



# Abundance, supply chain analysis and marketing of crustacean fishery products of Tinusa Island, Sumisip, Basilan Province, Philippines

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**Abstract.** Crustaceans are of great importance to humans as they are source of almost all economically important and high-priced commodities. Tinusa Island in Basilan Province is rich in crustacean resources that are utilized as the main food source and livelihood of the local residents. Herein, the abundance, supply chain analysis and marketing of crustacean fishery products of Tinusa Island, Sumisip, Basilan Province, Philippines were assessed. Three landing sites were identified namely, Langarey (Site I), Sahaya Bohe Batu (Site II) and Buli-Buli (Site III) from April to June 2018. A total of nine (9) economically important crustacean species were identified caught in the study area. One species belong to Order Stomatopoda, the zebra mantis shrimp *Lysiosquilla* sp. which is the most abundant species with a total of 5,070 individuals caught and harvested in Site I (Langarey). Eight species belong to Order Decapoda: *Panulirus femoristriga*, *Panulirus* sp., *Panulirus versicolor*, *Portunus pelagicus*, *Scylla serrata*, *Ranina ranina*, *Parribacus antarcticus* and *Scyllarides squammosus*. The supply chain analysis and marketing of the crustaceans shows a high pricing by the wholesaler from the fishermen. With its remote island location from the main markets in Zamboanga City, this supply chain analysis plays a crucial role for the national economy with its highly fluctuating abundance and peculiarities of the fishing gears. Support from the government through modern tools or fishing gears may help fisher folks ensure food security in Basilan. While some of these crustacean fishery products are considered as rare food delicacy offered in the region, proper regulation is needed such that catching of smaller and gravid crustaceans should be strictly monitored to ensure sustainable crustacean fisheries.

**Key Words:** crustaceans, gravid, wholesaler, retailer, consumer.

**Introduction.** Crustaceans (Phylum Arthropoda: Class Crustacea) are marine invertebrates characterized by five pairs of legs and two pairs of antennae. Ecologically, they play an important role in the food web by being an important link between benthic and pelagic organisms. They can also be used as indicators of environmental change since they are very sensitive to the influence of biotic and abiotic factors (Kyomo 1999). Economically, they are considered as cooking delicacy and are among the most valuable components of human diet (Szaniawska 2017).

There are approximately 40,000 crustacean species worldwide, which includes shrimp, lobsters, barnacles, crabs, krill, penaeid and non-penaeid prawns, stomatopods and other related species worldwide (Khade 2016; Maheswarudu 2017). In the Philippines, a revised checklist of Philippine crustacean decapods by Estampador (1959) and SEAFDEC (2017) revealed 522 species distributed among 207 genera under 58 families. According to SEAFDEC (2017), the Philippine waters are rich in crustaceans and many species are of economic importance which produces a large amount of food for human consumption. However, its abundance and catch are not scientifically documented since the marketing process involves typically from the fishermen to a dealer, then automatically either to the live market, then to a grocery store or a restaurant for consumers to purchase. Some may even engaged in exporting rare and high-priced crustaceans (Sullivan 2015).

Having the world's largest archipelago, Philippines ranked eleventh (11<sup>th</sup>) among the top fish producing countries in the world (FAO 2005) which includes crustacean fisheries. The market for these crustaceans is growing due to high consumption of seafood worldwide and the rising global population (Khade 2016). Certain species such as red frog crab, lobsters, mud crabs, blue crabs and sea mantis are considered as prestigious commodity due to its high price in the market (Wahyudin et al 2017).

Basilan in the southernmost part of the Philippines is a home to a number of rare and high-priced crustacean species. As an island province surrounded by bodies of water, the island is blessed with natural resources both on land and seas (PIA Basilan 2018). Even with the rich abundance of some rare and high priced crustaceans such as sea mantis, tiger lobsters and the red frog crab (*Ranina ranina*) as reported in the coastal waters of Zamboanga City Sulu, Tawi-Tawi and Basilan (Tito & Alanano 2008; Matondo & Demayo 2015), recent reports states that the Philippines is facing an uphill battle in terms of fisheries production. Overharvesting may be one reason since these species are most demanded for export in Japan, China, among others (Gonzales & Taniguchi 1995).

Tinusa Island in Sumisip, Basilan is an island that is separated from its mainland. Its waters are rich in marine resources that are utilized as one of the main food source and livelihood of the local residents. The Provincial Government of Basilan through the Department of Agriculture (DA) and Bureau of Fisheries and Aquatic Resources (BFAR)–ARMM saw the need to engage all stakeholders of the fishery and aquatic resources and enjoined all government agencies to ensure sufficient supply and harvest for food security and sustainability in Basilan (PIA Basilan 2018).

To address this need, supply chain analysis is seen crucial in the aquaculture industry especially with the increasing issues on overharvesting and illegal harvesting. A supply chain analysis is a linked network of individuals, organizations, resources and activities involved in the manufacture and sale of a product or service (Kleab 2017). In this study, crustacean species will be evaluated in terms of its supply chain with specific emphasis on its fishery potential. Further, through supply chain analysis, fishery potential will address economic issues through its pricing per kilogram.

As Gonzales & Taniguchi (1995) stated, more detailed biological and ecological information on the commercial species of these crustaceans are encouraged in order to formulate adequate management and conservation plans for these crustacean resources in the Philippines, particularly Basilan Province. Thus, this study was conceptualized which focuses on the assessment of the abundance, supply chain analysis and marketing of crustacean fishery products of Sumisip, Basilan Province.

## Material and Method

**Description of the study sites.** Basilan is an island province of the Philippines just off the southern coast of the Zamboanga Peninsula. Sumisip Municipality is one of the 11 municipalities of Basilan with rich abundance of crustaceans. The main site of this study is Tinusa Island located at 06°23.822'N, 122°02.346' E where fishermen caught crustacean species. Three landing sites were identified namely, Langarey (Site I), Sahaya Bohe Batu (Site II) and Buli-Buli (Site III). Most locals are engaged in fishing in its coastal waters surrounding the 48,265 hectares land area (LGU Sumisip 2017). Figure 1 shows the map of the area.

**Survey questionnaire.** A survey questionnaire adapted and modified from Marine Fish Division Fisherman's Indicators and Marketing of Fisheries Products by Municipal Fishermen in Panguil Bay, Philippines by the International Center for Aquaculture was utilized to assess the fisherman's demographic profile, fishing history and fishing management plan. This was translated by the interviewer according to the language used by the local fishermen (Yakan & Sinama). The respondents were comprised of local fishermen randomly subjected to the questionnaire using fish bowl method. Based on the data provided by the local government, there are 140 fishermen in the area. Fifty percent (50%) were randomly surveyed as key informants. A prior informed consent was employed to key informants.

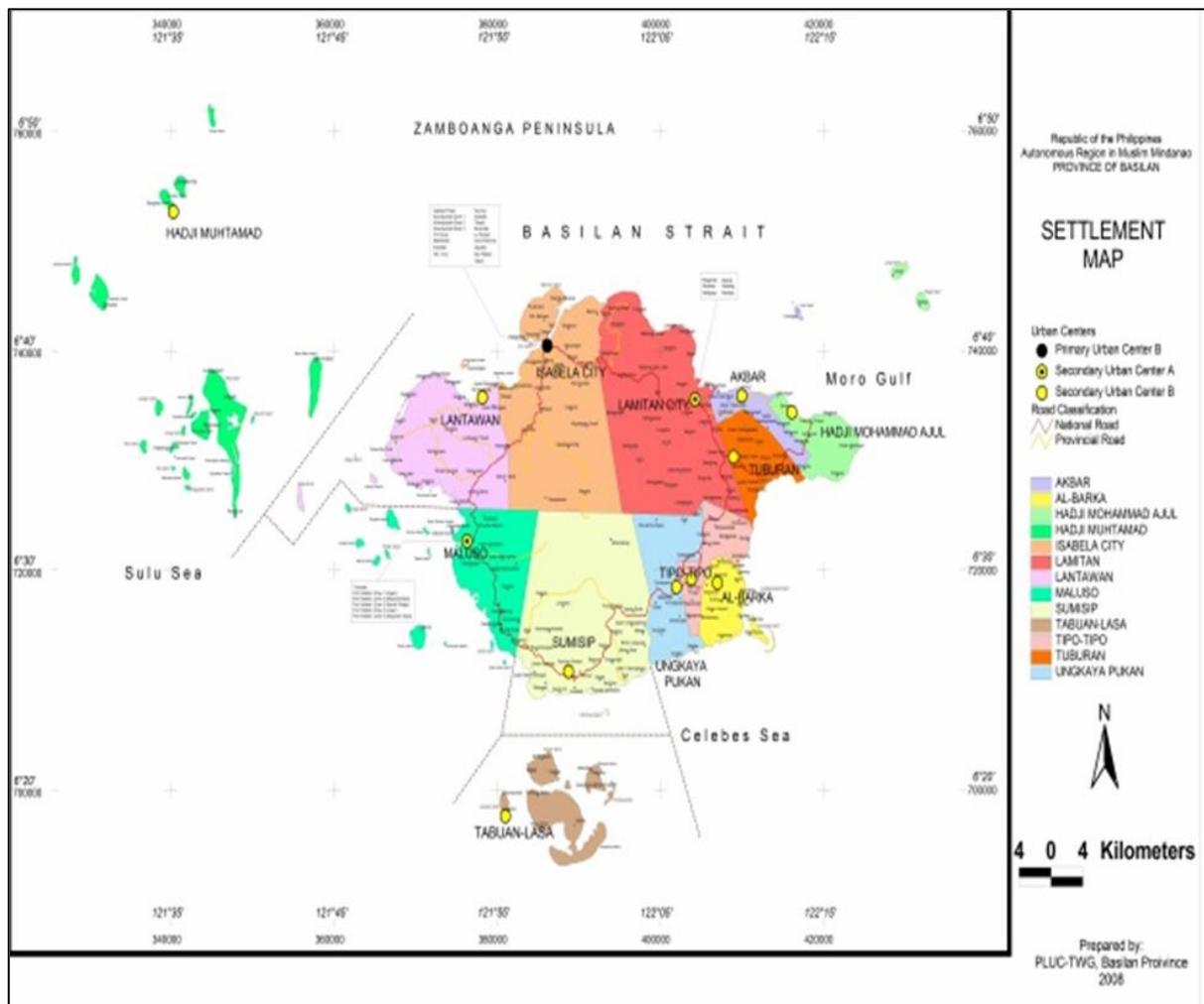


Figure 1. Map of Basilan Island, where Sumisip (encircled) is one of the municipalities (obtained from LGU, Basilan, 2017).

**Identification of crustacean fishery products and abundance assessment.**

Identification was done by initially taking photodocumentation in the landing sites. These were then compared to literatures and validated by an expert. In terms of abundance, the number of sample catch per day in each landing site was recorded for a period of three months (April to June 2018).

**Supply chain analysis and marketing of crustaceans.** A supply chain analysis was done based on the responses from the key informants. Pricing from the fishermen to the consumer were also determined to assess its marketing potential in terms of Philippine peso.

**Results.** There are nine (9) species of economically important crustaceans inhabiting the study site and sold in landing sites of Sumisip, Basilan Province. One (1) species belongs to Order Stomatopoda while eight (8) species belong to Order Decapoda (Figures 2-10).

Among the 9 crustacean species identified, five (5) are of “least concern status” as determined by the International Union for the Conservation of Nature (IUCN 2012). However, four (4) of these species are not yet evaluated: blue-swimmer crab (*P. pelagicus*), red frog crab (*R. ranina*), zebra mantis shrimp (*Lysiosquilla* sp.) and mud crab (*S. serrata*). Table 1 shows the abundance of crustacean fishery products in the three sites for the three successive months (April, May and June 2018).

The zebra mantis shrimp *Lysiosquilla* sp. is only caught in Site I and exhibits the highest abundance among the rest of crustacean fishery products of Tinusa Island, Sumisip, Basilan for three successive months. On the other hand, *P. versicolor* exhibits

the least abundant, with only 16 individuals caught in Sites 1 and 2. Common species caught in the three sites are crab fishery products such as *P. pelagicus*, *S. serrata* and *R. ranina*.

Three ethnic groups comprised the demographic profile of the fishermen: Badjao, Samal and Yakan, aged 21-50 years old with fishing history of more than five (5) years. Even with this experience, the fishermen express their need to help improve their fishing experience. Table 2 shows the summary of the responses among the fishermen in terms of crustacean fishery products caught and their respective fishing gear, problems encountered and their opinion in their catch rate in the three sites.

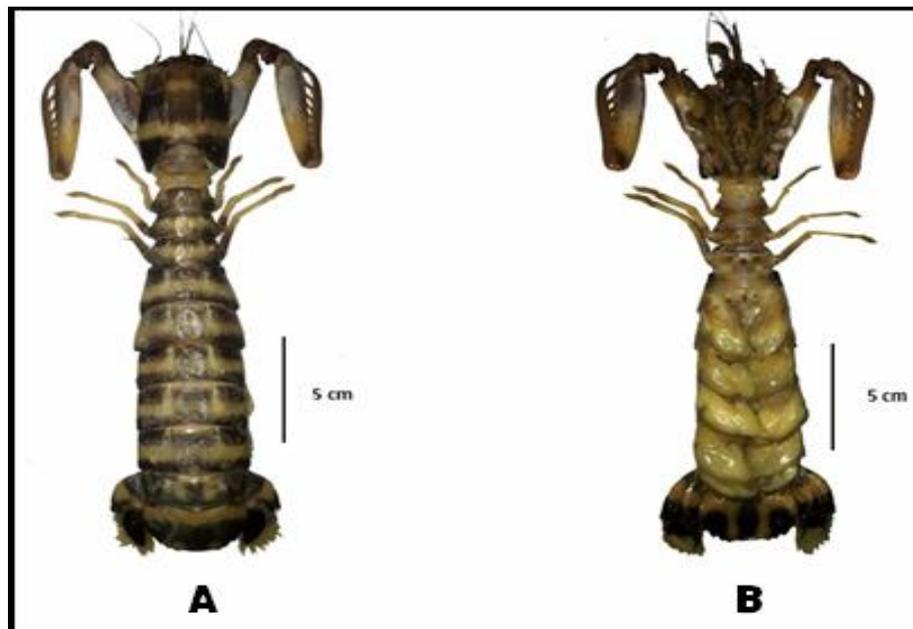


Figure 2. *Lysiosquilla* sp. (zebra mantis shrimp): **A**-dorsal view; **B**-ventral view.

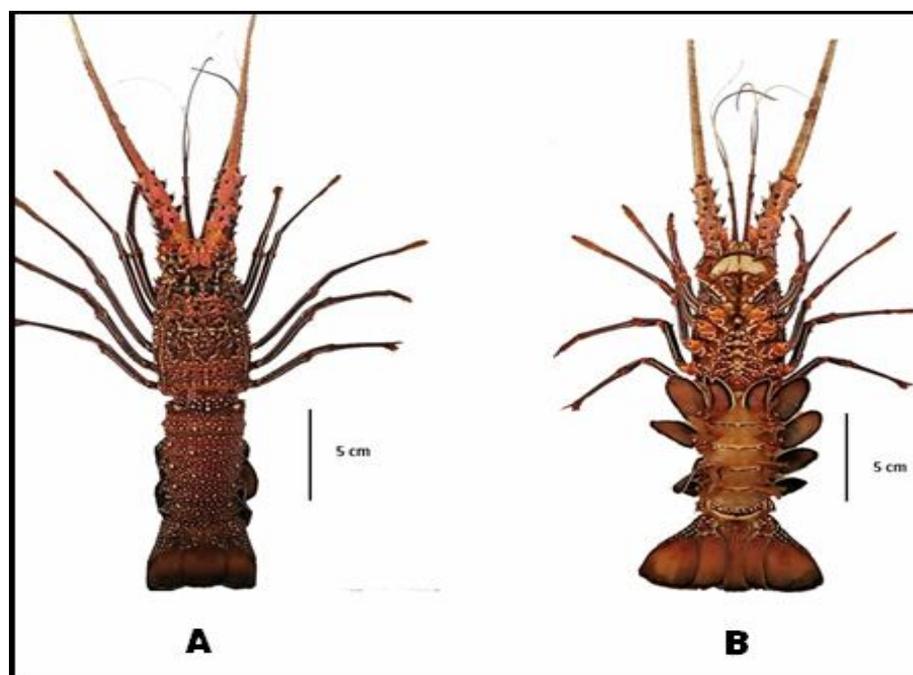


Figure 3. *Panulirus femoristriga* (striped-leg spiny lobster): **A**-dorsal view; **B**-ventral view.

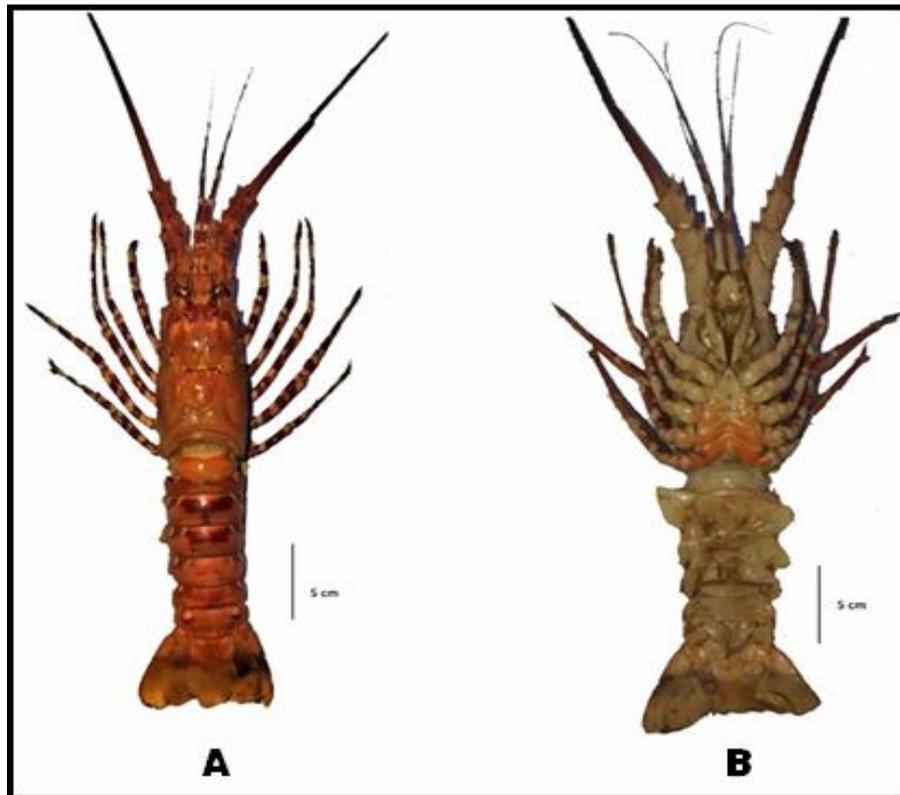


Figure 4. *Panulirus* sp. (ornate spiny lobster): **A**-dorsal view; **B**-ventral view.

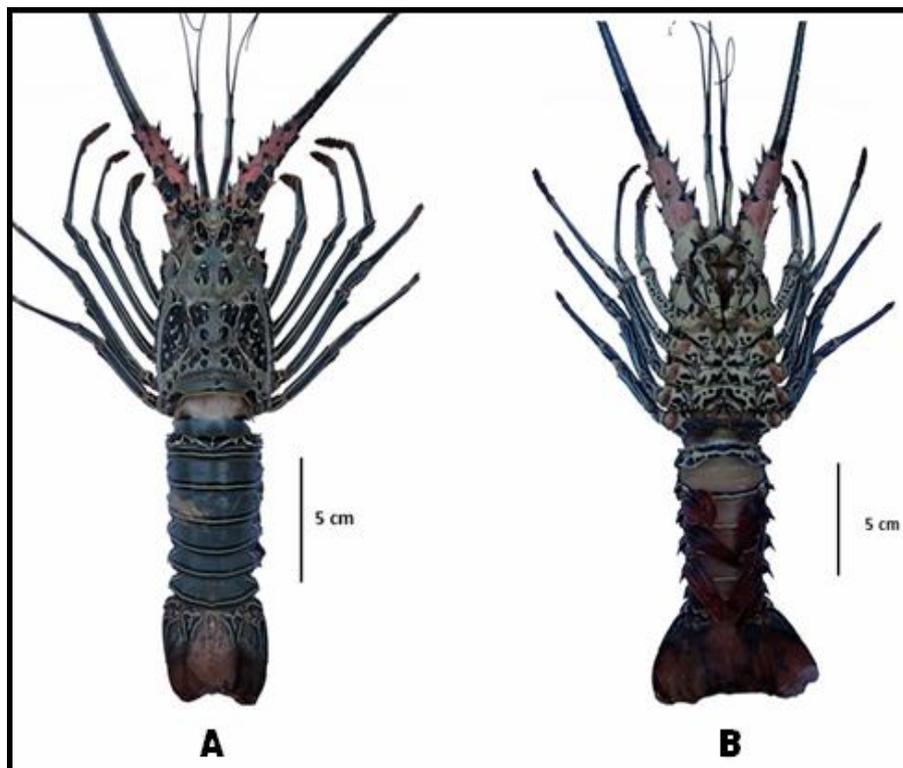


Figure 5. *Panulirus versicolor* (bamboo lobster): **A**-dorsal view; **B**-ventral view.



Figure 6. *Portunus pelagicus* (blue-swimmer crab): **A**-dorsal view; **B**-ventral view.

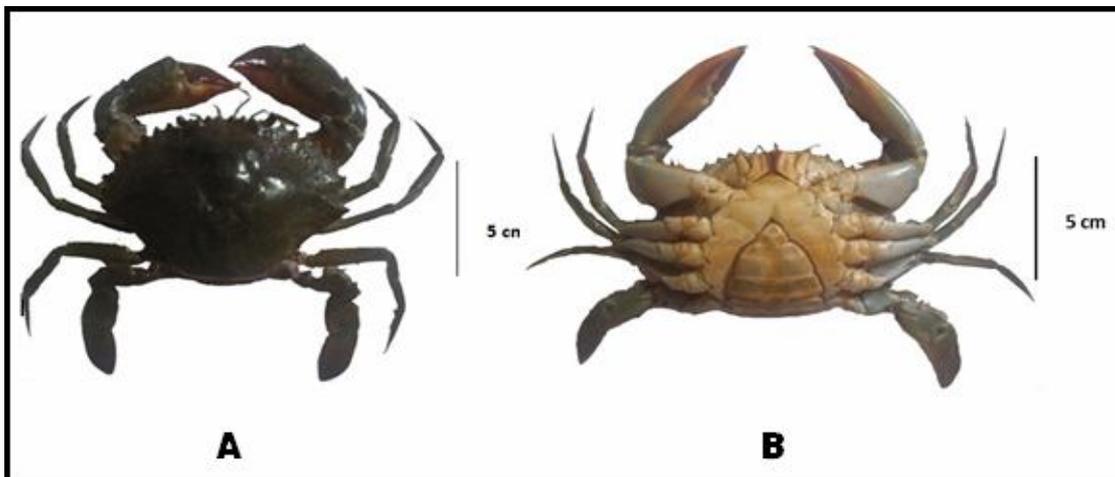


Figure 7. *Scylla serrata* (mud crab): **A**-dorsal view; **B**-ventral view.

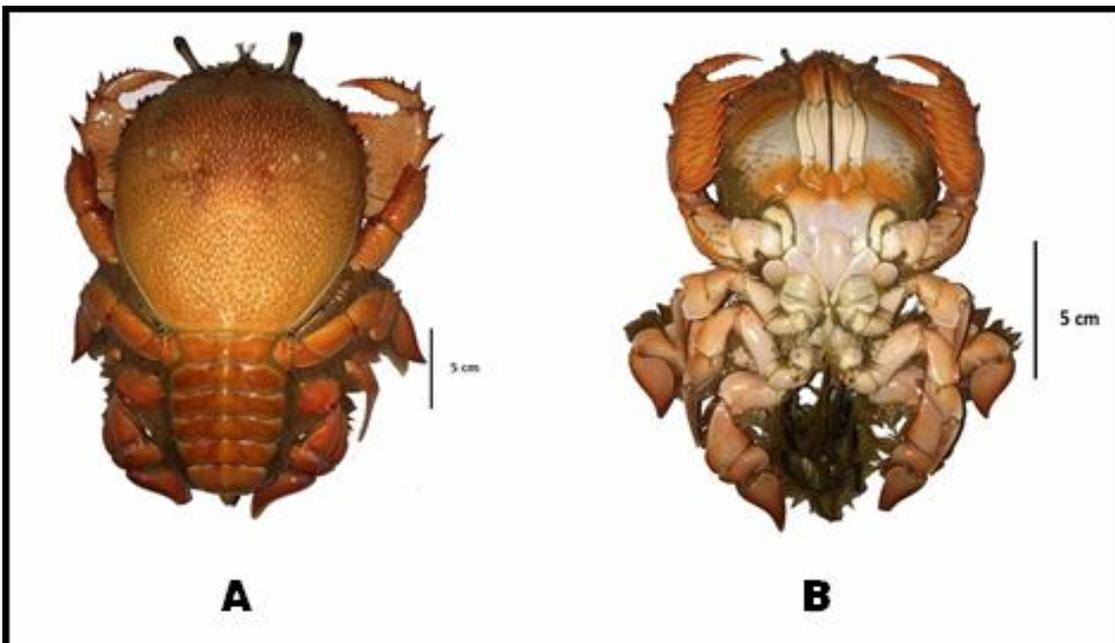


Figure 8. *Ranina ranina* (red frog crab): **A**-dorsal view; **B**-ventral view.

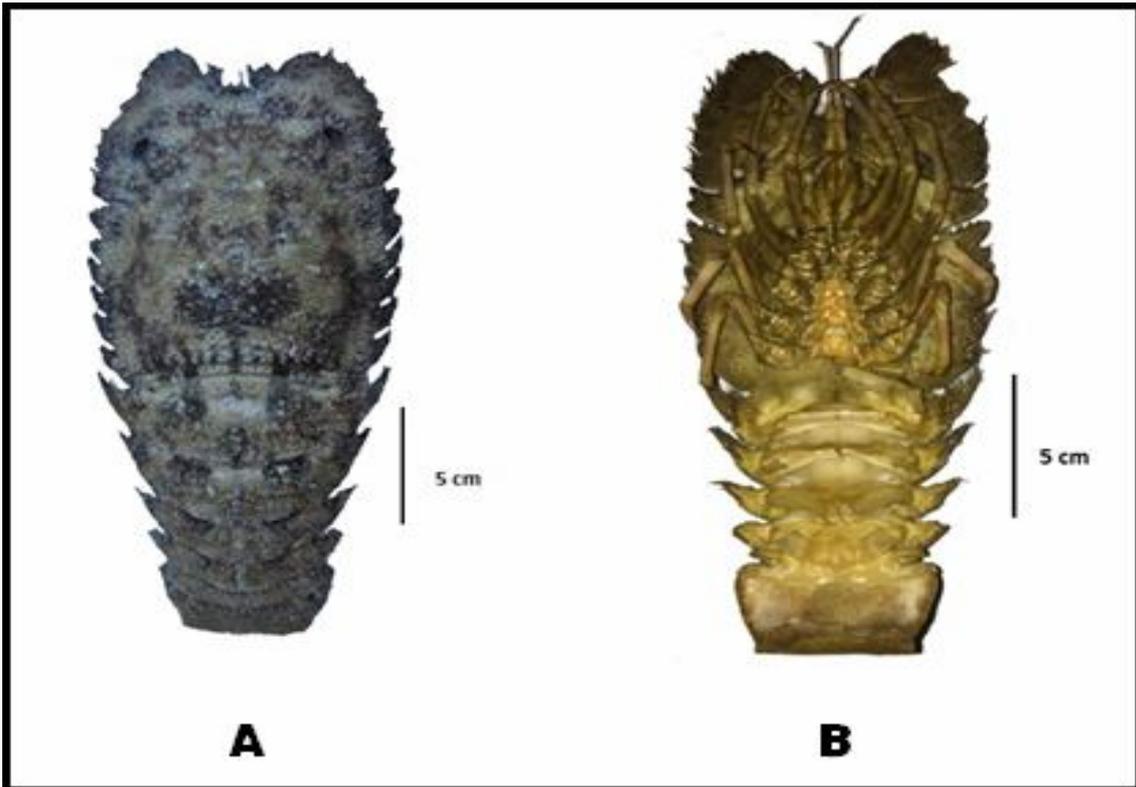


Figure 9. *Parribacus antarcticus* (sculptured mitten lobster): **A**-dorsal view; **B**-ventral view.

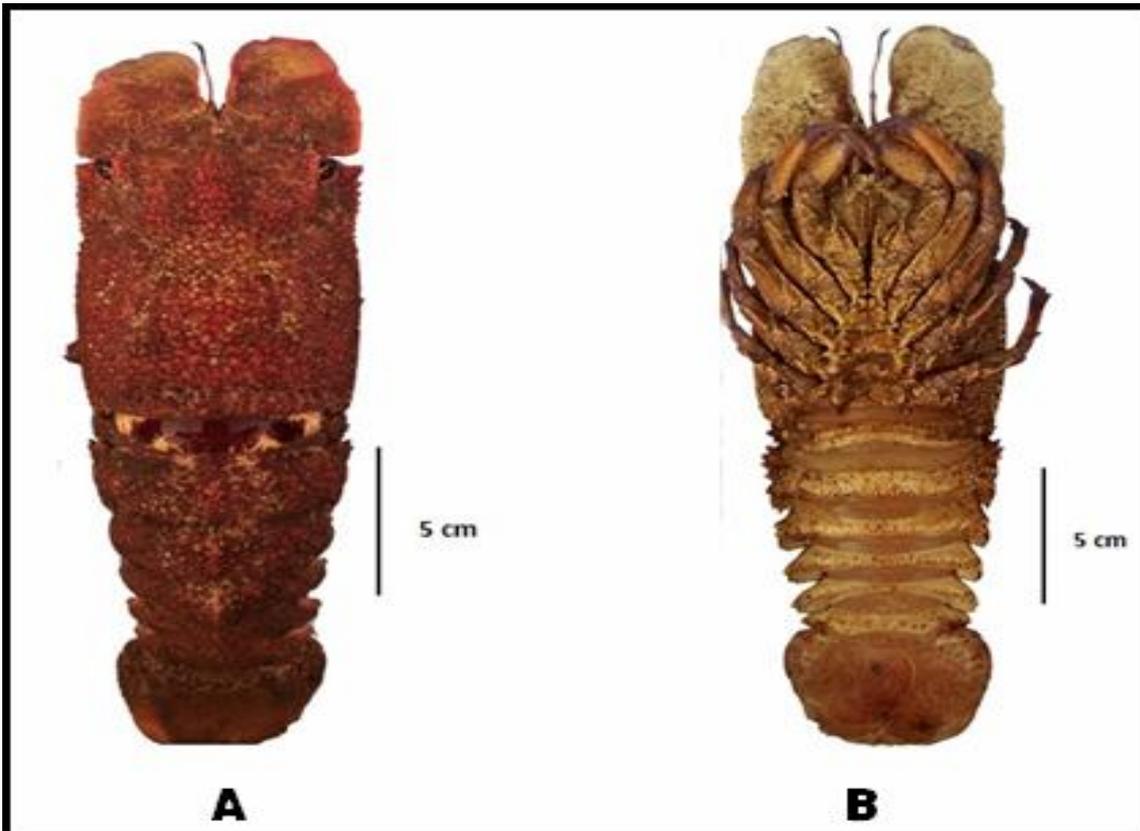


Figure 10. *Scyllarides squammosus* (blunt slipper lobster): **A**-dorsal view; **B**-ventral view.

Table 1

Abundance of crustacean fishery products in the three sites during the three successive months (April, May and June 2018)

<i>Crustacean fishery products</i>	<i>Site 1 (Langarey)</i>	<i>Site 2 (Sahaya)</i>	<i>Site 3 (Buli-Buli)</i>
<i>Lysiosquillina</i> sp.*	5,070	-	-
<i>Panulirus femoristriga</i>	12	6	-
<i>Panulirus</i> sp.	11	6	-
<i>Panulirus versicolor</i>	9	7	-
<i>Portunus pelagicus</i>	46	58	57
<i>Scylla serrata</i>	95	100	107
<i>Ranina ranina</i>	62	117	179
<i>Parribacus antarcticus</i>	31	20	-
<i>S. squammosus</i>	32	21	-

Legend: \* - most abundant crustacean species.

Table 2

Summary of the responses among the fishermen in terms of crustacean fishery products caught and their respective fishing gear, problems encountered and their opinion in their catch rate in the three sites

<i>Crustacean fishery products caught</i>	<i>Fishing gear used</i>	<i>Problems encountered</i>	<i>Catch rate (current vs last year)</i>
<i>Lysiosquillina</i> sp.	Bamboo stick with bait	Weather	Higher
<i>Panulirus femoristriga</i>	HF/GN/Compressor	Weather	No change
<i>Panulirus</i> sp.	HF/GN/Compressor	Weather	No change
<i>Panulirus versicolor</i>	HF/GN/Compressor	Weather	No change
<i>Portunus pelagicus</i>	Crab trap	Weather	No change
<i>Scylla serrata</i>	Crab trap	Weather	No change
<i>Ranina ranina</i>	Crab trap	Weather	Higher
<i>Parribacus antarcticus</i>	Hand-fishing	Weather	No change
<i>S. squammosus</i>	Hand-fishing	Weather	No change

Legend: HF - hand-fishing; GN - gill net.

Fishermen use different fishing gears for the varying crustacean fishery products. All fishermen from all sites use crab trap as their gear in catching all kinds of crab species *i.e.* (mud crab, blue crab, red frog crab). For catching lobsters, they revealed the use of hand, gillnet and compressor. While for catching sea mantis, a modified traditional bamboo stick tool with bait was used.

Weather is seen to be a crucial problem encountered by fishermen that affects their daily catch. When comparing their catch from the previous year, accordingly there is "no change" for almost all of the crustacean fishery products. However, in the case of *Lysiosquillina* sp. and *R. ranina*, the most offered unique delicacy component in Zamboanga City restaurants, the catch is accordingly higher than the previous year. In terms of implication to fishery management, the following questions were also raised as summarized in Table 3.

Table 3

Implication to fishery management

<i>Questions related to fishery management implication</i>	<i>Respondents' answer (N = 70)</i>			
	<i>YES</i>	<i>NO</i>	<i>A LOT</i>	<i>FEW</i>
Did you receive help from any government agency related to your fishing activities?		100%		
Are you member of cooperative organization?		100%		
Do you need assistance from any government agency?	100%			
How will you describe your small crustaceans catch this year as compared to last year?			27%	73%
Do you catch female gravid crustaceans?	100%			

All of them did not receive help from any government agency and not a member of any cooperative organization like *Samahan ng mga Mangingisda*. Seventy-three percent (73%) stated that they still catch few small crustaceans, while the remaining twenty-seven percent (27%) stated that a lot were caught. Further, all of them stated that even gravid crustaceans were caught and sold. Figure 11 shows samples of small-sized and gravid crustaceans (mud crab).

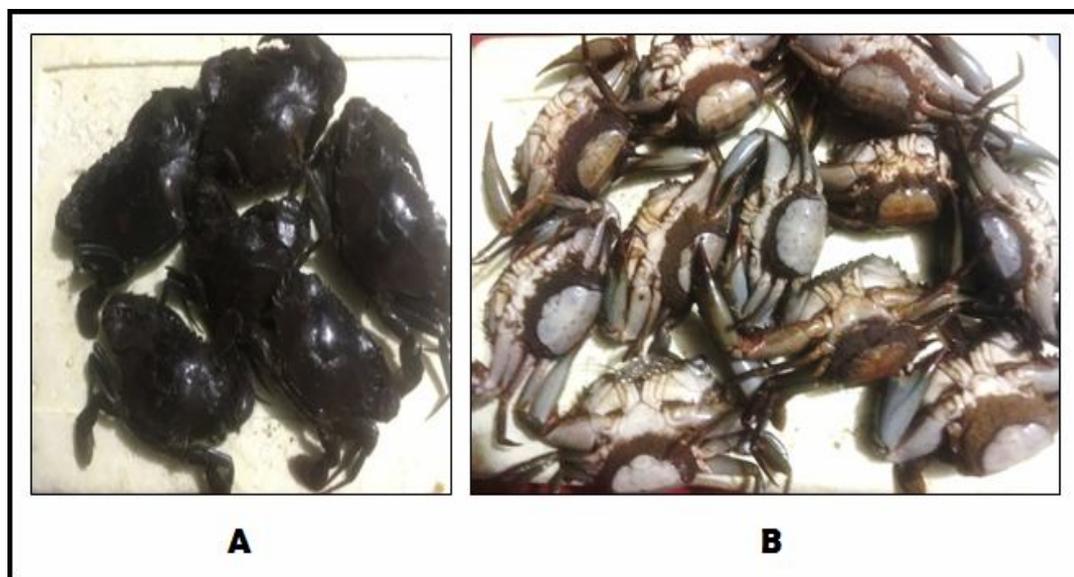


Figure 11. Small-sized (A) and gravid crustaceans (B) (mud crab).

According to the responses by the key informants, small and gravid crustaceans are still in demand in the market. The pricing will also depend on the size since they immediately sort out (*i.e.* small, medium, large) to the dealer's landing site or immediately to the market. Figure 12 shows the supply chain analysis and marketing of crustacean fishery products.

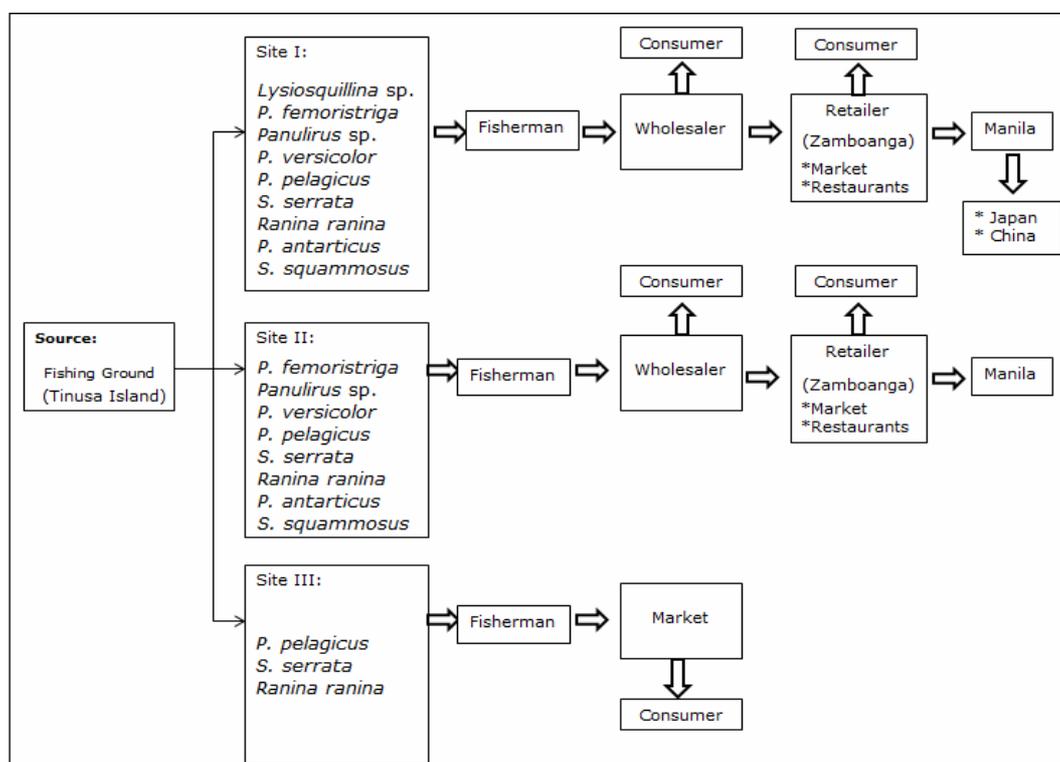


Figure 12. Supply chain analysis of economically important crustacean species of Tinusa Island, Sumisip, Basilan Province, Philippines.

There are many actors involved in the supply chain analysis such as the fisherman, wholesaler, retailer and consumer. As illustrated in Figure 12, it shows that fishermen from Site I (Langarey) are the only ones catching *Lysiosquilla* sp. The fishermen from the 3 sites sold their catch to the wholesaler. The wholesaler from Site I (Langarey) and Site II (Sahaya Bohe Batu) sold the crustacean species either to the retailer or directly to the consumer. Some consumers prefer to buy crustacean species directly from the wholesaler. Crustacean species from the retailer were sold in supermarkets and restaurants. When in Zamboanga City, the retailer will buy the species and deliver it to Manila where another retailer exports it to China and Japan. In Site III (Buli-buli), it can be seen that from the fishermen, the crabs' crustacean species goes directly to the markets as the retailer then to the consumer.

With its remote island location from the main markets in Zamboanga City, efficient supply chain management plays a crucial role for the national economy (Hameri & Palsson 2003). This supply chain analysis is supported by its marketing potential in the three sites through its actual pricing range in Philippine peso (P) per kilogram (kg) (Figures 13, 14 and 15).

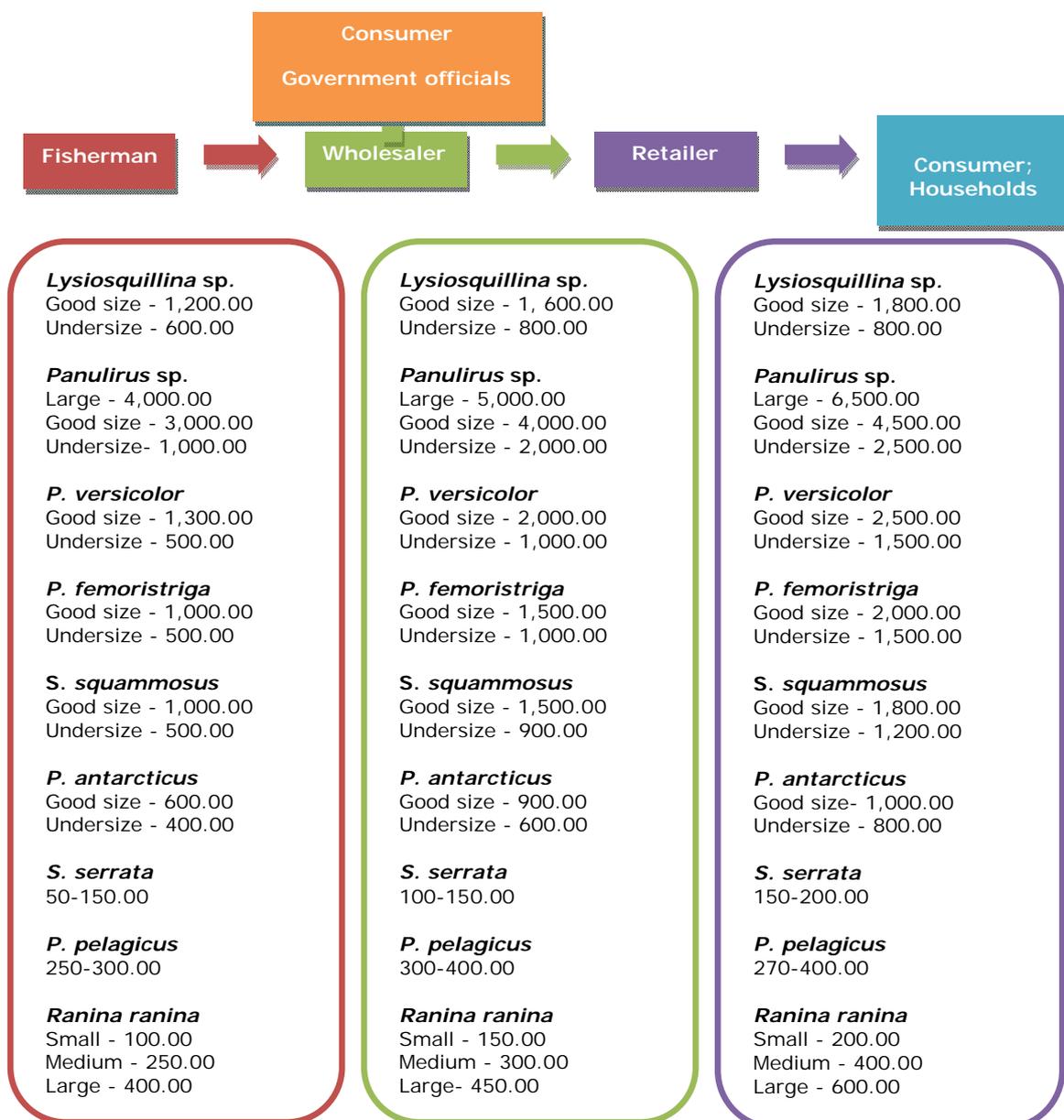


Figure 13. Marketing of crustacean fishery products of Site 1 (Langarey).

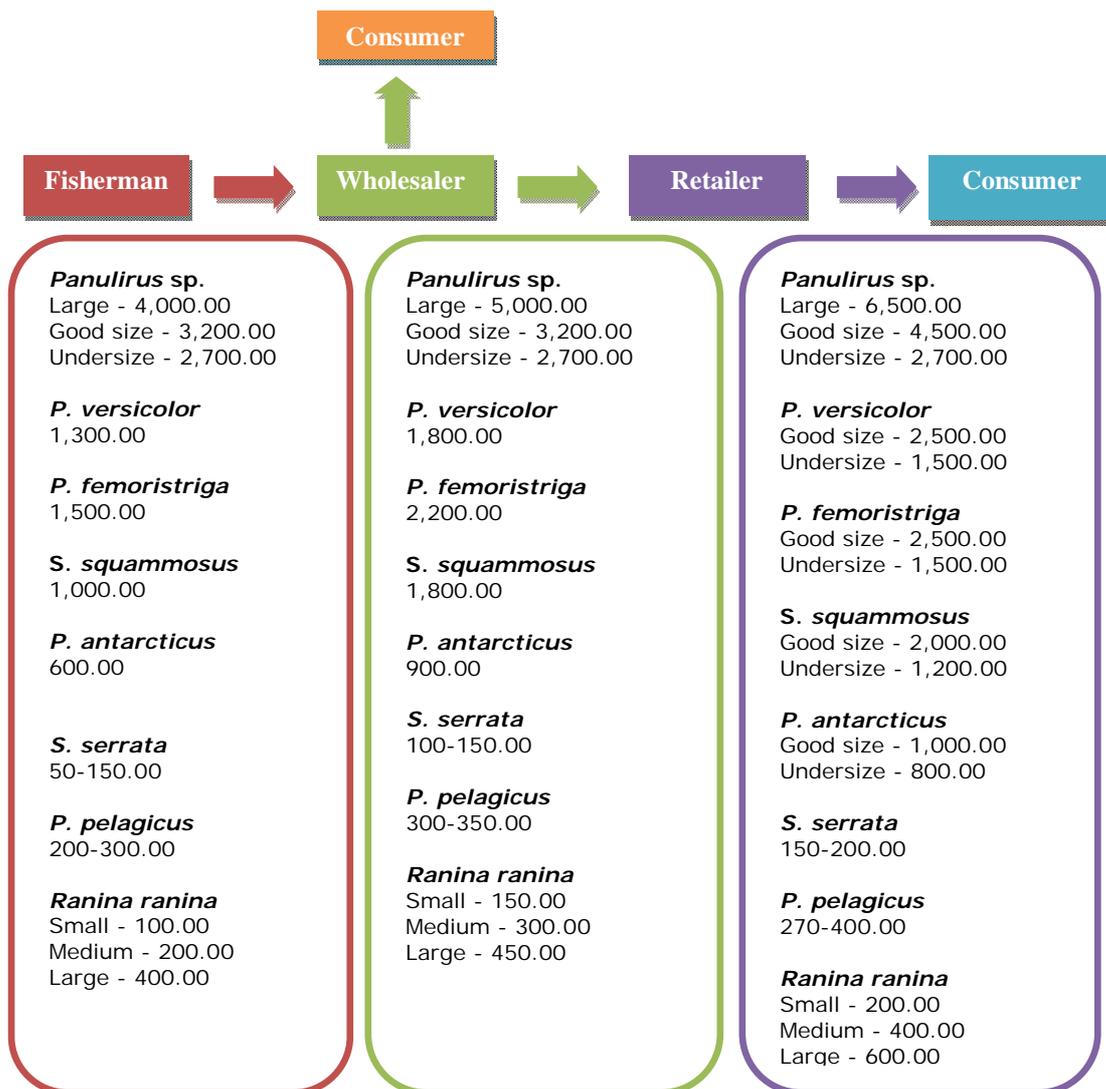


Figure 14. Marketing of crustacean fishery products of Site 2 (Sahaya Bohe Batu).

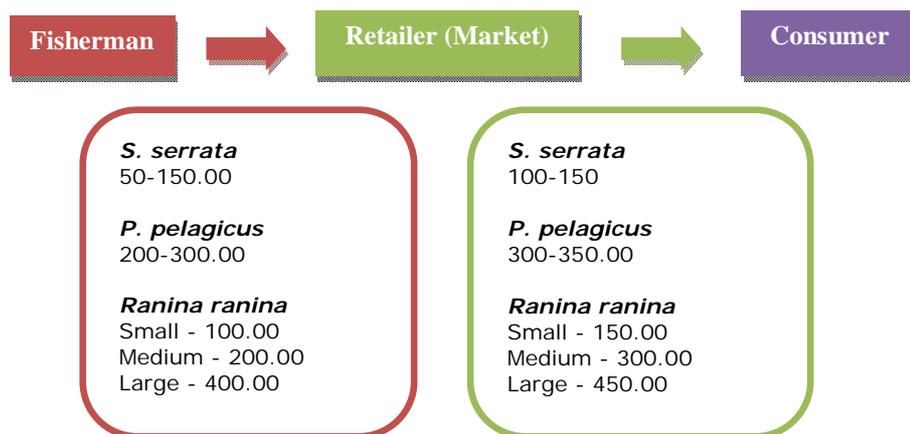


Figure 15. Marketing of crustacean fishery products of Site 3 (Buli-Buli).

The marketing potential among the crustacean lobster species is most expensive in large *Panulirus sp.* (ornate spiny lobsters) which are bought at P4,000.00/kg from the fishermen, then becomes P5,500 when sold to retailer. The consumer bought it around P6,500/kg. The "good size" mantis shrimp bought by the wholesaler from the fishermen is at P1,200/kg, then sold to the retailer at P1,800/kg. The pattern seen is "the larger the

crustacean species caught, the higher its price will be". In a similar manner, the cheapest among the crustacean fishery products is the mud crab, which can be bought as low as P100/kg (small size). Most of the prices are the same in the three sites however, sizing (good size and undersize) in Site 2 (Sahaya Bohe Batu) for *P. femoristriga*, *S. squammosus* and *P. antarcticus* took place at the level of the retailer.

**Discussion.** Among the nine economically important crustacean species caught and sold in the three landing sites of Tinusa Island, Sumisip, Basilan, Philippines, the high-priced sea mantis *Lysiosquilla* sp. reflects the most abundant catch for three successive months (April, May and June 2018). This is accordingly accounted to the unique and modified fishing gear "*sahat*" made of a bamboo stick placed with bait in the nylon and the peculiarities in selling it (Figures 16a and b).

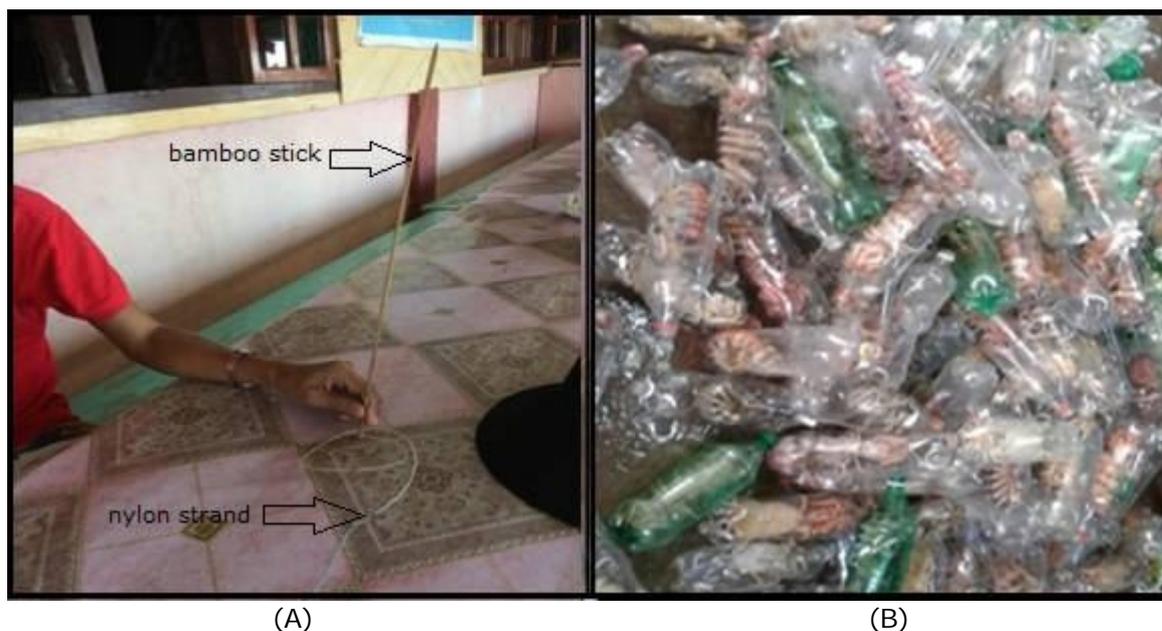


Figure 16. Peculiar modified fishing gear ("*sahat*") which explains for the abundant catch of *Lysiosquilla* sp. in Site 1 only (Langarey) (A) and the mode of selling by placing in plastic bottles (B).

This "*sahat*" is accordingly provided by the wholesalers who directly bought their fresh catch in the landing site. They are then placed individually in plastic bottles since live *Lysiosquilla* sp. (zebra mantis shrimp) has the tendency to fight against each other if placed together.

*Lysiosquilla* sp. are increasing its popularity as a delicacy in Zamboanga City due to its sweet meat taste (Baigtu & Echem 2018) especially the sexually mature females of this species which are recognized by their visible orange ovaries that run the length of the thorax and abdomen. Further, the red frog crab *R. ranina* has been considered by tourists and locals as the major unique Zamboanga's delicacy (locally termed "*curatcha*"). Due to the popular demand in the market, this may be the reason for the response of the fishermen that the catch for these two species are accordingly higher than the previous year.

*P. versicolor* (bamboo lobster) was found to be the least abundant species. The fishing of this species in Site I and Site II is accordingly "life-threatening" or "*buwis-buhay*" with the alleged use of illegal fishing gear (compressor). According to FAO (2014), compressors are illegal and destructive fishing practices. As further specified in Republic Act 10654 (An Act to Prevent, Deter and Eliminate Illegal, Unreported and Unregulated Fishing), the use of prohibited gear such as this is a serious violation. No use of fine mesh net was reported however, the capture of breeders/spawners or gravid fishery species is accordingly considered unlawful. Gravid species of mud crabs (*S. serrata*) were reported to be caught in this study.

In terms of IUCN status for these crustacean species, five (*P. femoristriga*, *Panulirus* sp., *P. versicolor*, *P. antarcticus* and *S. squamosus*) are categorized as “least concern” which indicates that a taxon has been evaluated against the red list criteria and does not qualify for critically endangered, endangered, vulnerable or near threatened. Widespread and abundant taxa are included in this category therefore, these species means that their abundance is not yet threatening. Four (4) of these including the *Lysiosquilla* sp., *P. pelagicus*, *S. serrata* and *R. ranina* are not yet evaluated in terms of their IUCN status however. This is a category on the IUCN red list of threatened species which indicates that a taxon has not yet been evaluated against the criteria (IUCN 2012). These criteria include population size of matured individuals through its fluctuating or continuing decline and geographical distribution.

This “least concern” status indicates that no assessment of extinction rate has been made. Until such time an assessment is made, these categories should not be treated as if they were non-threatened. Thus, baseline data on their abundance and supply chain analysis are needed for sustainable fishery management.

In fishery point of view, the market demand of crustacean species like the *Lysiosquilla* sp. (sea mantis) is increasing overtime. *Lysiosquilla* sp. has also a high value in the market. The value of this commodity ranges from 1500 and above per kilo. The demand of this species is high and it is exported in other countries such as Mainland China, Hongkong and Japan (Baigtu & Echem 2018).

The value of the commodity varies according to its species. In Basilan, lobsters have the highest value ranging from P2000-7000 pesos. Out of the five lobsters *Panulirus* sp. has the highest value. It is probably caused by its beautiful colors (Wahyudin et al 2017). Lobsters are usually delivered as live product to several places because live lobster has the highest price. Another species of lobster *P. antarcticus* has also potential specific market. For the last years, the demand of this exotic slipper lobster increased.

The supply chain analysis and marketing of the crustaceans shows a high pricing by the wholesaler from the fishermen. Due to the high-priced demand in the market and the provided fishing gear by the wholesalers, the fishermen who belonged to the three ethnic groups (Badjao, Tausug and Yakan) were provided with a high income depending on their catch/day. As stressed by Baigtu & Echem (2018), supply chain analysis nowadays are of increasing concern in the seafood industry because of the issues impacting the chain such as labor exploitations and other economic issues.

This supply chain may imply that illegally harvested crustacean species will be avoided. Evaluating the supply chain and marketing system will give an idea to the government to give the fishermen the utmost importance, for without them there will be no available crustaceans that are difficult to catch such as the high-priced lobsters and sea mantis. From the fishermen's responses, they accordingly need assistance from the government through modern tools or fishing gears. As supported by PIA (2018), support to fisher folks and farmers ensure food security in Basilan.

**Conclusions.** Nine (9) economically important crustacean species (*Lysiosquilla* sp., *Panulirus* sp., *P. versicolor*, *P. femoristriga*, *P. antarcticus*, *S. squamosus*, *P. pelagicus*, *S. serrata* and *R. ranina* are caught and sold in Tinusa Island, Sumisip, Basilan Province, Philippines. The most abundant crustacean species caught for three successive months is the zebra mantis shrimp *Lysiosquilla* sp. which is only caught in Site 1 (Lanagarey) due the unique gear used in fishing. On the other hand, the bamboo lobster *P. versicolor* is the least abundant species which can be accountable to fishing difficulty and unavailability of appropriate fishing gear. There are many actors involved in supply chain which includes the fisherman, wholesaler, retailer and consumer. Most of the crustaceans recorded in the site were bought from the fishermen at high-price, increasing from one hand to another. With the area's remote island location from the main markets in Zamboanga City, this supply chain analysis plays a crucial role for the national economy with its highly fluctuating abundance and peculiarities of the fishing gears. While some of these crustacean fishery products are considered as rare food delicacy offered in the region, proper regulation is needed such that catching of smaller and gravid crustaceans should be strictly monitored to ensure sustainable crustacean fisheries.

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