

# Assessment of macro-faunal diversity of nipa swamp in Bisagu, Aparri, Cagayan, Philippines

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**Abstract.** *Taguiam JMB, Bayani GU, Pacris Jr. FA, Banadero RR, Baloloy MV. 2022. Assessment of macro-faunal diversity of nipa swamp in Bisagu, Aparri, Cagayan, Philippines. Biodiversitas 23: 1852-1856.* Nipa (*Nypa fruticans*) is one of the most common, widely distributed, and useful trees in the mangrove forest of Southeast Asia. It is being utilized in the production of roof thatching, wine and vinegar, and recent scientific studies have been done for the utilization of nipa sap in the production of bio-ethanol. Moreover, nipa has also contributed ecologically as it acts as a barrier during typhoons and storm surges helps prevent soil erosion along the banks of villages near river areas. The study area is located in barangay Bisagu, Aparri, Cagayan, Philippines where nipa plantation covers 550.51 ha and is utilized by the community. As we all know, mangroves areas as home to aquatic animals thus the study conducted takes on the diversity of macrofaunal species in a nipa-dominated mangrove area. Sampling areas were constructed, the proximal, middle and distal quadrat with 10 m by 10 m dimensions. Species collected in the area yield 11, where 10 is successfully identified and 1 species is not identified. Results showed that macrofaunal species in a nipa-dominated mangrove area show very low diversity. Shannon-wiener diversity index of the community showed a result of only 0.97457 and its equitability at 0.04, which concluded as low species evenness distribution.

**Keywords:** Diversity, macrofaunal, nipa palm, species composition

## INTRODUCTION

Nipa (*Nypa fruticans*) is one of the most common, widely distributed and useful trees in the mangrove forest of Southeast Asia, as stated by Tsuji et al. (2011). However, this mangrove palm is considered an invasive species in Nigeria that offers no benefits to their community as compared to its indigenous mangrove plant species (Udoiong and Ekwu 2011). In the Philippines, nipa is widely accepted for its many uses. Nipa palm in the Philippines is utilized for the production of roofing and partition materials using its leaves, its sap is processed to produce wine that is locally known as “tuba” and vinegar, its fruit is consumed as a snack (Carandang et al. 2009), lastly scientific studies has been done for the utilization of nipa sap as feedstock for bio-ethanol production (Tamunaidu et al. 2013.). With these economic uses, nipa is also ecologically important as it serves as a refuge to different aquatic animal species where some are harvested for human consumption or peddled in the market, as a barrier against strong wave actions during high tides and storm surges and it also helps in the prevention of soil erosion along the banks of villages that are near river areas.

Macrofauna is estuarine and marine organisms visible to the naked eye (>0.5 mm) that commonly inhabit the benthos, where they can be found buried in sediment or attached to a fixed substrate. Certain macrofauna could also be observed moving on the sediment surface as epifauna or in the water column. Often abundant macrofauna in the

benthos includes flatworms (Platyhelminthes), sipunculids, nematodes, polychaetes, isopods, amphipods, stomatopods, pycnogonids, chitons, bivalves, gastropods, echinoderms, bryozoans, and urochordates. Macrofauna is also commonly found in the water column, which includes the following species: jellyfish, ctenophores, salps, and some larvae of benthic invertebrates such as sponges molluscs, polychaetes, and crustaceans that exceed 0.5 mm in length (Bastida-Zavala and Moreno-Dávila 2016).

With the many uses of the nipa palm, it also shelters many different aquatic animals that are utilized by the local community as market products and an additional source of food. In the study conducted by Udoiong and Ekwu (2011) in Nigeria of a densely populated nipa palm area, they identified 23 species from 18 genera of organisms. They belong to the taxa of decapoda, pisces, bivalvia and gastropoda. Another study conducted in the same country by Ubulom et al. (2018) nipa is also home to many different arthropods, like the *Aedes* mosquitoes, which are the vectors of yellow fever, dengue and encephalitis, utilizes nipa groves as breeding areas.

Despite these contributions of nipa economically and ecologically, it is still prone to habitat degradation and deforestation. Commonly nipa palms are overly harvested for its frond that is used in shingle making, local practice tends to only leave the immature frond that can lead to the death of the nipa. Mismanagement (effects) is also a problem as nipa reproduces by rhizome. The growth of nipa is observed to be sideways and they grow rapidly,

without management of these plantations, nipa can grow vastly and eventually. In Aparri, Cagayan, a vast plantation of nipa stands exists with a total area of 1408.98 hectares that provides a source of livelihood of the local community.

Unfortunately, there are limited studies regarding baseline information on the macro-faunal diversity on nipa palm groves thus, this is a seminal field study assessment of macro-faunal diversity in Aparri, Cagayan and will be essential for the management, protection and conservation of the nipa groves. The study aimed to assess the macrofaunal diversity of the nipa swamp in Bisagu, Aparri, Cagayan. Specifically, the study aimed to calculate the diversity index of the mangrove community; to get the equitability of the area; and discuss the species found for its economic/ecological role.

## MATERIALS AND METHOD

### Study site

Aparri is one coastal municipality of the province of Cagayan, Philippines. Located at 18°21'North and 121°38' East, the municipality and has a total land area of 286.64 km<sup>2</sup> that encompasses 42 barangays and constitutes 3.08% of the province total land area. This study is conducted in Bisagu, Aparri, Cagayan, located at 18.35° North and 121.60' East with a vast plantation of nipa palm. Sampling areas are established in barangay Bisagu, wherein the station is densely populated with nipa. Nipa plantation in

the area constitutes to 550.51 hectares of the land area of the barangay. The sampling area is divided into three parts: proximal, middle and distal. The proximal area is the nearest area that is approached by water during high tide and the distal is the farthest area where the tide cannot reach but is still with a dense population of nipa palm. The sampled area is limited to the accessible part as the area is unmanaged, having a dense population of nipa, making it hard to penetrate.

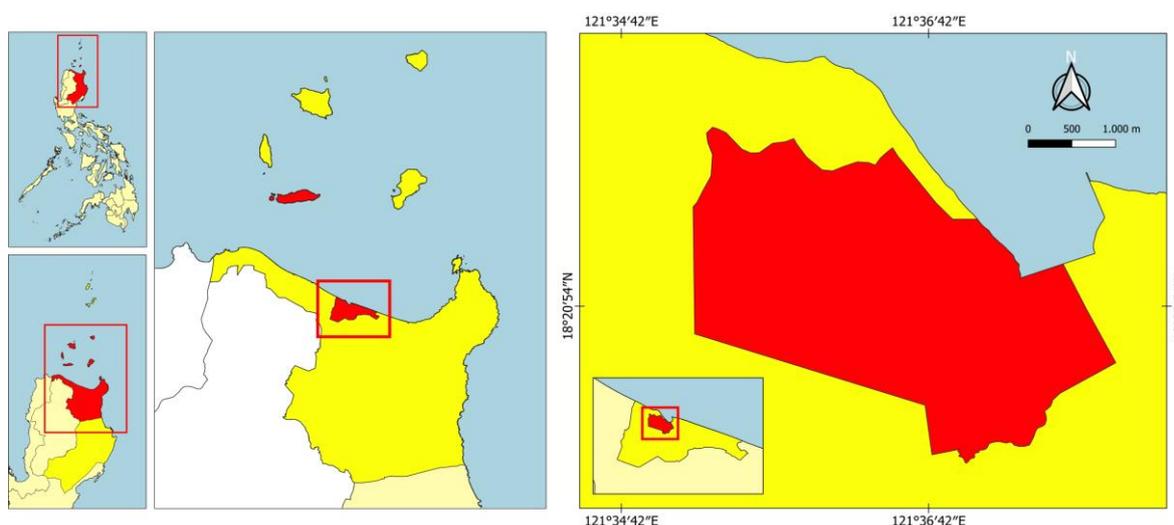
### Sampling method

A sampling of aquatic macro-faunal species was done using 100 meters transect line that separates the proximal, middle, and distal station. A 10 by 10-meter quadrats were constructed as sampling areas. Gleaning/handpicking and traps are used to gather/collect the sample species. Sample species are then put into jars with 70% alcohol as a preservative agent for the samples/animals that are collected.

### Data analysis

Sample species are sent to the laboratory of the Bureau of Fisheries and Aquatic Resources (BFAR) for morphological identification. The data were then grouped and statistically analysed using the Shannon-Weiner diversity index for species and evenness. A descriptive review is given to each identified species to show its relevance in the community.

	Index x	Diversity in terms of x:	Diversity in terms of p <sub>i</sub> :
Species richness x ≡	$\sum_{i=1}^S p_i^0$	x	$\sum_{i=1}^S p_i^0$
Shannon entropy x ≡	$-\sum_{i=1}^S p_i \ln p_i$	exp(x)	$\exp(-\sum_{i=1}^S p_i \ln p_i)$
Evenness= E=	$H'/H_{\max}$ or $E= H'/\ln S$		



**Figure 1.** Sampling site in Bisagu, Aparri, Cagayan, Philippines

## RESULTS AND DISCUSSION

Constructed quadrats during the sampling are characterized as follows: quadrat 1/proximal quadrat is located nearest to the water source in this case is a river tributary, it is inundated twice a day during high tide (morning and night). The flora mostly consists of Nipa palms and with a few numbers of *Bruguiera* sp. and *Excoecaria agallocha* species. Quadrat 2/middle quadrat is only slightly inundated with water during high tide as it is located 100 meters away from the tributary, with a flora consisting of nipa stands and *Acrostichum* sp. Lastly, the quadrat 3/distal quadrat also consists of the same species of flora to quadrat 2 as they are more landward, it is not at all inundated with water during high tide.

$$\text{Shanon - Wiener Index} = \sum_{i=1}^S p_i^0 \quad 0.97457$$

Evenness of the species is computed using the equitability formula:  $E = H'/H_{\max}$  or simply  $E = H'/\ln S$ . Equitability of the area is recorded at  $E = 0.04$  that states low equitability because for an area to be described as having an even spread number of species, equitability should be equal to 1.

$$E = H'/H_{\max} \text{ or simply } E = H'/\ln S$$

$$E = 0.97457/20 \text{ or } E = 0.97457/\ln(20)$$

$$E = 0.04$$

Having a low diversity and evenness in the area may be attributed to nipa having no stilt roots that provide shelter to fish this is found out by Isebor et al. (2003) where they stated in their study entitled "The incidence of *Nypa fruticans* (Wurmb) and its impact on fisheries production in the Niger Delta mangrove ecosystem", that vegetation with dominant nipa palm have shown a low incidence of encrusting fauna and little to no evidence of crab burrowing due to its close stands and rhizome stem, further nipa also produces no leaf litter compared to mangroves, where it plays an important role in food production of aquatic species, therefore nipa dominated vegetation affects species diversity that uses it.

**Table 1.** List of all species found in all of the sampling site

Family name	Common name	Scientific name
Gobiidae	Common goby	<i>Pomatoschistus microps</i>
Thalassinidae	Mud lobster	<i>Thalassina anomala</i>
Varunidae	River swimming crab	<i>Varuna litterata</i>
Palaemonidae	Freshwater prawn	<i>Macrobrachium</i> spp.
Penaeidae	White shrimp	<i>Penaeus</i> spp.
Ampullariidae	Golden snail	<i>Pomacea canaliculata</i>
Corbiculidae	Mangrove clam	<i>Polymesoda erosa</i>
Viviparidae	River snail	<i>Angulyagra oxytropis</i>
Pachychilidae	Freshwater snail	<i>Jagora asperata</i>
Portunidae	Mud crab	<i>Scylla serrata</i>
-	Snail species (unidentified)	-

**Table 2.** List of species found in each quadrat/ sampling area

Common name	Quadrat	Quadrat	Quadrat
	1	2	3
Common goby	+	+	-
Mud lobster	+	+	-
River swimming Crab	+	+	-
Freshwater prawn	+	-	-
White shrimp	+	-	-
Golden Snail	+	+	+
Mangrove Clam	+	-	-
River Snail	+	-	-
Freshwater snail	+	+	+
Mud crab	+	-	-
Snail species(unidentified)	+	+	+

Note: (+) Species is present in the sampling sites, (-) species is not present

**Table 3.** Diversity index of the area

Community	pi	ln (pi)	pi*ln(pi)	(-pi*ln(pi))
Proximal	0.55	-0.5978	-0.32881	0.32881
Middle	0.3	-1.204	-0.36119	0.36119
Distal	0.15	-1.8971	-0.28457	0.28457

However, some of the species found are economically important. Among the three sampling areas established, the most occurring species are the snail species, wherein they occurred in all areas due to their amphibious nature. In the first quadrat/ proximal area registered, all of the species were found in both the middle and distal quadrats. Some of the species are deemed important species, such as Mud crab, freshwater prawns and shrimps which are highly valued aquatic products, this species is harvested and traded locally and internationally.

On the other hand, other species found are also utilized locally as food sources of the surrounding community. Mud crab/Mangrove crab habitat is mangrove forests or swamps, typically associated with sheltered tropical to subtropical estuaries and embayments. Mangrove vegetation is important to mud crabs as it provides both habitat and food supply, Mud crab diet in the wild consists mainly of marine detritus, molluscs, crustaceans and fish (Shelley and Lovatelli 2011). In 2015, Quinto stated that the total production of mud crab from aquaculture was estimated at 13,720 tons valued at US\$77,025,000 in 2009 and 14,437 tons valued at US\$86,511,000 in 2010. Sources of crablets/seeds for crab farming are caught from the wild and small portions come from the hatchery, this dependency has caused overexploitation and habitat losses that resulted in reduced catch and lower capture size crablets.

Currently, as of PSA records of 2020, mud crab production accounted to 22, 192.69 metric tons, which is at 0.5% of the total volume of fisheries production in the country. Thus, some members are engaged in catching juvenile mud crabs locally known as "rising". Freshwater Prawn species live in tropical freshwater environments influenced by adjacent brackish-water areas, in which the

sampling area is located adjacent to the sea. It is often found in extremely turbid conditions. Gravid females migrate downstream into estuaries, where eggs hatch as free-swimming larvae in brackish water (FAO 2004). Freshwater prawn is cultured in the Philippines to diversify the commodities used for freshwater aquaculture, which is currently dominated by tilapia. It is a high-value species and its culture could offer better profit. Due to its characteristic of being hardy and fast-growing, being able to grow in freshwater and low brackish water conditions. The freshwater prawn has many biological advantages for commercial culture, including attaining maturation in captivity, large size, and rapid growth rate (Rosario and Tayamen 2004).

In 2018, white shrimp production in the country was at 1.74 thousand metric tons (MT), where 65.70% came from inland fisheries. Central Luzon, Calabarzon and Cagayan valley combined to make up 60.66% of the country's total production (PSA 2018). River swimming crab also called "paddler crabs" in the Philippines it is locally known as "talangka", it is a euryhaline crab and can be found in rivers, brackish waters, or at sea (Bouchard et al. 2013), it usually occupies mangroves, estuarine and freshwater environments, shallow subtidal regions and found under rocks, logs and dead leaves and lives in burrows along the embankments (Devi 2013).

In 2010, the Bureau of Fisheries and Aquatic Resources (BFAR) listed *Varuna litterata* as an important species for food purposes through the Fisheries Administrative Order 233 (annex A). And also plays a crucial role as a decomposer of the estuarine environment by degrading organic matters (Suppapan et al. 2017) that make the soil fertile. Mangrove clam, *Polymesoda erosa*, together with *P. expansa*, *P. bengalensis* and *Batissa violacea*, are the most common species of mud clams abundant in Southeast Asia as stated by Morton, 1984 as cited by Elvira and Jumawan (2017), is a filter feeder that only feeds during immersion in settling stage during low-tide where there is frequent inundation, thus, *P. erosa* during the study is only found in the proximal quadrats as it is highly inundated with water and is usually harvested for food. Mud lobster is widely distributed in the indo-west pacific region, often found in mangrove areas and estuaries where they make their burrows. These burrows do not only serve as their home but also for other species. It is also due to these constant digging and burrowing activities that mud lobster helps aerate the mangrove soil by bringing fresh mud to the surface, thus playing a role in the recycling of nutrients in the mangrove ecosystem, eventually resulting to richer soil for mangrove regeneration (Bedi and Primavera 2018).

Goby is a small fish growing up to 6 cm in length with its top of the head, nape and throat are scaleless. Usually, grey or sandy in color, with darker blotches across the back and faint marks along the side of the body and also has a dark area at the base of the pectoral fins and tail fin. Lastly are the four species of snail found in the area from all of the sampling sites as these species of molluscs are good adapters of the different environments from aquatic to drylands. Among the species found one has not been identified morphologically, but three were named

Freshwater snail, River Snail and Golden Snail (Table 1). Golden Apple Snail is locally known in the Philippines as Golden Kuhol and Miracle snail. Introduced in the country in 1980's as a potential additional food source and traded as an aquarium pet, but it has become an invasive species that is widely distributed in lakes, rivers, ponds, and swamps in the country and feeds greatly on water plants. Freshwater snail also known as "agurong" is an endemic freshwater snail species found in the Philippines. Typically, this species is harvested for food consumption and little is known about other purposes that it serves. River snail, locally called "leddeg" is also harvested by locals for its food value and there has been little to no information about other purposes it serves.

With all of these resources harnessed in nipa groves, it has established itself as a useful part of the local community and to other species that thrive within and among this ecosystem. Information campaigns and management are necessary to preserve these resources and fully achieve its economic and ecological potential.

Therefore, it can be concluded that nipa-dominated vegetation has low species diversity as the growth of nipa in close stands affect the spatial area for species growth, further, it also does not produce leaf litter that serves as food to aquatic species. Thus, to quantify the effect of vast nipa plantation in Aparri it is recommended to conduct larger-scale research on the faunal composition of the area. To improve species diversity in the area, it is recommended to implement holistic management and introduction of sustainable livelihood from nipa to avoid overexploitation that would affect the presence of the animal species found on the nipa stands, research on the soil and water analysis and reintegration of local/ native mangrove species in the area for species diversification of flora and fauna. Reassessment of nipa swamps every five years to document its development and changes. Policy development from the local government is also recommended to protect the swamp as its serves as a livelihood to the people, protection against typhoons and refuge of different animal species.

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## REFERENCES

- Bastida-zavala R, Moreno-dávila B. 2016. Macrofauna. In: Kennish MJ (eds). Encyclopedia of Estuaries. Encyclopedia of Earth Sciences Series. Springer, Dordrecht.
- Bedi AMB, Primavera JH. 2018. New record of *Thalassina spinosa* (Crustacea: Decapoda: Gebiidea: Thalassinidae) from the Philippines. Philipp J Sci 147 (3): 357-361.
- Bouchard JM, Poupin J, Cleva R, Dumas J, Dinhut V. 2013. Land, mangrove and freshwater decapod crustaceans of Mayotte region (Crustacea, Decapoda). Atoll Res Bull 592: 1-69. DOI: 10.5479/si.00775630.592.

- Carandang MG, Camacho LD, Carandang AP, Camacho SC, Gevaa DT, Rebugio LL, Youn YC. 2009. Sustainable thatching materials production from nipa (*Nypa fruticans*) in Bohol, Philippines. *For Sci Technol* 5 (1): 17-22 DOI: 10.1080/21580103.2008.9656343.
- Devi PL. 2013. Habitat ecology and food and feeding of the herring bow crab *Varuna litterata* (Fabricius, 1798) of Cochin backwaters, Kerala, India. *Arthropods* 2 (4): 172.
- Elvira MV, Jumawan JC. 2017. Species abundance distribution of mud clam (*Polymesoda erosa*) in selected mangrove wetlands of Butuan Bay, Philippines. *J Biodivers Environ Sci* 11 (3): 1-6.
- Fisheries Situation Report January to December 2020. <https://psa.gov.ph/sites/default/files/attachments/ird/specialrelease/Fisheries%20Situation>
- FAO [Food and Agriculture Organization]. 2004-2021. Cultured Aquatic Species Information Program. *Macrobrachium rosenbergii*. Cultured Aquatic Species Information Program. Fisheries and Aquaculture Division, Rome.
- Isebor CE, Ajayi TO, Anyanwu A. 2003. The incidence of *Nypa fruticans* (Wurmb) and its impact on fisheries production in the Niger Delta mangrove ecosystem. *Aqua Docs*. <http://hdl.handle.net/1834/21300>.
- Rosario WR, Tayamen MM. 2004. Culture of giant freshwater prawn: Philippines. Aquaculture Department, Southeast Asian Fisheries Development Center. <http://hdl.handle.net/10862/660>.
- Shelley C, Lovatelli A. 2011. *Mud Crab Aquaculture: A Practical Manual*. FAO, Rome, Italy.
- Suppapan J, Pechsiri J, O-Thong, S, Vanichanon A, Sangthong P, Supmee V. 2017. Population genetic analysis of Oceanic paddle crab (*Varuna litterata*) in Thailand. *Sains Malaysiana* 46 (12): 2251-2261. DOI: 10.17576/jism-2017-4612-01.
- Tamunaidu P, Matsui N, Okimori Y, Saka S. 2013. Nipa (*Nypa fruticans*) sap as a potential feedstock for ethanol production. *Biomass Bioenergy* 52: 96-102. DOI: 10.1016/j.biombioe.2013.03.005.
- Tsuji K, Ghazalli NF, Ariffin Z, Nordin MS, Khaidazar MI, Dulloo ME, Sebastian LS. 2011. Biological and ethnobotanical characteristics of nipa palm (*Nypa fruticans* Wurmb): A review. *Sains Malaysiana* 40 (12): 1407-1412.
- Ubulom PME, Umoh GS, Ekong EJ. 2018. Abundance of arthropods of medical importance in nipa invaded wetlands of eastern Obolo, Nigeria. *Proceedings of 6<sup>th</sup> NSCB Biodiversity Conference*. Uniuyo, Nigeria, 6-12 May 2018.
- Udoidiong OM, Ekwu AO. 2011. Nipa Palm (*Nypa fruticans* Wurmb) and the intertidal epibenthic macrofauna east of the Imo River Estuary, Nigeria. *World Appl Sci J* 14 (9): 1320-1330.