The output of which could be utilized in the formulation of effective fishery resource management policies for sustainable use of the resources.

This study will present the result of an 11-year assessment (2001-2011) of Leyte Gulf fisheries.

Within the context of the NSAP, this study aims to generate data on:

1. Annual (2001-2011) fish production trends, catch per unit effort (CPUE), and percentage catch contribution by sector;
2. Summary of existing fishing gears being used and percentage catch contribution;
3. The dominant families and top 10 species composition and their relative abundance; and
4. The population parameters for *Rastrelliger kanagura, Leiognathus bindus, Gazza minuta, Selar crumenophthalmus,* and *Nemipterus hexodon.*

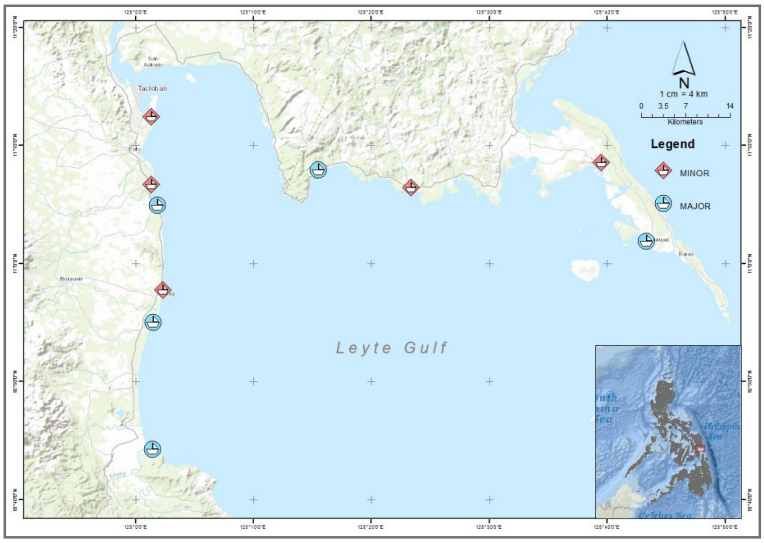

Figure 1. Leyte Gulf study area

2. MATERIALS AND METHODS

The data used were from primary sources, monitored landed catch of fishers. Landing sites for sampling were identified. Data processing followed the NSAP's suggested methodology. The data analyzed covered a period of 11 years, from 2001 until 2011.

Sampling Sites/Landing Centers

Ten (10) fish landing centers of municipalities surrounding Leyte Gulf were designated as sampling sites, namely: Sto. Niño, Abuyog, Leyte; Taraguna, Mc. Arthur, Leyte; Rizal and San Jose, Dulag, Leyte; and Bislig and San Roque, Tanauan, Leyte. The sampling sites in Eastern Samar are Lupok and Public Market, Guiuan and Balangiga and Lawaan (2002-2007), Salcedo. In 2008, San Jose, Tacloban was added as one of the sampling sites (Fig 1).

Data Collection

Data collection was done every after two days in each landing center with a total of 10 to 11 sampling days per month per sampling area, regardless of Saturdays, Sundays, and holidays. Two enumerators were assigned to cover alternately both minor and major landing sites. All boat landings were monitored during sampling days and the following catch and effort information were gathered:

- Name of landing center and fishing ground;
- Name of vessel/fisherman/fishing operator;
- Type of fishing gear used and corresponding effort;
- Total catch (weight) of the boat by gear type; and
- Sub-samples by weight were taken to determine the species composition in the catch by gear and the length measurements of species.

Data encoding and processing

All these information were recorded in NSAP forms. The gathered data were encoded in our NSAP Database using Microsoft Access Software.

Data Analysis

Population parameters were computed using the Electronic Length Frequency Analysis (ELEFAN) routines of the software on Fisheries Stock Assessment Tool (FiSAT II). The software computes for the fish population parameters using generally the von Bertalanffy growth function: $Lt = Linf\ (1 - e^{-K(t-to)})$; where Lt is the length at age t; (Linf) length infinity is length that the fish of a population would reach if they were to grow indefinitely (also known as asymptotic length); k is the parameter of the von Bertalanffy growth function (also known as growth coefficient), expressing the rate (1/year) at which the asymptotic length is approached; e is the base of Naperian logarithm, to is the hypothetical age the fish would attain at length zero.

Other population parameters with the following formula were also computed through:

Total Mortality: Z=M+F. Where M is the instantaneous natural mortality coefficient or death caused by predation, old age, pollution, disease, etc.; and F is the instantaneous fishing mortality coefficient or death caused by fishing.

M is estimated from Pauly's empirical formula:

$$\text{Log } M = 0.654 \log K\ 0.28 \log L_{\infty} + 0.463 \log T$$

Where L_{∞} and k are the von Bertalanffy growth parameters and T is the average temperature of the fishing ground.

These mortality components are also expressed in the form of an index to determine the rate of exploitation,

E=F/Z, Where E is the exploitation rate, and F and Z are fishing and total mortality coefficient

3. RESULTS AND DISCUSSION

Monitored Annual Fish Catch

The annual fish catch from CY 2001-2011 presented in (Figure 2) showed the highest yield of about 26, 367.32 MT in 2003 and the lowest at 12, 483.52 MT in 2008.

Fish catch from Leyte Gulf formed a plateau in 2004-2007 at 20,000 MT, then a fluctuating trend occurred from 2009 until 2011.

The landed catch data of both commercial and municipal fisheries is presented in Figure 3.

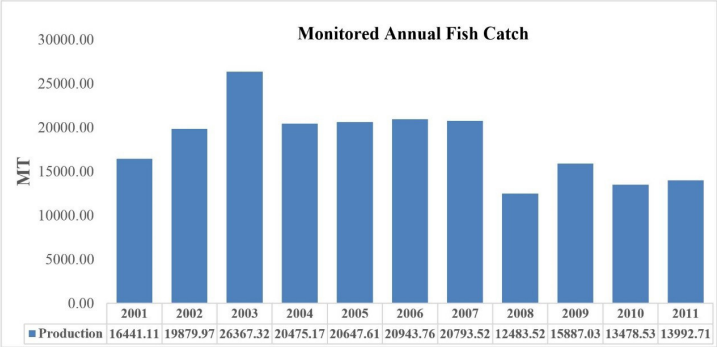

Figure 2. Annual fish catch

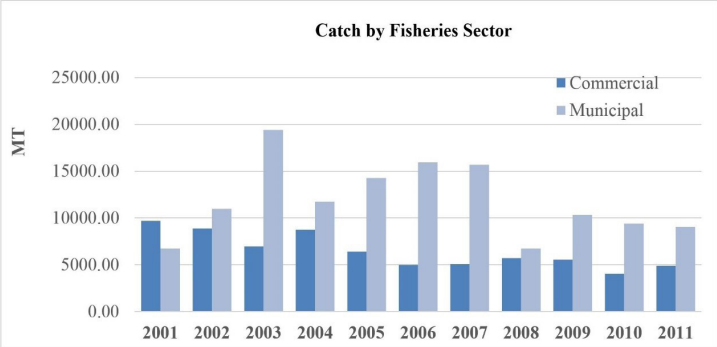

Figure 3. Catch by fisheries sector

The annual fish catch of municipal fisheries sector ranged from 6, 742.93–19,405.20 MT; the lowest was recorded in 2001 and the highest in 2003. For the commercial fisheries sector, the catch ranged from, 4,070.53–9, 698.18 MT; the lowest recorded was in 2010 and the highest in 2001. Municipal fishery sector had a higher catch contribution compared to the commercial except in 2001 where it was higher by 30 percent.

Data from Philippine Fish Profile showed that from 1998-2000 the commercial catch was higher by 42.4% compared to the municipal catch. And in 2001, it was still higher by 27.22%. However, in the succeeding years from 2002 until 2011, commercial fishers were replaced by municipal fishers in terms of fish catch volume. This could be due to the rigorous implementation of the RA No. 8550 of the Philippine Fisheries Code of 1998 which prohibits commercial fishing vessels or fishing using active gears in the municipal waters.

Catch Contribution by gear, CPUE of commercial and municipal gears

Thirty-eight (38) types of fishing gears were identified in this report and out of this number, eighteen (18) were considered active while twenty (20) were passive gears (Table 2). In an unpublished report of Francisco et al (2002), twenty-one (21) different types of fishing gears were reported operating in the Gulf in 1998: 9 active gears and 12 passive gears. This shows an increase of 17 types of gears. The number of active gears increased by three (3) types and the passive gears by eight (8) in a span of 9 years as three passive gears were modified (Gillnet, Liftnet, and Troll line).

DSC had the highest catch percentage of about 22.4% among active gears from 2001-2011 (Table 2). This was followed by Trawl (commercial, TC) at 17.8%. The least among active gears are Modified troll line (0.03%) and Round Haul Seine (0.003%).

GN, on the other hand, was highest among passive gears having a 35.67% share of the aggregate catch followed by HL with 12.13%. The least were modifications of hook and line (i.e., Hook and line with 3 hooks with 0.01% and Hook and line with float with 0.003%).

Table 2. Summary of active and passive gears used in Leyte Gulf from 2001-2011

Gear Type		Gear Name	%	Gear Type		Gear Name	%
Active	1	Danish seine(commercial)	20.94	Passive	1	Gill net	35.67
	2	Trawl (commercial)	16.61		2	Hook and line	12.13
	3	Bag net (municipal)	15.18		3	Drift gill net	8.38
	4	Bag net (commercial)	13.78		4	Crab net	8.32
	5	Ring net	6.57		5	Modified gillnet	6.94
	6	Danish seine	6.56		6	Multiple hook and line	5.28
	7	Spear gun w/ light	6.21		7	Multiple hook and line (Pelagic)	5.07
	8	Trawl (municipal)	4.01		8	Hook & line(2 hooks)	4.13
	9	Modified liftnet	3.51		9	Hook & line w/ light	3.83
	10	Troll line	2.85		10	Fish pot	3.38
	11	Spear gun with compressor	1.16		11	Fish corral	2.87
	12	Dragnet	0.86		12	Gill net with light	1.90
	13	Spear gun	0.71		13	Fish trap	1.14
	14	Push net	0.68		14	Set gill net	0.48
	15	Jigger	0.20		15	Crab trap	0.22
	16	Beach seine	0.13		16	Squid pot	0.11
	17	Modified troll line	0.03		17	Multiple hook and line with light	0.10
	18	Round haul seine	0.003		18	Set long line	0.04
					19	Hook and line(3 hooks)	0.01
					20	Hook and line with float	0.003

Catch using dynamites were also accounted. Catch percentage share using dynamite increased from 0.03% to 0.13%.

Catch, CPUE of commercial and municipal gears

The catch and CPUE in kilograms per boat landings of four (4) identified active commercial gears operating in Leyte Gulf are shown in Figures 4 and 5, respectively.

The catch of commercial gears are as follows: Danish seine (DSC) ranged from 1,203.05–4,243.30 MT; Trawl (TC), 1,046.37–3,802.98 MT; Bagnet (commercial, BNC), 623.56–3,053.34 MT; Ringnet (commercial, RNC), 0–2,722.64 MT. CPUE are as follows: DSC, 154.43–288.66 kgs/boat/day; TC, 144.52–226.37 kgs/boat/day; BNC, 103.94–204.23 kgs/boat/day; RNC, 0-416.26 kgs/boat/day.

Both the DSC and TC, considered the most efficient among gears, displayed relatively stable CPUE though they showed declining trends in fish catch (Figure 4 and 5). DSC recorded its highest catch in 2004 and the lowest in 2007 while TC's highest catch was in 2001 and the lowest in 2011. In 1998, commercial Trawl had the highest total catch percentage contribution of about 49.04% (Francisco et al. 2002). They were replaced by Danish seine fishers in 2002 having a total catch percentage share of 18.3% while TC has 15%. BNC and RNC showed an unstable catch trend from 2001-2011 due to the seasonality of target species, the anchovies. The highest recorded catch of BNC was in 2009; the lowest, however, was in 2005 (Figure 4). RNC was the least among the four gears in terms of catch with a 5% share in the total production. Its highest catch was in 2005 (Fig 4).

The CPUE of the top three (3) active fishing gears in Leyte Gulf, DSC, TC, and BNC, generally presents a linear decreasing trend except for RNC which showed the most unstable CPUE trend, not to mention that it also had the highest recorded CPUE in 2006 (Figure 5). Moreover, in a study conducted by Warfel and Manacop (1949), a CPUE of about 27.7 kg/hr was recorded for Trawl. The results of this present study show that it has decreased to 18.9 kg/hr in 2001, that would be 8.8 kg/hr decline after 52 years and an average drop of

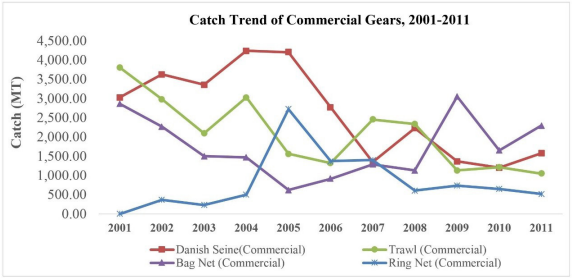

Figure 4. Catch of commercial gears, 2001-2011

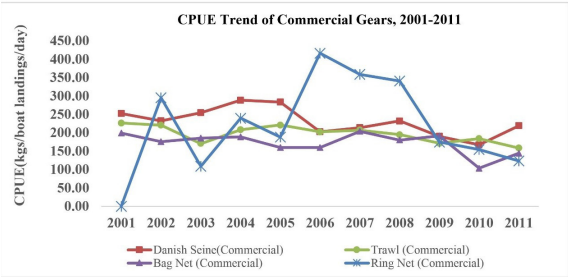

Figure 5. CPUE of commercial gears, 2001-2011

1.7 kg/hr every after 10 years. Then from the results in 2001, this has further decreased to 13.21 kg/hr in 2011, a decline of 5.6 kg/hr in the catch of trawl from 2001 to 2011. This shows that the rate of decline in the catch of trawl was much faster in the last 11 years, clearly showing a consequence of overfishing activities in the last 60 years.

Gillnet (GN) and Hook and line (HL), both passive gears, had the highest catch among municipal gears from 2001-2011. Their catch and CPUE are presented in Figures 6 and 7.

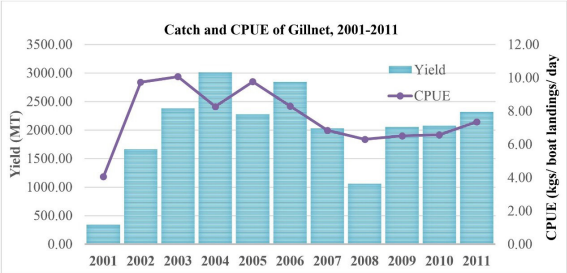

Figure 6. Catch and CPUE of Gillnet, 2001-2011

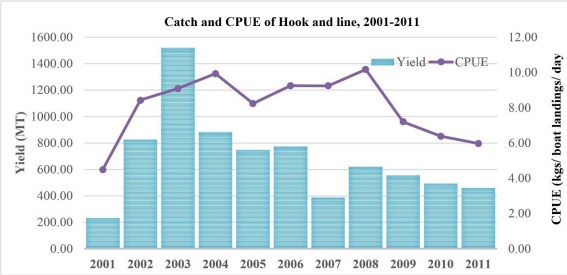

Figure 7. Catch and CPUE of Hook and line, 2001-2011

The highest observed catch of GN was about 3,010.72 MT in 2004 while the lowest was about 339.37 MT in 2001. The catch of GN showed an increasing trend from 2001 to 2004 with an average increase of 1,848.59 MT every year. In 2008, the catch significantly dropped to 1,061.74 MT but increased the following year until 2011 (2,320.04 MT). The CPUE, on the other hand, exhibited the same kind of trend with the catch except in the years 2004 until 2006 where CPUE was low opposite to its catch. The highest recorded CPUE of GN was in 2003 at about 10.07 kilograms per boat landing per day and the lowest in 2001 at 4.05.

Furthermore, Figure 7 shows that the highest catch of Hook and line was in 2003. CPUE of HL presented a generally fluctuating trend from 2001-2011 although with two documented peaks, in 2004 at 9.93 kg/boat/day and in 2008 at 10.17 kg/boat/day, which was also the highest recorded CPUE.

The presence of commercial fishing vessels within the municipal waters of Leyte Gulf shows a conflict in the use of resources as these gears are very efficient in catching demersal and pelagic species thereby increasing competition in the fishery with small municipal fishermen who is dependent on fishing for subsistence.

Catch Composition

The total number of families caught in Leyte Gulf from 2001 to 2011 were 142: 106 finfishes (75 percent); 5 crustaceans (3.5 percent); 7 mollusks (4.9 percent); 6 shellfish (4.2 percent); 1 sea cucumber (0.70 percent). The summary of the catch from 2001-2011 is presented in Figure 8.

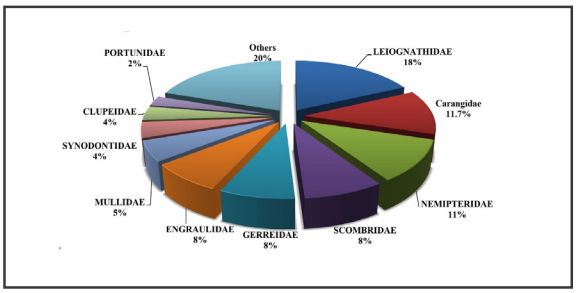

Figure 8. Top ten families, 2001-2011

The number of species caught by municipal fishers totaled to 809 while commercial fishers have 293 from 2001–2011. This data implies that municipal waters are rich in terms of fish biodiversity. Likewise, the municipal fishers will bear a greater impact on the biodiversity of the Gulf.

Species belonging to the families *Leiognathidae* (Slipmouths, 18%) were the most abundant and commonly caught in Leyte Gulf (Table 3). *Leiognathus bindus* ($\bar{x}$=10.14 percent) topped the list of the most dominant species followed by *Pentaprion longimanus* ($\bar{x}$=7.16 percent) and *Encrasicholina punctifer* ($\bar{x}$=5.88 percent). *L. bindus* was observed highest in catch in the years 2001, 2002, 2005, and 2011. *L. bindus* is mostly caught by DSC with an average catch of 98.33 MT per year. The highest catch of DSC for this species was in 2002 with a 90.51% share. It can also be noted that *E. punctifer* had been on the top list of most dominant species caught for four years (2003, 2004, 2006, and 2009). *E. punctifer,* on the other hand, is mostly caught by Bagnet municipal and commercial. This is another indication of commercial boats fishing around the municipal waters.

The three species from the family Leiognathidae which belonged to the top 10 (Table 3) were also among the top 20 trawl-caught species in 1994–1995 in San Pedro Bay which is a part of the Leyte Gulf (Armada 1996, cited in Campos 2012). In another paper by Edralin et al. (1992) on the Leyte Gulf trawl fishery from CY 1987-1988 showed that the *Carangidae* (30-53%) and Scombridae (21-30%) dominated the whole catch. The change in the catch composition in the tropics is a common observation in a fully exploited fishing ground even when the total catch does not appear to be declining yet (Edralin et al. 1992). Moreover, a high percentage of Leiognathids (slipmouths) could also be an indicator that the demersal fish stock in the area may be heavily fished (Villoso and Aprieto 1983).

Table 3. Relative abundance of top ten (10) species caught in Leyte Gulf for 2001, 2006, and 2011

Top 10 species (2001)	%	Top 10 species (2006)	%	Top 10 species (2011)	%
Leiognathus bindus (Leiognathidae)	11.5	*Encrasicholina punctifer (Engraulidae)*	8.9	*Leiognathus bindus (Leiognathidae)*	17.3
Pentaprion longimanus (Gerreidae)	11.2	*Pentaprion longimanus (Gerreidae)*	6.06	*Upeneus quadrilineatus (Mullidae)*	12.0
Encrasicholina punctifer (Engraulidae)	4.97	*Selaroides leptolipes (Carangidae)*	5.70	*Ratsrelliger kanagurta (Scombridae)*	11.5
Saurida undosquamis (Synodontidae)	4.30	*Nemipterus hexodon (Nemipteridae)*	5.63	*Selaroides leptolipes (Carangidae)*	11.0
Gazza minuta (Leoignathidae)	4.13	*Leiognathus bindus (Leoignathidae)*	4.28	*Amblygaster sirm (Clupeidae)*	9.94
Nemipterus hexodon (Nemipteridae)	4.0	*Upeneus quadrilineatus (Mullidae)*	3.77	*Pentaprion longimanus (Gerreidae)*	8.8
Mulloidichthys vanicolensis (Mullidae)	3.88	*Secutor indicus (Leiognathidae)*	3.58	*Nemipterus hexodon (Nemipteridae)*	8.55
Leiognathus splendens (Leiognathidae)	3.59	*Portunus pelagicus (Portunidae)*	3.50	*Leiognathus splendens (Leiognathidae)*	6.68
Ratsrelliger kanagurta (Scombridae)	3.55	*Gazza minuta (Leoignathidae)*	3.29	*Gazza minuta (Leoignathidae)*	3.92
Saurida gracilis (Synodontidae)	2.89	*Selar crumenophthalmus (Carangidae)*	3.10	*Decapterus maruadsi*	2.25
Others	45.9	Others	52.2	Others	8.1

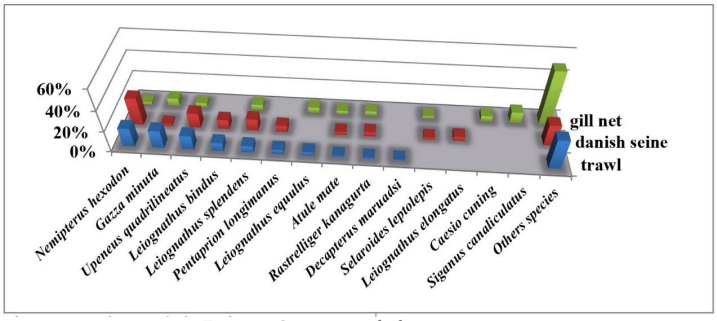

Figure 9. Species caught by major gears

In Figure 9, six out of the top ten species were caught by trawl, Danish seine, and gill net. Eight species are common between trawl and Danish seine; while nine are common to two or three of the major gears. This study found that gill nets are able to catch 603 species which is almost twice that of Danish seine (313 species) and thrice that of trawl (203 species, see Figure 9). Though gill nets are able to catcht more diversified fish species, being a stationary gear it doesn't destroy critical habitats such as seagrass beds found only in municipal waters. Further, this supports the banning of trawl and Danish seine from municipal waters since they exploit the same species beyond municipal waters but its operation destroys habitats such as coral reefs and seagrass beds located within municipal waters.

Seasonality, Relative Abundance

Armada (1996) pointed out that the estimates of population parameters of most abundant species are required in the assessment models for tropical multi-species stock. In this study five species belonging to the top 20 were subjected to this kind of analyses. The seasonality of the five is presented in Figures 10-10d.

Rastrelliger kanagurta, commonly known as Indian mackerel belongs to the top 6 most abundant species caught with a catch percentage share of 4.29 percent. It is mostly caught by DSC (66.93%), GN (11.18%), RN (9.27&), and TC (5.00%). It appeared to have two (2) peaks every year, one in the month of April and the other in the months between October until January as shown in (Figure 10).

Leiognathus bindus (Orangefin ponyfish), was observed to be abundant from May to August and November until February (Figure 10a).

Gazza minuta, locally known as Toothpony, was observed highest in production in November and January until February (Figure 10b). This is mostly caught by TC (63.70%), DSC (13.72%), BNC (9.65%), and GN (7.90%).

Table 4. Length at maturity (Lm) of species abundant in Leyte Gulf

Species	Lm (cm)	Source
Rastrelliger kanagurta	18.75	Pathansali (1961, 1967) and Chee (!980)
Leiognathus bindus	10.0	Froese and Pauly (2000)
Gazza minuta	10.0	Jayabalan and Ramamoorthi (!980)
Selar crumenophthalmus	20.67	Gonadal Examination, Otter Trawl Survey in Leyte Gulf (2014)
Nemipterus hexodon	19.72	Ramos, M. H., et al (2002)

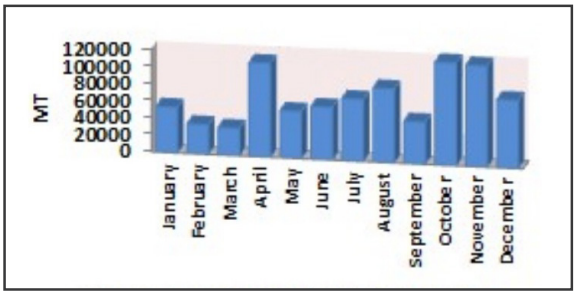

Figure 10. Seasonality of *R. kanagurta,* 2001 - 2011

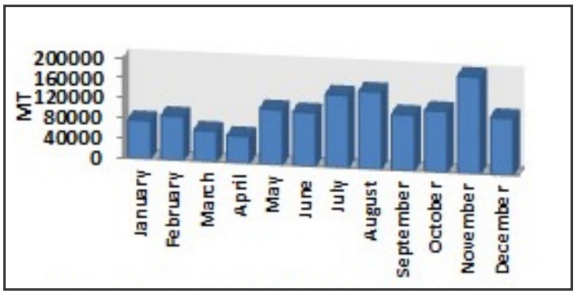

Figure 10a. Seasonality of *L. bindus,* 2001 - 2011

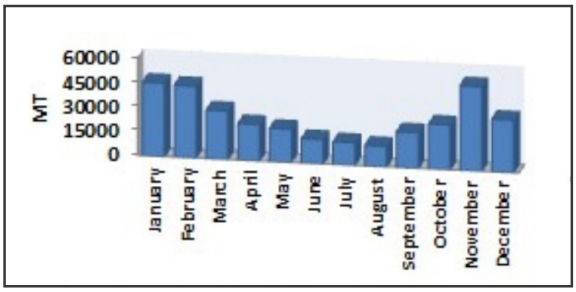

Figure 10b. Seasonality of *G. minuta,* 2001 - 2011

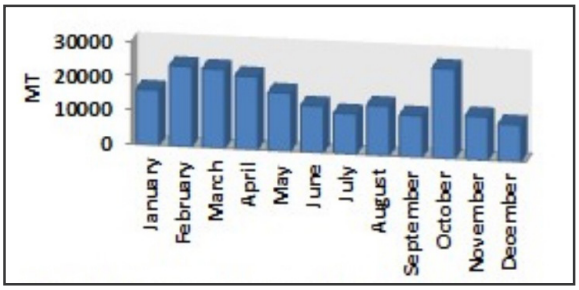

Figure 10c. Seasonality of *S. crumenophthalmus,* 2001 - 2011

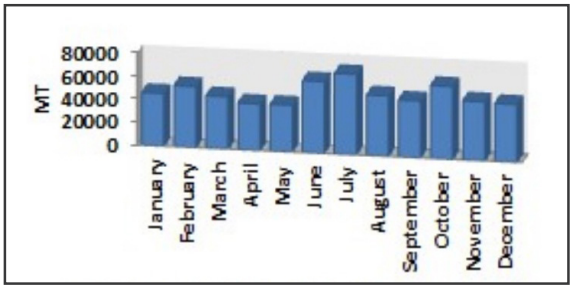

Figure 10d. Seasonality of *N. hexodon,* 2001 - 2011

Peak months of *Selar crumenophthalmus* (big eye scad) were observed to occur in October and February to March. In the study conducted by Mansor et al (1996), they identified these months as spawning periods. DSC is the top catcher of this species. It constitutes 34.67% share of the total catch followed by Multiple Hook and Line Pelagic (MHLP) with 28.81%, GN with 23.36%, Multiple hook and line (HL) with 5.69%, and TC (3.95%).

Nemipterus hexodon (Ornate threadfin bream) is relatively abundant year-round but peaks during the months of June, July, and October (Figure 10d). DSC (42.19%), TC (37.01%), Fish pot (11.79%), Danish seine (3.64%), and GN (1.96%) are the gears that usually catch this species.

Length Frequency Distribution, Length at maturity (Lm)

The length or sizes of the five (5) dominant species (Figure 11-11d) caught in Leyte Gulf are as follows: a.) *R. kanagurta* (4.25-30.25 cm); b.) *L. bindus* (4.25–15.25 cm); c.) *G. minuta* (4.74–20.25 cm); d.) *S. crumenophthalmus* (9.25–30.25 cm); e.) *N. hexodon* (6.25–29.25 cm). The values in Table 4 show the lengths at maturity of the five selected species based on supporting studies. It will be used as a standard measure of the status of the stock in support to the E-values by comparing the sizes of the catch of the top four gears that exploit the above-mentioned species which is shown in Figures 11-11d.

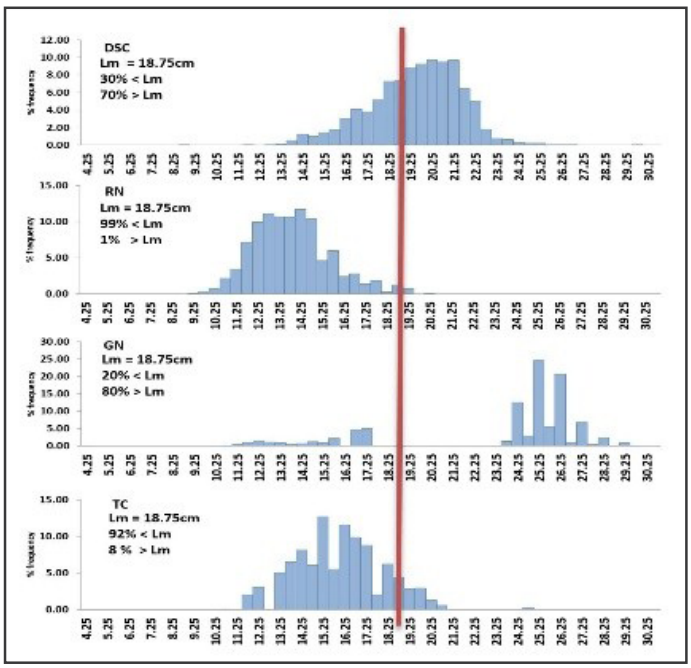

Figure 11. Length frequency distribution of *R. kanagurta* by trawl, gillnet, ring net, and Danish seine commercial from 2001-2011

R. kanagurta, considered as a high-value species, is usually caught by DSC (66.9%), GN (11.2%), RN (9.27%), and TC (5.00%). Of the four gears, RN and TC are very efficient in exploiting this species as 99% and 92%, respectively, of its catch were smaller than the length at maturity (Lm=18.75 cm). This means that only 0.84-7.85% of the stock may have been given the chance to spawn. Moreover, between GN and DSC, GN is much friendlier to the stock and is good for sustainable fishing. Only 20% was caught below the Lm (Figure 11).

L. bindus was the dominant stock from the aggregate production of 2001 until 2011 and was mostly caught by commercial and active gears. Fig 11a shows a high percentage of small sizes caught by commercial gears (DSC – 81 percent, TC – 75 percent, BNC – 95 percent)

G. minuta, another species that is mostly caught by the commercial gears Trawl, Danish seine, and Bagnet, have catches with size compositions that are bigger than Lm which is equal to 10.00 cm. Meaning, most of the catch, if not all, are mature and may have probably reproduced since only 3–23% were below the Lm (Figure 11b).

S. crumenophthalmus which is one commercially important species was mostly caught by the gears commercial Danish seine, gillnet, trawl commercial, and multiple hook and line. Of the five gears, GN proved again to be sustainable as it catches only 13% that was below the Lm which is 21 cm. DSC and TC caught 50% and 65%, respectively, that were below Lm. MHL caught 76% which was below the Lm (Figure 11c).

The size catch composition of *N. hexodon* from 2001 to 2011 by the five gears as shown in Figure 11d presents 55-93% of the stocks caught by the gears fish pots, commercial Danish seine, municipal Danish seine, and commercial Trawl were below the length of maturity which is equal to 15.30 cm. Ninety–two (92) percent of gillnet catch was above the Lm which implies that this gear exploits *N. hexodon* that have already spawned.

These figures suggest that Leyte Gulf was experiencing growth and recruitment overfishing since the majority of the stock of the above-mentioned species were caught at relatively small sizes and some even before they were allowed to grow and reproduce. It is worth noting that these stocks are short-lived species. Hence, they can easily replenish their population in a short period of time. Therefore, this amount of fishing pressure may be considered tolerable; however, increasing it would be detrimental to the stocks or even to the state of the fishery resources.

Length Infinity (L_∞) and k values

The five (5) selected species were subjected to the FiSAT routines to get the growth parameter estimates which are shown in Table 5.

Estimates of L_∞ of *R. kanagurta* showed a fluctuating trend from 2001 to 2011. The highest value was obtained in the year 2007 at 32.96 cm and the lowest at 27.03 cm in 2003. The values obtained were still within the range of L_∞'s from other literature which is 24.7-39.00 cm. The K values generated by the software ranged from 0.8-1.48 cm/year^{-1} while the k-values from other literature ranged from 0.7-1.5 cm/year^{-1}.

The L_∞ estimates of *L. bindus* varied every year. It was recorded highest at 15.75 cm in 2007 and lowest at 12.78 cm in 2005. Data from 2002 to 2003 and 2008 to 2011 were insufficient. Values for the L_∞ from other literature ranged from 8.2-13.75 cm. K values obtained ranged from 0.84-1.80 cm/year^{-1} while from other literature it ranged from 0.88-1.3 cm/year^{-1}.

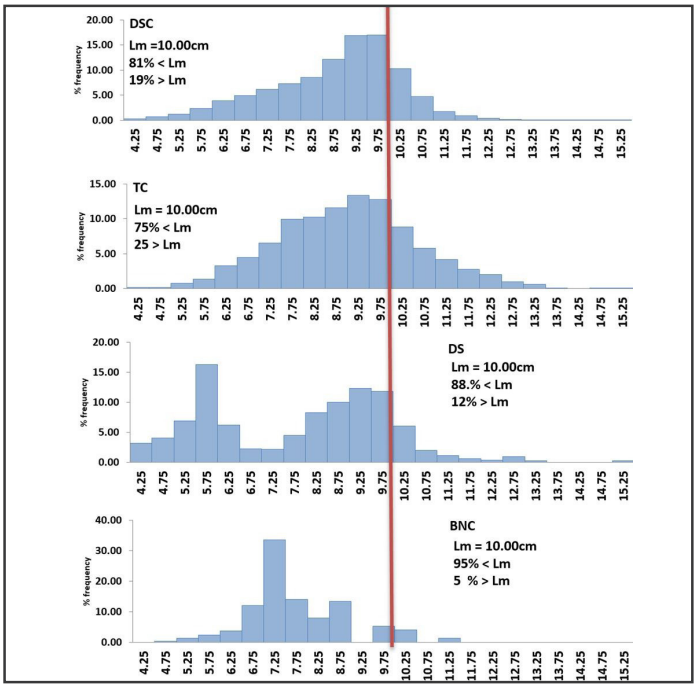

Figure 11a. Composite length frequency distribution of *Leiognathus bindus* caught by Danish seine commercial, trawl commercial, Danish seine (municipal), and bagnet commercial in Leyte Gulf (2001-2011)

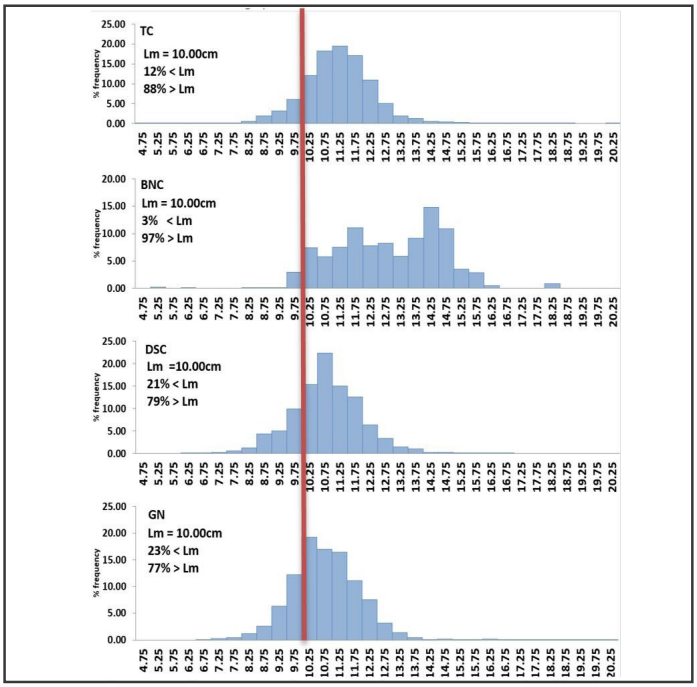

Figure 11b. Composite length frequency Distribution of *Gazza minuta* caught by trawl commercial, Danish seine commercial, bagnet commercial, and gillnet in Leyte Gulf (2001-2011)

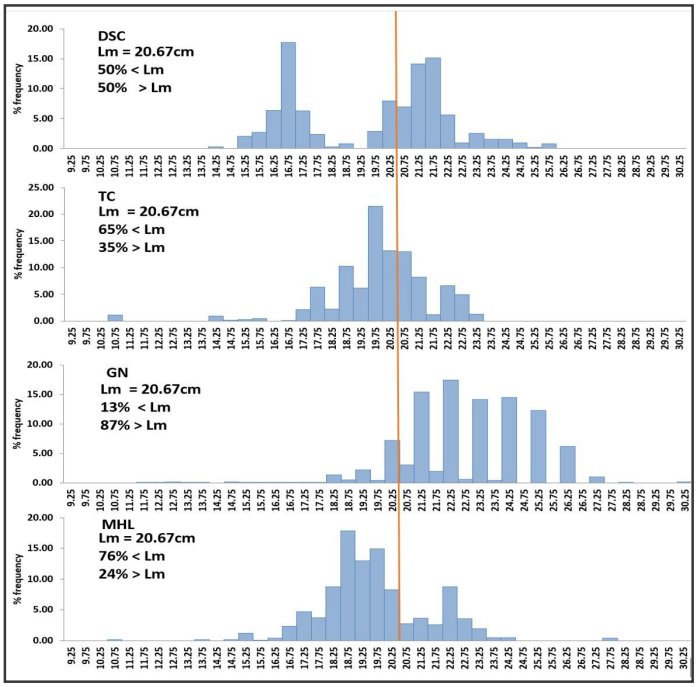

Figure 11c. Composite length frequency distribution of *Selar crumenophthalmus* caught by Danish seine commercial, gillnet, trawl commercial, and multiple hook and line in Leyte Gulf (2001-2011)

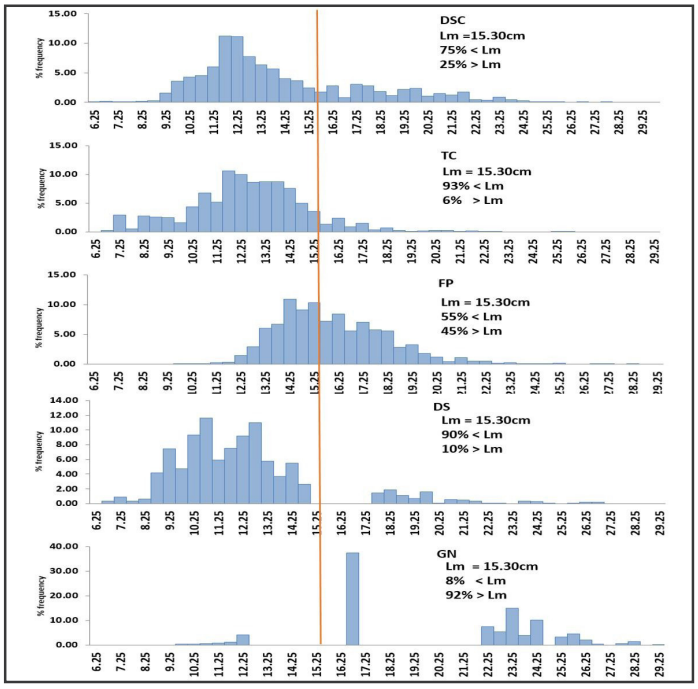

Figure 11d Composite length frequency distribution of *Nemipterus hexodon* caught by Danish seine commercial, trawl commercial, fish pot, Danish seine (municipal), and gillnet in Leyte Gulf (2001-2011)

The data of *G. minuta* that could only be analyzed by the software FiSAT was from the years 2004 until 2009. As for other years, the number of frequency (counts) of individuals were insufficient, therefore, it cannot be processed by the software. The estimates of L_∞ which ranged from 15.17-19.4 cm also varied each year. The highest value was obtained in 2007 and the lowest in 2008. Estimates from other literature ranged from 14.0-22.5 cm. K –values which also showed the same trend as the L_∞ ranged from 0.91-1.35 cm/year^{-1}. Although it slightly increased from 1.06 cm/year^{-1} to 1.15 cm/year^{-1} in 2004 to 2005, it decreased to 1.1 cm/year^{-1} the next year and then continued to fluctuate thereafter until 2009. The highest value obtained was in 2009 and the lowest in 2008. Based on other literature, their k values ranged from 0.7-1.30 cm/year^{-1}.

Table 5. Length infinity (L_∞), and growth parameter estimates (k), 2001-2011

Species/ Year	L_∞ (cm)	K	Species/ Year	L_∞ (cm)	K
Rastrelliger kanagurta			*Leiognathus bindus*		
2001	27.89	1.25	2001	13.59	0.87
2002	30.85	1.2	2002	Insufficient data	
2003	27.03	1.2	2003	Insufficient data	
2004	30.04	0.8	2004	14.83	0.84
2005	29.03	1.1	2005	12.78	0.97
2006	30.36	1.48	2006	14.2	1.05
2007	32.96	0.8	2007	15.75	1.8
2008	30.81	0.9	2008	Insufficient data	
2009	32.39	0.85	2009	Insufficient data	
2010	30.25	1.00	2010	Insufficient data	
2011	29.64	1.09	2011	Insufficient data	
Gazza minuta			*Selar crumenophthalmus*		
2001	Insufficitent data		2001	26.68	1.06
2002	Insufficient data		2002	Insufficient data	
2003	Insufficient data		2003	Insufficient data	
2004	16.72	1.06	2004	27.32	1.20
2005	19.36	1.15	2005	30.18	0.82
2006	15.96	1.10	2006	28.58	1.30
2007	19.4	1.20	2007	Insufficient data	
2008	15.17	0.91	2008	29.73	1.35
2009	18.0	1.35	2009	26.9	0.95
2010	Insufficient data		2010	Insufficient data	
2011	Insufficient data		2011	Insufficient data	
Nemipterus hexodon					
2001	32.85	1.0			
2002	32.37	1.04			
2003	33.62	0.80			
2004	28.04	0.80			
2005	32.86	1.0			
2006	Insufficient data				
2007	27.30	0.65			
2008	24.70	1.0			
2009	25.43	1.0			
2010	28.6	0.92			

For *S. crumenophthalmus,* L_∞ values which ranged from 26.9-30.18 cm, varied from 2001 until 2011. It was observed highest in 2005 and lowest in 2009. From the literature, values of L_∞ range from 23.3-36.5 cm. The k-values obtained ranged from 0.82-1.35 cm/year-1 while from other literature k-values ranged from 0.89-2.07 cm/year^{-1}.

For *N. hexodon*, the L_∞ values from 2008 until 2010 were increasing, but from 2001 to 2007 the values were fluctuating. It ranged from 17.07-32.86 cm, which was highest in 2005 and lowest in 2008. Based on other literature, L_∞ is 25.5 cm. For the k values obtained, it ranged from 0.65-1.04 cm/year^{-1} while from other literature k value was 0.48 cm/year^{-1}.

The species subjected to the growth analysis displayed high values of k and small length infinities. This suggests a high growth rate (greater than 0.5). Meaning, as they are small species of fish, they grow and mature early.

Mortality and Exploitation Values

One of the population parameters in fish stock assessments is the exploitation value (E). Researchers consider E values ranging from 0.4 to 0.6 as sustainable fishing. Pauly and Ingles (1984) even stated that the optimum fishing mortality of an exploited stock should be equal to the natural mortality (Fopt = M); thus, optimum exploitation rate should be equal to 0.50. E values higher than this is already suggesting an overexploitation of the stock. The mortality of a cohort is determined by factors such as mortality due to fishing (F), mortality due to natural causes (M), that is predation, disease, and aging. Exploitation rate (E) can be estimated given the above-mentioned factors by getting the ratio of fishing mortality over total mortality (Z) which then can be used to determine the condition of the fishing area.

The estimates of fishing mortality values of the five species presented in Table 6 were: a. *R. kanagurta*

Table 6. Mortality values, 2001-2011

Species/ Year	Z	M	F	Species/ Year	Z	M	F
Rastrelliger kanagurta				*Leiognathus bindus*			
2001	6.98	2.11	4.87	2001	4.74	2.04	2.7
2002	11.2	2.0	9.2	2002	Insufficient data		
2003	5.9	2.07	3.83	2003	Insufficient data		
2004	6.3	1.54	4.76	2004	8.52	2.13	6.39
2005	6.37	1.92	4.45	2005	4.10	2.37	1.73
2006	4.68	2.3	2.38	2006	4.91	2.27	2.64
2007	6.59	1.5	5.09	2007	6.91	3.14	3.77
2008	5.61	1.66	3.96	2008	Insufficient data		
2009	6.93	1.57	5.36	2009	Insufficient data		
2010	6.22	1.78	4.44	2010	Insufficient data		
2011	7.36	1.9	5.46	2011	Insufficient data		
Gazza minuta				*Selar crumenophthalmus*			
2001	Insufficient data			2001	6.01	1.88	4.13
2002	Insufficient data			2002	Insufficient data		
2003	Insufficient data			2003	Insufficient data		
2004	6.99	2.18	4.81	2004	4.43	2.07	2.36
2005	3.89	2.21	1.68	2005	3.5	1.57	1.93
2006	4.71	2.27	2.44	2006	3.88	2.15	1.73
2007	5.31	2.27	3.04	2007	Insufficient data		
2008	3.38	2.03	1.35	2008	5	2.18	2.82
2009	12.23	2.51	9.72	2009	6.79	1.78	5.01
2010	Insufficient data			2010	Insufficient data		
2011	Insufficient data			2011	Insufficient data		
Nemipterus hexodon							
2001	5.05	1.54	4.01				
2002	5.4	2.17	2.49				
2003	4.15	1.74	3.31				
2004	7.28	1.79	3.61				
2005	6.87	1.5	2.66				
2006	Insufficient data						
2007	5.37	1.38	3.99				
2008	4.64	1.89	2.75				
2009	5.74	1.87	3.87				
2010	4.58	1.83	2.75				
2011	4.18	1.71	2.47				

(2.38–9.2); b. *L. bindus* (1.73–6.39); c. *G. minuta* (1.35-9.72); d. *S. crumenophthalmus* (1.73–5.01); e. *N. hexodon* (2.47–4.01).

The natural mortality ranges for each species were: a. *R. kanagurta* (1.5–2.3); b. *L. bindus* (2.04–3.14); c. *G. minuta* (2.03– 2.51); d. *S. crumenophthalmus* (1.57–2.18); e. *N. hexodon* (1.38–2.17) as can be seen in Table 6.

The exploitation values (E) of the five major stocks presented in Figure 12 are as follows: a. *R. kanagurta* (0.51-0.82); b. *L. bindus* (0.42-0.75); c. *G. minuta* (0.40-0.80); d. *S. crumenophthalmus* (0.45 – 0.74); e. *N. hexodon* (0.51-0.78).

These figures show that a great factor of mortality is attributed to fishing and that the exploitation rates of these stocks are very high as it ranges from 0.6-0.82. However, it also shows a fluctuating trend which means that the species can still replenish its stock although it is being overexploited. This only shows that small demersal or pelagic species can tolerate high values of exploitation due to the fact that they are early maturing. However, if destructive fishing is not suppressed and their habitat is destroyed, this might reduce fish recruitment thereby also reducing species diversity or worst, possibly eliminate a population (Dayton et al. 1995).

4. SUMMARY AND CONCLUSION

Leyte Gulf is an active fishing ground that is relied upon by its surrounding locals for its marine produce. After the RA 8550 has been implemented, more fishermen resorted to municipal fishing, using only gears that the law allowed to be used in municipal waters. Hence, the catch shifted from commercial to municipal fisheries that is why in some stocks, a high percentage was caught by a municipal gear that is below the length at maturity (e.g. *S. crumenophthalmus* – MHL at 76%.

Species belonging to the families *Leiognathidae* (Slipmouths, 18%) were the most abundant and

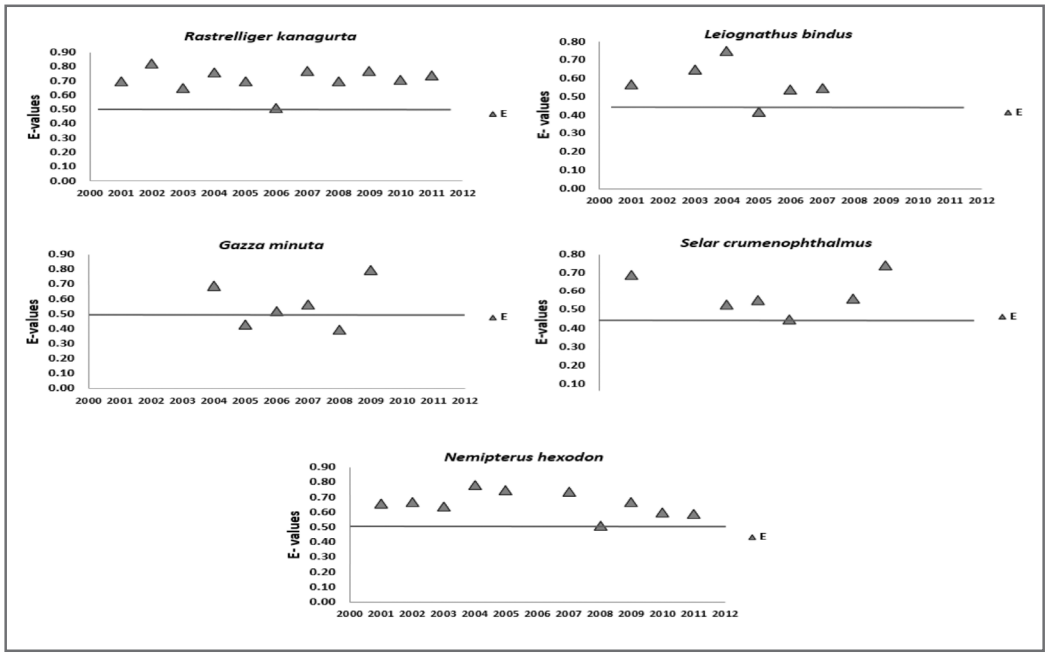

Figure 12. Exploitation values, 2001-2011

commonly caught in Leyte Gulf. This study showed that most of these species were abundant in the second half of the year, in relatively colder months while others were abundant year-round.

Armada (2004) pointed out the factors by which overfishing is occurring on a fishing ground: declining catch and catch rates, increasing effort, increasing mortalities and exploitation rates, changes or shift in species composition, leveling off of marine landings, and concentration of fishing effort within a small area. Some of these indicators were observed in Leyte Gulf. The catch has been declining in the study period of 11 years (2001-2011). Catch rates of Trawl also decreased by 52.31% (14.49 kgs/hr) in 62 years, from 1949-2011 (Warfel and Manacop 1950). The number of active gears increased by 5 types; passive gears doubled. Dynamite catch increased by 0.1%. Also, majority of the stock of the five selected species observed to be experiencing recruitment overfishing were caught even before they were allowed to grow and reproduce; 20-29% of *R. kanagurta* were caught before the length at maturity; *L. bindus*, 75-95%; *G. minuta*, 3-23%; *S. crumenophthalmus*, 13-76%; and *N. hexodon*, 8-93%. The exploitation rates of the selected stocks were higher than the Eopt=0.50: a. *R. kanagurta* (0.51-0.82); b. *L. bindus* (0.42-0.75); c. *G. minuta* (0.40-0.80); d. *S. crumenophthalmus* (0.45 – 0.74); e. *N. hexodon* (0.51-0.78).

5. ACKNOWLEDGEMENTS

We would like to extend our gratitude to the Bureau of Fisheries and Aquatic Resources Regional Office No. 8 for the financial support in making this program a success, especially to Dr. Juan D. Albaladejo for his guidance and encouragement in carrying out this paper.

For the time and extra effort put into by the enumerators in gathering the data, it is very much appreciated.

For the undying support of the NFRDI family, especially to Dr. Mudjekeewis Santos for inspiring us to write and write. Well, here's to more publications!

Finally, to the One true source of all wisdom-glory and honor to you, Abba Father.

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APPENDICES

Appendix A. Operational fishing gears, percentage catch contribution, and CPUE. CY 2001

CY 2001				
No.	Gear Type	Total Catch (MT)	%	CPUE (kgs/ boat landings/day)
ACTIVE GEAR				
1	Trawl (commercial)	3, 802.98	29.18	226.37
2	Danish seine (commercial)	3, 029.86	23.25	252.49
3	Bagnet (commercial)	2, 865.34	21.99	198.98
4	Bagnet (municipal)	1, 389.03	10.66	137.58
5	Trawl (municipal)	560.21	4.30	21.97
6	Modified liftnet	369.51	2.84	64.83
7	Spear gun with light	326.79	2.51	49.51
8	Ring net	233.88	1.79	259.87
9	Troll line	206.36	1.58	16.75
10	Danish seine (municipal)	126.30	0.97	38.93
11	Spear gun	87.32	0.67	8.32
12	Jigger	15.93	0.12	4.30
13	Beach seine	10.18	0.08	8.49
14	Modified troll line	5.07	0.04	16.90
15	Round haul seine	3.85	0.03	21.99
Total			100.0	
PASSIVE GEAR				
16	Multiple hook and line (pelagic)	345.32	14.48	47.80
17	Gillnet	339.37	14.23	4.05
18	Set gillnet	266.91	11.19	3.78
19	Hook and line	231.84	9.72	4.49
20	Drift gillnet	202.33	8.49	18.83
21	Gillnet with light	198.59	8.33	41.37
22	Crab net	180.94	7.59	3.21
23	Hook and light (2 hooks)	136.91	5.74	13.69
24	Fish corral	132.34	5.55	21.65
25	Multiple hook and line	112.29	4.71	5.75
26	Hook and line with light	88.80	3.72	12.33
27	Fish trap	63.24	2.65	7.81
28	Crab trap	3.36	1.69	3.36
29	Fish pot	38.90	1.63	12.0
30	Multiple hook and line with light	4.80	0.20	15.99
31	Squid pot	1.5	0.06	5.00
Total			100.0	
Others				
32	Dynamite	21.39		23.12

Appendix B. Operational fishing gears, percentage catch contribution, and CPUE. CY 2002

CY 2002				
No.	Gear Type	Total Catch (MT)	%	CPUE (kgs/ boat landings/day)
ACTIVE GEAR				
1	Danish seine (commercial)	3, 631.45	26.51	232.79
2	Trawl (commercial)	2, 982.82	21.77	220.95
3	Bagnet (commercial)	2, 270.01	16.57	175.97
4	Bagnet (municipal)	2, 192.97	16.01	114.57
5	Spear gun with light	584.19	4.26	65.23
6	Danish seine (municipal)	513.94	3.75	42.83
7	Modified liftnet	419.07	3.06	77.61
8	Spear gun	363.25	2.65	13.76
9	Ring net	362.62	2.65	295.0
10	Trawl (municipal)	209.41	1.53	19.39
11	Spear gun with compressor	111.47	0.81	9.78
12	Beach seine	33.26	0.24	18.94
13	Jigger	25.5	0.19	3.63
Total			100.0	
PASSIVE GEAR				
14	Gillnet	1664.76	27.13	9.74
15	Hook and line	825.08	13.46	8.44
16	Drift gillnet	669.96	10.93	32.89
17	Troll line	641.88	10.47	27.48
18	Multiple hook and line	432.05	7.05	11.66
19	Multiple hook and line (pelagic)	421.47	6.88	30.77
20	Crab net	404.91	6.61	3.05
21	Fish corral	261.22	4.26	22.54
22	Hook and line (2 hooks)	247.90	4.04	7.51
23	Gillnet with light	221.95	3.62	45.14
24	Hook and line with light	118.94	1.94	14.11
25	Fish trap	106.25	1.73	8.07
26	Crab trap	43.48	0.71	3.62
27	Fish pot	36.47	0.60	5.93
28	Set gillnet	31.31	0.51	17.83
29	Squid pot	1.00	0.016	56.45
Total			100.0	
Others				
30	Dynamite	51.37		34.83

Appendix C. Operational fishing gears, percentage catch contribution, and CPUE. CY 2003

CY 2003				
No.	Gear Type	Total Catch (MT)	%	CPUE (kgs/ boat land-ings/day)
ACTIVE GEAR				
1	Bagnet (municipal)	5, 263.14	32.94	160.95
2	Danish seine (commercial)	3, 362.44	21.05	254.73
3	Trawl (commercial)	2, 096.56	13.12	170.45
4	Bagnet (commercial)	1, 503.12	9.41	185.57
5	Spear gun with light	964.80	6.03	63.06
6	Danish seine (municipal)	770.10	4.82	48.43
7	Troll line	765.78	4.79	19.19
8	Modified liftnet	232.53	1.46	64.59
9	Spear gun with compressor	232.30	1.45	10.19
10	Ring net (municipal)	228.66	1.43	108.89
11	Trawl (municipal)	227.85	1.43	15.50
12	Spear gun	153.04	0.96	7.61
13	Jigger	119.58	0.75	9.97
14	Modified troll line	28.90	0.18	32.11
15	Beach seine	26.93	0.17	8.98
16	Push net	0.60	0.003	1.00
Total			100.0	
PASSIVE GEAR				
16	Gillnet	2, 379.52	22.91	10.07
17	Hook and line with light	2, 017.50	19.43	12.07
18	Hook and line	1, 520.01	10.93	9.10
19	Drift gillnet	1, 310.02	12.61	32.59
20	Crab net	707.65	6.81	4.17
21	Multiple hook and line (pelagic)	668.70	6.44	28.58
22	Gillnet with light	436.58	4.20	51.97
23	Multiple hook and line	348.39	3.35	5.50
24	Fish corral	339.10	3.26	17.13
25	Hook and line (2 hooks)	246.81	2.38	7.62
26	Fish pot	185.57	1.79	10.85
27	Fish trap	176.54	1.70	7.85
28	Crab trap	31.47	0.30	3.28
29	Squid pot	17.14	0.16	2.72
Total			100.0	
Others				
30	Dynamite	5.97		19.91

Appendix D. Operational fishing gears, percentage catch contribution, and CPUE. CY 2004

CY 2004				
No.	Gear Type	Total Catch (MT)	%	CPUE (kgs/boat landings/ day)
ACTIVE GEAR				
1	Danish seine (commercial)	4, 243.30	30.13	288.66
2	Trawl (commercial)	3, 027.97	21.50	208.27
3	Bagnet (municipal)	2, 556.20	18.15	167.07
4	Bagnet (commercial)	1, 472.02	10.45	188.72
5	Danish seine (municipal)	548.50	3.89	38.90
6	Ring net	498.47	3.54	240.00
7	Modified liftnet	485.40	3.45	147.09
8	Troll line	389.03	2.76	23.58
9	Spear gun with light	289.98	2.06	48.33
10	Trawl (municipal)	270.94	1.92	19.09
11	Spear gun with compressor	223.50	1.59	12.02
12	Spear gun	57.59	0.41	6.66
13	Jigger	12.63	0.09	5.26
14	Beach seine	5.40	0.04	7.80
15	Modified troll line	3.26	0.02	10.88
Total			100.0	
PASSIVE GEAR				
16	Gillnet	3, 010.72	45.56	8.27
17	Drift gillnet	1, 002.02	15.16	28.55
18	Hook and line	883.79	13.37	9.93
19	Crab net	739.38	11.19	4.19
20	Hook and line (2 hooks)	230.61	3.49	7.76
21	Fish pot	221.21	3.35	10.31
22	Multiple hook and line	182.82	2.77	4.29
23	Multiple hook and line (pelagic)	102.26	1.55	32.82
24	Fish corral	79.93	1.21	10.66
25	Gillnet with light	48.80	0.74	57.41
26	Hook and line with light	23.08	0.35	3.85
27	Squid pot	15.26	0.23	5.09
28	Hook and line (3 hooks)	8.77	0.13	19.48
29	Crab trap	5.39	0.08	1.63
Total			100.0	
Others				
30	Dynamite	5.80		19.93

Appendix E. Operational fishing gears, percentage catch contribution, and CPUE. CY 2005

CY 2005				
No.	Gear Type	Total Catch (MT)	%	CPUE (kgs/boat landings/ day)
ACTIVE GEAR				
1	Danish seine (commercial)	4, 201.24	28.82	283.27
2	Ring net	2, 722.64	18.68	188.05
3	Trawl (Municipal)	1, 662.61	11.41	135.17
4	Trawl (commercial)	1, 562.36	10.72	221.22
5	Bagnet (municipal)	1, 246.28	8.55	122.18
6	Modified liftnet	902.83	6.19	143.31
7	Bagnet (commercial)	623.56	4.28	159.89
8	Danish seine (municipal)	504.64	3.46	41.03
9	Spear gun with compressor	446.94	3.07	26.60
10	Spear gun with light	374.97	2.57	69.44
11	Troll line	243.38	1.67	27.98
12	Spear gun	67.71	1.56	6.45
13	Beach seine	13.66	0.09	6.45
14	Jigger	3.56	0.02	3.17
Total			100.0	
PASSIVE GEAR				
15	Gillnet	2, 279.01	37.54	9.76
16	Drift gillnet	1, 032.01	17.00	26.67
17	Hook and line	748.33	12.32	8.25
18	Crab net	603.14	9.93	3.56
19	Hook and line (2 hooks)	383.58	6.32	10.23
20	Fish pot	365.08	6.01	10.87
21	Multiple hook and line	236.12	3.89	4.66
22	Multiple hook and line (pelagic)	227.18	3.74	37.86
23	Fish corral	77.62	1.28	10.78
24	Gillnet with light	51.13	0.84	53.82
25	Fish trap	34.25	0.56	7.14
26	Squid pot	18.10	0.29	4.31
27	Hook and line with light	9.63	0.16	2.92
28	Multiple hook and line with light	3.23	0.05	3.59
29	Crab trap	2.82	0.05	1.04
Total			100.0	
Others				
30	Dynamite	-		-

Appendix F. Operational fishing gears, percentage catch contribution, and CPUE. CY 2006

CY 2006				
No.	Gear Type	Total Catch (MT)	%	CPUE (kgs/ boat landings/day)
ACTIVE GEAR				
1	Danish Seine (Commercial)	2,774.83	19.59	202.79
2	Trawl (Municipal)	2,619.85	18.49	196.14
3	Bag Net (Municipal)	2,276.55	16.07	268.77
4	Ring Net (Municipal)	1,373.67	9.70	416.26
5	Trawl (Commercial)	1,319.01	9.31	202.44
6	Bag Net (Commercial)	911.91	6.44	159.98
7	Drag net	770.70	5.44	734.00
8	Spear Gun w/ light	744.65	5.26	59.10
9	Spear Gun with Compressor	357.59	2.52	23.37
10	Modified Liftnet	295.97	2.09	140.94
11	Danish Seine	278.16	1.96	38.81
12	Push net	211.50	1.49	352.50
13	Troll line	109.52	0.77	18.68
14	Spear Gun	92.93	0.66	7.20
15	Beach Seine	30.04	0.21	46.10
16	Jigger	21.95	0.15	6.65
Total			100.0	
PASSIVE GEAR				
17	Gill Net	2,844.57	42.15	8.30
18	Modified Gillnet	899.64	13.33	25.33
19	Hook & Line	774.31	11.47	9.25
20	Crab Net	436.42	6.47	3.21
21	Multiple Hook & line (Pelagic)	375.77	5.57	40.41
22	Fish Pot	343.88	5.10	8.43
23	Hook & line(2 Hooks)	331.91	4.92	8.51
24	Drift Gill Net	276.54	4.10	27.93
25	Multiple Hook & Line	229.06	3.39	4.39
26	Fish Coral	144.55	2.14	11.21
27	Fish Trap	49.92	0.45	7.56
28	Hook & Line w/ light	11.83		4.54
29	Multiple Hook & line w/ light	10.61	0.18	21.21
30	Gill Net w/ light	7.88	0.16	52.50
31	Set Long Line	5.40	0.12	18.00
32	Squid Pot	3.31	0.08	2.28
33	Crab Trap	3.07	0.05	1.14
Total			100.0	
Others				
34	Dynamite	-		-

Appendix G. Operational fishing gears, percentage catch contribution, and CPUE. CY 2007

CY 2007				
No.	Gear Type	Total Catch (MT)	%	CPUE (kgs/ boat landings/day)
ACTIVE GEAR				
1	Danish Seine	5,336.73	33.54	860.00
2	Trawl (Commercial)	2,454.95	15.43	207.22
3	Bag Net (Municipal)	1,725.66	10.85	235.30
4	Ring Net (Municipal)	1,398.71	8.79	358.64
5	Danish Seine (Commercial)	1,347.84	8.47	213.94
6	Bag Net (Commercial)	1,286.71	8.09	204.24
7	Spear Gun w/ light	1,224.60	7.70	63.78
8	Modified Liftnet	522.21	3.28	145.06
9	Troll line	308.54	1.94	17.43
10	Spear Gun with Compressor	180.82	1.14	27.40
11	Jigger	74.41	0.47	15.50
12	Spear Gun	39.16	0.25	5.55
13	Beach Seine	11.33	0.07	20.08
Total			100.0	
PASSIVE GEAR				
14	Gill Net	2,030.75	41.60	6.84
15	Modified Gillnet	640.49	13.12	20.83
16	Crab Net	508.86	10.42	4.13
17	Hook & Line	388.29	7.95	9.24
18	Fish Pot	250.85	5.14	8.12
19	Hook & line(2 Hooks)	246.74	5.05	9.35
20	Multiple Hook & line (Pelagic)	244.61	5.01	35.45
21	Multiple Hook & Line	172.69	3.54	3.84
22	Drift Gill Net	149.09	3.05	37.75
23	Fish Coral	127.25	2.61	11.16
24	Fish Trap	50.60	1.04	7.33
25	Gill Net w/ light	36.08	0.74	40.09
26	Hook & Line w/ light	27.72	0.57	10.27
28	Crab Trap	7.84	0.16	1.54
Total			100.0	
Others				
29	Dynamite	-		-

Appendix H. Operational fishing gears, percentage catch contribution, and CPUE. CY 2008

CY 2008				
No.	Gear Type	Total Catch (MT)	%	CPUE (kgs/ boat landings/day)
ACTIVE GEAR				
1	Trawl (Commercial)	2,338.74	26.52	194.89
2	Danish Seine (Commercial)	2,228.91	25.28	232.18
3	Bag Net (Commercial)	1,135.72	12.88	180.27
4	Spear Gun w/ light	926.49	10.51	68.63
5	Ring Net	606.21	6.87	340.79
6	Bag Net (Municipal)	426.80	4.84	81.83
7	Drag net	421.75	4.78	401.67
8	Troll line	306.72	3.48	15.73
9	Modified Liftnet	179.70	2.04	119.80
10	Danish Seine	154.09	1.75	25.00
11	Spear Gun	36.92	0.42	6.23
12	Push net	27.60	0.31	92.00
13	Beach Seine	22.93	0.26	48.35
14	Jigger	5.36	0.06	17.85
Total			100.0	
PASSIVE GEAR				
15	Gill Net	1,061.74	28.99	6.30
16	Hook & Line	619.71	16.92	10.17
17	Modified Gillnet	478.31	13.06	18.51
18	Crab Net	287.32	7.85	5.54
19	Multiple Hook & Line	232.68	6.35	4.70
20	Fish Pot	212.91	5.81	7.97
21	Hook & line(2 Hooks)	205.19	5.60	5.90
22	Drift Gill Net	164.28	4.49	36.51
23	Fish Coral	152.17	4.16	10.79
24	Multiple Hook & line (Pelagic)	144.34	3.94	24.06
25	Fish Trap	41.55	1.13	6.59
26	Gill Net w/ light	34.86	0.95	29.05
27	Hook & Line w/ light	17.81	0.49	6.59
28	Multiple Hook & line w/ light	6.34	0.17	2.21
29	Hook and line with float	2.02	0.06	6.73
30	Crab Trap	0.60	0.02	1.19
Total			100.0	
Others				
31	Dynamite	3.75		12.50

Appendix I. Operational fishing gears, percentage catch contribution, and CPUE. CY 2009

CY 2009				
No.	Gear Type	Total Catch (MT)	%	CPUE (kgs/ boat land-ings/day)
ACTIVE GEAR				
1	Bag Net (Commercial)	3,053.34	28.03	192.03
2	Bag Net (Municipal)	1,945.45	17.86	154.40
3	Danish Seine (Commercial)	1,370.32	12.58	190.32
4	Trawl (Commercial)	1,132.22	10.39	171.55
5	Spear Gun w/ light	1,046.24	9.60	81.10
6	Ring Net (Municipal)	734.39	6.74	174.86
7	Modified Liftnet	462.38	4.24	140.12
8	Push net	419.00	3.85	698.33
9	Danish Seine	328.41	3.01	14.03
10	Troll line	314.21	2.88	16.89
11	Spear Gun with Compressor	41.27	0.38	9.83
12	Spear Gun	37.64	0.35	10.46
13	Beach Seine	8.05	0.07	13.42
Total			100.0	
PASSIVE GEAR				
14	Gill Net	2,054.90	41.32	6.51
15	Modified Gillnet	669.25	13.46	20.47
16	Hook & Line	555.66	11.17	7.21
17	Crab Net	404.97	8.14	6.37
18	Multiple Hook & Line	384.39	7.73	12.09
19	Hook & line(2 Hooks)	181.48	3.65	5.40
20	Multiple Hook & line (Pelagic)	169.28	3.40	25.65
21	Fish Coral	155.11	3.12	11.00
22	Fish Pot	147.54	2.97	7.93
23	Drift Gill Net	130.72	2.63	31.12
24	Fish Trap	48.63	0.98	7.37
25	Gill Net w/ light	36.58	0.74	32.51
26	Multiple Hook & line w/ light	19.38	0.39	21.53
27	Hook & Line w/ light	15.67	0.32	6.53
Total			100.0	
Others				
28	Dynamite	20.57		22.86

Appendix J. Operational fishing gears, percentage catch contribution, and CPUE. CY 2010

CY 2010				
No.	Gear Type	Total Catch (MT)	%	CPUE (kgs/ boat land-ings/day)
ACTIVE GEAR				
1	Bag Net (Commercial)	1,652.58	20.41	103.94
2	Trawl (Commercial)	1,214.89	15.00	184.07
3	Danish Seine (Commercial)	1,203.05	14.86	167.09
4	Spear Gun w/ light	1,182.33	14.60	91.65
5	Bag Net (Municipal)	1,104.35	13.64	87.65
6	Ring Net (Municipal)	648.60	8.01	154.43
7	Modified Liftnet	505.27	6.24	153.11
8	Danish Seine	251.38	3.10	10.74
9	Troll line	217.24	2.68	11.68
10	Push net	89.14	1.10	148.57
11	Spear Gun	21.29	0.26	5.91
12	Beach Seine	7.56	0.09	12.60
Total			100.0	
PASSIVE GEAR				
13	Gill Net	2,076.65	38.77	6.58
14	Modified Gillnet	774.99	14.47	23.70
15	Multiple Hook & Line	655.86	12.25	20.62
16	Hook & Line	492.36	9.19	6.39
17	Crab Net	407.86	7.62	6.41
18	Multiple Hook & line (Pelagic)	205.42	3.84	31.12
19	Hook & line(2 Hooks)	177.96	3.32	5.30
20	Fish Pot	143.63	2.68	7.72
21	Fish Coral	142.49	2.66	10.11
22	Drift Gill Net	131.00	2.45	31.19
23	Gill Net w/ light	59.36	1.11	52.77
24	Fish Trap	45.06	0.84	6.83
25	Multiple Hook & line w/ light	17.17	0.32	19.08
26	Hook & Line w/ light	13.73	0.26	5.72
27	Set Long Line	6.33	0.12	21.11
28	Squid Pot	5.80	0.11	4.00
Total			100.0	
Others				
29	Dynamite	25.15		27.95

Appendix K. Operational fishing gears, percentage catch contribution, and CPUE. CY 2011

CY 2011				
No.	Gear Type	Total Catch (MT)	%	CPUE (kgs/boat landings/day)
ACTIVE GEAR				
1	Bag Net (Commercial)	2,297.92	26.50	144.52
2	Danish Seine (Commercial)	1,577.21	18.19	219.06
3	Trawl (Commercial)	1,046.37	12.07	158.54
4	Spear Gun w/ light	931.67	10.74	72.22
5	Bag Net (Municipal)	882.88	10.18	70.07
6	Ring Net (Municipal)	519.18	5.99	123.62
7	Modified Liftnet	480.68	5.54	145.66
8	Troll line	445.41	5.14	23.95
9	Danish Seine	265.17	3.06	11.33
10	Push net	186.43	2.15	310.71
11	Spear Gun	21.05	0.24	5.85
12	Spear Gun with Compressor	14.49	0.17	3.45
13	Beach Seine	3.70	0.04	6.17
Total			100.0	
PASSIVE GEAR				
14	Gill Net	2,320.04	43.83	7.35
15	Modified Gillnet	831.76	15.71	25.44
16	Crab Net	465.31	8.79	7.32
17	Hook & Line	460.24	8.70	5.97
18	Multiple Hook & Line	278.23	5.26	8.75
19	Multiple Hook & line (Pelagic)	234.47	4.43	35.53
20	Hook & line(2 Hooks)	165.63	3.13	4.93
21	Fish Coral	163.66	3.09	11.61
22	Fish Pot	145.10	2.74	7.80
23	Drift Gill Net	114.42	2.16	27.24
24	Fish Trap	47.13	0.89	7.14
25	Gill Net w/ light	41.12	0.78	36.55
26	Hook & Line w/ light	22.44	0.42	9.35
27	Squid Pot	3.63	0.07	2.50
Total			100.0	
Others				
28	Dynamite	37.28		30.42