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Fishery of Blue Swimming Crab *Portunus pelagicus* (Linnaeus, 1758) in Northern Bohol, Philippines

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Key words: Blue swimming crab, Crab fishers, Crab trader, Market flow, Volume of production

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Abstract

The blue swimming crab fishery is considered a leading source of livelihood in Bohol province. This study aims to determine the status of blue swimming crab fishery, describe the market flow, and identify the problems and challenges involved in the blue swimming crab industry in Bohol. A mixed-methods of research was used in the study that employed collection of both qualitative and quantitative data. Data were gathered through surveys aided with survey-questionnaires validated with personal interviews and focus group discussion. The study was conducted in the four northern coastal municipalities in Bohol, namely Tubigon, Inabanga, Getafe, and Talibon, for three months from October to December 2018. A total of 150 crab fishers, 32 traders, and 5 crab meat picking plants were surveyed. Results revealed that there was a decline in blue swimming crab catch, but the demand for the product in the market was consistently high. The production of blue swimming crab in the identified areas showed an increasing trend from October to December. Generally, the blue swimming crab caught by the crab fishers are sold fresh locally to different channels of distribution, including traders, local wet markets, crab meat picking plants, local establishments, and end consumers. The problems involved include the steady decline in the volume of production of blue swimming crab primarily due to lack of awareness of the industry players on the existing policies regulating blue swimming crab fishery. The blue swimming crab industry is a continuous and stable fishery industry in Bohol; however, the industry is facing challenges that are threats to its sustainability.

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Introduction

The blue swimming crab (*Portunus pelagicus*), also known as flower crab, blue crab, blue swimmer crab or sand crab, is a large crab found in nearshore marine and estuarine waters throughout the Indic and West Pacific Oceans: from Japan, and Philippines throughout Southeast and East Asia, to Indonesia, the East of Australia, and Fidji Islands, and westward to the Red Sea and East Africa. Blue swimming crab occurs also in the Mediterranean Sea as lessepsian species along the coast of Egypt, Israel, and Lebanon, Turkey, the Syrian Arab Republic, Cyprus and the east southern coast of Sicily (FAO, 2013). Blue swimming crab is one of the most important commercial crab species in the Philippines (Germano, 1994) and the Blue Swimming Crab Fishery is a significant sub-sector of the crustacean fishery in the Philippines (BFAR, 2013). In 2010, Philippines supplied USA with 9.53% of its demand for pasteurized crab meat, putting it to rank 3 worldwide and rank 2 among its South East Asian peers. In 2011, the Philippines rose to 2nd major source of crab meat for the USA at 23%, next to China's 29%. In 2013, it became the 3rd major fishery export in the country in terms of fat and crab meat valued at PHP 2.89 B. It was considered as a major fishery export commodity, next to tuna, seaweeds and shrimp/prawn, with a total volume of 4,200 MT and value USD 55 million in 2016 (PSA, 2016).

The blue swimming crab fishery constitutes an important part in the local fisheries production in the Philippines (Germano, 1994). The main area where the blue swimming crab is fished is in Western Visayas, specifically the Guimaras Strait and the Visayan Sea (Ingles and Flores, 2000). Other fishing grounds contribute to the aggregate annual production of blue swimming crab include the Asid Gulf, Bohol Sea, Samar Sea, Carigara Bay, Sorsogon Bay, northern part of Ragay Gulf, Tayabas Bay, Malampaya Sound, Panguil Bay, and the waters of Tawi-Tawi in Mindanao (Ingles, 2004). In terms of regional crab production, the highest production is in region VI contributing 32.23% followed by region VIII at 21.46% and region V at 17.89% (BAS, 2007). The increasing global demand for the blue swimming crab and its wide distribution throughout the Indo-West Pacific makes it an important species to a number of countries (Lai *et al*., 2010; FAO, 2013). About 77% of production of the blue swimming crab from the Philippines is exported (Ingles, 2004). The increase in export demand has caused a boom and bust trend in various areas in the Philippines (Ingles, 2004). Due to high prices in export trade, fishers entered the fishery without any management restrictions that lead to increased exploitation of blue swimming crab and caused a decline in catch (Ingles 2004). Recorded blue swimming crab landings increased from 25, 000 MT in 1992 to 40, 000 MT in 2004 (Ingles, 2004), however, production declined from 31, 509 MT in 2008 to 28, 170 MT in 2010 (BFAR, 2013), which could be attributed to high commercial exploitation, ghost fishing and recruitment overfishing (Ingles and Flores, 2000).

In Bohol, fishing is the second main source of income and alternative source of livelihood of Boholanos. With 30 coastal municipalities, approximately 33% of Bohol population is directly defendant on fishing (PPDOB, 2018) and the blue swimming crab fishery is considered as a major source of livelihood in Bohol province (ECOFISH, 2015). The production of blue swimming crab in Bohol decreased from 359.74 Metric Tons (MT) in 2014 to 299.67 MT in 2016 (PSA, 2016). Although there are already studies regarding on blue swimming crab in Bohol (ECOFISH, 2015), there is a lack of information or data on the blue swimming crab fishery in Bohol. This study aims to provide basic information on the status of the blue swimming crab fishery in the four northern coastal municipalities in the province of Bohol through looking into the fishing and market flow of blue swimming crab in the identified areas. Results of this study may be used in formulating policies and local legislations to manage effectively the blue swimming crab industry in the province.

Materials and methods

Research Design

This study used a mixed-methods research design that includes both qualitative and quantitative research. Specifically, this study uses the exploratory

sequential design (QUAL-QUAN). For the qualitative data, the study required the collection of the data on the crabbing and trading practices of the respondents. For the quantitative data, the study required the collection of the data on the demographic profile of the respondents, volume of production, and the buying and selling prices of blue swimming crab.

Research Locale

This study was conducted in the municipalities of Tubigon, Inabanga, Getafe and Talibon that are located at the northern coast of Bohol, Philippines. These municipalities are identified to have wide coastal areas and presence of landing sites of blue swimming crabs. Previous studies on catch monitoring (ECOFISH, 2015) also provided additional information on the prevalence of blue swimming crabs in the areas. The research areas are also located within the vicinity of Danajon Bank, the most habitat-rich marine environment in the province and one of the major fishing grounds in Region VII, Philippines (Green *et al*., 2004).

Respondents of the Study

The respondents of the study were the crab fishers and crab buyers in the four northern coastal municipalities in Bohol. The population (N) of the crab fishers in each municipality were determined through the data provided by the Municipal Agriculture Office (MAO). The data taken from the MAO were the total number of Registered Fisherfolks (FishR) that include the listing of registered crab fishers which is in accordance on the guidelines of the Joint DA-DILG Administrative Order No. 1 series of 2014. From the records of the MAO, the sample size (n) in each municipality was computed using Slovin's formula. Moreover, additional data were collected from the blue swimming crab traders and picking plants. Purposive sampling was used to determine the sample size for the traders and picking plants. A total of 150 crab fishers, 32 crab traders, and 5 crab meat picking plants were surveyed in the study.

Data Gathering Procedure

To gather data in the study, two variants of data collection were employed; through personal interviews by the aide of survey-questionnaires and focus group discussion. Primary data such as the fishing and trading practices were collected through surveys with the crab fishers and crab buyers.

To determine the volume of production of blue swimming crab, data sheets were provided to the crab fishers where they recorded daily the volume of their catch, source (fishing grounds), type of fishing gear used and number of hours spent fishing or the soaking time. Data collection was done daily for three months, from October to December 2018. The data were then tabulated and collated monthly. In addition, data were collected from the crab traders and picking plants to determine the market flow of blue swimming crab in the research areas. A focus group discussion was done to validate the data gathered.

Data Analysis

The results of the study were subjected to different simple statistical treatments including the frequency, percentage and mean. Other statistical treatments adopted from de la Cruz *et al.* (2015) were used to determine the estimated average daily catch, catch per unit effort, and monthly production of blue swimming crab in the four northern coastal municipalities in Bohol.

The average daily catch for each month was computed. The average daily catch is the ratio of the total catch (kg) to the number of fishers within the day. The average daily catch was computed as:

$$\text{Ave. daily catch} = \frac{\Sigma dc}{d}$$

where:

Σdc = summation of daily catch of the monitored crab fishers

d = number of fishing days

The catch per unit effort (CPUE) was computed for a specific gear type used per day.

The CPUE for crab gillnet was computed as:

$$\text{CPUE Crab Gillnets} = \frac{\text{total daily catch (kg)}}{\text{total length of crab gillnet (m)}}$$

The CPUE for crab pot was computed as:

$$\text{CPUE Crab Pots} = \frac{\text{total daily catch (kg)}}{\text{total number of crab pots}}$$

The CPUE for crab liftnet was computed as:

$$\text{CPUE Crab Liftnets} = \frac{\text{total daily catch (kg)}}{\text{total number of crab liftnets}}$$

The Mean CPUE for the month was computed as:

$$\text{Mean CPUE} = \frac{\sum \text{CPUE}}{d}$$

where:

$\sum$CPUE = summation of daily CPUE

d = number of fishing days within the month

The monthly production for each fishing gear used to catch blue swimming crabs in the four coastal municipalities in Bohol was derived from:

The Monthly Production was computed as:

$Mi = (A1 * Fi)$

where:

Mi = monthly yield of the fishing gear

Ai = average daily catch for the month

Fi = average number of fishing days within the month

Results and discussion

Estimated Monthly Production

The estimated average monthly production of blue swimming crab in the four coastal municipalities in Bohol and of the three (3) dominant fishing gears were recorded. Fig. 1 shows the estimated monthly production of blue swimming crab in the four northern coastal municipalities in Bohol. The highest estimated production (2,253kg) was observed in Talibon, followed by Tubigon (2,083kg), and Inabanga (1,040kg). Moreover, Getafe had the lowest estimated production (869kg).

For the crab gillnet, Fig. 2a shows that the highest estimated production (1,846kg) was observed in Talibon on the month of December followed by Tubigon (1,802kg) and Inabanga (599kg). On the other hand, crab fishers from Getafe had the lowest monthly production (191kg). For the crab pot, the highest estimated production was observed in Getafe (626kg) on the month of December followed by Inabanga (441kg), Tubigon (280kg), and Talibon (264kg) that had the lowest monthly production (Fig. 2b). For the crab liftnet, a fishing gear used only by the crab fishers in the municipalities of Getafe and Talibon, Fig. 2c shows that Talibon crab fishers had higher production (144kg) compared to Getafe crab fishers (52kg).

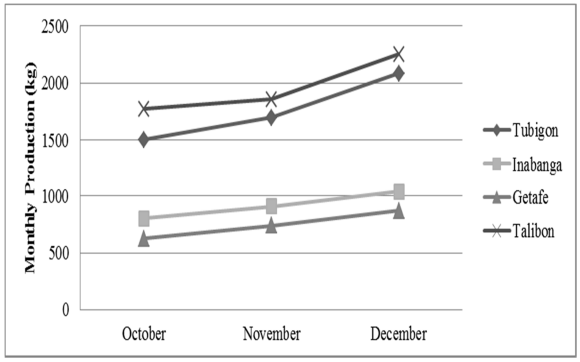

Fig. 1. Estimated Monthly Production (kg) of Blue Swimming Crab in the Four Northern Coastal Municipalities in Bohol from October to December 2018.

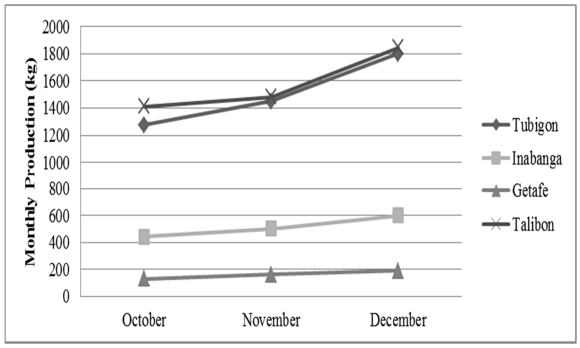

Fig. 2a. Estimated Monthly Production (kg) for Crab Gillnets in the Four Northern Coastal Municipalities in Bohol from October to December 2018.

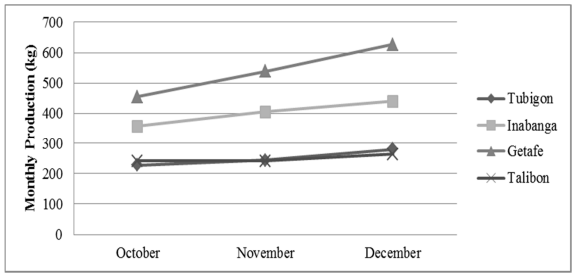

Fig. 2b. Estimated Monthly Production (kg) for Crab Pots in the Four Northern Coastal Municipalities in Bohol from October to December 2018.

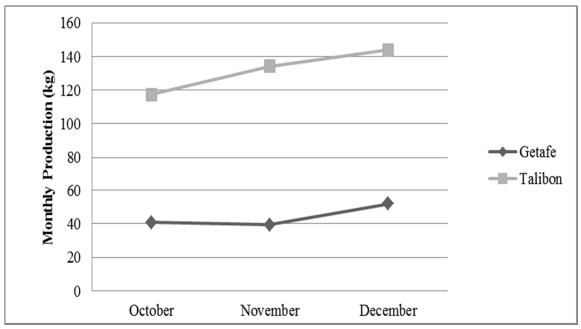

Fig. 2c. Estimated Monthly Production (kg) for Crab Liftnets in Getafe and Talibon from October to December 2018.

Results showed that in terms of estimated monthly production, crab gillnet yield the highest production followed by crab pot. Crab liftnet on the other hand, had the lowest estimated monthly production. Results also indicated that the estimated monthly production of blue swimming crab in the four coastal municipalities in Bohol follow an increasing trend from October to December. This is consistent to the study conducted by ECOFISH (2015), which found out that the peak season for blue swimming crab in Bohol is from August to December.

Estimated Average Daily Catch

The estimated average daily catch of the three dominant fishing gears used in catching blue swimming crabs in the four coastal municipalities in Bohol was recorded. Fig. 3a shows the estimated average daily catch of crab gillnets from November to December. The highest estimated average daily catch for crab gillnets (1.51kg day^{-1}) was observed in Inabanga on the month of December. For the crab pots, Fig. 3b shows that the highest estimated average daily catch was also observed in Inabanga (2.45kg day^{-1}) on the month of December. In Getafe and Talibon where the crab liftnets fishing gears were used, Getafe had higher average daily catch (1.26kg day^{-1}) compared to Talibon (Fig. 3c). The highest average daily catch for crab liftnets was recorded on the month of December.

Results revealed that of the three dominant fishing gears used to catch blue swimming crabs in Bohol, crab pots had the highest estimated average daily catch. This is consistent to the study conducted by de la Cruz *et al* (2015) that of the dominant fishing gears used to catch blue swimming crabs across the different grounds in Eastern Visayas crab pots had the highest daily catch (12.5kg) compared to crab gillnets (2.57kg) and crab liftnets (6kg). However, results also indicated that the average daily catch in Bohol decreased by 18.33% over the past 3 years. In the study conducted by ECOFISH (2015), the crab catchers in Bohol harvest an average of 3kg of blue swimming crab in a day.

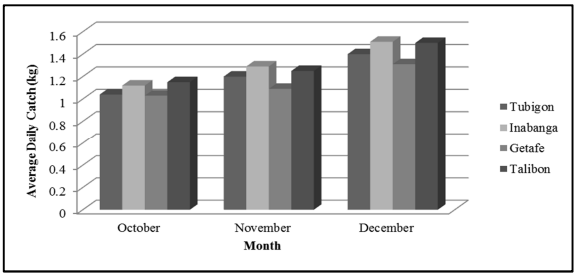

Fig. 3a. Estimated Average Daily Catch (kg) for Crab Gillnets per Crab Fisher per Month in the Four Northern Coastal Municipalities in Bohol from October to December 2018.

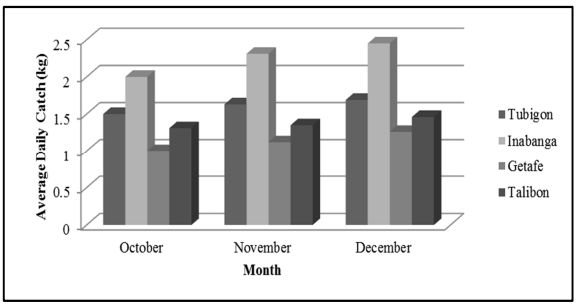

Fig. 3b. Estimated Average Daily Catch (kg) for Crab Pots per Crab Fisher per Month in the Four Northern Coastal Municipalities in Bohol from October to December 2018.

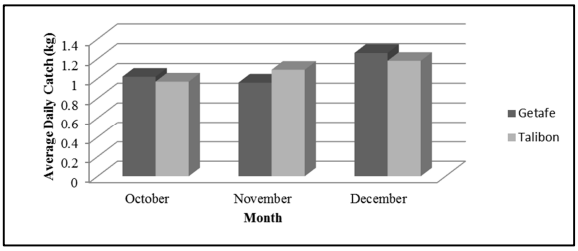

Fig. 3c. Estimated Average Daily Catch (kg) for Crab Liftnet per Crab Fisher per Month in the Four Northern Coastal Municipalities in Bohol from October to December 2018.

Estimated Average Monthly Catch Per Unit Effort (CPUE)

The average monthly CPUE by the three dominant fishing gears used in blue swimming crab fishing in the four coastal municipalities in Bohol were computed. Fig. 4a shows the computed average monthly CPUE for crab gillnets from November to December. The highest computed CPUE for crab gillnets (0.037kg meter^{-1}) was observed in Talibon on the month of December. For the crab pots, Fig. 3b shows that the highest computed CPUE was recorded in Tubigon (0.244kg pot^{-1}) on the month of December. For crab liftnets, Fig. 4c shows that in terms of highest computed CPUE, Getafe had a slightly higher CPUE (0.518kg liftnet^{-1}) compared to Talibon (0.512kg liftnet^{-1}). The highest computed CPUE for crab liftnets was recorded on the month of December.

Results of this study revealed that crab liftnet had the highest CPUE followed by crab pot. On the other hand, crab gillnet had the lowest CPUE among the three dominant fishing gears. According to de la Cruz *et al* (2015), increasing fishing effort might be the cause of declining catch. Lower CPUEs were attributed to growing number of gears used within a limited area. Also, the increasing number of individuals participating in the blue swimming crab fishery intensified the fishing pressure. On the other hand, higher CPUE values resulted from minimal fishing efforts coupled with lower number of crab fishers. High CPUE resulted from lower number of units of gears used along with fewer competitors, an indication that the blue swimming crab wildstock is already overfished.

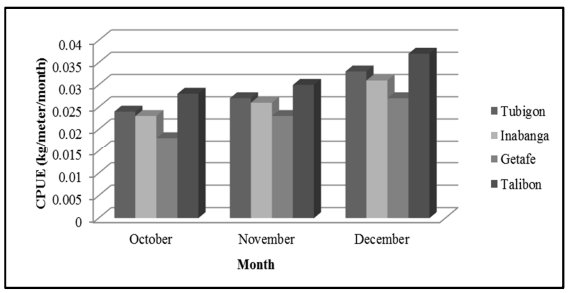

Fig. 4a. Estimated Average Monthly CPUE (kg/meter/month) for Crab Gillnets in the Four Northern Coastal Municipalities in Bohol from October to December 2018.

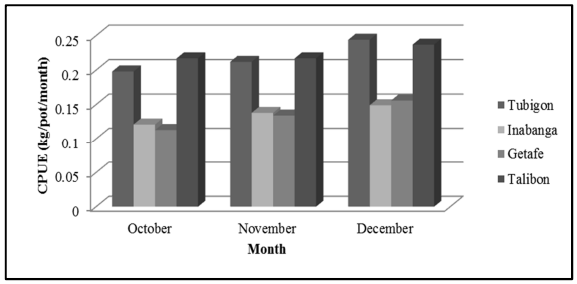

Fig. 4b. Estimated Average Monthly CPUE (kg/pot/month) for Crab Pots in the Four Northern Coastal Municipalities in Bohol from October to December 2018.

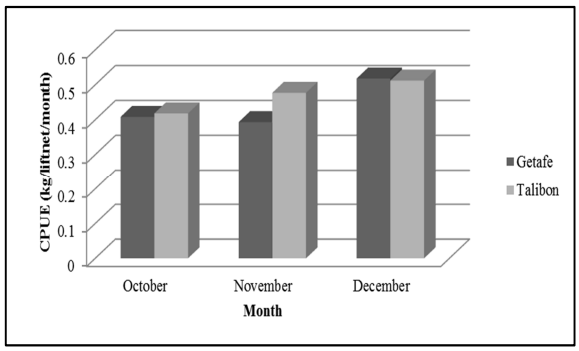

Fig. 4c. Estimated Average Monthly CPUE (kg/liftnet/month) for Crab Liftnets in Getafe and Talibon from October to December 2018.

Blue Swimming Crab Marketing Flow

The crab fishers sold their catch as fresh (live) locally to traders, local markets and end consumers. In areas where there are presence of picking plants such as in Inabanga and Talibon, many of the crab fishers directly sold their catch to the plants. All of the crab fishers in the four municipalities sold their catch as fresh to the traders, local markets, end consumers, and crab meat picking plants. Traders also sold the blue swimming crab as fresh to the local markets, crab meat picking plants, and other establishments such as supermarkets, hotels, restaurants, and resorts. The picking plants in Bohol cook the fresh blue swimming crabs and pick the crab meat and sold or forward the picked crab meat to processing plants in Cebu for further processing for international distribution.

Generally, the blue swimming caught by the crab fishers in Bohol are sold to traders, local markets, crab meat picking plants, end consumers and

establishments such as supermarkets, hotels, restaurants, and resorts.

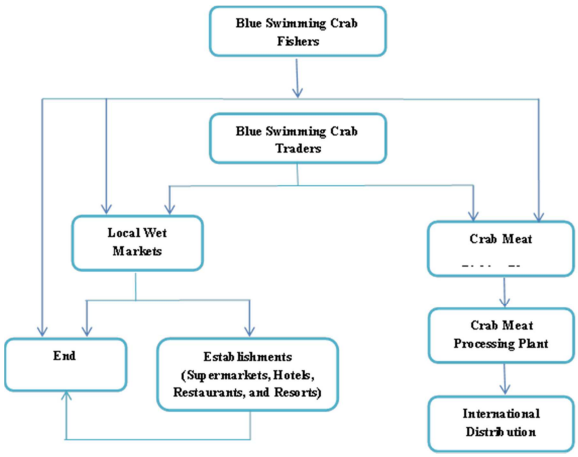

Fig. 4. Market Flow of Blue Swimming Crab in the Four Northern Coastal Municipalities in Boholo.

This is consistent to the study that was conducted by Nieves *et al* (2013), the distribution of commercially important crab species including blue swimming crab, in Sorsogon Bay and San Miguel Bay started from fishers onto broker, bidders, buyers, retailers, dealers, wholesalers, fish vendors, processors, and traders and finally went to the consumers.

Blue Swimming Crab Selling Price

Table 1 shows the average selling price of each industry player. The average selling price of crab fishers to traders, consumers, local markets and picking plants is PHP189.50 per kilo. Traders sell their purchased crabs to local markets, to Tagbilaran City establishments, Cebu wet markets and establishments, and picking plants at an average price of PHP 248.86 per kilo. Lastly, the local blue swimming crab picking plants in Bohol sell their picked crab meat to blue swimming crab processing plants in Cebu City at an average price of PHP 1,200.00 per kilo.

Table 1. Average Selling Price (PHP) of Blue Swimming Crab per Industry Player in the Four Crabbing Municipalities in Bohol.

Municipality	Crab Fishers				Crab Traders				Picking Plants
	To Traders	To Local Markets	To Picking Plants	To Consumers	To Local Markets	To Tagbilaran City)	To Cebu City	To Picking Plants	To Proceesing Plants
Tubigon	199.00	200.00	-	220.00	233.00	248.00	290.00	-	-
Inabanga	153.00	-	160.00	200.00	226.00	245.00	300.00	180.00	-
Getafe	174.00	-	-	215.00	230.00	250.00	350.00	190.00	1,200.00
Talibon	166.00	-	180.00	225.00	245.00	-	357.00	200.00	1,200.00
Total	692.00	200.00	340.00	860.00	934.00	743.00	1,297.00	570.00	2,400.00
Mean	173.00	200.00	170.00	215.00	233.50	247.67	324.25	190.00	1,200.00
Grand Mean	189.50				248.86				

Problems and Challenges in the Industry

The blue swimming crab industry in Bohol is also facing many problems and challenges. One of the problems noted include the steady decline of catch relative to previous years. This is due to lack of awareness of industry players on the existing policies regulating blue swimming crab fishery, prevalence of catching and trading of undersized crabs and berried female crabs, inadequate support and management to existing projects and programs, lack of adoption among crab fishers to the established projects and programs, and intrusion of illegal fishers in the municipal waters which often damage the fishing gears of the crab fishers. Challenges include lack of stock assessment and enhancement, lack of research and monitoring, and insufficient management precaution in protecting the wild stocks of blue swimming crab.

Conclusion

The blue swimming crab industry is a continuous and stable fishery industry in Bohol, however, the industry is facing challenges or threats to its sustainability that include the declining of catch yet increasing number of crab fishers and increasing fishing effort. The lower CPUE coupled with higher number of fishing gears and higher CPUE coupled with lower number of fishers signifies that the stocks

of blue swimming crab in the fishing grounds in Bohol are already overexploited. The crabbing activities of the crab fishers are crucial given the relatively low production yet high market demand of blue swimming crab.

Recommendations

Based on the results of the study, the following are recommended:

1. Local Government Units (LGUs) in cooperation with Bureau of Fisheries and Aquatic Resources (BFAR) and other concerned agencies should conduct an intensive information campaign regarding the National Blue Swimming Crab Management Plan and the JAO No. 1 series of 2014 to provide awareness particularly to the industry players at the ground level such as the crab fishers and crab buyers.
2. A close monitoring on the prevalence of trading practices particularly on undersized and berried female crabs must be done by the LGUs.
3. Cooperatives to help the crab fishers sustain their crabbing activities should be established in every crabbing municipalities in Bohol.
4. Holding cage or lying-in cage for berried female crabs should be established in all barangays with active blue swimming crab fishers.
5. LGUs by the assistance of BFAR should strengthen the implementation of the joint DA-DILG Administrative Order No. 1 series of 2014 to impose proper discipline and harvesting techniques among crab fishers.
6. Collaboration among LGUs, BFAR, concerned agencies and industry players in pursuing the sustainability of blue swimming crab should be established.
7. A proposal for seasonal closures to address the decline in population of blue swimming crabs in Bohol maybe considered.
8. A Blue Swimming Crab Summit is suggested and considered to be conducted annually to promote public awareness regarding the current trends of blue swimming crab industry.

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