Survey on Traditional Mangrove Crab Identification Methods of Filipino Fishermen

Qiuting W. Cai, Janella Kristine C. Chua, Evanae Schon N. Magpayo,
Aliexandra Heart G. Po, and Jennifer O. Sanchez
De La Salle University Integrated School, Manila

Abstract: The Philippines is one of the largest producers of mangrove crabs in the industry, but only three of the four Scylla species exist in the country. As one of the largest mangrove crab exporters, Filipino crab farmers must distinguish their harvest before catching them for crab farming since the growth and needs of crabs depend heavily on their species group. To determine the accuracy of widely used local traditional methods, survey questions were distributed to 34 respondents around the Philippines through selected online platforms. Data gathered included local methods for identifying mangrove crabs based on traditional ecological knowledge and experiences of the local fishers interviewed. The study found that 70.58% of those polled identify the species of crabs by looking at their claws and 55.88% observe the color of the crabs. Furthermore, 41.17% of respondents consider the width and size of the shell, while 11.76% examine the crabs' carapace. Unique methods to certain regions were reported, including observation of minor features and behavior of the crabs and reliance on texture, weight, and season. Difficulty in species identification of juvenile crabs has been reported but was also possible when the crabs turn 2-3 months old or grow to the size of a 5-peso coin or 5 centimeters. Feeding schedules and consistent pond management are also said as crucial tasks in growing mangrove crabs. The fishermen voiced out concerns and opinions regarding the technology development and government policies in the crab industry.

Key Words: Philippines; mangrove crabs; Scylla serrata; species identification; traditional methods

1. INTRODUCTION

The Philippines, alongside Indonesia, Thailand, and Vietnam, remains one of the top exporters for mangrove crabs in the Southeast Asian region; as of 2018, it is estimated that over 18,100 tonnes of mangrove crabs have been exported from the Philippines to the global market all over the world (Yxtung, 2020). Now, mangrove crab industries are significantly affecting the Philippines' economy as it was known to be the world's second-largest producer of mangrove crabs in the year 2013 for producing over sixteen thousand tonnes of mangrove crabs, valuing around 5.2 billion pesos (Quinitio & Parado-Estepa, 2017). Additionally, as of the year 2018, a total of 20, 762 metric tonnes of mangrove crabs (Aquaculture production, 2018). In the Philippines, three out of the four mangrove crab species, under the genus Scylla, are known, namely S. serrata, S. olivacea, and S. tranquebarica (Keenan et al., 1998). Mangrove crabs grow not continuously but mature through the stages of molting, which is the shedding of the old exoskeleton of the shell and replacing it with a new and protective layer (Shelli & Lovatelli, 2011). Molting lets the mangrove crab develop from the early larval stage to the megalopae to the juvenile stage and eventually to the sexually mature stage. This study focuses on the juvenile and adult stages and is based on environmental factors that may take 5-12 days from the megalopae stage (Meynecke & Richards, 2014).

In species identification, there are a lot of ways to identify the type of mangrove crab captured. In morphological techniques, crabs are classified through frontal lobe spine shape, carapace features, inner carpus spine, and shape of the cheliped dactyl prominences. However, mangrove crabs' physical parts only have minimal differences and are very hard to see through the naked eye. As a result, morphometric methods and molecular markers were introduced to improve ccuracy. These techniques take a long time to execute and require many samples to experiment on, so it is not feasible for fishers to perform these methods (Hoq & Alam, 2018). Even though there are many studies about the taxonomy of mangrove crabs, there is still not enough research conducted to prove the traditional methods of fishers to differentiate species of genus Scylla. Additionally, people have not yet found a way to efficiently determine mangrove crab species without gadgets and

equipment.

This research's main objective is to determine the different traditional methods fishers use to identify mangrove crabs here in the Philippines. The researchers also aim to identify the similarities and differences of species identification methods used by crab farmers in several localities from Luzon, Visayas, and Mindanao and determine which methods are commonly used by them.

2. METHODOLOGY

2.1 Sampling and Data Collection

In this research, the respondents were primarily mangrove crab growers and traders from different regions in the Philippines. All participants in the study came from Regions and V in Luzon, Regions VI and VIII in the Visayas, and Regions IX, X, and CARAGA in Mindanao, all with high productions of mangrove crabs. The target number of respondents in this research was 30 respondents from the specified regions all over the country, and 34 respondents participated in the research. The data was gathered through the use of online platforms, with the duration of the survey running from November 2020 to January 2021. Data from the survey was used to assess the efficacy of crab fishers' species identification methods. The survey was conducted through Google Forms and was distributed through Facebook as the researchers joined in private groups with local mangrove crab farmers. Messenger was also utilized for private messages, especially for follow-ups from target participants. Since internet connection is required on the mentioned platforms, text messaging and calls were also considered as backup plans. Text loads were provided to some of the respondents to communicate their responses and other concerns to the researchers

2.2 Survey Questions

The survey questions were divided into the following groups:.

A. On mangrove crab production - The questions address how much mangrove crabs are produced and exported in the local and international trading and the effect of misidentification on production success.

B. On species identification of mangrove crabs - Questions in this group mainly focus on the features or parts the fishers check to identify the mangrove crabs, the methods used in species identification, and their importance.

C. On environmental changes affecting harvest, catch, and production - These questions mainly delve into any changes that can affect the harvest and production of mangrove crabs and how and why such changes affect harvest and production.

D. On general mangrove crab fishing and farming practices - These questions focus on learning about the daily routine of a mangrove crab fisher during certain periods and the routines done to ensure a higher increase in harvesting the mangrove crabs.

2.3 Data Analysis

The study utilized both qualitative and quantitative research. The qualitative approach gave an in-depth understanding of the different species identification crab fishers use to identify Scylla serrata while the quantitative approach aimed to evaluate the effectiveness of the methods by comparison of production rates even in environmental fluctuations. The data collected was used to assess the different species identification methods from Luzon, Visayas, and Mindanao and check the differences and similarities of these such methods. Moreover, the data mainly focused on the frequency of crab farmers using a certain species identification method and also cross-referenced the common and unique traditional methods mentioned with the scientifically discovered proved species identification, both locally and internationally. Opinions and statements of fishers regarding the importance and acceptance of knowledge in mangrove crab farming were also part of the processed data. The researchers assessed this information by comparing the responses about the methods used by the fishers to study the effectiveness of each considering the environmental factors in their respective localities and utilized the results to know if fishers around the Philippines widely use the efficient methods in order to determine how the accuracy and knowledge of the methods impact the country's overall crab trading and production rates. Additionally, the insights and statements collected from the crab farmers were summarized for the researchers to explore more possibilities of new knowledge and lifestyles in mangrove crab farming for future studies conducted by other researchers in the same field.

3. RESULTS AND DISCUSSION

In the Philippines, three out of the four mangrove crab species, under the genus Scylla, are known, namely S. serrata, S. olivacea, and S. tranquebarica (Keenan et al., 1998). As one of the largest producers of mangrove crabs in the industry, it is vital that crab farmers need to distinguish their harvest before farming to avoid over-harvesting. Although numerous studies about the taxonomy of mangrove crabs have been conducted, there is still not enough research involving the traditional methods of fishers in differentiating the different species of genus Scylla without gadgets and equipment efficiently.

This is why the researchers have decided to survey 30 Filipino mangrove crab farmers from Regions III, V, VI, VIII, IX, X, and CARAGA to determine the various traditional methods fishers use in identifying mangrove crabs in the Philippines. With this, the researchers have further analyzed what similarities and differences their respective methods have from each other and which among these obtained methods are most commonly used.
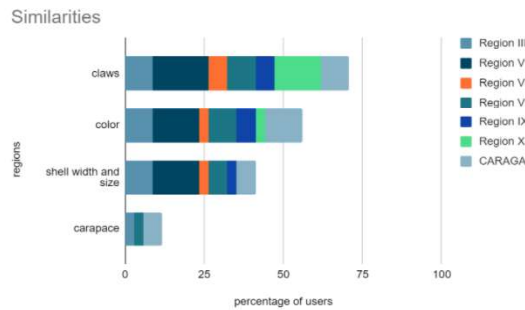
Graph 1. *Similarities of Species Identification Methods*

Graph 1 reveals that 70.58% of the respondents stated that they identify crabs species by observing their claws. According to them, the claws of Scylla serrata are usually larger than other species, and that the edges of their claws have more visible sharp "edges" or spine, and its color varies from dark green to purple. It also appears that 55.88% of the respondents observe the color of the crabs. The farmers pointed out that the chelae color of Scylla serrata is normally dark green or blue green. Scylla olivacea has a reddish brown hue, while Scylla tranquebarica is a vibrant purple, and Scylla paramamosain, which only 2.94% of the respondents are familiar with, has a light green color. White spots occur on the claws of the Scylla serrata and the back of its shell, according to 5.88% of respondents. Moreover, the graph indicates that observation of the width and size of the shell is 41.17%, S. olivacea is said to have a carapace diameter of 20.8-140.0 mm. S. tranquebarica has a carapace that measures 40.0-195.0 mm, while S. serrata has a carapace that measures 24.4-172.0 mm. Seasonal variations, on the other hand, will affect this. 41.17% of the respondents use this approach to assess the breadth and height of the shell. Another way to differentiate adult crab species is to search for inner carpus spines and the cheliped's dactyl prominence shape, which is blunt in S. olivacea. While only 11.76% of the respondents observe the crabs' carapace to identify chelipeds, search for their relative sizes and spins. Many fishers use various unique methods that are not found in other regions surveyed and instead base their species identification on mangrove crabs' appearances. This includes observing the crab's shape, checking the crab's back and feet, observing the color of the crab's bottom, sizing the claws, observing the venation at the back and the legs, and finally, checking the mouth of the crab. Some fishers can also determine the crab species by feeling the texture of the shells, weighing the crab, depending on the season, and observing how the crab walks. The percentage of users performing the aforementioned methods with their specific originated regions are illustrated in the graph below:
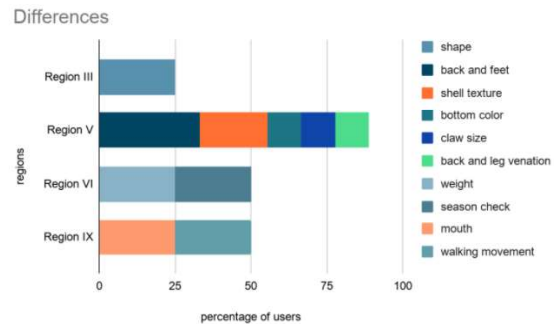
Graph 2. *Differences of Species Identification Methods*

However, the most precise approach is to identify the polygonal patterns on the thighs among these methods. However, the crabs' burrowing habits can cause them to change shape (Vince-Cruz Abeledo, Ting & Ablan-Lagman, 2018). Observing the white spots on the back of the shell is another practice that was not listed, suggesting that farmers have traditional ecological knowledge that has not been recorded or researched. The carpus spine, frontal spine, propodus spine, polygon patterns on chelipeds and pereopods, and carapace coloration, according to Hoq & Alam (2018), are used to classify mangrove crab species, especially those belonging to the genus Scylla. According to Lebata, Vay, Primavera, Walton, & Biñas (2007), the different groups of mangrove crabs under the genus Scylla are morphologically differentiated through color patterns. Meynecke, et al. (2010) discussed seasonal variations and environmental disparities that influence crab preferences, but they were not used as a mechanism for species identification.

Aside from the traditional methods, the researchers also considered the differences in identifying juvenile species and adult species. Crab farmers from Region III, V, VIII, IX, and CARAGA found it challenging to identify juveniles until they turn 2-3 months old; because as these crabs turn into adults, sometimes they turn out to be different species. In connection to this, respondents from Regions V and X continued to expound that once juvenile crabs grow into the size of a 5 peso coin or 5 cm, they will be identifiable through their claws and color. Besides differentiating juveniles from adult species, the researchers also concluded that when it came to pond management, all respondents believed

in doing site security surveys both for theft and biohazards twice a day. Moreover, all of the respondents believed in the importance of checking their ponds' water condition, perimeter fence, pests, dike, and surface to see if there are any issues present. Furthermore, the respondents were also very particular about maintaining their ponds salinity and pH level for crab growth since salty ponds are more favored by crabs, but excess salt may also cause them to grow slowly. Lastly, the crab farmers also mentioned how water temperature, level, and cleanliness significantly affect production.

4. CONCLUSIONS

Survey forms were distributed to 34 local fishers from Regions III, V, VI, VIII, IX, X, and CARAGA of the Philippines. The researchers found that methods across regions showed similarities in species identification, and some techniques are unique to specific regions through quantitative and qualitative data analysis. The most common practice in the Philippines for identifying mangrove crab species is through observation of the claws followed by observing the color, both of which are common in all surveyed regions. On the other hand, most reported unique methods come from Region V, including checking the crab's back and feet, feeling the shell's texture, observing the color of the bottom, and checking for venation on the back and the legs. Observation of the carapace pattern and checking the width and size of the shells are techniques done by a portion of the surveyed population and are methods reflected in published papers. Dependence on the season was used to determine the crab species and was discussed in a published paper but not as a method of species identification. Traditional ecological knowledge is said to be preserved after seeing that the observation of white spots on the shells is done across different regions and is not mentioned in any studied articles as well as other methods that can be found only in certain regions. Fishers from five out of the seven regions surveyed expressed how it was much more difficult, and to some impossible, to identify langaw-langaws or fly-sized crablets. In contrast, some fishermen from CARAGA and Region VI were confident that fly-sized crablets were identifiable by looking at their colors and the season. The fishermen were quite particular about the pond's management, particularly its water condition, depth, temperature, and security. They also highlighted the importance of maintaining a one-meter depth, a consistent feeding schedule, ensuring that the crabs are fed and monitored regularly, and frequently renewing the pond's water. Lastly, the researchers were also able to collect some of the fishermen's concerns and responses, like how they agreed that harsh and unpredictable weather conditions like rising sea levels could affect the growth of crabs. They also raised their concern on current government policies, illegal fishing, theft, and how they ultimately want to gain support from Local Government Units. Fishers also voiced their queries on how they want to apply the latest technology to help them be more knowledgeable and have an overall easier time identifying different crab species. 30 out of the 34 respondents were willing to learn an easier method of species identification as long as it does not compromise accuracy.

5. ACKNOWLEDGMENTS

6. REFERENCES

Abeledo, C. C.-C. (2018). A feast of (crab) kings [Image]. Retrieved from SHE-ENSYA:

https://sheensya.wordpress.com/2018/05/10/a-feast-of-kings/

Alberts-Hubatsch, H., Lee, S. Y., Meynecke, J.-O., Diele, K., Nordhaus, I., & Wolff, M. (2015). Life-history, movement, and habitat use of Scylla Serrata (Decapoda, Portunidae): Current

knowledge and future challenges. Hydrobiologia, 763(1), 5–21. https://doi.org/10.1007/s10750-015-2393-z

Aldon, E. T., & Dagoon, N. J. (1997). The market for mudcrab. SEAFDEC Asian Aquaculture, 19(3), 11-13.

Allan, G. (2004). Mud Crab Aquaculture in Australia and Southeast Asia. Australian Centre For Industrial Agricultural Research.

Aquaculture Production. (2018). Bureau of Fisheries and Aquatic Resources. BFAR On-line Information

System. https://www.bfar.da.gov.ph/profile?id=14&fbclid=IwAR0ppdgQaTwhIf%09ad Q4nGs

Balasubramanian, C. P., & Chandini, G. (2014). Diversification in coastal aquaculture: mud crabs. In Training manual on health management practices for finfish and shellfish of brackishwater environment (pp. 12-29). Central Institute of Brackishwater Aquaculture.

Bandibas, M. B. (2015). Crab biodiversity under different management schemes of mangrove ecosystems. Global Journal of Environmental Science and Management, 2(1), 19-30. http://dx.doi.org/10.7508/gjesm.2016.01.003

Basconcillo, J., Lucero, A., Solis, A., Sandoval, Jr., R., Bautista, E., Koizumi, T., & Kanamaru, H. (2016). Statistically Downscaled projected changes in seasonal mean
temperature and rainfall in Cagayan Valley, Philippines. Journal of the Meteorological Society of Japan. Ser. II, 94A(0), 151-164. https://doi.org/10.2151/jmsj.2015-058

Berkes, F., Colding, J., & Folke, C. (2000). Rediscovery of traditional ecological knowledge as

adaptive management. Ecological Applications, 10(5), 1251-1262. https://doi.org/10.1890/1051-0761(2000)010[1251:roteka]2.0.co;2
Castrence-Gonzales, R., Gorospe, J. G., Torres, M. A. J., Vicente, H. J., Roa, E. C., &

Demayo, C. G. (2018). The Fishery of the Mangrove Crabs, Scylla spp in Three Selected

Areas of the Philippines. Transactions on Science and Technology, 5(2), 155-170.

Choo, J., Zent, E. L., & Simpson, B. B. (2009). The importance of traditional ecological knowledge for palm-weevil cultivation in the Venezuelan Amazon. Journal of Ethnobiology, 29(1), 113-128.

Crear, B., Hart, P., Thomas, C., & Barclay, M. (2002). Evaluation of commercial shrimp grow-out pellets as diets for juvenile southern rock lobster, Jasus edwardsii. Journal of Applied Aquaculture, 12(3), 43-57. https://doi.org/10.1300/j028v12n03_05

Davis, J. L., Eckert-Mills, M. G., Young-Williams, A. C., Hines, A. H., & Zohar, Y. (2005). Morphological conditioning of a hatchery-raised invertebrate, Callinectes sapidus, to
improve field survivorship after release. Aquaculture, 243(1-4), 147-158. https://doi.org/10.1016/j.aquaculture.2004.09.027

De La Cruz, J. (2020). Expert warns crab farmers against 'fake' king crablets. Seafdec, https://www.seafdec.org.ph/2020/expert-warns-crab-farmers-against-fake-king-crablets/

Dissanayake, A., Galloway, T. S., & Jones, M. B. (2008). Physiological responses of juvenile and adult shore crabs Carcinus maenas (Crustacea: Decapoda) to pyrene exposure. Marine Environmental Research. https://doi.org/10.1016/j.marenvres.2008.07.006.

Estampador, E. P., (1949). Studies on Scylla (Crustacea: Portunidae) I. Revision of the genus. The Phillipine Journal of Science, 78, 95–109.

Fazhan, H., Waiho, K. & Ikhwanuddin, M. (2017). Non-indigenous giant mud crab, Scyllaserrata (Forskål, 1775) (Crustacea: Brachyura: Portunidae) in Malaysian coastal waters: a call for caution. Mar Biodivers Rec 10, 26 (2017). Marine Biodiversity Records. https://doi.org/10.1186/s41200-017-0128-8

Fazhan H, Waiho K, Quinitio E, et al. (2020). Morphological descriptions and morphometric discriminant function analysis reveal an additional four groups of Scylla spp. PeerJ. https://doi.org/10.7717/peerj.8066
Fielder, D.F. & Heasman, M.P. (1978). The mud crab. A Queensland Museum Booklet.

Queensland Museum.

Fisheries Statistics of the Philippines 2017-2019. (2020). Philippine Statistics Authority. https://psa.gov.ph/sites/default/files/Fisheries%20Statistics%20of%20the%20Philippines%2C%202017-2019.pdf

Fisheries Statistics of the Philippines 2016-2018. (2019). Philippine Statistics Authority. https://psa.gov.ph/sites/default/files/Fisheries%20Statistics%20of%20the%20Philippines%2C%202016-2018.pdf

Fuseya, R. & S. Watanabe. (1996). Genetic variability in the mud crab genus Scylla (Brachyura:

Portunidae). Fisheries Science, 62, 705–709.

FAO (2015). Global Forest Resources Assessment 2015: Desk Reference. UN Food and Agriculture Office, http://www.fao.org/forest-resources-assessment/past-assessments/fra-2015/en/

Google Forms. (2018). Google Tools Meets Middle School, 127-142.

doi:10.4135/9781506360188.n7

Hoq, E., & Alam, M. S. (2018). Morphometric identification of mud crabs of the genus Scylla available in Bangladesh waters. Bangladesh Journal of Fisheries, 30(2), 19– 206

Houde, N. (2007). The six faces of traditional ecological knowledge: challenges and opportunities for Canadian co-management arrangements. Ecology and Society, 12(2).

Inglis, J. (Ed.). (1993). Traditional ecological knowledge: Concepts and cases. IDRC.

J.-O. Meynecke, R. G. Richards, (2014) A full life cycle and spatially explicit individual-based model for the giant mud crab (Scylla serrata): a case study from a marine protected area. ICES Journal of Marine Science, 71(3), 484–498. https://doi.org/10.1093/icesjms/fst181

Kathirvel, M. & Srinivasagam, S. (1992). Resource and Exploitation of Mud Crab Scylla serrata (Forskal) in India. BOBP, Madras (India): 85–94.

Keenan, C., Davie, P. & Mann, D. (1998). A revision of the genus Scylla De Haan, 1833 (Crustacea: Decapoda: Brachyura: Portunidae). The Raffles Bulletin of Zoology 46: 217-245.

Lebata, M. J., Vay, L. L., Primavera, J. H., Walton, M. E., & Biñas, J. B. (2007). Baseline assessment of fisheries for three species of mud crabs (Scylla spp.) in the mangroves of Ibajay, Aklan, Philippines. Bulletin of Marine Science.

Leland, J. C., Bucher, D. J., Southern Cross University., & Fisheries Research and Development Corporation. (n.d.). Direct age determination with validation for commercially important
Australian lobster and crab species: Western, Eastern,Southern and ornate rock lobsters, and crystal, giant and mud crabs.

Le Vay, L., Ut, V. N., & Jones, D. A. (2001). Seasonal abundance and recruitment

in an estuarine population of mud crabs, Scylla paramamosain, https://doi.org/10.1023/A:1017511002066

Meynecke, J.-O., Lee, S. Y., Grubert, M., Brown, I., Montgomery, S., Gribble, N., . . . Gillson, J. (2010). Evaluating the environmental drivers of mud crab (Scylla serrata) catches in Australia.

Molt. (n.d.) [Image]. Retrieved from New World Encyclopedia:

https://www.newworldencyclopedia.org/entry/Molt

Moreau, E. (2020). Facebook Messenger: Everything You Need to Know. Lifewire. https://www.lifewire.com/facebookmessenger-4103719

Naim, D. M., Nor, S. A. M., & Mahboob, S. (2020). Reassessment of species distribution and occurrence of mud crab (Scylla spp., Portunidae) in Malaysia through morphological and molecular identification. Saudi Journal of Biological Sciences, 27(2), 643–652. https://doi.org/10.1016/j.sjbs.2019.11.030

Nakashima, D., & Roué, M. (2002). Indigenous knowledge, peoples and sustainable practice.

Encyclopedia of global environmental change, 5, 314-324.

P. J. Smith , W. R. Webber , S. M. McVeagh , G. J. Inglis & N. Gust (2003) DNA

and morphological identification of an invasive swimming crab, Charybdis japonica, in New Zealand waters. New Zealand Journal of Marine and Freshwater Research, 37:4, 753-762

Paterson, B. D., & Mann, D. L. (2011). Recent Advances and New Species in Aquaculture. Mud Crab Aquaculture. https://doi.org/10.1002/9781444341775.ch4

Pritt, B. S. (2015). Molecular diagnostics in the diagnosis of parasitic infection. Methods in Microbiology. https://doi.org/10.1016/bs.mim.2015.05.001

Province of Lanao del Norte. (2016). Gov't. plans to make Lanao Del Norte the "Crab capital of the Philippines". https://lanaodelnorte.gov.ph/2016/02/17/govt-plans-to-make-lanao-del-norte-thecrab-capital-of-the-philippines/

Quinn, N. J. & Kojis, B. L., (1987). Reproductive Biology of Scylla Spp. Bulletin of Marine Science 41, 234–241.

Quinitio, E. T., & Parado-Estepa, F. D. (2017). Development of a sustainable mangrove crab industry through science-based research. Fish for the People, 15(1), 47-51.

Rinkevich, S., Greenwood, K., & Leonetti, C. (2011). Traditional ecological knowledge for application by Service scientists. US Fish and Wildlife Service.

Saylor, C. R., Alsharif, K. A., & Torres, H. (2017). The importance of traditional ecological knowledge in agroecological systems in Peru. International Journal of Biodiversity Science, Ecosystem Services & Management, 13(1), 150-161.

Silbiger, N., & Munguia, P. (2008). Carapace color change in Uca pugilator as a response to temperature. Journal of Experimental Marine Biology and Ecology, 355(1), 41-46. https://doi.org/10.1016/j.jembe.2007.11.014

Shelley, C., & Lovatelli, A. (2011). Mud crab aquaculture: a practical manual. FAO Fisheries and

aquaculture technical paper, (567), I. https://doi.org/10.1002/9781444341775.ch4 Taylor, M. L. (1984). New species of mud crab found in Western Australia. FINS, 17(2), 15-18. Triño, A. T. (2000). Aqua-mangrove integrated farming: Shrimp and mud crab culture in coastal

and inland tidal flats with existing reforested or natural growth of mangroves. Technologies in Mangrove-Friendly Aquaculture. Final Report of and Papers Presented to the On-Site Training on Mangrove-Friendly Aquaculture, Hai Phong City, Socialist Republic of Vietnam, 19-30 April 1999 (pp. 157-188). Aquaculture Department, Southeast Asian Fisheries Development Center.

Vincecruz-Abeledo, C. C., & Lagman, M. C. A. (2018). A revised dichotomous key for the mangrove crab genus Scylla De Haan, 1833 (Brachyura, Portunidae). Crustaceana, 91(7), 847-865. https://doi.org/10.1163/15685403-00003798

Vince Cruz-Abeledo, C. C., Ting, K., & Ablan-Lagman, M. C. (2018). Identification of a species diagnostic character for instar and juvenile mud crabs (Genus Scylla). Aquaculture, 491, 205-209. https://doi.org/10.1016/j.aquaculture.2018.03.035

What are Facebook Groups? (n.d.). Big Commerce. https://www.bigcommerce.com/ecommerce-answers/what-are-facebook-groups/

Williams, M. J., & Primavera, J. H. (2001). Choosing tropical portunid species for culture, domestication and stock enhancement in the Indo-Pacific. Asian Fisheries Science, 14(2), 121-142.

Wu, Y. (2017). Periphyton and Its Study Methods. In Periphyton. https://doi.org/10.1016/b978-0-12-801077-8.00001-6

Yxtung (2020, August 16). Overview of the Mud (Mangrove) Crab industry in the Philippines (Q3-2019) | Industry Report. https://www.ras-aquaculture.com/post/overview-of-the-mud-mangrove-crab-industry-in-the-philippines-q3-2019-industry-report