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FISHING PRACTICES OF BLUE SWIMMING CRAB IN NORTHERN CATANDUANES, PHILIPPINES: IMPLICATIONS TOWARDS SUSTAINABLE MANAGEMENT

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Abstract: Fishermen in Northern Catanduanes rely heavily on Blue Swimming Crab (BSC) as a source of income. The goal of this study was to characterize the BSC fishery in the maritime environments of Viga, Panganiban, Pandan, and Bagamanoc. A survey was conducted to gather data on the BSC fishery in Northern Catanduanes from February to May 2023. The results revealed that the income of crabbers and their families was well below the poverty threshold. This was worsened by the lack of formal education among crabbers, which restricted their options for finding alternative sources of income. The primary fishing gears utilized by fishers were bottom set gill nets, crab pots, and crab lift nets with 55.77%, 14.90% and 15.38%, respectively. The peak fishing season for most municipalities occurred between May and July while the lean season varied from October to February. About 95.19% of the crab fishers violated regulation on the implementation of the minimum carapace width of 10.2 cm for blue swimming crabs allowed for catching, collecting and trading. The sustainability of the BSC fishery in Northern Catanduanes is under threat. It is critical to put in place efficient management strategies to deal with the issues causing the BSC stocks to decrease. In order to ensure sustainable fishing methods, these actions should prioritize lowering fishing pressure, keeping an eye on and informing crab fishermen, offering substitute revenue streams, and launching education and awareness initiatives.

Keywords: Blue Swimming Crab, Fishing gears, Northern Catanduanes, Sustainable Management.

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INTRODUCTION

Blue swimming crab (BSC), locally known as 'kasag' (Bicol), 'alimasag' (Tagalog), and 'lambay' (Bisaya). The BSC is a famous bottom dwelling scavenger and opportunistic carnivore crustacean. They were discovered in the Indo-West Pacific's nearshore marine and estuary waters (Kailola *et al.*, 1993). BSC competed commercially with other aquatic products like mud crab due to its high demand and economic value. Approximately 77% of crab production from the Philippines was exported (Ingles, 2004).

Due to strong consumer demand on the global market as well as the financial advantages originating from this species, a substantial portion of the nation's BSC output travels to the foreign market. As a result, the average has dramatically increased local retail cost per kilogram of BSC during a fifteen-year period, starting at according to PSA (2019), from PhP118.85/kg in 2004 to PhP305.49/kg in 2019. Coastal communities received certain benefits from marine resources; however, the current situation indicates a high level of degradation (DENR, 2001). This degradation is due to the open and unrestricted access to the oceans and some of the restricted fishing gears used. BSC fisheries occur throughout the Philippines (BFAR, 2013; Chakraborty and Patan, 2023). The BSC fishery is a multi-gear activity where crabbers are usually artisanal and capture crabs by gleaning, bamboo trap use, crab lift nets, crab pots, and gill nets (Germano and Melgo, 2003; Del Norte-Campo *et al*., 2004; Ingles, 2004). The most common artisanal gear used in shallow water is crab pots or panggal, but crabbers also use the bottom set gillnets, otter trawl, crab lift net or bintol, and push net (Mesa *et al*., 2018). In the study of Ingles (2004) and Mesa *et al*. (2018), they have identified eleven different fishing gear types used in catching BSCs in the Western Visayan Sea.

Catanduanes was renowned for its diverse marine resources, particularly crustaceans, among which was the blue swimming crab (BSC) aside from being known as the mudcrab capital. It used to be the livelihood and source of income for these communities. But little was known about BSC in Lagonoy Gulf, Catanduanes, and other bodies of water surrounding Catanduanes. There were number of studies conducted in Bicol Region, including Capture Fisheries Assessment of commercially important Marine Crabs in Sorsogon Bay and San Miguel Bay (Nieves *et al*., 2013), reproduction and larval ecology of the BSC, *Portunus pelagicus* in Ragay Gulf, Philippines (Ingles and Braum, 1989), and Blue Swimming Crab Stock Assessment in Asid Gulf, Masbate (Bonaos *et al*., 2022).

The Blue Swimming Crab (BSC) is one of the resources that the Philippines is working to preserve, manage, and use sustainably through the implementation of fishery legislation like RA 10654. Nevertheless, BFAR Joint DA-DILG Administrative Order No. 01, S. 2014 sought to control the blue swimming crab's conservation. However, despite these laws and administrative order, promoting sustainable fishing practices, violations persist. There is a need for community involvement in resource management. Hence, this study was aimed to gather preliminary information on BSC fisheries in Catanduanes such as socio economic profile, fishing gears, catch per trip, fishing season and existing market in Northern Catanduanes. It also aimed to know the anthropogenic activities that affects the fisheries.

MATERIALS AND METHODS

Data was gathered from the 208 crab fishermen in Northern Catanduanes using a survey questionnaire that was adapted from the Philippine Blue Crab Management Plan from BFAR (2013). In order to gather more information specifically for the purpose of monitoring blue crabs, a question about the demographics of crabbers, the type of fishing gear used, fishing season, market distribution of blue swimming crab and some anthropogenic activities that may affect the fishery are necessary. Utilizing descriptive statistics, the survey interview's outcome was calculated.

RESULTS AND DISCUSSION

Crab Fishers and their Fishing gears used

Numerous fishermen are employed by the crab fishing industry in Northern Catanduanes, Philippines, which contributes significantly to the local economy. To find out more about fishing techniques in this area, it's critical to comprehend the types of fishing equipment used there. Based on their preferred gear, Table 1 shows the distribution of registered crab fishermen in Northern Catanduanes. With 55.77% of the total, bottom set gill nets (BSGN) were the most common type of fishing gear used by fishermen. Crab pot (CP) fishers used it at 14.90%, and crab lift net (CLN) fishermen used it at 15.38%. These are the identical gears that have also been documented at Cagraray, Albay, San Miguel and on the nearby island of Catanduanes (Bo and Macale, 2021). Some crab fishers in Northern

Catanduanes employed a combination of BSGN, CP, and CLN. Bagamanoc had the highest number of BSGN users, while Pandan had the highest number of CP and CLN users.

The findings indicate that crab fishers in Northern Catanduanes utilized a variety of gears, including bottom set gill nets (BSGN), crab pots (CP), and crab lift nets (CLN) (Fig. 1). CP and CLN were favored by crabbers in Pandan, while BSGN was the preferred choice in Bagamanoc. Panganiban and Viga employed a combination of CP, CLN, and BSGN. However, except in Pandan, crab fishers in Northern Catanduanes generally prioritized BSGN as their primary fishing gear over CLN and CP. This preference resulted from the fact that using BSGN was simple and didn't require bait. The cost and accessibility of the materials needed to make gear also had an impact on the gears they chose.

Table 1: Number of Registered Crab Fishers by Gear in Northern Catanduanes.

Fishing Gears	**Number of Crab Fishers**	
	F	**%**
Bottom Set Gill Net (BSGN)	116	55.77
Crab Pot (CP)	31	14.90
Crab Lift Net (CLN)	32	15.38
BSGN+CP	11	5.29
BSGN+CLN	12	5.77
BSGN+CP+CLN	6	2.88
Total	**208**	**100**

Source: boatr.bfar.da.gov.ph and frs.bfar.da.gov.ph.

In contrast, crab fishers in Pandan preferred CLN and CP as their primary gears since they primarily targeted mangrove crabs, and the Blue Swimming Crab (BSC) was caught incidentally. Most fishers in Pandan were primarily engaged in tuna fishing. The choice of gear by the crab fishers was associated with their educational background. Those who had completed high school diplomas were predominantly BSGN users and had undergone the training offered by BFAR and other relevant agencies. The training they received included assembling BSGN and mud crab fattening. On the other hand, most Pandan crabbers used CP and CLN, which were traditional methods of catching crabs, and unfortunately, the Blue Swimming Crab was only caught incidentally. Pandan crab fishers did not know how to use BSGN.

Regarding income, crab fishers' earnings from blue crab fishing varied across municipalities. Those with high school diplomas and training in using BSGN tended to have higher incomes from crab fishing compared to those who were unfamiliar with BSGN. However, Pandan crabbers had the highest income from other sources, with a mean income of Php. 12,567.00, followed by Bagamanoc with a mean income of Php. 11,413.00. These two municipalities were not solely reliant on crab fishing but also engaged in tuna fishing and lobster fishing, which contributed to their monthly income by 68% (Bagamanoc) and 76% (Pandan). Panganiban and Viga were also dependent on farming activities such as copra farming and abaca farming, which augmented the monthly income by 26% and 19%, respectively.

Furthermore, there was a notable correlation between the average number of years engaged in crab fishing and the knowledge of effectively catching crabs. As the crab fishers gained more experience, their chances of successfully catching crabs tended to increase. This assertion is supported by the data collected from crab fishers in Northern Catanduanes, where the average

duration of the fishing experience was approximately 10 years. Specifically, the municipalities of Viga and Panganiban demonstrated higher levels of experience, with mean years of crab fishing at 18 and 16 years, respectively, in comparison to Pandan and Bagamanoc, which had an average of 8 years of crab fishing experience. These findings suggest that practical experience serves as the most effective teacher in honing the skills necessary for crab fishing. The various fishing gear employed for blue swimming crab capture are described in fig 1.

Fig. 1: Fishing gears used in Northern Catanduanes to capture blue swimming crabs: (a) Tire wire crab pot (b) Bamboo strip crab pots (c) Monofilament polyamide netting crab lift net (d) Bottom set gill net.

Crab Pot

The crab pot, locally known as 'panggal' or 'bobong pangasag', is a handcrafted device made of bamboo strips or tie wire, along with multifilament polyethylene netting featuring an 8 cm mesh size. It has dimensions of 12-15 cm in length, 41 cm in breadth, and 12 cm in depth (1m). Shaped like a dome, the net is wrapped around a bamboo framework, creating a trap for the fish. Some variations of crab pot designs utilize a structure entirely made of braided bamboo strips instead of mesh nets. The pot features a non-returning valve made of bamboo strips or a plastic tube, allowing crabs to enter but not exit (Armada, 1996).

Crab Lift Nets (CLN)

Crab lift nets, also known as 'bintol',are square or round gears constructed with monofilament polyamide netting. They are held by two bamboo slats or polyethylene ropes arched across opposite sides of the frame. Typically, a 12-meter-long rope connects the gear to an improvised buoy, such as Styrofoam balls or boxes, or plastic bottles. This type of CLN utilizes nylon netting and tie wire with a circular tie wireframe and two polyethylene ropes across two opposing edges. Bait, such as lawayan (*Leiognathus splendens*), sapsap (*Leiognathus bindus*), tahong (*Perna viridis*), and piyong (*Mytilus* sp.) is often suspended above the net. Crab lift nets are typically operated by a single crabber and require regular inspection. Compared to crab pots, lift nets have a shorter soaking time and are favored by crabbers due to their affordability, lightness, ease of assembly, stacking convenience on deck, and space-saving characteristics (Vasquez *et al.,* 2006).

Bottom Set Gill Net (BSGN)

It is known locally as 'pukot panglambay/ pangngasag', the bottom-set gill net comprises of numerous panels of nylon, polyamide, or kuralon nettings with varied mesh sizes. Gill nets are long passive gears held in a vertical position by the opposing forces of the float attached to the head rope and the sinkers attached to the footrope. The gear is divided into several sections or 'banata', with the length of each section varying across fishing grounds and locales. Crabbers from Northern Catanduanes typically use bottom-set gill nets ranging from 200-2000 meters in length. Nylon No. 4 is the preferred material for these nets, with mesh sizes (mata) around 4-8 cm. The setting and hauling operations of the gear can vary based on the season, with crabbers deploying the nets in the morning and hauling them in the afternoon during peak months. Bottom-set gill nets are effective in capturing not only BSC but also other crab species (Portunidae), mud crabs, flatfish (Bothidae), mugil (Mugilidae), shrimps (Penaeidae), squid (Loliginidae), and other benthic fishes. Crabbers may operate alone or with a companion, although a majority of crabbers in Northern Catanduanes fish alone (Armada, 1996).

Catch Per Trip and Fishing Seasons

Table 2 shows the average catch per trip by gear type, as well as the peak and lean fishing seasons by the municipality. Viga had the highest catching rate of 20.17 kg/trip, followed by Bagamanoc (9 kg/trip), Panganiban (7.5 kg/trip), and Pandan (4.5 kg/trip) according to BSGN data during the peak fishing season. During the lean season, on the other hand, the BSGN capture from Viga had the highest recorded catch rate of 4.67 kg/trip, while the catch from Pandan had the lowest recorded catch rate of 1.94 kg/trip. Viga consistently had the highest catch rates across all fishing gears during both lean and peak fishing seasons. Viga's usage of BSGN produced noticeably larger catches than neighboring municipalities. When it came to preferred gear, several towns also used CP and CLN, but their catch rates were typically lower than BSGN's with 4.33 kg/trip and 3.99 kg/trip during peak season, respectively. This means that BSGN gear is generally more effective in catching blue swimming crabs during peak season. When it comes to lean season, the highest lean catch was also recorded for BSGN gear at 4.67 kg/trip. This suggests that BSGN gear may be more effective in catching blue swimming crabs even during lean seasons. However, it is important to note that the lean catch for all gears is still relatively low; indicating that the blue swimming crab population may be under stress. Therefore, BSGN gear is the most effective gear for catching blue swimming crabs, both during peak and lean seasons.

In contrast in San Miguel bay, the mean catch for CLN and CP was 6.0 kg/trip and 12.5 kg/trip, respectively which were higher to the catch per trip recorded in the present study (Nieves *et al.,* 2013). In addition, Samar and Letye, as Germano and Melgo (2003) reported a mean CPUE of 2.8 kg/gear/day regardless of the month followed by crab pot with 2.67 kg/gear/pot and in the month of January the with a mean CPUE of 4.5 kg/gear/day was obtained by two types of gear which was higher than the mean CPUE recorded in the present study, implying an overexploitation of marine crabs in most fishing grounds in the country. However, it is important to use all gears responsibly and to avoid overfishing.

The fishing seasons for BSC aligned with certain months of the year. The peak fishing season for most municipalities occurred from May to July, coinciding with the Habagat or Southwest monsoon, while the lean season varied between October and February. The Habagat season is a preferred season for catching blue crabs in the Northern Catanduanes. The strong winds, heavy rains, currents, and warmer water temperatures all help to increase the number of BSC larvae that survive to adulthood. This in turn leads to higher catches of blue crabs during the Habagat season. According to Wiyono *et al.* (2006), the mixed layers of the sea surface near the coast get shallower during the dry season, scattering the fishing sites. In contrast, as rainfall increases throughout the rainy season, the mixed layers of the sea's surface near the coast become deeper, reducing species landing and abundance.

Table 2: Average Catch (in kg) per Fishing trip and Fishing seasons of Blue Swimming Crab in Northern Catanduanes.

Municipality	Fishing gear	No. of gear units	Average catch (kg/trip)		Lean months	Peak months
			Peak	Lean		
Bagamanoc	BSGN	43	9	1.94	Oct-Feb	March to September
	CLN	9	3	0.75	Oct-Feb	March to September
Viga	BSGN	44	20.17	4.67	August-April	May-July
	CP	9	4.33	2.8	August-April	May-July
	CLN	10	3.99	1,56	August-April	May-July
Panganiban	BSGN	42	7.5	3.5	August-April	May to July
	CP	14	4.1	1.5	August-April	May to July
	CLN	13	3.5	1	August-April	May to July
Pandan	BSGN	13	4.5	2.2	August-April	March-May
	CP	25	3.05	2.24	August-April	March-May
	CLN	18	3.12	2.16	August-April	March-May

In addition, variations in temperature and salinity of the water had an impact on the Pangkajene Kepulauan blue swimming crab population (Kamrani *et al*., 2010). Juwana (2002) stated that blue swimming crabs may survive in salinities between 11 and 53 parts per thousand. The quantity of blue swimming crabs is driven by temperature and salinity of the water, and is assumed to be impacted by the monsoon season (Potter *et al*., 1998). During the rainy season, when water run-off increases, salinity in coastal water decreases, causing crabs to migrate to the open ocean, posing various obstacles to the small-scale fisherman. Conversely, when the water run-off reduces during the dry season, the salinity of the coastal waters returns to normal and crabs migrate to the coastal zone. This gives crab fishers lots of opportunities to catch them. Peak fishing months were noted to be May through July, which coincided with the Southwest monsoon or Habagat.

Market and Channel of distribution

The blue swimming crab (BSC) fishery plays a crucial role in the economic livelihood of coastal communities in Catanduanes. However, there are a number of challenges facing this fishery, such as poor distribution channels and restricted market access. Currently, the market for BSC in Catanduanes is primarily confined to local buyers and consumers. As a result, the crabs were only sold within the region, restricting the potential market and preventing fishermen from obtaining fair prices for their catches.

The selling price of BSC in Catanduanes ranges from 150-180 pesos, which is lower compared to the prices in Sorsogon and San Miguel (Nieves, 2013). The relatively small market access in Catanduanes makes it challenging to attract the attention of larger buyers. Crabbers in Catanduanes, on the other hand, like mangrove crabs because of their greater market value, which can range from 450 to 700 pesos depending on the size. Exporting BSC from Catanduanes is further hampered by inadequate infrastructure, including as cold storage facilities and transit connections.

Furthermore, the lack of readily available information about the blue swimming crab (BSC) fishery in Catanduanes poses challenges for potential buyers. The absence of detailed information makes it difficult for buyers to locate the crabs and determine appropriate prices for purchasing them.

Anthropogenic activities affecting crab fisheries in Northern Catanduanes

Anthropogenic activities including pollution, microplastics etc. badly affect the living beings (Prakash and Verma, 2022; Verma and Prakash, 2022; Singh *et al.*, 2023). The specific anthropogenic activities that have an immediate impact on the Northern Catanduanes crabbing areas are broken down in depth in Table 3. The poor capture rates and output of blue swimming crabs in recent years have shown a considerable downturn in the fishery, according to local crab fishermen. This decrease can be linked to a number of factors related to resource extraction that is not sustainable. However, sustainable development is influenced by climate change up to reasonable extent (Verma, 2021).

The findings highlight that anthropogenic activities serve as the primary contributors to the challenges faced in the fishing industry. Among the identified activities, the most significant is increasing fishing pressure, accounting for 47.12% of the total reported activities. High fishing pressure can result in the removal of a large number of crabs, including both mature and immature individuals. This can lead to a decline in the overall population size and limit the reproductive potential of the stock.

Illegal and unsustainable fishing activities also pose a significant problem, representing 16.35% of the reported activities. These activities include the use of mesh sizes below the legal limit of 3cm, engaging in illegal fishing practices, and employing unsustainable fishing methods. These activities can lead to overexploitation, reduced recruitment of new crabs, and disruption of the natural balance within the population.

Another major concern is the overharvesting of crabs, accounting for 16.35% of the reported activities. This indicates that crab populations are being harvested at unsustainable rates, potentially resulting in population declines and ecological imbalances. The ecological balance is needed for widespread biodiversity (Kumar, 2017).

Additional reported activities comprise catching undersize crabs, capturing gravid (pregnant) crabs, pollution (air, land, and water), habitat destruction, climate change, and other practices like illegal exports and improper post-harvest activities. While these activities individually represent smaller percentages, they collectively contribute to the overall degradation of the fishing industry and the marine environment.

Addressing these anthropogenic activities requires the implementation of sustainable fishing practices, stricter regulations, and effective enforcement measures. These measures are crucial for ensuring the long-term viability of fish stocks, safeguarding marine ecosystems, and supporting the livelihoods of those dependent on the fishing industry.

Furthermore, certain environmental activities such as incorrect disposal of household and municipal wastes, as well as sewage sludge, contribute to resource depletion. Similarly, agricultural operations such as the application of fertilizers and pesticides are estimated to account for nearly half of all surface water contamination. In coastal areas, the improper disposal of plastic trash emerges as a major contributor to marine litter deposits and the discharge of solid waste into aquatic environments. Plastics endanger wildlife through entanglement, ghost fishing, and ingestion (Gregory, 2009).

Table 3: Anthropogenic Activities Affecting the Fishery of Blue Swimming Crab in Northern Catanduanes.

Anthropogenic Activities [n=208]	**F**	**%**
Illegal and unsustainable fishing activities (i.e., use of mesh size below 3cm, illegal activity, unsustainable activity)	34	16.35
Increasing fishing pressure	98	47.12
Overharvesting of Crabs	34	16.35
Catching of undersize crabs	12	5.77
Catching of Gravid Crabs	4	1.92
Pollution (air, land, and water)	15	7.21
Habitat destructions	3	1.44
Climate Change	4	1.92
Others (illegal export, improper post-harvest activity)	4	1.92
Total	**208**	**100.00**

CONCLUSIONS

The study conducted on blue swimming crab (BSC) fishers in Northern Catanduanes revealed important findings regarding fishing practices and trends in the region. The primary fishing gears utilized by fishers were bottom set gill nets (BSGN), crab pots (CP), and crab lift nets (CLN). The peak fishing season for most municipalities occurred between May and July, coinciding with the Habagat or Southwest monsoon, while the lean season varied from October to February.

In Northern Catanduanes, it was found that the Habagat season was the best time to catch blue crabs. Both deliberate and inadvertent rule breaking by the crab fish, which may choose to break the rules or not know they exist. The results of the study indicate that there is a risk to the sustainability of the BSC fishery in Northern Catanduanes. Therefore, it's critical to implement effective management techniques to address the problems underlying the decline in BSC stocks. Lessening the burden on fishermen, bolstering enforcement, keeping an eye on and updating crab fishermen, offering other revenue streams, and launching education and awareness campaigns to ensure sustainable fishing methods ought to be the primary objectives of these endeavors.

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