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RESEARCH ARTICLE

Status of *Nematopalaemon tenuipes*, Spider Prawn (Family: Palaemonidae) Stocks Caught in Aparri, Cagayan: A case of Gentleman's Agreement Management Strategy

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ABSTRACT

The "aramang" industry's economic contribution to the local and export markets has been significant for more than two decades. However, due to resource overexploitation, stock depletion is being experienced. A management strategy called "Gentleman's Agreement" (GA), an informal agreement based on oral arguments and thrusts of all parties involved has been adopted by the "aramang" fisherfolk in Aparri, Cagayan, as a tool to conserve and bring back the abundance of the stocks. This study tries to assess the status of stocks when this GA is being implemented in the area as a basis for policy formulation to improve resource utilization. Stock assessment methodologies and participatory rural appraisal (PRA) were used. Results show that GA as a strategy needs concrete policies to be effective in achieving its goal of attaining resource sustainability. The drift filter net and pair trawl, the fishing gears being used to catch *N. tenuipes*, have brought negative effects on the size at harvest, catch trend, and CPUE. The result of the length-converted catch curve shows that fishing mortality (F=3.23) is higher than natural mortality values (M =1.66) suggesting that most of the *N. tenuipes* population is experiencing high fishing pressure. Conversely, the observed exploitation ratio (E=0.66) is already beyond the sustainable level of exploitation.

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1. INTRODUCTION

Nematopalaemon tenuipes, locally known as "aramang," a soft-shelled spider shrimp (Figure 1) caught mainly in the coastal waters of Aparri, Cagayan, has been the subject of exploitation by fishers in the area for several years now. This shrimp has a lifespan of only 18 months and has an age at first maturity estimated at 0.57 years for males and 0.59 years for females (Ramamirthan 1979). This means that they can spawn within a year from birth and whether the species are caught or not, natural mortality will occur. They are believed to spawn twice during their lifespan at a minimum size of 50–52 mm for females (Ramamirthan 1979). They breed throughout the year with peaks observed in the Philippines in April and October (Culasing 2013). On the Bombay coast, the first peak of spawning is recorded from July to October, and the second peak from March to April (Kunju 1979).

Existing management options for conserving the highly exploited *N. tenuipes* are inadequate to ensure production sustainability. At present, a co-management strategy called "Gentleman's Agreement" (GA), which is only based upon oral arguments (Broster 2019) and the trust and confidence of fishers and all parties that catch "aramang" for livelihood, is being implemented to sustain the productivity of the resources. Legally, the instrument cannot be used as evidence in court but is enforceable in nature. The strategy is not binding but is being used by the fishers in the locality as a strategy to control overfishing due to the increasing market demand for the goods locally and internationally. However, GA as a strategy cannot be said to be the best strategy in managing *N. tenuipes* in the area because the observed catch trend

Figure 1. *Nematopalaemon tenuipes* (Aramang) is a soft-shelled shrimp caught along the coastal waters of Aparri, Cagayan, Philippines.

is decreasing during its implementation (Rodriguez 2018; Molina et al. 2014; Calicdan et al. 2018). Because of this, fishers resort to frequent improvement of the fishing gear they use to increase its efficiency, thus placing the resource under stressful conditions.

The potential and economic importance of this resource on the livelihood of the fishers and all actors involved in its value chain served as a motivator that propelled resource managers to look into ways of addressing issues on equity and sustainability. In this way, the common norm that fishers will remain poor despite efforts exerted by them in fishing because of its open access nature can be reversed for these resources. Equitable distribution, which is the primary problem, needs to be addressed immediately. Other concerns include fluctuating prices, traders' monopolies (Javier 2019), an unorganized marketing system, and erratic weather conditions. The latter has a direct influence on the price of goods since product quality and pricing are highly weather-dependent. Therefore, integration of climate-resilient technologies may help improve product marketability. The absence of a good drying facility added to the problem. Spoilage happens when *N. tenuipes* is not dried immediately. Hence, post-harvest technologies are also deemed necessary.

Another problem identified by Javier (2019) is the inadequacy of science-based information that will guide policymakers on resource management. In-depth studies are insufficient for policymakers to formulate laws and ordinances to conserve the resources. Unless sound conservation and management measures are undertaken, sustainability and equity will not be achieved.

Thus, this study tries to determine the status of stocks as a result of GA as a management strategy and come up with recommendations for sustained resource utilization. Specifically, the study determined the fishing ground of *N. tenuipes*, mechanisms of the GA, stock catch trend, CPUE, seasonality, and some population parameters.

2. MATERIALS AND METHODS

2.1 Study site

The study was conducted in Aparri, Cagayan near the estuarine area of Cagayan River Basin (Figure 2). Data were collected in the established National Stock Assessment Program (NSAP) landing sites (Barangay Punta, Centro and Paddaya). Aparri sits at the mouth of the longest river in the Philippines, the Cagayan River. It is located 55 miles north of Tuguegarao City, the provincial capital. It has a land area of 286.6 square kilometers with a population of 68,839 people (PSA 2021). The town is subdivided into 42 barangays, most of which are located near the

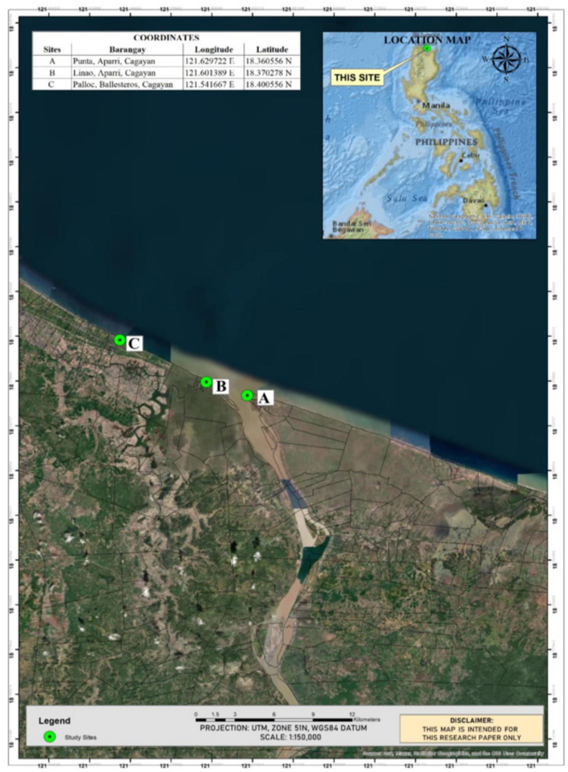

Figure 2. Location of landing area (green dots) for *Nematopalaemon tenuipes* monitoring in Cagayan River Basin (CRB) under the NSAP.

Cagayan River. Fishers from barangay Bisagu, Sanja, Maura, Macanaya, and Centro are among the direct users of this resource.

2.2 Data collection

For the stock assessment, data were collected from 2014 to 2020. The sampling scheme involved monitoring of landed catch, which was done every other two (2) days regardless of Saturday, Sunday, and holidays, following the NSAP Methodology described by Lopez (Santos et al. 2017). Direct interviews with the fishers were conducted upon catch unloading to determine the total catch, effort, and the fishing gear used during the operation. All fishing boat unloadings were sampled and recorded. Sub-samples were randomly collected from each tub per fisher for length-frequency measurements (cm). Lengths of *N. tenuipes* were measured starting from the eye to the tip of the tail (TL) and recorded in millimeters (mm) (Figure 3). A minimum of ten (10) length data were collected per gear per landing per sampling period. Total length (TL) was determined to the nearest 0.1 cm, which was eventually converted to the millimeter, and the length data were grouped at 2 mm intervals since the species is an invertebrate and subsequently analyzed using the Fisheries Stock Assessment Tool (FiSAT) II software (Gayanilo et al. 2005). Data gathered include catch trend, seasonality, Catch per Unit Effort (CPUE), and some population parameters. Information gathered was encoded in an Excel spreadsheet for processing and analysis. A total of 970 (unraised) length frequency data were collected from January 2014 to December 2020.

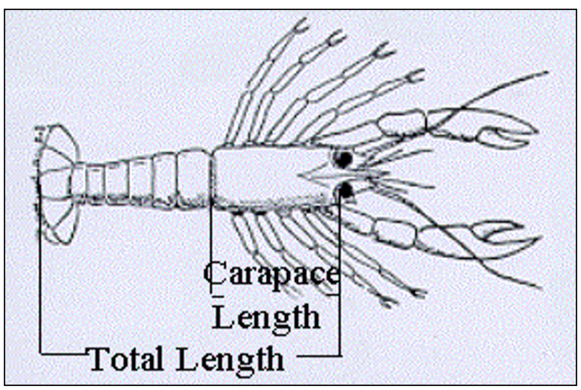

Figure 3. Length measurement used in measuring *Nematopalaemon tenuipes* in the Cagayan River Basin.

Local knowledge and geo-spatial mapping using ArcGIS were used to locate the exact fishing ground. All other information, like the GA mechanism, historical trends, and other socio-economic information, was derived through participatory rural appraisal (PRA) by Calub (2004) and focus group discussions (FGD). Key respondents were the 25 key informants comprising fisherfolk leaders, vendors, Local Government Unit (LGU) officials of Aparri, and technical staff of the Bureau of Fishery and Aquatic Resources - Provincial Fishery Office (BFAR-PFO) of Cagayan. The consent of the fisherfolk leader and the LGU was obtained before the actual activity was conducted. The descriptive method was used to analyze the data gathered from the participants.

3. RESULTS

3.1 Fishing ground

The major fishing ground, as identified by the fisher respondents, is the coastal water near the mouth of the Cagayan River estuary in Aparri, Cagayan, around two (2) to three (3) kilometers away from the shoreline with a depth of up to 150 fathoms especially when the water is clear (Figure 4). When the water becomes turbid, usually after heavy rain, the shrimp rises and can be caught only at a depth of about 10–15 fathoms. This may be due to ocean bottom disturbances brought about by the effluents from the upland as it drains to the sea, especially during heavy downpours. Turbidity is also caused by the limited mangrove habitat in the area due to its open-accreting coastal type, where large deposits of mud and sand

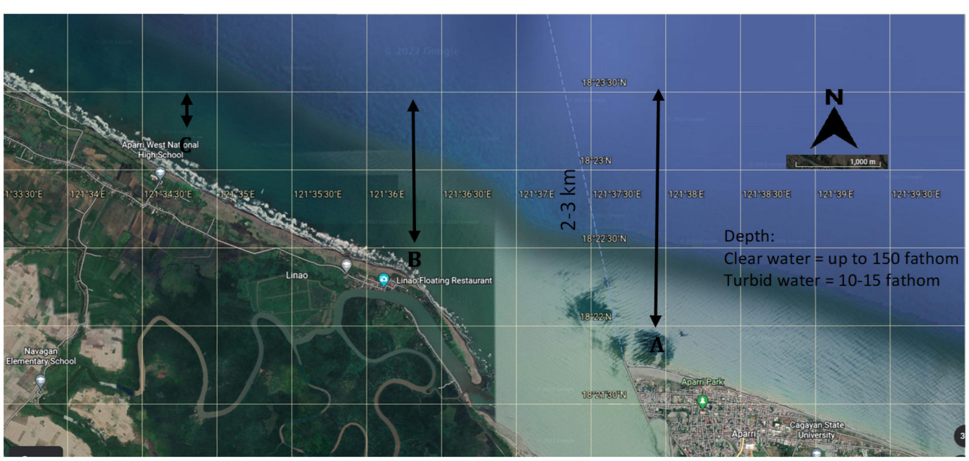

Figure 4. *N. tenuipes* fishing area along the coastal waters of Aparri, Cagayan. The arrows indicate the extent of the fishing ground.

are present (Japan International Cooperation Agency 1999). The rich alluvial deposits coming from the upland during inundation also contributed to the existence of the species in the area.

3.2 The Gentlemen's Agreement (GA)

3.2.1 Historical Sketch

Through FGD, historical accounts of stock abundance before the implementation of GA, 10 years after the implementation of the GA, and 20 years after were considered in this study (Table 1). According to the respondents, "aramang" gathering started as early as 1960. Fishing is done every after a typhoon or when the water is turbid. During that time, no fishing regulations were imposed. Fishing was done 24 hours daily using a drift filter net (DFN) or "banuar" with a wooden handle. Commercial fishing boats (> 3 GT capacity) were used because small bancas cannot tolerate strong waves and currents in the gathering area. Production before the GA implementation is approximately 1.4 MT or 2.1 MT translated from the 14 kg/can per fishing boat. The selling price ranges from PHP 10 to PHP 20 per can for the fresh catch and PHP 30–60 per kilo for the dried. Drying was done in Lallo, Cagayan since the area has a ready-drying facility being used for drying rice. Ilocos in Region 01 was the main market during that time. From 1990 onwards, the market expanded to Manila.

In 1991, a sudden collapse in the stock population was experienced due to unregulated gathering. Fisherfolk could hardly catch a can, and stocks seemingly disappeared. Cases like this showed that the overexploitation of resources has affected the ecosystem and fisheries (Lorance and Trenkel 2024). A study by Culasing (2013) suggested that reproductive processes were affected when both the breeding population and the immature stocks were caught.

Fishers were alarmed by the situation and hence sought the assistance of the LGU to help them revive again the population of *N. tenuipes* in the area. In 1992, through the initiative of LGU Aparri, spearheaded by Mayor Ismael Tumaru, a meeting was held to discuss issues confronting the industry. A "Gentleman's Agreement" was formalized through that meeting to revive the waning "aramang" resources. The stocks partially recovered, but because GA is an informal rule and violators were not punished, the catch trend still declined. Fishermen sought gear improvement to increase their catch efficiency without considering its effects on the stocks.

3.2.2 The GA process

The GA implementation was based on the premise of resource revival and resource sustainability after its collapse in the 1990s. The rules are informal and only based on oral agreement among fishers and the LGU. Spearheaded by the Aramang Fisherfolk Federation chairman, informal rules were set through regular meetings before any fishing operation. Around seven fisheries associations from the 11 Barangays with direct access to the resources were federated to compose the GA team.

3.2.2.1 Group composition

The GA group is composed of the LGU, fisherfolk federation officials, fisherfolk leaders in the barangay, the traders and vendors who are responsible for marketing the produce, the BFAR-PFO, the Philippine Coast Guard (PCG), and the Maritime Industry Authority (MARINA). The Cagayan State

Table 1. Historical trend of Aramang resource utilization in Aparri Cagayan, before and after implementation of the Gentleman's Agreement (collapse of fisheries in 1991).

Particulars	Before implementation of the GA (before 1990)	10 years after the implementation of the GA (1992–2002)	20 years after GA Implementation (1992–2012)
Production	100–150 cans per boat to less than a can per boat	200–250 cans per boat	100–150 cans per boat
Fishing gear used	Drift Filter Net (Banuar with rope and GI pipe as handle) trawl, Pair trawl (saplar)	Drift Filter Net (Banuar with wood handle); Pair trawl (Saplar)	Drift Filter Net (Banuar with rope and GI pipe as handle. Pair trawl was prohibited by virtue of RA 10654 or the Fisheries Code
Number of gatherers	There is a gradual increase in gatherers due to the high market demand for Aramang.	There are more than 100 boats engaged in aramang, and there are 11 persons in a boat, more than 1100 fishers.	There is a gradual increase in gatherers. All the Pair trawl operators switch to DFN.

University based in Aparri is also sometimes invited during the meeting to address science-based issues needing in-depth research studies.

The Fisherfolk Federation chairman served as the convener of the meeting. They set the date, time, and location of the meetings. They are the ones who issue invitations to the participants through their group chat (GC) messaging application. The secretary of the federation records all the agreements set during said meetings. The municipal mayor or its representative served as a mediator whenever conflicts occur.

The fisherfolk leaders, which is usually the president of the barangay fisheries association in each barangay, are responsible for directly communicating the result of the meeting to their constituents. They are the provider of the information needed in setting the catch limits and all other issues that may be encountered in the process.

Traders and vendors are responsible for marketing the catch within and outside the municipality. They are the financier who set the price ceiling for the fresh and dried forms. They are also responsible for drying the catch.

Other agencies are regulatory bodies such as the BFAR, which is responsible for the conservation and management of the country's fisheries resources (DA-BFAR 2024), and the PCG whose mandate is to conduct inspections on all merchant ships and vessels, prior to departure (DOTC-PCG 2012), MARINA which is responsible for the development, promotion, and regulation of the country's maritime industry (DOTC-MARINA 2024), served as observers and advisers during the meeting. They are required to help in resolving issues pertaining to their mandate.

3.2.2.2 Setting of goals and objectives

The main goal in the GA is to attain resource sustainability and equitable distribution of benefits. The goal served as their guiding principle in all the decisions they made during the meeting. The objectives of each meeting are focused on setting harvest control rules (HCR) in terms of the number of fishing days and the catch's buying price. No limitation is set on the number of fishing boats. Their main concern is equitable distribution of catch and access to the resources.

3.2.2.3 Setting of informal agreements

3.2.2.3.1 Harvest control rule (HCR)

Relating local knowledge and experiences on stock status, an HCR regarding the number of fishing days and hours has been decided to form part of the agreements. At the onset, white flags are placed on the houses of barangay leaders to signal the start of the fishing operation and red flags to indicate the stop of the operation. Fishing hour was set at 6 AM to 5 PM. A maximum of five (5) to seven (7) days of continuous operation is allowed for each fishing operation. In cases of inclement weather, the number of days may be lessened, but in no case, be extended to more than the set number of days. In addition, a 10-day close fishing regulates the catch volume and extraction. The decisions were based on the stocks' observed maturity size and reproductive behavior.

As per the agreement, fishers must all go together on the first day of the fishing operation to equally allow access to the resources. This strategy is to avoid misunderstandings and disputes among the resource users in the area. Also, no operation shall be done during bad weather conditions to avoid spoilage since there is no available drying facility in the area.

3.2.2.3.2 Price control

An important factor in the agreement is the pricing of produce. Most often, the buyers or the traders set the price limit. However, if the fisherfolk deemed it too low and no agreement was set, suspension of fishing operation is done. The marketing system plays a crucial role in the fishing operation and distribution of benefits among fishers. Though they infuse investment, they get most of the benefits and earnings.

3.2.2.4 Implementation of the agreed rules

Good governance plays a very important role in the GA mechanism. The LGU, which facilitates and mediates during meetings, guides the players on the right decision to be made. The other agencies set regulatory measures based on laws and ordinances to sustain the utilization of resources. In addition, the BFAR regularly monitors stocks under its National Stock Assessment Program (NSAP).

3.2.2.5 Enabling instruments

The GA mechanism is backed up with policies that guide and regulate illegal and excessive use of the resources. The closed season policy (ordinance No. 2015-1510) of the LGU, issued on June 15, 2015, prohibits "aramang" fishing from September 1 to November 15 of every year. This short period corresponds to the spawning season of the shrimp (Culasing 2013), thus allowing the natural reproduction of the species. Standard regulatory policies under RA 10654, like the prohibition on the use of boats with a size greater than 3 GT in municipal waters, securing local transport permits, fisherfolk, and boat registration, are among the regulatory policies imposed by the BFAR to limit fishing efforts. The PCG and MARINA have similar policies on permits and clearances before any operation is done to ensure the safety of the fisherfolk.

3.2.2.5 Monitoring

The LGU and the BFAR monitor the status of stock regularly to determine stock status and be able to implement precautionary measures to ensure sustainable use of the resources. The LGU records the landed catch of each fisher in every fishing operation and imposes local dues, while the BFAR assesses stock status and some biological parameters under its NSAP program that can be used in decision-making during the GA meetings.

The problem with the GA is that they cannot punish the violators because of unstable policies or ordinances; hence, violators persist.

3.3 Stocks status

Looking at the impact of GA as a management strategy, catch trend, seasonality, CPUE, and some population parameters were assessed.

3.3.1 Catch trend

A decreasing trend was observed from 2014 to 2020 (Table 2). This study obtained the highest peak in 2015 (209.456 kg) and lowest in 2018 (33,801 kg) Figure 5. Fishing efforts were high in 2019 (236 boats) and 2020 (114 boats). Also, the average fishing month in a year is seven, except in 2020 when the COVID-19 pandemic affected the capacity of the fishers to go out to fish due to protocols imposed by the LGU on going out of residences.

3.3.2 Seasonality

N. tenuipes are said to be caught throughout the year. However, the tropical monsoon climate of Cagayan affects the fishing activity, limiting the fishing

Table 2. Catch data of *N. tenuipes* from 2014 to 2020, Aparri, Cagayan, Philippines.

Year	No. of fishing months	No. of boats	Total catch (Kg)	Average catch (MT/boat)
2014	10	16	125,224	7.54
2015	8	33	209,456	7.68
2016	6	54	122.097	1.96
2017	7	18	129,536	6.01
2018	7	18	33,801	1.86
2019	7	236	94,286	0.48
2020	5	114	50,453	0.51

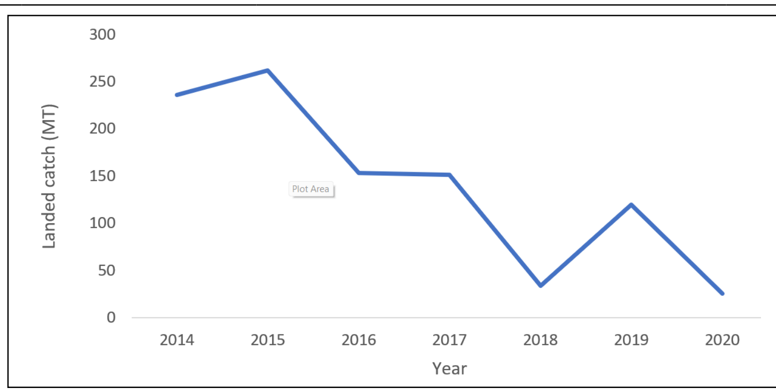

Figure 5. Catch trend of *Nematopalaemon tenuipes* in Aparri Cagayan, 2014–2020.

season to seven months. Peak season is in January and June of every year, and the lean season starts from September to December or during the wet season in the area (Figure 6). Similar data was gathered from the key informants during FGD.

3.3.3 Catch per unit effort (CPUE)

Two types of fishing gear are being used to catch *N. tenuipes* in Cagayan: the drift filter net (DFN) and the pair trawl (PT). Notably, the CPUE of DFN decreased during the seven (7) years of the study, with the highest annual landed catch recorded in 2015 (209,456 kg). However, the highest CPUE was noted in 2019 (13,683 kg/hr), but the observed effort is very minimal. On the contrary, the lowest catch and CPUE were observed in 2020, with a volume of 25,771 kg and 2,680.74 kg/hour, respectively (Figure 7).

A similar pattern was seen using PT. Though the data on PT is only available for four (4) years, a pronounced trend on the CPUE and catch can be observed (Figure 8). The highest landed catch and CPUE were observed in 2014, with 137,971 kg and 27,206.90 kg/hr, respectively. Similarly, the lowest landed catch (130.2 kg) and CPUE (32.55 kg/hr) were observed in 2018.

3.3.4 Population parameters

Using the FAO ICLARM FiSAT II Software, the obtained VBGF growth constant (K) was 1.35, the asymptotic length (L_∞) was 78.9 millimeters, and the phi prime (ϕ) was 3.92. The result of the length-converted catch curve (Figure 9) shows that fishing mortality values (F = 3.23) obtained are higher than the natural mortality (M = 1.66) values. The values obtained only showed that most of the *N. tenuipes* population is experiencing high fishing pressure. Conversely, the observed exploitation ratio (E = 0.71) is already beyond the sustainable level of exploitation.

N. tenuipes exhibited a bimodal pattern of recruitment, which comes in almost equal strengths (Figure 10) in which major pulse occurs during southwest monsoon (February to April) and minor

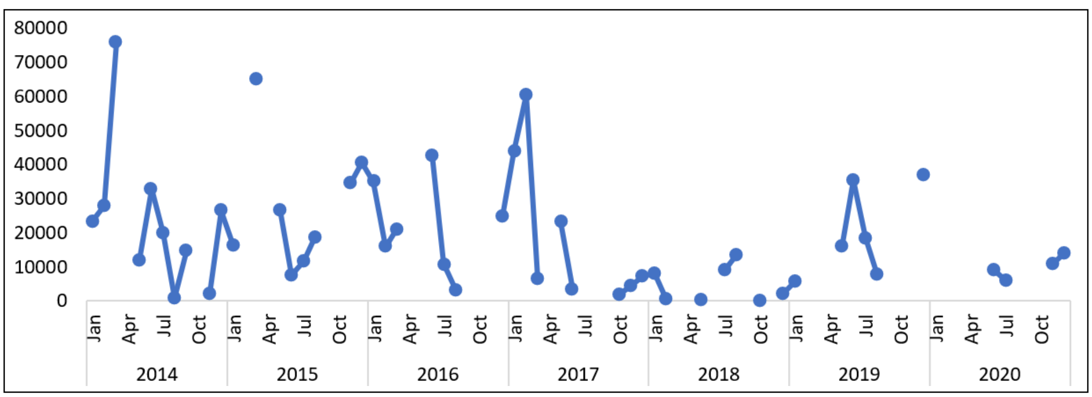

Figure 6. Seasonality of *Nematopalaemon tenuipes* in Aparri, Cagayan from 2014 to 2020.

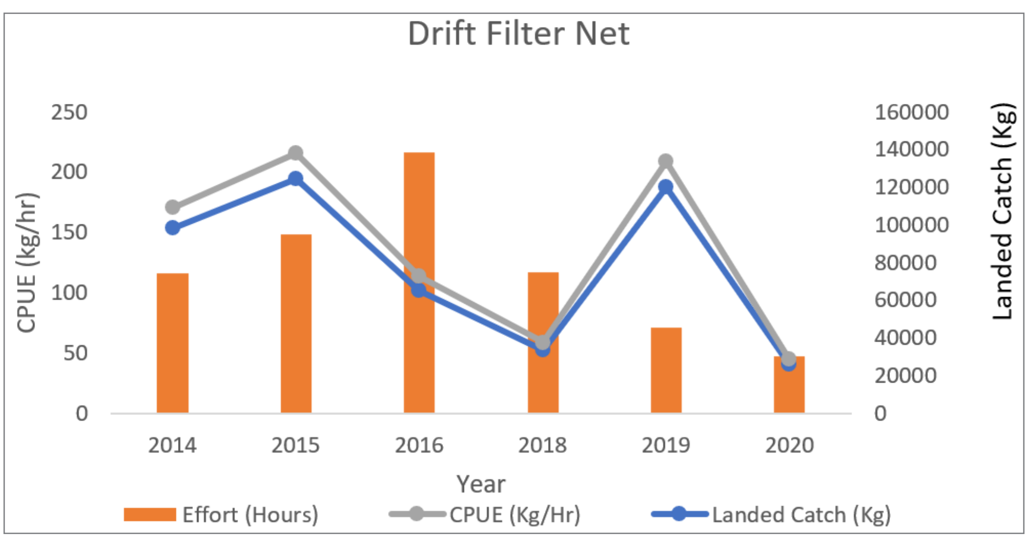

Figure 7. Catch, effort, and CPUE of Drift Filter Net in Aparri Cagayan from 2014 to 2020.

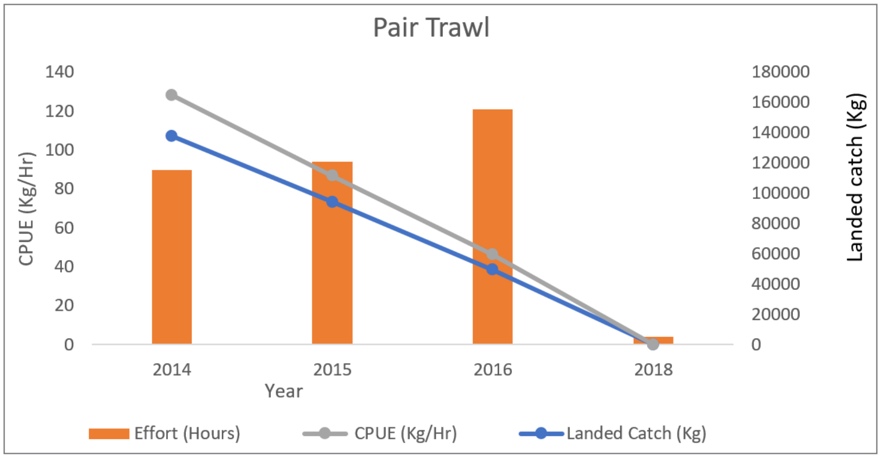

Figure 8. Catch, effort, and CPUE of Pair Trawl in Aparri, Cagayan from 2014 to 2020.

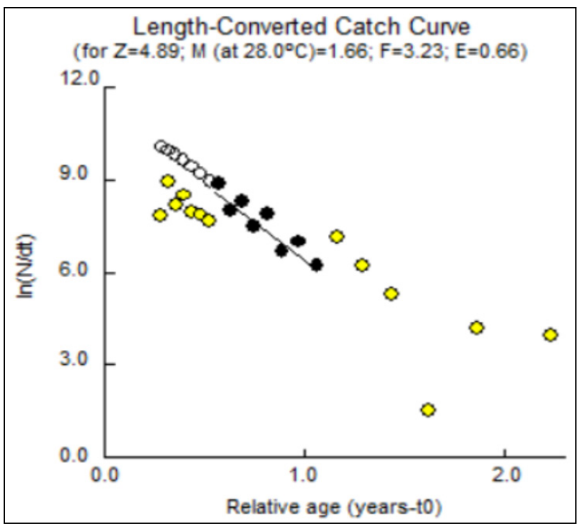

Figure 9. Length converted catch curve of *N. tenuipes* in Aparri, Cagayan.

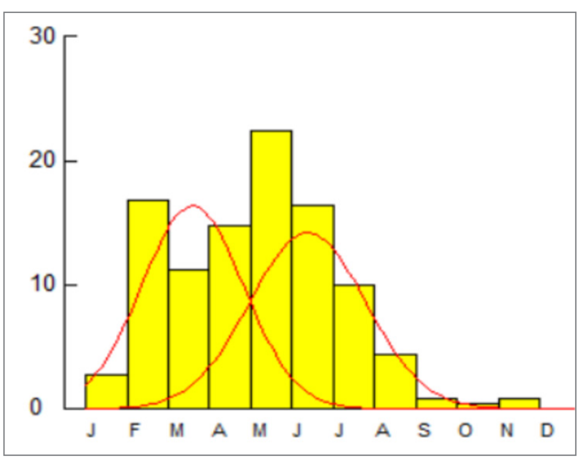

Figure 10. Recruitment pattern of *N. tenuipes* in Aparri, Cagayan.

pulse occurs during the onset of northeast monsoon, particularly in the months June to July.

Results of the length converted catch curved (Figure 11) for DFN and PT using the logistic transformation showed that at size 28.35 mm, 39.84 mm, and 42.39 mm, for year^{-1}, 25% (L_{25}), 50% (L_{50}), and 75% (L_{75}) respectively are vulnerable to the gear. Also, the knife edge selection feature of the FiSAT program used to analyze the relative yield per recruit (Y'/R) to determine the optimum exploitation rate of the fishing gears catching *N. tenuipes* (Figure 12), shows that the current exploitation rate was E = 0.66 to the E_{max} = 0.550. This implies that *N. tenuipes* caught in the coastal waters of Aparri, Cagayan using DFN and PT have already reached the sustainable exploitation level (E/E_{max} = 1.20 year^{-1}). The Z/K of the species was computed at 4.2 year^{-1} and it has a relative yield per recruit of 1.22 year-^{1}.

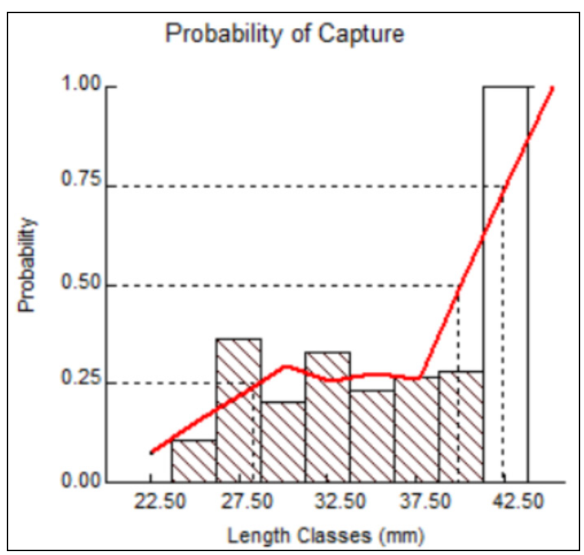

Figure 11. Probability catch curve of *N. tenuipes* in Aparri, Cagayan.

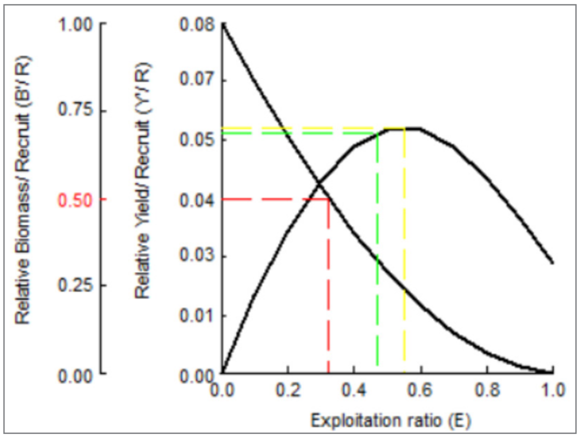

Figure 12. Yield per recruit of *N. tenuipes* in Aparri, Cagayan, showing the values of E10 (green line), E50 (red line), and E_{max} (yellow line).

4. DISCUSSION

4.1 GA mechanism implementation

Although informal in nature, the GA contribution to the immediate recovery of *N. tenuipes* stocks in the area is significant. The empirical knowledge of the fishers on the cause of resource collapse served as a motivational factor enabling resource users to develop harvest control measures to save the resource from extinction. Since the use of HCR differs in different situations (Kvamsdal et al. 2016), catch limitation by lessening the number of fishing days and the 10 days of close fishing have been effective in arresting further population decline of the *N. tenuipes* population. Harvest control rules are pre-agreed guidelines that determine the limits in fishing activities in a certain area based on the status of the resources (Free et al. 2022). The rules are dependent on the stock condition (Punt 2010). The GA's effectiveness can also be attributed to the good governance and the cooperation of the regulatory bodies that guided the fishers in making the right decisions. Apparently, the marketing system influenced resource management and affects the distribution of benefits among resource users. This aspect should be given attention in order to bring back to the people the good life they deserve. However, since informal rules are not legally binding and violators can exist, the negative effects on the resources may happen and may further be used to create and impose illegal rules.

4.2 Stock status

The continuing decline in the catch trend of this species has been seen from 2008 up to 2020 (Ayson et al. 2008; Calicdan et al. 2018; Culasing 2013). It was observed that the increase in production is reflected only by the increased number of efforts exerted by fishers. Drift filter netters operate an average of nine (9) hours a day for 21 days a month during peak season and 15 days a month during lean season. The same fishing days were also observed for pair trawlers with an average effort of five (5) hours per fishing day. Market-based pressure is adding to the cause of increased exploitation of the stocks. Fishing is still guided by the rules set under the GA. Another factor affecting the production could be misreporting of the data gatherers, particularly when the total landed catch for a day was not properly monitored and recorded. Catch monitoring during the pandemic has been limited due to imposed travel restrictions. Hence, observed data were limited to four (4) months, putting production and CPUE at their lowest value. Fluctuating production has been noted, in which the same observation was also documented by Culasing et al. (2013) and Molina (2015) in the last five (5) years.

The seasonality of the species is highly influenced by southwest and northeast monsoons, along with the implementation of GA among fishers. *N. tenuipes* is most abundant when frequent heavy precipitation occurs, making the river's water turbid, which usually happens during the northeast monsoon. Generally, the CPUE for both fishing gear is very dependent on the total catch. As the catch decreases, the CPUE also decreases. The expended effort sometimes does not affect the increase or decrease of the landed catch and the CPUE. It can be further observed that a lesser number of efforts sometimes has the highest landed catch, or the higher the effort is, the lesser the landed catch. This is perhaps due to some factors like biological (abundance of the species), environmental (sudden change of weather), and economic (lesser price during the rainy season). The decreasing trend on both catch and CPUE for both gears only indicates declining production over the years.

The largest and smallest length observed for *N. tenuipes* was 20 mm and 74 mm, respectively, which is smaller than the observed values of Culasing (2013), which is 26 mm and 82 mm for the smallest and largest length, respectively. The asymptotic length observed in the study, which was 78.9 mm, was smaller than the observed length infinity of 89 mm by Culasing (2013). This implies that the size of the stocks is becoming smaller as the years pass by.

Mortality values showed that most of the stocks are experiencing high fishing pressure, and exploitation already exceeds the optimum level. This is further supported by the decreasing population, catch trend, and CPUE, as well as the result obtained from the yield per recruit analysis. The high fishing mortality values could be due to the increased number of efforts exerted by fishers over the years, even if there is a management intervention (i.e., Gentlemen's Agreement) in place.

The result of the recruitment pattern in this study showed a dual mode of recruitment with almost equal strength. According to Culasing (2013), the females spawn 5–6 times from March to October, which this study confirmed. L_{50} showed that 50% of the species at length 31.14 mm is vulnerable to the gear in which the length at maturity computed by Culasing (2013) for this species was 36 mm. This only shows that the species have not yet reached maturity or spawning before they are caught and contribute to production.

For the yield per recruit, Beverton and Holt (1959) indicated that the M/K ratio should usually fall in the range of 1–2.5, which often becomes a tool to verify the accuracy of the natural mortality estimates. The value obtained on the mortality estimates in this study, which was 1.22, indicates that natural mortality was considered reasonable. The estimated exploitation rate seemed to be higher than the optimum level of exploitation (E = 0.5), based on the assumption that a stock is optimally exploited at E = 0.66. Similarly, the estimated E_{max} value showed that the maximum limit of exploitation of the stocks should only be at 0.550. However, due to high fishing pressure, the allowable exploitation level for the stock already exceeded the 0.5 limit as set by Gulland (1971), in which the author states that a stock is optimally exploited if fishing mortality is equal to natural mortality; F_{opt} = M or E = 0.5 hence higher than 0.5 suggests overexploitation.

5. CONCLUSIONS

Based on the status of *N. tenuipes* stocks, GA as a management strategy needs to be translated into a concrete policy or ordinance to use the resources effectively. This can be gleaned from the decreasing catch trend, CPUE, and the general state of its fisheries. Over the years, the decreasing catch and CPUE could be the effect of massive "aramang" gathering in previous years. This was supported by the high fishing mortality observed and the decreasing size of the stock. Over-exploitation is evident in the high fishing mortality as compared to natural mortality. It can be further concluded that the species of *N. tenuipes* were already caught by the fishing gear drift filter net and pair trawl before they had the chance to mature and reproduce.

Policy recommendations such as the establishment of catch quota per fishing season, legalizing the harvest control rules in the GA emphasizing the common agreements during the meeting, such as the 5–7 days of fishing during daytime only and the right boat size and gear mesh that can be operated in the fishing ground is important. Fishing efforts restrictions and the formation of cooperatives may also help manage the "aramang" resources in Aparri. Regular meetings of the fisher leaders before fishing may be continued as a facilitation process to discuss issues and problems encountered due to observed changes in the catch or marketing of the commodity. It is evident that governance plays a very important role in the policy implementation and regulatory processes. The LGU, as a mediator and prime mover, has been essential in the conservation efforts and sustainable resource utilization of "aramang" stocks. The regulatory bodies such as BFAR, PCG, and all other stakeholders supporting the efforts being initiated by the LGU guided the fishers in making decisions to sustainably manage the "aramang" resources. Application of the Ecosystem Approach to Fisheries Management (EAFM) concepts and principles may answer issues on equitability, environment protection, and social justice.

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AUTHORS CONTRIBUTIONS

Ame EC: Conceptualization, Methodology, Validation, Formal analysis, Writing - Original Draft, Visualization, Review & Editing, Supervision, Project administration, Funding acquisition. **Calicdan MC**: Conceptualization, Methodology, Validation, Formal analysis, Writing - Review & Editing. **Laeno FB**: Visualization and Validation.

CONFLICT OF INTEREST

The authors declare that there is no conflict of interest in any way.

ETHICS STATEMENT

The authors obtained prior informed consent from participants included in this study.

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