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Ethnoichthyology of the First Record of Spine Bahaba (*Bahaba polykladiskos*) from Muar, Johor, Malaysia

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ABSTRACT

The Spine Bahaba (*Bahaba polykladiskos*), locally known as 'Gelama Tirusan,' is a member of the Sciaenidae fish family that is distributed across Southeast Asia, reaching as far as North Australia. This species is renowned for its swim bladder, which produces a distinctive loud sound. Despite its distribution in Southeast Asia, no previous studies have reported the presence of the Spine Bahaba in Peninsular Malaysia. This research aims to document the first-ever record of *B. polykladiskos* in Muar River, Johor, and provide ethnoichthyological insights regarding this species. The ethnoichthyological data were collected using a convenience snowball sampling technique, involving the collection of information from communities residing in the Muar area. In total, 47 respondents participated in the study. The results indicate that a majority of the respondents were familiar with (98%) and had encountered (94%) *B. polykladiskos* in both the Muar River and the local fish market. The study also documented the demand and trade associated with *B. polykladiskos* in Muar, with recorded prices ranging from RM 20 to RM 11,500 per fish. Furthermore, this research provides an introductory description of the uses and perceived benefits of *B. polykladiskos* in traditional medicine, particularly in relation to sexual prowess among male respondents. The study successfully establishes a baseline information for *B. polykladiskos* in Peninsular Malaysia using an ethnoichthyological approach, thus extending the known geographical distribution of this distinctive species.

Keywords: Gelama Tirusan, Peninsular Malaysia, Sciaenidae, traditional medicine

INTRODUCTION

Spine Bahaba, *Bahaba polykladiskos* (Bleeker, 1852), known locally as 'Gelama Tirusan' in Malaysia, was originally described from Banjarmasin, Borneo, Indonesia. This species is highly targeted due to the lucrative value of its swim bladder. However, the taxonomic classification of *B. polykladiskos* remains problematic. Chao *et al.* (2020) suggest that it should be reclassified under the genus *Boesemania*, (Trewavas, 1977). Nevertheless, pending the completion of additional studies, it has been decided to maintain the name *B. polykladiskos* (Bleeker, 1852) as suggested by Parenti (2020). Belonging to the family Sciaenidae, fish in this family are commonly referred to as croakers or drums. The Sciaenidae family is one of the largest perciform fish families and comprises several economically significant species (Nelson, 2006; Lo *et al.*, 2017). The name "croakers" or "drums" stems from their unique ability to produce sound by utilising their swim bladder as a resonating chamber (Nelson, 2006; Ramcharitar *et al.*, 2006). The Spine Bahaba can reach a maximum size of 200 cm in standard length (Nurhayati *et al.*, 2016). Its head and body are entirely covered by scales, with the complete lateral-line scales. The species possesses a long and continuous dorsal fin, with a noticeable notch between the anterior dorsal spines and the posterior soft rays. The anal fin consists of two spines, with the second spine being enlarged (Sasaki, 2001). The

caudal fin of the Spine Bahaba is typically emarginate. The body coloration of the species displays significant variation, ranging from silvery to dark brown (Figure 1).

Similar to other sciaenids, the Spine Bahaba typically exhibits demersal behavior and occupies habitats characterised by sandy or muddy substrates (Robins *et al*., 1986; Murdy *et al.*, 1997). It is predominantly found in shallow coastal waters and estuaries, often in close proximity to continental regions. In certain instances, it has been known to venture into freshwater environments (Nurhayati *et al.*, 2016). The species can be found in a depth range of 10 to 35 m (Nelson, 2006; Chao *et al.*, 2020). Records of the Spine Bahaba's distribution include the Gulf of Thailand (Yoshida *et al.*, 2013), the Mekong drainage (Kottelat, 1989; Rainboth *et al.*, 2012; Huan *et al.*, 2016; Tám *et al.*, 2019), South Sumatra (Nurhayati *et al.*, 2016; Ridho & Patriono, 2017), the South China Sea (Randall & Lim, 2000), and extending westward to south Borneo (Kottelat, 2013; Chao *et al.*, 2020; Parenti, 2020) (Figure 2). However, there is a notable absence of official reports documenting the presence of this species in the waters of Peninsular Malaysia within the existing literature.

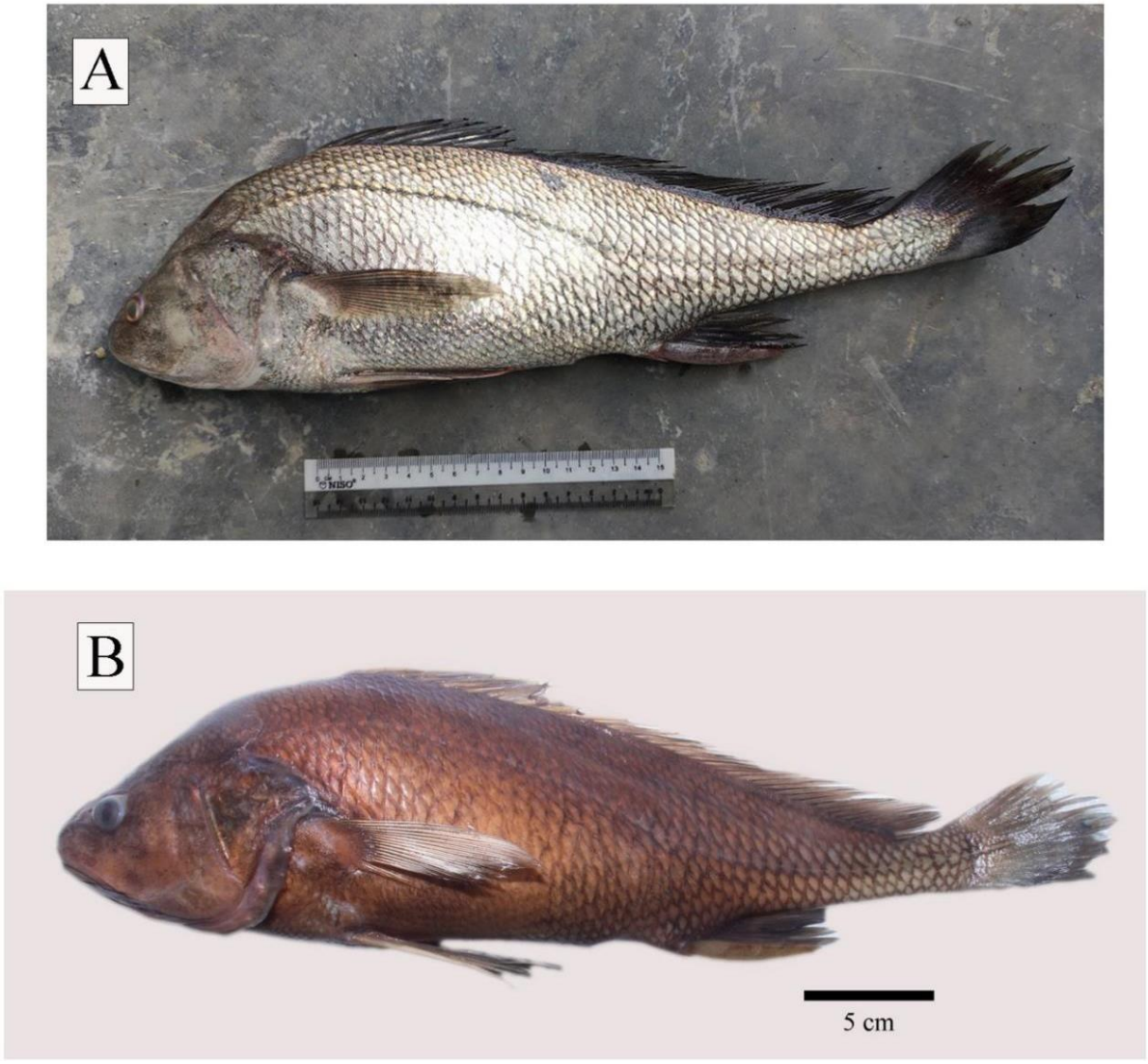

Figure 1. Specimen of Spiny Bahaba UMKL 12883 collected in Muar, Johor. A) Freshly caught specimen. B) Preserved specimen

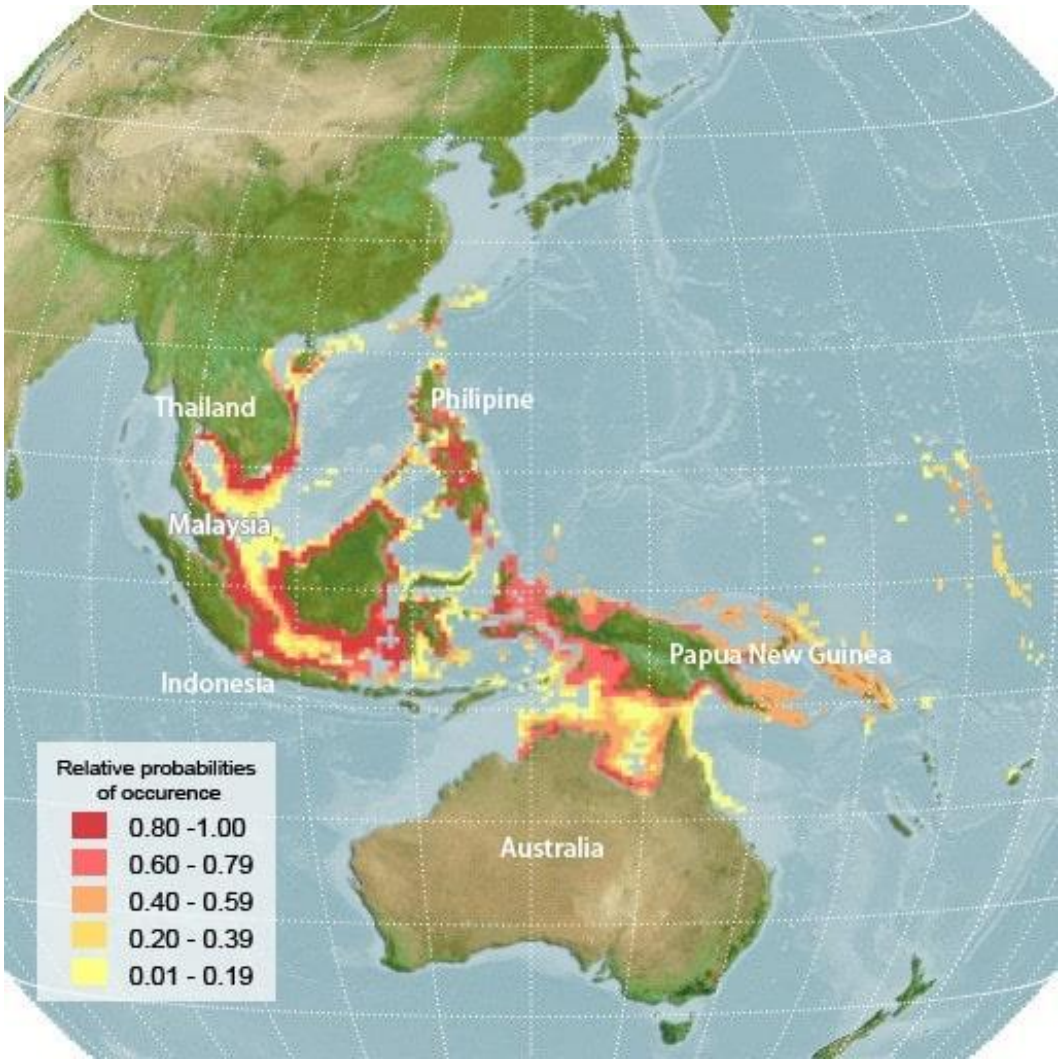

Figure 2. Computer generated native distribution of *B. polykladiskos*. (AquaMaps 2019)

Ethnoichthyology, as a branch of ethnobiology, focuses on exploring the intricate relationships between humans and fish (Oishi, 2016; Svanberg & Locker, 2020). The local fishing communities possess valuable traditional ecological knowledge that can serve as a significant source of information, particularly regarding fish behavior, abundance and distribution, owing to their extensive expertise in fish biology and classification (Djidohokpin *et al.*, 2020). However, despite their wealth of knowledge, the local information derived from fishing communities has yet to be formally integrated into fisheries management practices. By bridging the gap between scientists and decision-makers, it becomes possible to interpret and supplement the local fishing community's knowledge with scientific information, thereby enhancing the development of effective management strategies for small-scale fisheries (Berkes *et al.*, 2001). Therefore, a comprehensive understanding of ethnoichthyology is crucial, as it not only enhances our comprehension of marine ecosystem dynamics and fishing activities but also contributes to improving the community's livelihoods, especially when it involves medicinal purposes or subsistence practices (Djidohokpin *et al.*, 2020). The potential of ethnoichthyological studies to serve as valuable management tools is significant, as they shed light on critical information that can provide essential guidelines for biological research, particularly within the context of the Muar fishers community.

The documentation of fish utilisation, particularly for medicinal purposes, requires immediate attention. It is essential to preserve and document this knowledge, as it currently remains unavailable for further study and future reference. Given the escalating anthropogenic activities, the alarming rate of biodiversity loss, and the degradation of natural habitats, the

invaluable knowledge and insights related to fish are at risk of extinction, rapidly disappearing if not adequately documented. Therefore, the present study aimed to document the occurrence of *B. polykladiskos* in the Muar River, while also collecting ethnoichthyological information from the local communities.

MATERIALS & METHODS

Study Area

The study area encompasses the Muar River, as depicted in Figure 3. Serving as the main artery of the Muar River Basin, the river spans an estimated width of 150 to 300 m. Its origin lies within the longitudes 102°14'00" East to 103°04'00" East and latitudes 1°52'00" North to 2°54'00" North. Flowing across three states in South Peninsular Malaysia—Negeri Sembilan, Pahang, and Johor—the river stretches a total length of 329 km (Bahaman *et al.*, 2011; Ching *et al.*, 2015; Idris *et al.*, 2016). The Muar River is situated in a region characterised by distinct seasons: the Southwest Monsoon prevails from April to September, while the Northeast Monsoon dominates from October to March. Over the period from 1991 to 2021, the average annual rainfall in the Muar River region was recorded at 2470 mm, accompanied by a mean air temperature of 25.6 °C (Muar Climate, 2023). The local topography ranges from 253 m to 1 m above sea level. The land cover in the water catchment areas consists of 1.6% wetlands, 8.2% urban areas, 40.8% agricultural land, and 49.4% forested areas (Ching *et al.*, 2013). Historically, the Muar River served as a vital trade route for merchants accessing the East Coast of Peninsular Malaysia (Idris *et al.*, 2016). Presently, the river is primarily utilised for recreational activities, such as fishing and camping, by local residents (Samah *et al.*, 2011). The distinct landscape of the Muar River has also attracted attention from sociological studies (Samah *et al.*, 2011), providing an exciting opportunity for ethnoichthyological research. The local population relies on the Muar River for various socio-economic activities, including fishing, aquaculture, recreation, tourism, and sports (Samah *et al.*, 2011). The lower section of the Muar River was selected as the study site due to the presence of several fish markets, which offer a wide range of potential respondents with knowledge and experience related to *B. polykladiskos*.

Figure 3. The area of sampling for respondents in Muar City

Data Collection and Analysis

The fish specimen from Muar River, Johor was caught using a gill net. The specimen was fixed in 10% formalin and later transferred into 70% ethanol for long term preservation. The preserved fish was deposited in the Muzium Zoologi Universiti Malaya, Kuala Lumpur (UMKL). Methods of counting and measuring generally followed Hubbs & Lagler (1964). The measurements were taken to the nearest 0.1 mm with digital calipers on the left side of the fish and measurements of the body parts were recorded as proportion of standard length (SL). Fish specimen was identified following Sasaki (2001) and Yoshida *et al*. (2013).

Data on ethnoichthyological knowledge associated with *B. polykladiskos* were obtained through the distribution of questionnaires among local communities in Muar. These questionnaires, derived from the EthnoKIT©, were specifically designed for an exploratory study, as this research represents the first documentation of *B. polykladiskos* in the area. The questionnaires were structured into two sections: a demographic questionnaire and an ethnoichthyological assessment, mirroring the format of EthnoKIT©, which also comprises two sections. To ensure the acquisition of relevant data, an exponential non-discriminative snowball sampling method was employed, utilising the Google Forms platform. This approach allowed us to effectively target respondents within the fisheries-related community. The survey was conducted over the course of one month in June 2021. Subsequently, all collected data were meticulously cleaned and analysed using Microsoft Excel and SPSS software (version 22). Descriptive and inferential analyses were conducted to examine the data, employing appropriate statistical techniques to derive meaningful insights.

RESULTS

Species Account

Class Actinopterygii
Order Perciformes
Family Sciaenidae
Bahaba polykladiskos (Bleeker, 1852)
Table 1; Figure 1

New record. UMKL 12883, 1 ex., 340 mm SL; Malaysia: Johor: Muar River estuary (2° 2.9974 N, 102° 33.9468 E); coll. Mohd Ilham Norhakim Lokman, 20 February 2021.

Description. Body relatively elongated with a standard length 340 mm. Caudal peduncle slender (7.0% of SL), dorsal fin continuous with a deep notch (XI, 28), lateral line scales extending onto caudal fin (46+9), anal fin with two spines and 7 soft rays (II, 7) with the second spine largest and stout. Freshly caught fish silvery color (Figure 1). Detailed morphometric measurements and meristic counts are provided in Table 1.

Table 1. Morphometric and meristic data of *Bahaba polyklasdiskos* UMKL 12883 in present study. Measurements in millimeter (mm)

Measurements (mm)	
Standard length (SL)	340
Measurements in % of SL	
Head length	33.5
Eye diameter	4.3
Snout to anal-fin origin	66.2
Snout to dorsal-fin origin	34.1
Snout to pelvic-fin insertion	33.7
Pectoral-fin length	23.8
Pelvic-fin length	23.4
Body depth	28.4
Body width	18.3
Dorsal-fin base length	68.2
Longest dorsal spine length	15.2
Anal-fin base length	10.5
Longest anal spine length	17.7
Caudal peduncle depth	7.00
Meristics	
Dorsal-fin rays	XI, 28
Anal-fin rays	II, 7
Pectoral-fin rays	18
Pored lateral line scales	46+9
Scales above lateral line	7
Scales below lateral line	7
Circumpeduncular scales	15

Ethnoichthyological Study

A total of 47 local individuals residing in the vicinity of the Muar River participated in the

questionnaire concerning *B. polykladiskos* during the month of June 2021. Table 2 presents the socio-demographic characteristics of the study respondents. The majority of the respondents were male, accounting for 96% (n=45) of the total, while females constituted only 4% (n=2). In terms of age distribution, 21% (n=10) fell within the range of 18-30 years, followed by 38% (n=18) in the 31 - 40 age group, and 40% (n=19) were 41 years old or older. The respondents included individuals from the Malay community (77%) as well as the Chinese community (23%). Regarding educational background, the highest proportion of respondents completed O-level or SPM (70%), followed by those with a Diploma (23%), and a bachelor's degree (4%). The survey revealed that approximately 32% of the respondents were self-employed, 30% worked in the private sector, 17% were engaged in fishing activities, 13% worked as fishmongers, while the remaining individuals consisted of business owners (4%) and government sector employees (4%). In terms of income, the majority of respondents reported earning between RM 1000 - 2,999 per month (40%), followed by those earning between RM 3000-4999 per month (30%), above RM 5000 per month (21%), and below RM 1000 per month (9%).

Table 2. Demography of respondents

Demography	Frequency	Percentage (%)
Gender		
Male	45	96
Female	2	4
Age		
18-30 years old	10	21
31-40 years old	18	38
41 years old and above	19	40
Race		
Malay	36	77
Chinese	11	23
Education		
Diploma/Matrik/STPM	11	23
Degree	2	4
Malaysian Skill Certificate	1	2
UPSR/PMR/SPM	33	70
Occupation		
Business owner	2	4
Fishermen	8	17
Fishmonger	6	13
government	2	4
Private	14	30
Self-employed	15	32
Income range per month		
under RM 1000	4	9
RM 1,000-2,999	19	40
RM 3,000-4,999	14	30
above RM 5,000	10	21

Knowledge and Demand of *B. polykladiskos*

In relation to personal experiences of the respondents with *B. polykladiskos*, a noteworthy 98% of the respondents demonstrated recognition of the species, with 94% having actually observed it (Table 3). When queried about the sources from which they acquired

information about the species, 41% of the respondents cited firsthand encounters through netting the fish, followed by anglers at 20%, and gaining knowledge through the process of buying and selling at 13%. Additionally, 13% mentioned learning about the species through acquaintances. Other sources of information were each mentioned by less than 10% of the respondents, including the internet (7%), consumption as a luxury food item (2%), information obtained from magazines (2%), and personal discovery (2%). The survey also revealed that the respondents primarily encountered this species in the Muar River (74%) and in market areas (21%). To gauge the demand for *B. polykladiskos*, respondents were asked about their experiences with purchasing and selling this species (Figure 4). The results indicate that 79% of the respondents stated that they would not buy the fish, while only 21% expressed willingness to purchase it. Correspondingly, 81% of the respondents had never bought the fish. However, with regard to selling the species, 70% of the respondents reported having experience in selling *B. polykladiskos*. This is reflected in their responses regarding the price of *B. polykladiskos*, with the maximum recorded price reaching RM 11,500 and a mean price of RM 2,238.22 per fish. It is

Table 3. Knowledge and experience of Muar communities with *B. polykladiskos*

Knowledge and experience with *B. polykladiskos*	Yes (%)
Personal experience	
Recognize *B.polykladiskos*	98
Have seen *B. polykladiskos*	94
Source of information	
Angler	20
Buyer & seller	13
Fisherman (netting)	41
Friends	13
Internet	7
Luxury food	2
Magazine	2
Self-discovery	2
Location of *B. polykladiskos*	
Market	21
Muar river	74
Never seen	5

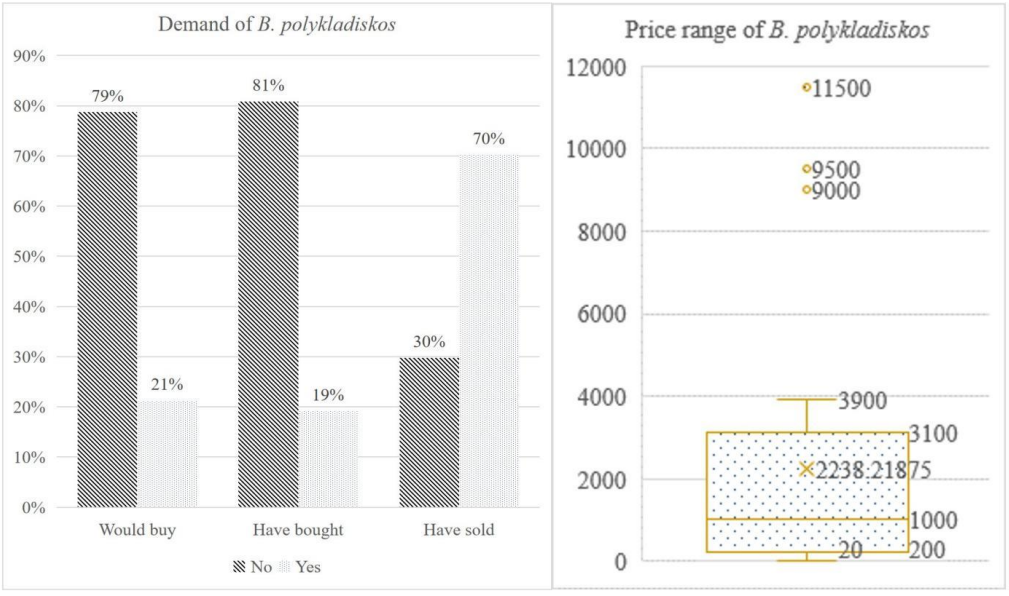

Figure 4. Demand and price range of *B. polykladiskos* in Muar

worth noting that the price range for this species is quite disparate, as the lowest recorded price stood at only RM 20. This disparity in price was initially determined by its gender with male has higher price than female. Then, the price was determined by its weight whether it exceed 2 kg. Lower than 2 kg would definitely has lower price. The price only plummeted after the weight exceeds 5 kg as based on the weight, the swim bladder would logically be bigger and highly sought for traditional medicine.

Activities Involving *B. polykladiskos*

Subsequently, we aimed to evaluate the level of involvement of each respondent in catching *B. polykladiskos*. Notably, a considerable 66% of the respondents reported having participated in the capture of *B. polykladiskos*, while the remaining 34% had not engaged in such activities. Among those involved in catching *B. polykladiskos*, diverse opinions were expressed regarding the optimal timing for catching the fish (Figure 5). The most frequently cited response was during periods of brackish water (39%), primarily in the vicinity of the Muar River. This was followed by preferences for capturing the fish during the rainy season (20%) and at night-time (20%). Additional responses falling under the category of "Others" included catching *B. polykladiskos* during the early part of the year (6%), towards the end of the year (7%), during daytime, and during neap tide (2%).

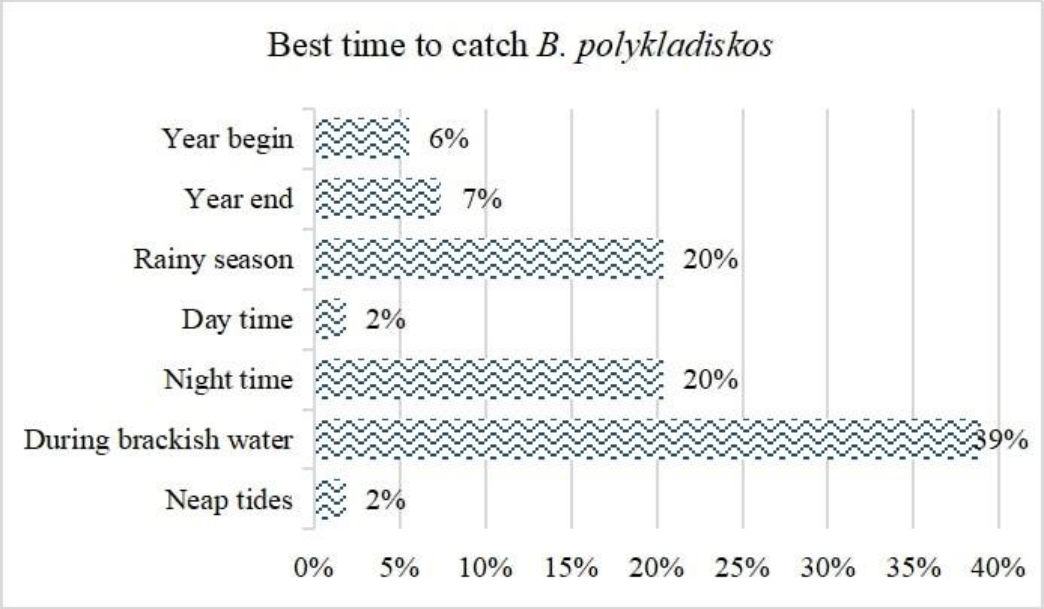

Figure 5. Best time to catch *B. polykladiskos* in Muar

Belief and Uses of *B. polykladiskos*

Table 4 illustrates the diverse uses and associated benefits of consuming *B. polykladiskos* as reported by the respondents. Among the participants, 60% attributed the use of this species to beliefs and folklore, while 30% acknowledged its utilisation as a food source. Additionally, 17% recognized *B. polykladiskos* for its traditional medicinal properties. Interestingly, a smaller proportion (6%) mentioned its application in surgical sutures. When examining the perceived benefits of consuming *B. polykladiskos*, the respondents highlighted its contribution to general health (66%), maintenance of internal organ health (60%), enhancement of sexual prowess (40%), and potential longevity effects (15%). On additional information of the use of *B. polykladiskos* is the use in making traditional cuisine. The Spine Bahaba species, known for its mild taste and affordability (typically priced at RM 10 or below), finds a unique utility in local culinary practices. The swim bladder, commonly referred to as 'gelembung ikan,' is skillfully transformed by the community into bite-sized crispy snacks through deep frying. These crispy morsels are then incorporated into herbal soups, where they serve as a traditional remedy in local folk medicine. Apart from that, *B. polykladiskos* also known as the symbol of grandeur, as it is frequently utilized by locals as a collector's item.

Table 4. Uses and benefits *B. polykladiskos*

Uses of *B. polykladiskos*	Answered yes (%)
Food	30
Traditional medicine	17
Folklore & believe	60
Surgical suture	6
Believed benefit of *B. polykladiskos*	
Longevity	15
Sexual Prowess	40
Internal organ health	60
General health	66

DISCUSSION

This study represents the first documented occurrence of *B. polykladiskos* in Peninsular Malaysia, specifically within the Muar River in Johor, Malaysia. The conservation status of *B. polykladiskos* is currently classified as data deficient (DD) in the IUCN Red List of Threatened Species due to the scarcity of information regarding its population and life history (Chao *et al.*, 2020). Habitat degradation poses a significant threat to this species, as unprotected spawning habitats in estuaries can adversely affect the larvae and juveniles of *B. polykladiskos* (Chao *et al.*, 2020). A clear example of the impact of such threats can be observed in the case of its sister species, *Bahaba taipingensis*, which is endemic to China. The intensive use of bottom trawling has resulted in high juvenile mortality and has ultimately led to the commercial extinction of *B. taipingensis*, warranting its listing as critically endangered (CR) on the IUCN Red List of Threatened Species (Sadovy & Cheung, 2003; Moore, 2012; Liu, 2020).

In comparison to previous studies, the application of the ethnoichthyology method in this research extends beyond the mere taxonomic identification of fish based on local names. It also encompasses aspects such as fish morphology, ecology, behavior, and medicinal uses (Djidohokpin *et al.*, 2020). Although the ethnoichthyological information collected in this study remains limited to the basic knowledge held by local communities, it serves as a valuable resource for researchers, laying the groundwork for future investigations, given that this represents the first-ever report of *B. polykladiskos* in Peninsular Malaysia.

The fish maw derived from *Bahaba* species holds significant value in traditional Chinese medicine, as it is believed to possess various health benefits, including anti-fatigue properties (Zhao *et al.*, 2016), immune-boosting effects (Wen *et al.*, 2015), and anti-aging properties (He *et al.*, 2021). Consequently, fish maw can be sold at high prices. Our findings reveal a wide price range for *B. polykladiskos*, dependent on the size and quality of the fish. While the maximum price recorded reached RM11,500, it remains lower than the reported price in Sarawak, East Malaysia, where *B. polykladiskos* fish maw was sold for RM60,000 per kg (Latip, 2019). The fish maw trade holds considerable global market value, with Hong Kong serving as a major trade hub. Import data from Hong Kong for the years 2015 to 2018 indicate declared import values ranging from 264 to 394 million USD (de Mitcheson *et al.*, 2019). Given the significant conservation implications, such as high demand (Ben-Hasan *et al.*, 2021), the uncertain IUCN status, and evidence of trade activity, it is crucial to establish specific regulations and conduct further research on this species in the future.

CONCLUSION

This study presents the initial documentation of Gelama Tirusan (*B. polykladiskos*) in Peninsular Malaysia, specifically within the Muar River of Johor. Through the application of the ethnoichthyology approach, the investigation successfully elucidates the trade activity, uses, and perceived benefits of this species among local communities. As a next step, we strongly recommend the conduction of further research to ascertain the species' distribution and population size, as well as to gain a comprehensive

understanding of its biology and ethnoichthyology within the Malaysian context. Such studies would significantly contribute to the knowledge base surrounding Gelama Tirusan and its conservation in Malaysia.

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