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Assessment of capture fisheries in coastal waters surrounding Lahuy Group of Islands, Caramoan, Camarines Sur, Philippines

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Abstract

This study assessed the capture fisheries of the coastal waters along Lahuy group of Islands in Caramoan, Camarines Sur for baseline data. Demographic data, socioeconomic profile, inventory of boat ownership, number of fishing gears, fishing trips per month day per month, estimated CPUE of fish gear during peak and lean season, and catch composition of each gear were described.

Data were gathered through survey using semi-structured interview questionnaire and key informant interview. Fisher respondents were determined through referral and purposive sampling using snowballing technique. Descriptive statistics were used to analyze data.

Keywords: Assessment, Capture Fisheries, Lahuy Group of Island

INTRODUCTION

The small-scale fisheries of Lahuy Group of Islands plays a critical role in the food security, livelihood, and adaptive capacity of its fishing communties. It not only serves as a source of cash for fishers, but for an unexpectedly large number of rural households in the islands that live close to the coastal waters and engage in gleaning activities for subsistence.

Lahuy Group of Islands is located in the coastal municipality of Caramoan, Camarines Sur. Caramoan is bounded on the north by the town of Garchitorena and the Philippine Sea of the Pacific Ocean; on the north-east by the island province of Catanduanes ; on the south by Lagonoy Gulf; on the east by the Maqueda Channel and on the west by the municipality of Presentacion . The Lahuy Group of Islands is composed of three main islands namely, Lahuy Island, Haponan Island and, the nearby small island of Guinahoan which is connected by a sandbar, and the island of Haponan where a part of Barangay Daraga of Lahuy Island extends. Among the three group of islands, the Island of Lahuy has four fishing barangays namely, Daraga, Gogon, Oring Gata and Gogon. The islands are located between 13.93 N and 123.82 N close to the bifurcation point of the Northern Equatorial Current (NEC) system which occurs between 118N and 14.58N, and tends to shift to the north with increasing depth (Qui and Lukas, 1996). An upwelling occurs when ocean surface waters are pushed offshore and water is drawn from below to replace the water that has been pushed away. The upward movement of this deep, colder water is called upwelling. The deeper water that rises to the surface is rich in nutrients. These nutrients "fertilize" surface waters, encouraging the growth of plant life, including phytoplankton which provide food for fish, and marine mammals, supporting productive marine ecosystems and support most important fisheries. It also faces the Philippine Rise up the Northern Bicol Shelves (NBS) which is believed to host diverse stocks of tropical marine fish species (Figure 1).

The economic condition of the island communities being located in a remote coastal municipality in Partido, and the proximity of the island's fishing ground to the bifurcation point in the NEC system and the Philippine Rise as well in the Western Pacific, provide both interesting settings for assessing the abalone gleaning and small scale fisheries as valuable inputs for implementing fisheries management to address the current issues of resource sustainability, coastal environmental conservation and community resiliency in the context of poverty alleviation.

Most fisheries in our country are heavily fished to a degree that substantially alters the species composition,

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Fig. 1. Spot map of Lahuy Island in Camarines Sur and Northern Bicol Shelves

abundance and ecology of the fish communities. Exploitation is one of the key drivers affecting fisheries. Heavy fishing pressure reduces the abundance of desired species (reducing the value of the catch) and affect the fish population or community structures (size and species).These will heavily compromise the overall production from the fishery, and the quality and value of the fisheries could shift towards lower-value products consumed locally. Fishery resources apart from overfishing are also subject to numerous anthropogenic perturbations which will also cause shifts in the status of the fisheries and general decline in the yield. Thus, promoting the sustainability of the total catches, protection and conservation of habitats and ecosystems, and enhancing adaptive capacity to achieve resilient fishing communities to impact of climate change become important aspects of many small-scale fisheries.

The challenge therefore is to determine the appropriate typology of fishery management and resource governance, particularly for the typically subsistence and fishery resource-dependent island communities such as the Lahuy Group of Islands. In order to pursue a fishery management strategy that addresses these issues, there is a need for information on the nature of the island's fisheries as an extractive livelihood activity to understand the capacity and rate of the local fishery resource extraction, and how these gears impact the ecosystem, the species composition of catch that will provide insights on the abundance, and ecology of fish communities, and the cost and revenue of fishing operations as well, that will provide understanding on the profitability of the livelihood and economic conditions of fishers. These information will subsidize coastal fisheries and marine environmental management and species conservation plans of the community, the local government unit and the partners working in the island for coastal and fishery management, ecosystem conservation and adaptive management that take into account the socioeconomic, the resource and ecological, as well as climate change impact realities in the small- small fishing communities of Lahuy Island that is highly valorized from the standpoint of fisheries oceanography owing to its geographic location close to the most dynamic current systems of the Western Pacific near the NBS.

This paper assessed the small-scale fisheries of Lahuy Group of Islands. Specifically, it characterized the small-scale fisheries in terms of nature of boats owned, made inventory of the fishing gears used by fishers, described the frequency of fishing operations of each fishing gear and their fish catch, examined the composition of these fish catches, and the profit performance of each fishing gears.

METHODOLOGY

This study was conducted in Lahuy Group of Islands, Caramoan, Camarines Sur covering the main island of Lahuy, and the islands of Guinahoan and Haponan from May to November 2021.

A gear inventory survey was carried out using a semi-structured interview questionnaire to gather vital information pertaining to the number of fishing gear units, fishing frequency and seasonality of fishing operation of various fishing gear, catch and effort data, species composition and cost and revenue from fishing activity.

A total of ninety (90) fisher respondents were identified through referral and purposive sampling following snowballing technique. A sample size of 90 respondents was used which were taken from Barangays Gata (28%), Oring, (21%), Gogon, 14% Daraga-Guinahoan (20%), and Haponan (17%) (Table 1). Identification of fishing gear and its classification were based on the guide by Umali (1950).

The data were analyzed using descriptive statistics such as frequency count, percentage and mean.

Table 1. Number of respondents per barangay

Barangay	Number	Percent (%)
Gata	25	28
Haponan	15	17
Oring	19	21
Gogon	13	14
Guinahoan, Daraga	27	20
Total	90	100

RESULTS

Fishing Boat Ownership and Fishing Boat Profile

Fishing Boat Ownership

More than one half of the fishers, or 78% own boats, while the rest do not own boats for fishing. Out of 90 fishers, 20 or 22% do not own boat (Table 2).

Table 2. Fishing boat ownership

Characteristics	Frequency (f)	Percentage (%)
Boat ownership		
Owned	70	78
Not owned	20	22
Total	90	100

Fishing Boat Profile

More than one half, or 54% of the fishing boats in the area are motorized (Table 3). The engines capacity ranges from 5 to 22 Hp. The length of the boats ranges from 0.21 m to 1.78 m; while the width of the boat ranges from 3m to 10.5 m.

Table 3. Fishing boat profile

Characteristics	n	Percentage (%)
Motorized/Non-motorized		
Motorized	38	54
Non-motorized	32	46
Total	70	100

Fishing Gear Ownership and Categories

Fishing Gear Ownership

Almost all, or 97% of the respondents own fishing gears, while the rest don't own fishing gears. Out of 90 fishers, only 3 do not own fishing gears (Table 4).

Table 4. Fishing gear ownership

Ownership	n	%
Owned	87	97
Not Owned	3	3
Total	90	100

Categories of Fishing Gears

Among the fishing gears used by respondent fishers, less than one half are spear guns (42%), followed by hook and line (28%) and bottom set gill net (19%). The gears that were less used include drift gill and squid jig which are owned by merely 5% of the respondents. A measly 1% used bottom set longline. The dominant of proportion of crude fishing gears such as spear guns and hook and lines indicated the sustenance nature of the fisheries in the island employing fish catching devices with low investments.

Table 5. Categories of fishing gears used in Lahuy Group of Islands fisheries

Gear	Local Name	n	%
Drift Gill Net	*Lambat Palutang*	7	5
Bottom Set Gill Net	*Lambat Palubog*	25	19
Hand line/Hook and Line	*Kawill/Banwit*	37	28
Bottom Set Longline	*Kitang*	1	1
Spear Gun	*Pana*	56	42
Jig	*Pangkulambutan*	7	5
Total		133	100

Composition of Catch by Gear Type

Drift Gill Net

A total of 25 species comprise the catch of drift gill net in the fishing areas of Lahuy Islands. Of these, almost one fourth, or 24% is composed of Tembong (Leognathidae). This is followed by Bugiw (Hemiramphidae) which comprise 15% of the total catch. Samaral (Siganidae). Turingan (Scombridae) and Duwal (Belonidae) both shared 11% of the catch. The rest of the species are thinly distributed among Bisugo (Nimepteridae) at 8%, followed by Ulapay (Scaridae) 5%, Manuping (Lethrinidae) 4% and Tangigi (Scombridae); while Bataway (Siganidae) and Balanak (Mullidae) each posted 3%. Bat-og (Sphyraenidae), Buraw (Scombridae) Lupani (Leognathidae), Salaysalay (Caragidae), Sapsap (Leognathidae) and Tarakitok (Carangidae) both each posted 2% to the total catch. Posting the lowest proportion to the catch composition of drift gill nets are Atuloy (Carangidae), Sandig (Siganid), Baraka (Serranidae) and Paso (Pomacentridae) wherein each merely posted 1% of the total catch.

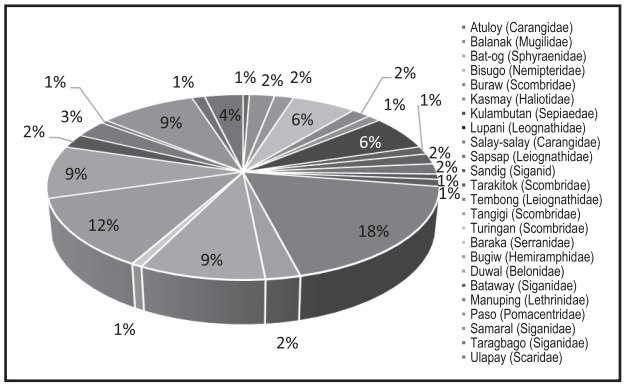

Fig. 2. Drift gill net catch composition

Bottom Set Gill Nets

A total of 11 species of fish comprise the catch of bottom set gill net. Of these, Lupani (Leognathidae) and Turingan (Scombridae) posted the relatively higher percentage of catch at 13% and 12% respectively. These were followed by Salaysalay (Carangidae) posting 9% to total catch. The rest of the proportion of catch composition are thinly spread across the 9 other species with Sal-igan (Lethrinidae) and Buraw (Scombridae) sharing at 7% of total catch; Bisugo (Nemipteradae) Ulapay (Scaridae), Sapsap (Carangidae) and Bataway (Siganidae) merely registereing 6%, for the two former (Bisugo and Ulapay) and 5% for the two latter species (Sapsap and Bataway). Surprisingly, the gear catches Kasag, or Blue swimming crab (Portunidae) which comprise a small proportion of 2% of the total catch.

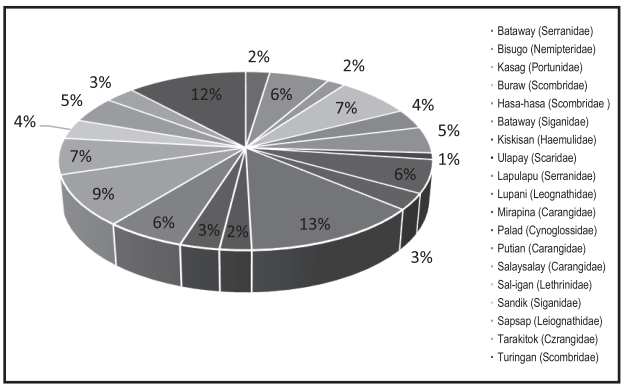

Fig. 3. Bottom set gill nets catch composition

Hand Lines / Hook and Lines

A total of 14 species comprise the composition of catch of hook and line. Almost one half of the catch, or 44% is composed of Dalagang Bukid (Casionidae). The rest of the composition of catch are thinly distributed among Tarakitok (Carangidae) 10%,Tagiptipon (Carangidae) 9%, Mamsa (Carangidae) and Baraka (Serranidae) both at 7%, Tanguigi (Scombridae), Turingan (Scombridae), Dula (Belonidae) and Lapulapu (Serranidae) at 6%, 4%, 3% and 2% respectively. The rest of the four species posted measly 1% of the total catch including Sandig (Siganidae), Sal-igan (Lehirinidae), Ulapay (Scaridae) and Manuping (Lethrinidae).

Bottom Set Longlines

A total of 3 species comprise the total catch of bottom set longline. Of these, Buboon (Scombridae) and Mayamaya (Lutjanidae) both each comprise less than one half of the total catch. While Sal-igan merely comprise 20% to the total catch.

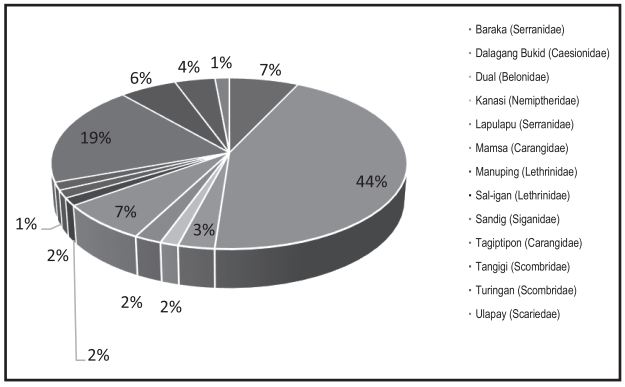

Fig. 4. Hand lines /hook and lines catch composition

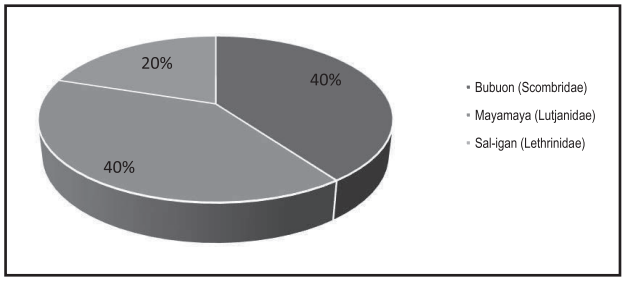

Fig. 5. Bottom set long lines catch composition

Spear Gun

A total of 13 species comprise the total catch of spear guns. Almost one half, or 44% of the catch are composed of Dalagang Bukid (Casionidae). This is followed by Tagiptipon (Carangidae) which comprise 19% of the catch. Baraka and Mamsa (Carangidae), both each comprise 7%, while Tanguigi (Scombridae) posts 6% followed by Turingan (Scombridae) and Wal-an (Labridae) which posts 4% and Dual (Belonidae which posts 3% of the total catch. The species that post the lowest proportion to the catch composition at measly 1% are Manuping (Lethrinidae), Sal-igan (Lethrinidae), Sandig (Sihanidae) and Ulapay (Scaridae).

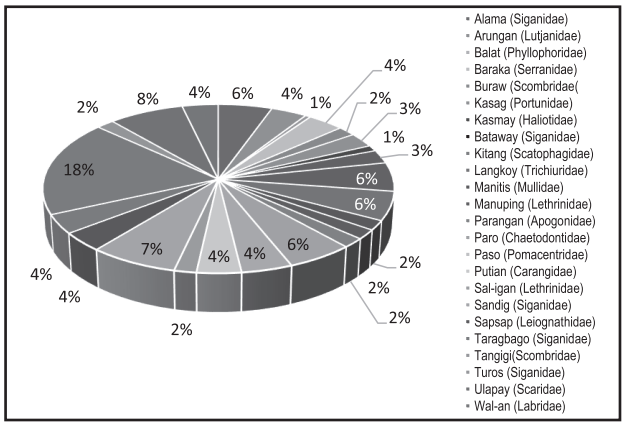

Fig. 6. Spear gun catch composition

Jig

Only two species comprise the catch of jigs, namely Kulambutan (Sepiaedae) and Kugita (Octopedidae). Kulambutan (Sepiaededae) occupies more than one half, or 62% of the total catch; while Kugita (Octopedidae) occupies less than one half, or 38% of the total catch of the gear.

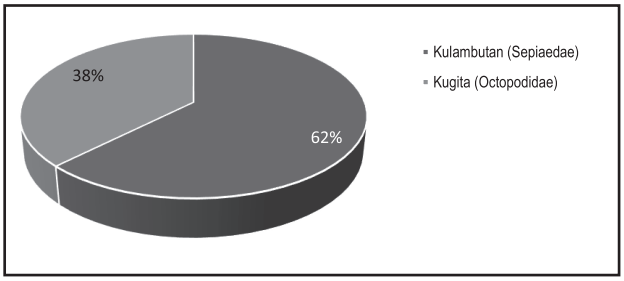

Fig. 7. Jig catch composition

Frequency of Fishing Operations by Gear Category

All of the gears make a single trip in a day. However, their number of operations on a weekly basis vary. Drift gill nets and bottom set gill nets both make a total of 6 fishing trip a week. Jigs make a total of 5 trips weekly, followed by hand line and hook and line which make a total of 4 trips a week. Bottom set longline and spear guns make a total of 3 trips per week.

On a monthly basis, drift gill nets and bottom set gill nets make a total of 22 trips a month. Jigs make a total of 20 fishing trips monthly; while hand lines and hook and lines complete a total of 16 fishing trips in a month. Bottom set longlines and spear guns make 12 operations per month.

The data indicate that fishers, irrespective of gear category only make an average of a single trip per day. This suggests the longer duration of time spent for fishing in the area implying the reduced status of fish stocks, or over capacity in terms of fishing efforts currently exerted on the fishery. On the other hand, the number of fishing trips incurred by drift gill nets and bottom set gill nets indicated the two gears as major gears in use in the area. This suggests that the fishing areas around Lahuy Group of Islands abounds in both pelagic and demersal fish species.

Table 6. Frequency of fishing trips per day, per week and per month across gear categories

Gear	Number of fishing trip per day (trip/day)	Number of fishing trip per week (trip/week)	Number of fishing trip per month (trip/month)
Drift Gill Net	1	6	22
Bottom Set Gill Net	1	6	22
Bottom Set Longline	1	3	12
Hand line/Hook and Line	1	4	16
Spear Gun	1	3	12
Jig	1	5	20

Catch Per Unit Effort and Quantity of Catch per Day, Per Week and Per Month by Gear Category

On the average drift gill nets post an average catch of 11 kilos per trip, the highest among the gears. This is followed by bottom set gillnet and hand line or hook and lines which posts an average of 8 kilos and 7 kilos of catch per trip. Bottom set gill net catch an average of 6 kilos, while spear gun and jigs catch and average of 4 kilos and 2 kilos respectively.

Among the gears, drift gill nets make an average catch of 11 kilos a day. This translates to an average 66 kilos a week or 242 kilos monthly. Bottom set gill nets catch an average of 6 kilos a day. This translates to 36 kilos a week or 132 kilos monthly. Bottom set long lines catch an average of 8 kilos a day. This translates to 24 kilos a week or 96 kilos monthly. Hook and lines or hand lines catch an average of 7 kilos a day. This translates to 28 kilos a week or 112 kilos monthly. Spear guns catches 4 kilos a day. This translates to 12 kilos weekly or 48 kilos a month. Jigs merely catch 2 kilos a day which translates to a weekly catch of 10 kilos or 40 kilos monthly.

The data indicate that fishing gears vary in catch rate per week and months.The weekly and monthly catch rates of each gear is defined by the frequency of operations per week and month.

Table 7. Quantity of catch per unit effort, per week and per month across gear categories

Gear Category	Average Catch per Unit Effort	Quantity of Catch		
		Average catch per day (Kilos)	Average catch per week (Kilos)	Average catch per month (Kilos)
Drift Gill Net	11	11	66	242
Bottom Set Gill Net	6	6	36	132
Bottom Set Longline	8	8	24	96
Hand line/ Hook and Line	7	7	28	112
Spear Gun	4	4	12	48
Jig	2	2	10	40

Value of Catch by Gear Category per Day, Per Week and Per Month

Among the gears, the drift gill nets posted the highest monthly revenue estimated at PhP 20,812. This is followed by bottom set longlines and hand lines /hook and lines which posted PhP 19,488 and PhP 15,568 per month respectively. The jigs registered the lowest monthly revenue at PhP 8,800 only.

The relatively highest monthly revenue posted by drift gill net despite the average low selling price of its catch is

explained by the efficiency and the frequency of operations of the gear per month being the highest among the gears. Whereas for jigs which showed the lowest monthly revenue among the gears, is explained by the frequency of operations per month which is the lowest, despite having one of the relatively highest selling price per kilo of catch.

These suggest that the variability of monthly value of catch among the gears is defined both by the quantity and quality of catch.

Table 8. Value of catch per day, per week and per month across gear categories

Gear Category	Selling price per kilo per catch (PhP)	Value of Catch		
		Value of catch per day	Value of catch per week	Value of catch per month
Drift Gill Net	86	946	5,676	20,812
Bottom Set Gill Net	101	606	3,636	13,332
Bottom Set Longline	203	1,896	5,688	19,488
Hand line/Hook and Line	139	973	3,892	15,568
Spear Gun	237	948	2,844	11,376
Jig	220	440	2,200	8,800

Analysis of Monthly Costs and Benefits by Gear Category

Among the gears, the drift gill nets posted the highest monthly net return at PhP 19,834. This is followed by bottom set longlines and hook and lines which registered monthly net returns of PhP 19,469 and PhP 18,469 monthly. The jigs registered the lowest monthly net return at PhP 8,572.

The profit analysis for drift gill nets was based from a monthly operating expenses of PhP 978, wherein PhP 841.5 comes from variable costs and PhP 136 from depreciation cost of fixed assets. The variable costs are mainly composed of gasoline expenses (PhP 292.50 for 0.83 gallons), oil expenses (PhP96 for 1 liter), ice (PhP 96 for 12 pieces), cost of repair of gear (PhP250) and food expense (PhP 43). The cost of key fixed asset was PhP 10,000 with estimated 7 serviceable years.

For bottom set longlines, the estimation of monthly net return was based from a monthly operating expense of PhP 242 wherein PhP 228 comes from variable costs and PhP 14 comes from depreciation cost of fixed assets. The variable costs are mainly composed of expenses for gasoline (PhP 153) and food (PhP 75) expenses. The cost of key fixed asset is PhP 1,300 with estimated life span of 8 years.

For hook and lines and longlines, the estimates of monthly net return was based from a monthly operating expense of PhP 1,019 wherein PhP 778.50 comes from variable costs and PhP 675 from cost of depreciation of fixed assets. The cost of key fixed asset was PhP 651 with estimated life span of 5 years. The variable costs are mainly composed of expenses for gasoline (PhP 463.50 for 1.68 gallons), oil (PhP 246 for 1.17 liters), bait (PhP 202 for 2.33 kilos) and food (PhP43).

Table 9. Monthly cost and benefit analysis of gears across categories

	Drift Gill Net	Bottom Set Gill Net	Bottom Set Longline	Hand line/ Hook and Line	Spear Gun	Jig
Monthly Revenue (PhP)	20,812	13,332	19,488	19,488	11,376	8,800
Monthly Operating Expenses (PhP)	978	1,043	242	1,019	268	228
Monthly Net Income (PhP)	19,834	12,289	19,246	18,469	11,108	8,572

Sites of Operations of Gears and Reasons for Shift in Fishing Sites

Almost one half, or 49% of the fishing operations are done in coral reefs. Around one fourth, or 24% of fishing activities are conducted along the seagrass beds. While more or less, a tenth of fishing operations are done either in muddy or sandy shores (16%), or offshore (11%).

More than three fourth or 78% of the respondents are shifting their fishing operations from previous fishing sites to look for viable fishing area due to declining fish catch (59%),

Table 10. Site of Fishing Operation

	n	%
Fishing Sites		
Corals	57	49
Mangrove	0	0
Seagrass	28	24
Muddy/ Sandy	19	16
Offshore	13	11
Total	117	100
Shift in fishing areas		
Yes	70	78
No	20	22
Total	90	100
Reason for shifting of fishing areas		
Availability of fish	18	27
Look for viable fishing area due to declining fish catch	41	62
Strong waves	2	3
Fishing season	3	5
Delivery area	1	2
More catch in coral reefs	1	2
Total	66	100

fishing season (5%), and condition of the sea (3%).

These indicate that the around one half of the current operations of fishing gears are done in coral reefs seagrass beds and closer fishing areas, with only few are fishing offshore. This is explained by the fact that less than one half of the fishers don't have motorized boats. If ever, their boats are powered with low capacity engines that will enable fishing farter offshore. These suggests that the current fishing conditions of coral reefs are no longer providing good catch for the gears which prompts fishers consider to look for other fishing areas due to declining catch from fishing on the usual fishing sites i.e. coral reefs, seagrass beds, and mangrove areas.

DISCUSSION

The small-scale fisheries of Lahuy Group of Islands completely demonstrated the common nature of artisanal fisheries in tropical countries which is multi-species and multi-gear.

The catch of the fishing gears are diverse covering small pelagics, demersal fishes, reef, seagrass and mangrove fishes, crustaceans, and echinoderms. The diversity of the species are evident on the composition of catch of the fishing gears composed of 32 species belonging to a total of 23 families. The diversity of catch of drift net and hand line indicated the abundance of small pelagic species in the area. While the diversity of catch of bottom set longline and bottom set gillnet indicated the abundance of demersal fishes in the area. The type of fishing ground of Lahuy island explains for the diverse composition of catch in both pelagic and demersal fish catching gears in use by fishers. The geographical location of the area close to the Western Pacific, and its proximity to the upwelling areas of the Kuroshio Current supported the diverse population of pelagic fish species in the area. The soft and shallow bathymetry of the coastal areas and coves within the fishing areas around the Lahuy Group of islands with the deposition of run-offs of minerals from the adjacent mountain ranges of Caramoan and its riverine systems supported the diverse population of demersal fish species in the area.

There are three general categories of gears employed in the fisheries catching varied species of fish and other aquatic products namely, nets, hand instruments, and hook and lines. These gears are in operations in an almost daily basis completing a single trip a day and having frequency of operations ranging from 3 to 7 times a week. Majority of the fishers own boats. Only few don't own boat and make do of the constraint by borrowing boat from kins or sharing with fishers having boat. For those who have boats, only more than one half, or 54% are motorized and of low capacity for fishing farther offshore.

Of the net category, two variants are in use namely, drift gill net and bottom set gill net. Of the hand instrument category, two variants are employed by fishers, they are spear gun and jig. The hook and line category has also two variants in current use namely, hand line and longline. Among the gears, the spear guns are the most dominant comprising almost one half of the total, followed by hook and line and hand lines. The dominance of spear guns indicated the highly selective nature of fishing in the area targeting mostly high priced predator fishes in the coral reefs, seagrass beds and mangroves. This will have grave implications on the ecology of these critical coastal habitats as selective fishing for large predatory fishes will alter the food web by depleting the larger fishes and increasing the population of smaller fishes making the fisheries demonstrate the phenomenon called as "fishing down the food web" where fish catches becomes smaller and smaller, and fewer species over time. This situation will compromise the resiliency of the fish stocks in terms of being able to replace those that have been extracted through severe fishing exploitation and were no longer able to repopulate due to loss of parent stocks and altered food web dynamics

Notably, almost one half of the proportion of fishers are conducting fishing operations in coral reef and sea grass bed areas and cited that they are considering to shifting to other fishing grounds due to observed declining quantity of catch in the present area of fishing operation. The fishers have the expectation that a shift of fishing operation in other fishing areas will offer more catch. These connect the current information on the dominance of spear guns among the gears and the declining catch of large predatory coral reef species from the composition of catch such as serranids (groupers), labrids (wrasses), sphyrinids (barracudas), and the declining catch of holothurians (sea cucumbers) and haliotids (abalones) in seagrass areas. It is possible to pinpoint that the high selectivity of these gears and having the most number of units used for fishing in the waters surrounding Lahuy Group of Islands resulted to the decline of commercially valuable coral reef and seagrass species and the resulting considerations of fishers towards a shift to other fishing areas to capture other available species. Scheffer, Carpenter and de Young (2005) warn that not only are target species in severe danger of significant decline, but this shift also disrupts interactions of all organisms in an ecosystem. Ecosystem overfishing, characterized as ecological imbalance caused by excessive removal of target species (Green et al, 2003, as cited by San Diego and Fisher, 2014), is a serious threat to resource sustainability (FAO, 1999 as cited by San Diego and Fisher, 2014).

Among the gears, the drift gill nets have the most diverse of catch composition posting 25 species, followed by hand lines and spear guns registering 13 and 14 varied species

respectively. The bottom set longlines and jigs have the least diverse catch composition of all the gears by having only 3 and 2 species respectively. The catch of these gears are dominated by small and large pelagics as well as demersal fishes such as scombrids, caranguids, and sphaerinids with few reef, and mangrove species such as labrids, pomacentrids, serranids, siganids and lutjanids. Among the crustaceans, cephalopods and mollusks that were caught by the gears include blue swimming crabs, squids and octopuses and abalones.

The composition of small and large pelagic and demersal fishes in the catch of the fishing gears such as scombrids and caranguids explained for the dominance of hook and lines among the gears, second to only to spear guns. These small and large pelagic and demersal fishes are caught using hook and line and hand lines. The reduced proportion of reef and mangrove fish species from the composition of catch demonstrated the impact of selective fishing using spear guns and the use of other active fishing gears such as bottom set gill nets and drift gill nets, which suggest high fishing pressures on the critical coastal fish habitats which include coral reefs, seagrass beds and mangroves which have grave implications on the productive capacity of these critical ecosystems and their sustainability. The fishing gears used as tools by small-scale fishers in gathering or capturing fishery resources in the Lahuy Group of Islands are categorized into active gears and passive gears. The active gears include drift gill net, spear gun, jigs. These gears are characterized by presence of gear movement, and/or pursuit of target species which can destroy coral reefs, selectively catch fish or catch even the smallest fishes which make the use of these gears unsustainable. The passive gears include hook and line, hand lines, bottom set longlines and bottom set gillnets. These gears are characterized by absence of gear movement, and/or absence of pursuit of target species which have relatively less impact on coastal critical habitats which make the use of these gears comparatively sustainable.

The catch rates of the fishing gears ranges from a low 2 kilos per trip (jigs) to a high of 11 kilos per trip (drift gill net) and a median of 6 kilos per trip (bottom set long lines). The relatively lower catch rates of all fishing gears in the area which almost share the situations in other key fishing grounds in the region such as Sorsogon Bay (see Olano et al, undated), Albay Gulf (see Macale et al, 2020) indicated symptoms of heavy fishing pressure and overfishing in the area. These phenomenon could be explained by the fact that the Lahuy Group of Islands' small scale fishery is generally artisanal in nature and devoid of greater capacity and investments to exploit other fishing grounds outside their local fishing ground, or offshore to the more pristine fishing grounds in the Pacific which can reduce the amount of fishing pressure that it is currently experiencing. Artisanal fisheries comprise fishing households with small amounts of capital and access to simple gear that can be used from the shore or small boats (UNEP-Nairobi Convention and WIOMSA, 2015).

Also the distant location of the island from economic hubs in Camarines Sur due to its remoteness and the islands' geographical barrier for mobility which constrain opportunities for employment and diversified economic activities make livelihood of the communities highly dependent on the fishery resources, which increases further the pressure on the fishery resource.

The traditional nature of the Islands' fishery which depict a classical subsistence fishery demonstrated the dynamics of the poverty-coastal environment degradation nexus wherein the lack of employment opportunities and the marginal economies in fishing communities which make fishing as an occupation of last resort and as a safety valve against economic shocks, puts heavy pressure on ecosystems and resources that are considered common property and are open access to all. The economic behavior of each resource users to maximize utility from open access common pool resource coastal and fishery resources reduces the incentive for sustainable resource utilization and thus each fisher as resource users contributes to the degradation of the coastal ecosystems and its fishery resources.

Revenue is the money value obtained from the result of fish product sales that is influenced by the amount of the caught and the price when the fish caught are being landed. The revenue is obtained from the amount of the caught. Every species of the fish is multiplied by the price of the species (Hapsari and Fitri, 2016). The value depends on the kind and the total weight of the fish caught (Brandt, 2005). In this study, the revenue of each fishing gear represents the average catch rate per trip multiplied by the average value per kilo of its diverse species in the catch which also have varied prices.

The average value of the catch of the gears ranges from a low of PhP 86 (drift gill nets) to a high of PhP 237 (spear guns) and a median of PhP 139 (handline and longlines). The variations in revenues from fishing of the gear categories is both explained by the quantity and quality of the catch. Some gears posted higher quantity of catch as depicted by the catch rate per trip, but the quality of the catch command low value, resulting to relatively lower net returns. For example, drift gill nets and bottom set long lines posted the relatively higher catch rates among the gears, but its catch composition is composed of average and lowly priced small pelagic fishes such as flying fishes, needle fishes, bullet tunas and mackerel.

Some gears posted low quantity of catch as demonstrated by their catch rates per day, however the catch command high value per kilo, resulting to relatively higher net returns. For

example, jigs, hook and lines and spear guns posted relatively lower catch rates among the gears, but their catch compositions are composed of highly priced species such as caranx, marlins, and tuna and tuna-like species (handlines); squids and octuposes (jigs); and abalone and barracudas (spear guns).

Gears with higher catch rates and catch high priced fish species result to higher returns from fishing. An example is the bottom set longline which catches demersal fishes such scombrids, luthnids and scombrids. Demersal bony fishes are typically fatty because of their feeding habit thriving on the nutrient-rich part of the sea bottom making their flesh fatty and good to taste as fish food inducing higher preference by fish consumers thus commanding higher prices.

The monthly net returns from fishing varies among the gears which ranges from a low of PhP 8,572 (Jigs) to a high of PhP 19,834 (drift gill net) and a median of PhP 12,289 (bottom set gill net). The relative profitability of active, more efficient but environmentally unsustainable fishing gears (such as drift gill net, and bottom set longline than the passive, less efficient fishing gears such as hook and line and jigs will cause more fishers to invest on these gears and shift later to more active fishing gears when fish catch declines over time. This scenario will aggravate the existing over capacity in fishing effort that precedes the occurrence of overfishing in the area.

Evidently, the small scale fisheries in the islands contributes as a source of cash for its households, not only for families of gleaners and full-time fishers but for an large number of rural households that live close to water bodies and engage in fishing activities for only a few weeks or few months each year and the year round operations of all gears. These offered households the possibility to generate revenues on an almost daily basis. Fishing plays a critical role as a 'bank in the water' (Bene' et al. 2009) for the communities in the islands that largely rely on this activity to access cash quickly.

SUMMARY, CONCLUSION AND RECOMMENDATIONS

Fishing gear inventory and catch composition assessments are types of rapid studies commonly conducted to characterize a fisheries in a data-deficient fishery for the purpose of rationally managing the fishery for coastal ecosystems conservation, rational fishery resource utilization, and adaptive capacity. The data generated by this study depicted the small-scale fisheries of Lahuy group of Islands as multi-species and utilizes multi-fishing gears dominated by handlines and entangling nets. A key weakness of this study is that the catch composition was not taken from randomized sampling of landed catch by gear. The diversity of catch composition of most of the gears is explained by its proximity to the region of upwelling due to the bifurcation of the NEC near NBS. Studies indicated that this key hydrographic feature of the NBS is where relatively large chlorophyll concentrations together with the largest values of total zooplankton and pelagic fish biomass and total larval fish are. Upwelled water is generally associated with high production capacity and is the likely reason that this specific area is able to support large consumer concentrations, i.e. multi-species fisheries (Noblezada and Campos, 2008). In addition, the fishing ground's location as catchment for various inland bodies of water emanating from the mountain ranges of Caramoan National Park which supply organic nutrients and minerals to the bay area through surface run-offs.

However, these potential of the coastal waters surrounding Lahuy Group of Islands as a highly productive fishing ground seemed to be slowly squandered over time as this study revealed symptoms of forms of overfishing which threaten the sustainability of its critical ecosystems, their resiliency and continuing productivity. The information on the catch per unit effort of almost all fishing gears inventoried in this study, as a traditional index of stock abundance, indicated reduced catch rates of fishers that translate to low income from fishing that abets situations of poverty and economic vulnerability.

To address the problems of high fishing pressure and overfishing and to protect the coastal ecosystems of fishing grounds around Lahuy Group of islands from further degradation, this study recommends:(1) institutional building such as strengthening the fisherfolk organizations, and cooperative creation of special bodies, committees/technical working groups and other groups/organizations relevant to fisheries; (2) strengthening the implementation of existing marine fish sanctuary-reserve and marine managed areas by augmenting budgetary allocations to support its operation; (3) incentivize community-based law enforcement units such as Bantay Dagat; (4) institutionalize the creation of Integrated Caramoan Bay Management Council which provide representation for various stakeholders of coastal and fishery resource use in the area in fisheries governance, (5) provision of an Integrated Coastal Zone Management Plan; and (6) Enacting an enhanced fisheries ordinance that integrates the installation of the following resource management options: a) strict enforcement of fishery laws (regarding the use of fine meshed nets, active gear and other destructive fishing operations such as the use of *kalwot* in harvesting abalones from coral reefs; b) seasonal closures such as closed fishing seasons to prevent harvesting of spawning sessile marine species such as abalone, sea cucumber, c) size limits on catch of juvenile species, d) gear size limit and restriction, e) provision of alternative livelihood programs, and f) advocacy towards resources conservation and sustainable development.

Managing a multispecies fisheries is a challenging task;

therefore, continuous effort must be made over the years to develop new models to manage the complex fisheries system. For example, a community-based abalone resource management system must be established in the Pawican Island area to protect the abalone fishery and the community culture to this fishery as it not only foster livelihood but also promotes the tradition of food sharing as a social network of support that reinforces bonding and bridging social capital which lubricates people's cooperation in sustainable fisheries and coastal management. There is also a need for a serious and comprehensive research in the future to examine the symptoms of biological and economic over fishing of fish stocks that were detected by this study. This study employed a less costly method that can observe certain indicators like characterization of fishing gears in operation, catch per unit of effort, composition species in the catch and selling price which are also serve as good references to address overfishing in data poor system like the small scale fishery of Lahuy Group of Islands. However, detailed scientific data on stock levels, regeneration, and catch are prerequisite as robust basis for reduction of fishing effort (number of boats and gross tonnage) to a proportion that promotes sustainability the fishery and its ecosystem and economic resiliency of the fishing communities that depend solely on the fishery for livelihood.

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ANNEX

Catch Composition by Gear and Value per Trip

Gear	Catch Name (Local)	Family Name	CPUE (Average catch per trip)	Price per kl (PhP)	Value per trip (PhP)
Drift Gill Net	Balanak	Mugilidae	1	60	60
	Baraka	Serranidae	1.25	90	113
	Bugiw	Hemiramphidae	20		0
	Duwal	Belonidae	15	60	900
	Kataway	Siganidae	0.5	80	40
	Manupi	Lethrinidae	5	60	300
	Paso	Pomacentridae	1	47	47
	Samaral	Siganidae	15	60	900
	Talakitok	Scombridae		120	0
	Taralbago	Siganidae	2	80	160
	Turay	Clupeidae		80	0
	Ulabay	Scaridae	1		0
Bottom Set Gill Net	Bataway	Serranidae	2	80	160
	Bisugo	Nemipteridae	5	100	500
	Blue crab	Portunidae	1.5	220	330
	Buraw	Scombridae	6.25	113	708
	Hasa-hasa	Scombridae	3	90	270
	Kataway	Siganidae	4	70	280
	Kiskisan	Haemulidae	1	100	100
	Lapay		5	70	350
	Lapulapu	Serranidae	2.5	100	250
	Lupani	Leognathidae	11.3	85	956
	Manuping	Lethrinidae		120	0
	Mirapina	Carangidae	2	130	260
	Palad	Cynoglossidae	2.5	100	250
	Putian	Carangidae	5	60	300
	Salaysalay	Carangidae	7.8	120	930
	Sal-igan	Lethrinidae	5.5	80	440
	Sandik	Siganidae	3	100	300
	Sapsap	Leiognathidae	4	80	320
	Talakitok	Scombridae	2.5	100	250
	Turingan	Scombridae	10	97	967
Hook and Line	Baraka	Serranidae	4.82	107	514
	Dalagang Bukid	Caesionidae	30	150	4500
	Dual	Belonidae	2	60	120
	Dugso	Lutjanidae		120	0
	Kanasi	Nemiptheridae	1	120	120
	Lapad	Cynoglossidae		100	0
	Lapulapu	Serranidae	1.5	578	876
	Maligimago			120	0
	Mamsa	Carangidae	5	133	667
	Manuping	Lethrinidae	1	160	160
	Mayamaya	Lutjanidae		135	0
	Pututan			80	0
	Raskita	Caesionidae		70	0
	Sal-igan	Lethrinidae	1	100	100
	Sandig	Siganidae	1	120	120
	Tagiptipon	Carangidae	6	100	600
	Talakitok	Carangidae	7	200	1400
	Tangigi	Scombridae	4	175	700
	Turingan	Scombridae	2.8	104	291
	Ulapay	Scariedae	1	40	40

Spear Gun	Alar		3		0
	Arungan	Lutjanidae	2	60	120
	Balat	Phyllophoridae	0.3	1800	450
	Baraka	Serranidae	2.8	86	237
	Bataway	Serranidae	2.3	87	195
	Buraw	Scombridae	1	100	100
	Gulapay	Siganidae	3		0
	kasag	Portunidae	1.5	100	150
	Kasmay	Haliotidae	0.6	2675	1672
	kataway	Siganidae	1.4	82	111
	Kitang	Siganidae	3	80	240
	Kulambutan	Sepiidae		120	0
	La-na	Serranidae		80	0
	Langkoy	Trichiuridae	3	60	180
	Lapay			70	0
	Lapulapu	Serranidae	1.5	933	1400
	Manitis	Mullidae	1	70	70
	Manuping	Lethrinidae	1	70	70
	Parangan	Apogonidae	1	100	100
	Paro	Chaetodontidae	3	60	180
	Paso	Pomacentridae	2.3	40	93
	Putian	Carangidae	2	100	200
	Sadig	Siganidae	3	80	240
	Sal-igan	Lethrinidae	1	80	80
	Sandig	Siganidae	1	100	100
	Sapsap	Leiognathidae	2	50	100
	Squid	Loliginidae		130	0
	Suga	Holocentridae		50	0
	Talagbago	Siganidae	1	80	80
	Tangigi	Scombridae	10	110	1100
	Taragbago	Siganidae	1	80	80
	Turos	Siganidae	1	80	80
	Ulapay	Scaridae	1.2	58	70
	Wal-an	Labridae	2	60	120
Jigger	Cuttlefish	Sepiidae	5	110	550
	Octopus	Octopodidae	3		0
Bottom Set Longline	Baraka	Serranidae			0
	Bubuon		10	00	5000
	Maya Maya	Lutjanidae	10	120	1200
	Parangan	Apogonidae			0
	Sal-igan	Lethrinidae	5	90	450
Gill net	Atuloy	Carangidae	1	70	70
	Balanak	Mugilidae	3	60	180
	Bataway	Siganidae	1	80	80
	Bat-og	Sphyraenidae	3	80	240
	Bisugo	Nemipteridae	10	50	500
	Buraw	Scombridae	3	100	300
	Dulaw			60	0
	Kasmay	Haliotidae	2	80	160
	Kataway	Siganidae	2.5	80	200
	Kulambutan	Sepiidae	10	140	1400
	Lupani	Leognathidae	2.3	70	161
	Manuping	Lethrinidae		70	0
	Salay-salay	Carangidae	3	100	300
	Sapsap	Leiognathidae	3	65	195
	Sundig	Siganid	1.5	120	180
	Talakitok	Scombridae	2	100	200
	Tambong	Leiognathidae	30	35	1050
	Tangigngi	Scombridae	4	100	400
	Turingan	Scombridae	14.5	100	1450
	Ulapay	Scaridae	5	60	300
	Yellow fin tuna	Scombridae	2	120	240
Kalwot	Kataway	Siganidae	2	70	140

SOCIOECONOMIC PAPER

Table A. Fixed Assets

Gears	Unit Cost	No. of Units	Unit of Measure	Total Cost	Estimated life span (yrs)	Annual Depreciation
A. Drift Gill Net	10,000	2	*banata*	20,000		
Containers	100	3	pcs	300		
Tub(banyera)	350	2	pcs	700		
Storage Bins	40	1	pc	40		
Rubber	100	1	pc	100		
B. Bottom set gill net	8,662	11	meter	95,282		
Containers	36	1	pc	36		
Storage Bins	70	2	pc	140		
Stryrofoam	300	1	pc	300		
Scoopnets	50	1	meter	50		
Fins	150	1	pc	150		
Diving googles	500	1	pc	500		
C. Hook and Line	651	5	pcs	3,255		
Containers	50	1	pc	50		
Styrobox	390	1	pc	390		
Flashlight	325	1	pc	325		
Battery	43	1	pc	43		
D. Spear Gun	653	1	pc	653		
Containers	52	1	pc	52		
Storage Bins	300	1	pc	300		
Mask	50	1	pc	50		
Rubber Band	65	1	pc	65		
Flashlight	340	1	pc	340		
Gas Mask	900	1	pc	900		
Googles	1,200	1	pc	1,200		
Pail	70	1	liters	70		
E. Jigger	200	1	pc	200		
Googles	150	1	pc	150		
F. Gill Net	5,063.85	8.13	*banata*	41,169		
Containers	133.33	1	pc	133		
Tub(banyera)	30	1	pc	30		
Storage Bins	537.50	2	pc	1,075		
Pail	28	1	pc	28		
Flashlight	150	1	pc	150		
G. Bottom set Longline	1,300	1		1,300		
H. Kalwot	self-made	2	pcs			
Pail	20	1	pc	20		

Table B. Operating Expenses

Gears	Unit Cost	No. of Units	Unit of Measure	Total Cost
A. Drift Gill Net				
Gasoline	253	0.83	gallon	210
Diesel	235	0.7	gallon	165
Oil	160	1	liter	160
Ice	8	12	pcs	96
Repair	-	-	-	250
Food	43	1	rice	43
B. Bottom set gill net				
Gasoline	253	0.7	gallon	172
Diesel	87	2.6	liters	226
Oil	143	0.9	liter	128
Ice	15	6.5	pcs	98
Food	53	3	kg of rice	158
bait	125	2	kg	250
Repair	-	-		3,100
C. Hook and Line				
Gasoline	209	1.68	gallon	351
Diesel	260	1.31	gallon	341
Kerosene	150	1.5	gallon	225
Oil	210	1.17	liters	246
Bait	87	2.33	kg	202
Repair	-	-	-	10,500
Food	83	1		83
D. Spear Gun				
Gasoline	255	0.6	gallon	153
Repair	-	-	-	9,800
Food	75	1		75
E. Jigger				
None				
F. Gill Net				
Gasoline	188	0.75	gallon	141
Diesel	26	2.5	bottle	65
Ice	10	3	pcs	30
Oil	190	1.5	liters	285
Ice	10	3	pcs	30
Repair	-	-	-	2,533
G. Bottom set Longline				
None				
H. Kalwot				
None				