Faculty of Resource Science and Technology

Length Weight Relationship of *Phalacronotus apogon* from Batang Kerang floodplain, Balai Ringin, Sarawak

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A project submitted in partial fulfilment of the
Final Year Project 2 (STF 3015) course

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DECLARATION

I hereby declare that no portion of the work referred to in this dissertation has been submitted in support for another degree or qualification to this university or any other institution of higher learning.

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ABSTRACT

Length-weight relationship of *Phalacronotus apogon,* locally known as "Ikan Lajong", a freshwater catfish from Batang Kerang, Balai Ringin was studied. The biometric measurement of this fish species was also have been documented. Fish samples were collected from 23rd to 24th March 2022 at four distinct stations. A total of 66 individuals of the fish samples were collected during the sampling period. The mean weight of *P. apogon* is 362.86 ± 293.20, while the mean of total length is 43.13 ± 8.80. The length weight relationship has been expressed in linear regression. The length-weigh relationship obtained is *log W = 3.1894 log TL + 2.723,* whereas, the coefficient of determination (R^2) is 0.9772. The results obtained showed that the growth pattern of the fishes was positive allometric growth with *b* values obtained 3.1894 in aspect of total length. This study provided the first baseline data of length-weight relationship and its biometric measurement of *P. apogon* from Batang Kerang, Balai Ringin, Sarawak.

Key words: Batang Kerang; Length-weight relationship; biometric measurement; *Phalacronotus apogon*; freshwater catfish

ABSTRAK

Hubungan panjang-berat Phalacronotus apogon yang dikenali sebagai ikan Lajong oleh penduduk tempatan merupakan ikan air tawar telah dikaji dari Batang Kerang, Balai Ringin. Pengukuran biometric sepsis ikan ini juga telah didokumentasikan. Ikan telah dikumpul dari 23 hingga 24 Mac di empat stesen yang berbeza, Sebanyak 66 individu sampel ikan telah dikumpul dalam tempoh persampelan tersebut. Purata berat P. apogon ialah 362.86 ± 293.20, manakala purata panjang ialah 43.13 ± 8.80. Hubungan berat panjang P. apogon telah dinyatakan dalam regresi linear. Persamaan regresi linear dalam graf ialah log W = 3.1894 log TL + 2.723, manakala pekali penentuan (R^2) ialah 0.9772. Keputusan yang diperolehi menunjukkan pola pertumbuhan species ikan ini adalah pertumbuhan alometrik positif dengan nilai b diperolehi adalah 3.1894 dalam aspek jumlah panjang ikan tersebut. Kajian ini telah menyediakan data asas pertama hubungan Panjang-berat dan ukuran biometrik P. apogon dari Batang Kerang, Balai Ringin, Sarawak.

Kata kunci: *Batang Kerang; Hubungan panjang-berat; pengukuran biometrik; Phalacronotus apogon; ikan air tawar*

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LWR	Length-weight relationship
TL	Total Length
BW	Body Weight
SL	Standard Length

INTRODUCTION

1.1 Background

Fish plays an important role in a country's development such as food sources for its low-cost, source of high-nutrient protein (Ndiaye *et al.*, 2015), high in vitamins and includes varying amounts of fat and minerals that are beneficial to human health (Dan-Kishiya, 2013). Moreover, because of their high nutritional value, fish products are highly in demand. This led to the general well-being of the fish is important to be monitored in order to produce good quality product of the fishes. In contrast, the growth of fish depends on their food consumption and aquatic environment for its survival and growth. Batang Kerang is situated at Balai Ringin, Sarawak and are abundance with freshwater fish species (Rahim *et al.*, 2009). Meanwhile, *Phalacronotus apogon* that is locally known as "Lajong" fish, is a freshwater catfish which also comes from a member of the Siluridea family. According to Elvyra *et al.* (2020), humans consume this catfish species which also have great economic value that can be served as smoked fish.

Healthy river may also become a source for healthy fishes. Moreover, the measurement of healthy fish can be obtained with length and weight analysis. Length weight relationship research can be a low-cost method of assessing pollution's impacts on fish health. Amonodin *et al.* (2018) stated that, the research of length-weight relationship is extremely crucial for the conservation and management of fish in aquatic systems, particularly freshwater systems, which are the most common region of effective pollution sources and this is because of the intensity, length, and severity of anthropogenic impacts. Therefore, this relationship could be used to calculate the fish's well-being, and the data collected can be used to quantify the influence of the aquatic environment on the same species in other water bodies (Gupta & Tripathi, 2017).

Size information is a vital characteristic for measuring fish development, weight, gender, classification and species identification (Hao *et al.,* 2016). In fisheries and fish biology, the length-weight relationship (LWR) of fishes is vital because it allows for the determination of the fish's weight average of a certain length group by establishing a mathematical connection between them (Sarkar *et al.,* 2013). Fish population metrics must be understood in order to improve better management and also for conservation.

LWRs allow comparisons of life histories and morphology between various fish species or populations from different environments and/or locations. As a result, we need to establish the length-weight relationship of fish taken at a specific location over a specific time period. The study conducted for this purpose established length-weight relationship of *P. apogon* from Batang Kerang, Balai Ringin, Sarawak.

1.2 Problem statement

The study and information of length weight relationship of the *P. apogon* was merely studied comprehensively in Peninsular Malaysia but none in Sarawak, more notably in Batang Kerang, Balai Ringin. Moreover, the current population growth of *P. apogon* are poorly known in this area. This study potentially could for future research on this species. As a result, the compilation of a complete baseline data set for *P. apogon* in this region will be provided.

1.3 Objectives

The purpose of this study mainly aims:

1. To document the biometric measurement of the *Phalacronotus apogon* in Batang Kerang, Balai Ringin, Sarawak;

2. To determine the length and weight relationship of the *P. apogon* from Batang Kerang.

LITERATURE REVIEW

2.1 Batang Kerang, Balai Ringin, Sarawak

The study area is situated at Batang Kerang Balai Ringin, Serian, Sarawak. According to Rahim *et. al.* (2009), Batang Kerang floodplains are flooded with woodlands and floating plants which are valuable habitats for the fishes. The water quality of the Batang Kerang floodplain can be divided into two categories which is the brown water river and the black water river (Rahim *et al.,* 2009). Furthermore, Rahim *et al.,* (2009) mentioned that brown water river has far more species that the black water river in Batang Kerang floodplain. Brown water also provide broad and diverse environment compare to black water. Meanwhile, the high concentration of humic acids in black water rivers causes the water to have dark appearances (Rahim *et al.,* 2009). This floodplain is filled with abundance of freshwater species. Examples of fish families that are found in this floodplain are Anabantidae, Bagridae, Belontidae, Channidae, Clarriidae, Cobitidae, Cyprinidae, Eleotrididae, Helostomatidae, Luciocephalidae, Pangsaiidae, Siluridae and Tetraodontidae (Rahim *et al.,* 2009).

In addition, the brown water river is muddy because of the high sediment level. Large mats of floating aquatic vegetation such as *Hanguana malayana* and *Eichhornia crassipes* and other submerged aquatic plants can be seen in some parts of the brown water (Rahim *et al.,* 2009). Moreover, the acidic water of the black water river comes from the peat swamp forests. The floating vegetation and flooded forests of Batang Kerang floodplains is essential for the fishes as it provides food source and also its habitat. Apart from that, Batang Kerang river is an important ecosystem for the local people as it can provide food sources and income from fishing activities.

2.2 Family of Siluridea

There are 39 families under the Order Siluriformes and which includes the family of Siluridea (Froese & Pauly, 2000). The Siluridae family are freshwater catfish that has 107 recognised species, the majority of which are found in South and Southeast Asia, although several are also found in Europe (Ditcharoen *et al.,* 2019). Siluridae is based on the Latin word 'silurus', which means a type of fish. According to Atack and Ch'ien (2006), catfishes are a major freshwater family including over 100 species and 21 species found in Borneo. This family may grow to be 5 metres long as example one of the species is *Silurus glanis* (Atack & Ch'ien, 2006).

The general characteristics of Siluridea family is where the body is compressed and the head is depressed. Dorsal fins having less than seven rays, occasionally absent, and not followed by a spine. There are one or two pairs of mandibular barbels, one or two pairs of maxillary barbels, and no nasal barbels. the pelvic fins are small or missing, and the anal fin is rather long from 41 to 110 rays. Their adipose fin is absent. This family having about 13 genera, which includes *Kryptopterus* (glass catfish), *Micronema, Ompok, Phalacronotus, Belodontichthys, Ceratoglanis, Hemisilurus, Kryptoglanis, Pinniwallago, Pterocryptis Silurichthys, Silurus* (*Parasilurus* may be a synonym), and Wallago (Nelson *et al.*, 2016)

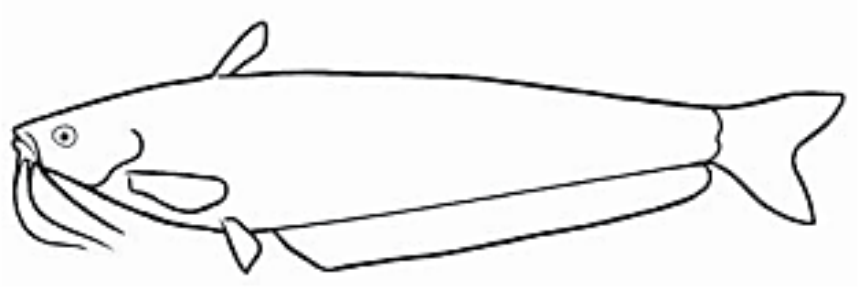

Figure 1 Structure of Siluridae family (Nelson *et al*, 2016)

2.3 Background of *Phalacronotus apogon* (Bleeker, 1851)

The common name for *P. apogon* is "Lajong". According to Froese & Pauly (2018), *P. apogon* is a freshwater fish inhabit Malaysian river (Malaysia Biodiversity Information System, 2018; Tropical Freshwater Fish, 2013). The fish comes from the Asia country such as Peninsular Malaysia, Mekong and Chao Phraya basins, Sumatra and Borneo (FishBase, 2018). This species inhabits turbid waters within large rivers (Kottelat, 1998), streams, canals and lakes (Kottelat & Widjanarti, 2005).

According to Elvyra *et al.* (2012), *P. apogon* naturally live in swamp river ecosystem which also the flood plain river. This can be proven by other studies (Fahmi-Ahmad *et al.*, 2015; Rashid *et al,* 2015) where *P. apogon* can be found at the Tasek Bera Ramsar Site, Pahang where it is a freshwater swamp-lake which is distinctive and important freshwater ecosystem in Peninsular Malaysia (Fahmi-Ahmad *et al.*, 2015). This also relates to the study conducted in Pahang River, Maran district Pahang (Zulkafli *et al.,* 2015) and Tembeling River, Pahang (Zulkafli *et al.,* 2016) where *P. apogon* can be found in both rivers respectively. These rivers both known for their abundance in ichthyofauna (Zulkafli *et al.*, 2015; Zulkafli *et al.,* 2016). In Pahang river, it is mostly covered by 73.2% forest, rubber plantations are 10%, rivers, marshers, and lakes made up for 10%, agricultural and urban areas for 2.8%, and 4% of oil palm plantations (Tachikawa *et al*., 2004, as cited in Rashid *et al,* 2015). Meanwhile, for Tembeling river, 66% of the area is primarily covered by forests, 13% of rubber plantations, 12% by oil palm plantations and 9% by marshes, lakes, rivers (Rashid *et al,* 2015). These habitats almost show the similarity of its in Batang Kerang, Balai Ringin, Sarawak.

P. apogon can be seen as a species that preferred to live and thrive in floodplain zone. According to FishBase (2018), they feed on pelagic species in midwater to high depths. During high water levels, this fish migrates into flooded riparian woodlands and

most likely, floodplains (Termvidchakorn & Hortle, 2013). Throughout the wet seasons, it spawns. In October, young fish start to return to the rivers, where they are plentiful until January (Termvidchakorn & Hortle, 2013). As the study of this fish species are still scare and limited, therefore, the maturity size of this fish is still unknown. However, they can reach on maximum length of 130 cm of their standard length (FishBase, 2018). Elvyra *et al.* (2012) mentioned that this fish species contains with high economic value which can be consume especially if in smoked fish form. In addition, it is a significant commercial species in Cambodia (Termvidchakorn & Hortle, 2013).

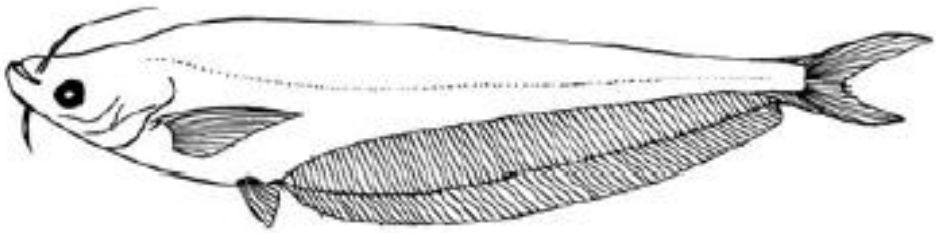

Figure 2 Adult *Phalacronotus apogon* (Termvidchakorn and Hortle, 2013)

2.3.1 Taxonomy

Phalacronotus apogon is a freshwater catfish species belong to Siluridae family in Order Siluriformes. Additionally, the previous name for *P. apogon* is known as *Micronema apogon* and *Kryptopterus apogon*. In taxonomy, whenever the scientific knowledge of animal species and their relationships are changing, their scientific name might change as well (Myers *et al*, 2022). Thus, the species is shifted from one genus to the other, and a name recorded at one level is changed to the other in the taxonomic hierarchy (Mori, 2013)

Phylum	Chordata
Class	Actinopterygii
Order	Siluriformes
Family	Siluridae
Genus	*Phalacronotus*
Species	*apogon* (Bleeker, 1851)
Synonym	*Kryptopterus apogon* (Bleeker, 1851)
	Micronema apogon (Bleeker, 1851)

List of taxonomy of *P. apogon* (Source: Malaysia Biodiversity Information System, 2018)

2.4 Status population of *Phalacronotus apogon* in Malaysia

There are studies of length-weight relationship of *P. apogon* (Zulkafli *et al.*, 2015; Zulkafli *et al.*, 2016) found in Malaysia. In contrast, *P. apogon* can be found in Tasek Bera, Ramsar Site, Pahang (Fahmi-Ahmad *et al.*, 2015), and Sungai Pahang, Maran District, Pahang, Malaysia (Rashid *et al.*, 2018). In addition, this species has been found in two different rivers which were in Pahang River have found 86 fish and in Ulu Tembeling River found 27 of *P. apogon* fish (Sukeri *et al.*, 2020). Moreover, *P. apogon* have been found in Rajang Basin in Sarawak, Malaysia under the synonym of *Micronema apogon* (Parenti *et al.*, 2005; Bleeker, 1851).

2.5 Length and Weight Measurement

2.5.1 Length Measurement

In the fish industry, length is used as assessment method to determine the length at which fish may be harvested. On other hand, the length of fish is frequently utilized for fish populace evaluations and in many cases utilized in sport fishing guidelines (Lynch, 2014). Onsoy *et al.*, (2011) stated that the body length of fish is often measured as a proportion of standard length (SL), total length (TL), and fork length (FL) The total length is the longest length of the entire body in straight line, not across the curvature of the body, but between the most anterior and most posterior points (Froese & Pauly, 2000). In contrast, the total length is measures from the tip of the snout to the caudal fin's endpoint (Onsoy *et al.*, 2011). For the fork length, it is measured from the snout's tip until the centre of the concave tail (Onsoy *et al.*, 2011). This measurement is used rather than standard length in fish where the end of the vertebral column is difficult to determine, and it is used rather than total length in fish with rigid, forked tails, such as tuna (Froese & Pauly, 2000). Whilst, the standard length is the distance between the snout and the tail end of the vertebral column (Onsoy *et al.*, 2011). The standard-length measurement is utilised because long-preserved fish frequently lose the ends of their caudal fin rays due to fracture following the desiccation impact of alcohol (Froese & Pauly, 2000).

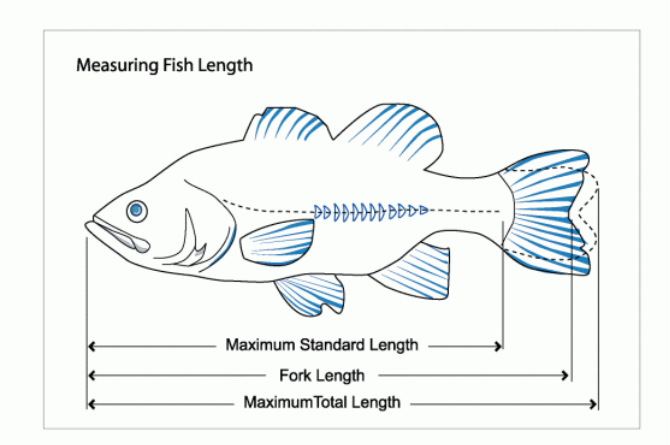

Figure 3 Length measurement of fish (FishXing, 2006)

2.5.2 Weight Measurement

Another measurement technique that depicts the fish growth phase is weight. Weight can be estimated from a group of fishes, an individual fish, or from a portion of the fish such as the gonads, liver, visceral fat, and so forth. The weight of a fish fluctuates as it dries therefore, weighing should be done immediately after catch (Mous *et al.,* 1995). Fish have various shapes and sizes. This shows the presence of specific highlights of qualities, shape, and size of the fish in nature.

2.6 Length-weight relationship

The relationship between fish length and weight is one of the complimentary data in managing fishing resources, translating catch data, projecting population size and death rates, and identifying which type of dragnet should be employed to collect specific-size fish. Several research on length-weight relationship (LWR) characteristics of the fish species have been undertaken in order to estimate fish's weight average for a specific length group, fish health, and morphometric differentiation of species and populations between various areas (Das *et al.,* 2021).

The length-weight relationship of fishes can estimate for both marine and freshwater fish species. Freshwater fish such as *Clarius batrachus* have shown a positive allometric growth on its b value of its length-weight relationships (Kumar *et al.,* 2017). The growth of *C. batrachus* also supported by other studies of cultured *C. batrachus* for its both sexes. The study also mentions where the individual condition factors, such as the fish's well-being and its degree of fatness, might explain the weight disparities in the study (Kumar *et al.,* 2017).

In Kerian River Basin and Pedu Lake, the study length-weight relationship of freshwater species has revealed that b value in the regression analysis ranging from 2.66 of *Chela* sp. to 4.1063 of *Labiobarbus lineatus* (Isa *et al.,* 2010). According to Isa *et al.* (2010),

the trend of growth, increase in length and weight of many fish species also revealed that the longer the length, the weight will be heavier. The study from Adebiyi (2013) states that the *Pomadasys jubelini* length-weight relationship have predicted the increase of its weight with increasing length regardless of the species age or sex. However, b value of this species in this study indicated that its growth trend was allometric negative ($b < 3$). When allometric growth resulted in a fish, (Tesh, 1968, as cited in Dan-Kishiya, 2013) observed that fish do not develop symmetrically and as they increase in length, they become thinner.

Mustafa *et al.* (2021) did a research on the length-weight relationships study of three polynemid fishes. Their findings on the studied fishes which are *Filimanus xanthonema, Polynemus melanochir* and *P. paradeseus* have showed their allometric growth were all negative. According to Hossen *et al.,* (2017), the body size of smaller groups of fishes frequently have greater b values than the body size of larger groups of fish. However, difference in pattern of the fish's growth for the same species are not uncommon, as the b value is impacted by various aspects of parameters including age, sex, diet and their eating habits (Hossain *et al.,* 2012).

2.7 Factor influencing on length-weight relationship

The length-weight relationships characteristics of fish can vary depending on the season and their environments (Olim and Borges, 2006, as cited in, Adebiyi, 2013). For instance, the differences in weight growth of *C. batrachus* might connected to the season because the largest weight of fish was observed in September, which is the post-monsoon season (Kumar *et al.* (2017). Azim *et al.* (2018) state that it is possible for Carangid fish with a positive growth rate for *D. macrosoma* and *S. leptolepis* species where they were more tolerant to water parameter change and fluctuation, especially in the estuary environment which also allowing them to live and develop better. Further explained by Azim *et al.* (2018), the result

of this species has been agreed on few studies where it have shown same negative allometric value on other Carangid species in Malaysia. Furthermore, present study conducted by Das *et al.* (2021) for commercially trawl species and found that two out ten fish species which were *G. erythrourus* and *D. punctata* have showed negative allometric results. Consequently, the differences in result may due to environmental factors like food availability, spawning factors or even temperature (Das *et al.*, 2021).

However, several studies indicate that length-weight relationship of fish was not only influence by the environment but also due to other factors such as gonad maturity, fullness of the stomach, size range and health of fish in general (Das *et al.*, 2021). The study of freshwater fish *Amblypharyngodon mola* reported that the female's regression coefficient *b* was higher compare to the male's (Gogoi & Goswami, 2014). Females had a greater exponent value might be related to their overall gonadal contents, appetite and environmental factors (Gogoi & Goswami, 2014). Sarkar *et al.* (2013) also mentioned that the differences in *b* value include, differences in the length observation of the caught specimens, as well as in handling the preservation procedures. This also support on the growth of *C. batrachus* where differences in *b* value can be attributed to a variety of factors such as differences in the number of specimens' studies, region and season impacts (Kumar *et al.*, 2017). Adeosun (2018) added on length-weight relationship of *Parachanna obscura* a freshwater species where he found that the size of this species was less compare to its optimum size which are within the range of 35 cm to maximum 50 cm (Egwui *et al.*, 2013, as cited in Adeosun, 2018). Having said that, he concluded that this occurrence is possibly due to overfishing of the species in the waterbodies and the mesh size that were used while capturing the fish species causes the size to be different (Adeosun, 2018).

2.8 Growth performance of fish

Quality and quantity of the food that fish consume are the most significant elements determining fish development, its survival and mortality. Lochmann (2019) states that, fish require critical amino acids in proteins to help for its development, cell growth, overall health conditions, and also for reproductions. On the other hand, the growth performance of fish is really depending on their environment and food availability. The study from Azim *et al.* (2018) proofs that it's safe to suppose that the bodies of the Carangid fishes develop quicker than their body size, indicating healthy environmental conditions and food availability in their environments. In contrast, the fish's health and growth are also linked to the quality of water in which they are grown. Physical chemical/biochemical, or perhaps a combination of these factors influences in fish growth and yield in freshwater aquatic systems (Viadero, 2005). For instance, Nile Tilapia's growth performance was affected with factors such as water quality, water temperature, pH, nutrient waste and dissolved oxygen (Workagegn *et al.,* 2014). To sum up, fish growth really depends on variety of reasons and caused. Each of growth differences in every fish species are influence by many factors.

MATERIALS AND METHODS

3.1 Study area

The study area was located at the Batang Kerang floodplain where the sampling was taken from brown waterbody on 23rd and 24th March 2022. The sampling of the *P. apogon* was carried out at four stations located in brown water river shown in Figure 4.

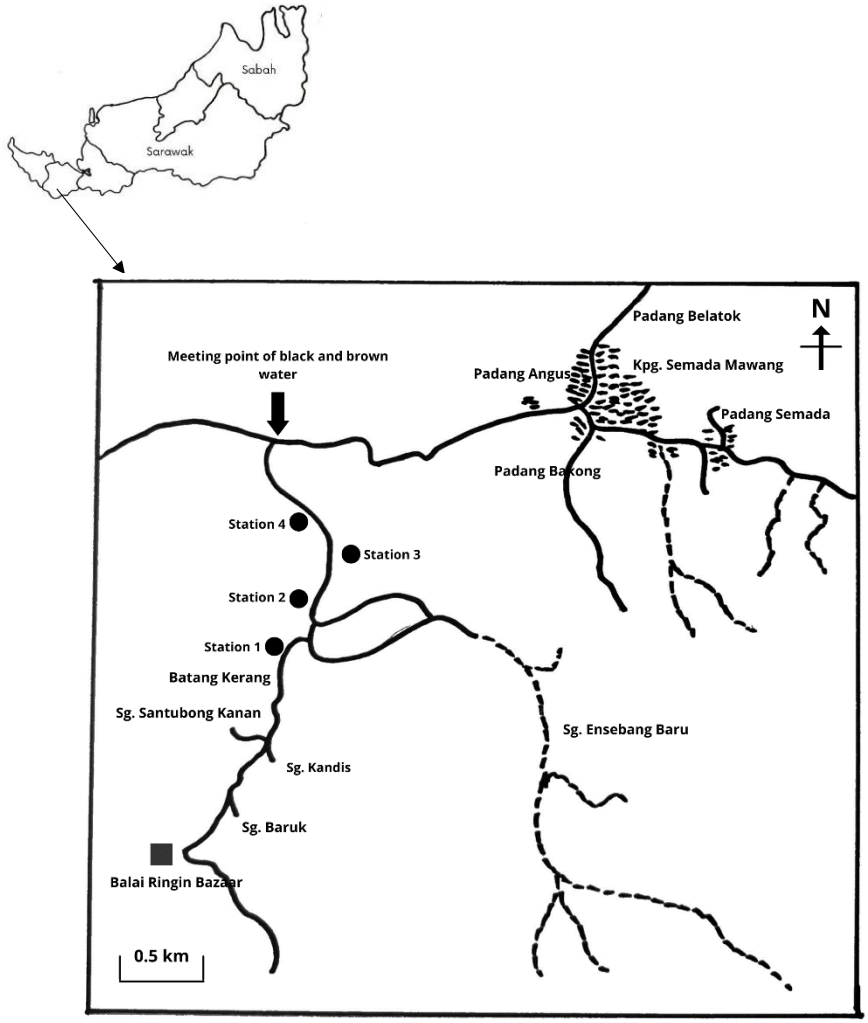

Figure 4 Location of Batang Kerang, Balai Ringin, Serian, Sarawak