

## PRELIMINARY CHECKLIST OF FRESHWATER FISHES OF ULU PAIP ECO-PARK FOREST, KEDAH, PENINSULAR MALAYSIA

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### ABSTRACT

This report is the first on freshwater fishes of Ulu Paip Eco-Park Forest, Kedah, which aims to document the fish species richness in this recreational forest. All species were collected from the main stream, Sungai Karangan, and its unnamed tributaries. In total, 20 species of fishes from 10 families were recorded. Cyprinidae is the most dominant family with six species followed by Danionidae with three species. Other families contribute at least one species each. Most of the species recorded here are commonly found in the northern part of Peninsular Malaysia. Further studies should be expected to record more species and the utilization of various sampling gear such as electro fishing technique would be able to record the true species richness of fishes in this area.

**Key words:** Species richness, Ulu Paip, logging, Gunung Bongsu, recreational forest

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### INTRODUCTION

Peninsular Malaysia was blessed with countless numbers of small to large streams within its catchment areas. These water-bodies were able to sustain diverse species of aquatic organisms, particularly freshwater fish species. To date, about 289 freshwater fish species were known to be existed in Peninsular Malaysia (Zakaria-Ismail *et al.*, 2019), and the number was expected to increase especially for the cryptic species with the advancement in the genetic studies. There were few studies on fish species richness has been conducted in the recreational areas (Shah *et al.*, 2009; Ahmad *et al.*, 2018a) as well as in the stream associated with the farm field (Ahmad *et al.*, 2018b). Based on the studies, *Barbodes binotatus*, *Hampala macrolepidota*, and *Mystacoleucus obtusirostris* were among the common species that inhabit the small stream's habitat in the recreational areas. There were 22 species of fishes were recorded by Ahmad *et al.* (2018b) in the farm field area while recreational areas

had recorded a diverse number of fish species which were 32 species (Ahmad *et al.*, 2018b) and 37 species (Shah *et al.*, 2009), respectively.

However, the fish species richness in Ulu Paip Eco-Park Forest that is situated within the Gunung Bongsu Forest Reserve was yet to be explored. This recreational forest is surrounded by agricultural areas including oil palm and rubber plantations, and small orchards thus, prone to the indirect effect of wastewater run-off and chemical discharges sporadically. Also, the illegal logging activity at the upper stream has diminished some of the pristine habitats within this area especially the stream itself. Given its large area for flora and fauna to flourish, only one study on amphibians has been conducted at this site to date (Shariza & Ibrahim, 2014). Looking at the rapid deterioration of the surrounding areas and the water quality of the stream, it would be supremely urgent to obtain some information on the ichthyofauna living here. This rapid assessment of ichthyofauna in this recreational area was carried out to document the fish species richness as baseline information that may be useful for habitat management and conservation plans in the future.

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## MATERIALS AND METHODS

Ulu Paip Eco-Park Forest, Kedah is a lowland dipterocarp forest located in the north-eastern parts of Gunung Bongsu Forest Reserve, 20 km from Kulim town, and can easily be accessed by road. The main stream, Sungai Karangan is originated from Gunung Bongsu (658 m above sea level), flows into Sungai Muda through Sungai Sedim before being discharged into the Straits of Malacca. The stream is shallow with sandy substrate punctuated mainly by boulder and pebble beds. The riparian vegetation canopy covered most of the stream banks but the middle section of the stream is often exposed, allowing the penetration of sunlight during the day to reach the bottom depth of the stream.

Fishes were collected from Sungai Karangan (5°23'37.1" N, 100°40'00.4" E) which flows within the Ulu Paip Eco Park Forest (Figure 1). The fish collection was carried out using a hand-held push net (mesh size 3 mm) and cast net (mesh size 10 mm) during four sampling occasions (April, May, July, and September 2014). All the fishes were placed in an aerated bucket filled with stream water to reduce stress and mortality. Most of the species were identified *in situ* and released back into the stream upon identification. All the species were identified into species level using standard taxonomic references of Rainboth (1996) and Zakaria-Ismail *et al.* (2019) and van der Laan and Fricke (2020) while the current taxonomic of Cypriniformes follows Tan and Armbruster (2018). The familial arrangement follows Kottelat (2013). Voucher specimens were collected whenever possible and fixed in 10% formalin. After two weeks, voucher specimens were transferred into 70% alcohol for long term storage and deposited at General Laboratory, Universiti Malaysia Terengganu.

## RESULTS AND DISCUSSION

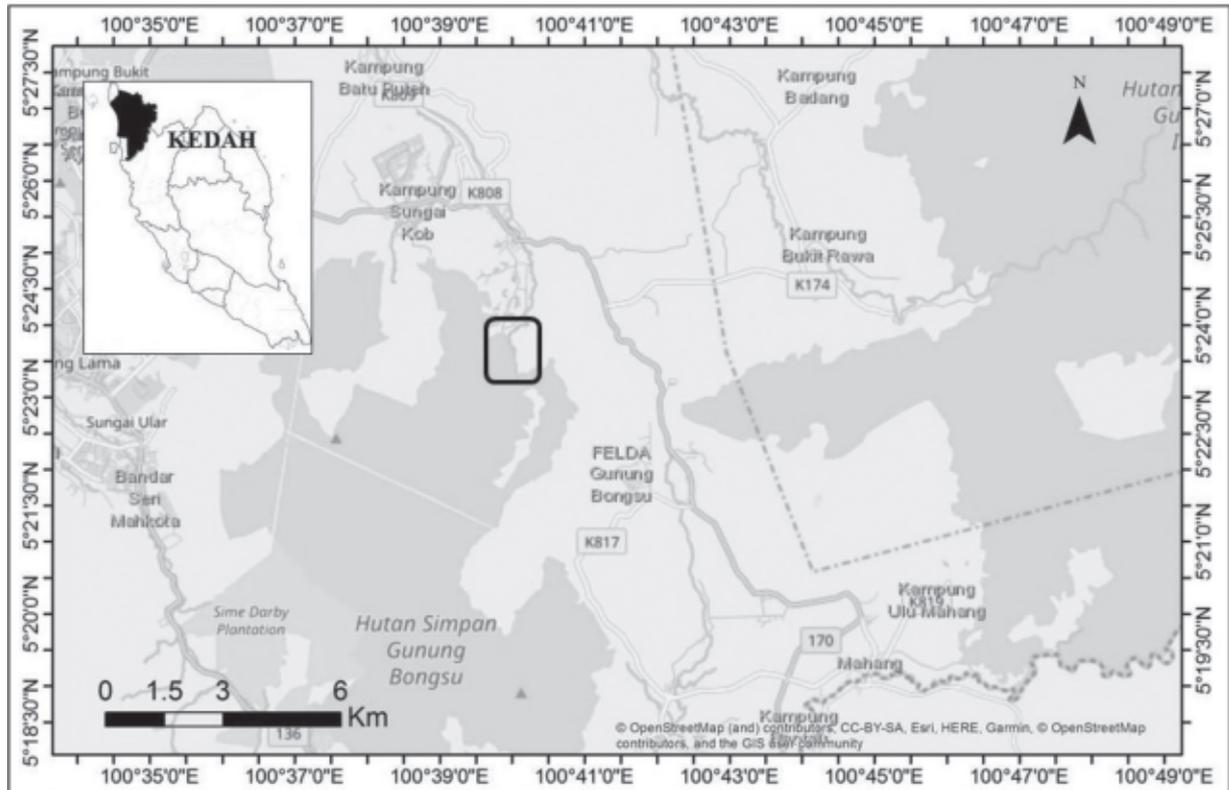
A total of 20 species from 10 families of freshwater fishes was recorded during the surveys in Ulu Paip Eco Park Forest (Table 1). Family Cyprinidae is the dominant with six species, followed by Danionidae (three species), Bagridae, Mastacembelidae, and Channidae with two species each while other five families – Sisoridae, Siluridae, Clariidae, Zenachopteridae, and Oshpronemidae with one species each.

The mountainous area in Kedah holds numerous headwater streams which were not studied extensively except in Gunung Jerai (Ahmad *et al.*, 2006; Shah *et al.*, 2009) and Ulu Muda Forest Reserve (Sah *et al.*, 2012; Lee *et al.*, 2013). Most of the streams located in the recreational area thus, prone

to various disturbances including pollution by humans, agricultural waste, and logging. Several streams in Ulu Muda Forest Reserve were already been affected by logging activities (Rahman, 2018) with no exception in Ulu Paip Eco-Park Forest (Rahman, 2017). Some of the fish species which cannot tolerate the environmental changes will not have the chance to survive due to habitat degradation, leading to the reduction of fish fauna as this study managed to collect only 20 species of freshwater fishes. We expect that more fish species will be collected with the continuous collection and efficient sampling techniques especially using electro fishing to collect bottom dweller and cryptic species.

Families Cyprinidae and Danionidae made up the major proportion of fish fauna in this area. Both families were known as the most dominant families of freshwater fishes in Peninsular Malaysia (Zakaria-Ismail *et al.*, 2019). Previously, species from the family Danionidae was placed into family Cyprinidae but later they were split which family Danionidae consist of species that include rasboras, danios, and their allies (Tan & Armbruster, 2018), which did not have the Y-shaped ligament that connecting the ethmoid and kinethmoid bones (Liao & Kullander, 2013). The family composition between this study and other studies elsewhere was different since different sampling methods were used which could be biased for the direct comparison. There is one interesting species complex namely *Barbodes cf. binotatus*, that is widely distributed in Peninsular Malaysia but needs further taxonomic clarification especially using the molecular approaches (see Fahmi-Ahmad *et al.*, 2020). Other species recorded were common species that can be found in the hilly streams throughout Peninsular Malaysia. One of the most abundant species found here was *Devario regina* (family Danionidae) that the distribution was limited to the northeastern part of Peninsular Malaysia until as far north as Thailand (Ahmad *et al.*, 2006).

Logging activities can directly affect the sediment load in the streams that might affect fish species richness as the reduction of water qualities. According to Jones III *et al.* (2001), logging or removal of riparian forest vegetation will reduce fish diversity and ability to fertilize the egg since the sediment load is higher. Hence, the egg will not firmly attach or deposit on the spawning site. However, Rowe *et al.* (2002) and Dias *et al.* (2010) found that there was no significant effect on fish assemblages in both logged and non-logged forests in their studies. Plus, in Malaysia, a study by Martin-Smith (1998) also found only a subtle effect of timber extraction on fish diversity. In the point of conservation, this could be a good indicator that fish can tolerate intermediate disturbance but it should



**Fig. 1.** The map of Peninsular Malaysia (inset) showing the state of Kedah (shaded region) where the study area is located. The main map showing the surrounding lands of Ulu Paip Eco Park (black rectangle) is located within Gunung Bongsu Reserve Forest.

**Table 1.** Checklist of fishes recorded from Ulu Paip Forest Eco-Park, Kedah

Order	Family	Species
Cypriniformes	Cyprinidae	<i>Barbodes cf. binotatus</i>
		<i>Barbodes lateristriga</i>
		<i>Hampala macrolepidota</i>
		<i>Ceratogarra cambodgiensis</i>
		<i>Mystacoleucus obtusirostris</i>
		<i>Neolissochilus hendersoni</i>
	Danionidae	<i>Brachydanio albolineata</i>
		<i>Devario regina</i>
		<i>Rasbora vulgaris</i>
Siluriformes	Sisoridae	<i>Glyptothorax fuscus</i>
	Siluridae	<i>Silurichthys schneideri</i>
	Clariidae	<i>Clarias leiacanthus</i>
	Bagridae	<i>Batasio fluviatilis</i> <i>Hemibagrus capitulum</i>
Beloniformes	Zenarchopteridae	<i>Hemirhamphodon pogonognathus</i>
Synbranchiformes	Mastacembelidae	<i>Macrogathus maculatus</i>
		<i>Mastacembelus tinwini</i>
Anabantiformes	Osphronemidae	<i>Betta pugnax</i>
	Channidae	<i>Channa lucius</i> <i>Channa limbata</i>

Plate 1. *Barbodes cf. binotatus*Plate 2. *Barbodes lateristriga*Plate 3. *Hampala macrolepidota*Plate 4. *Ceratogarra cambodgiensis*Plate 5. *Mystacoleucus obtusirostris*Plate 6. *Neolissochilus hendersoni*Plate 7. *Brachydanio albolineata*Plate 8. *Devario regina*Plate 9. *Rasbora vulgaris*Plate 10. *Glyptothorax fuscus*



Plate 11. *Silurichthys schneideri*



Plate 12. *Clarias leiacanthus*



Plate 13. *Batasio fluviatilis*



Plate 14. *Hemibagrus capitulum*

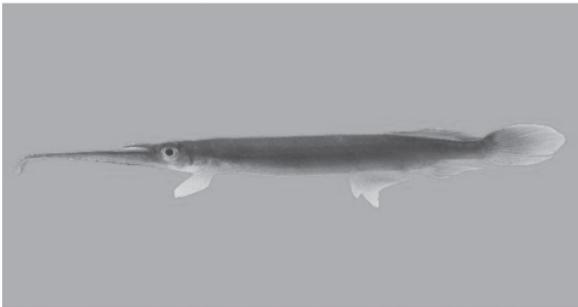


Plate 15. *Hemirhamphodon pogonognathus*

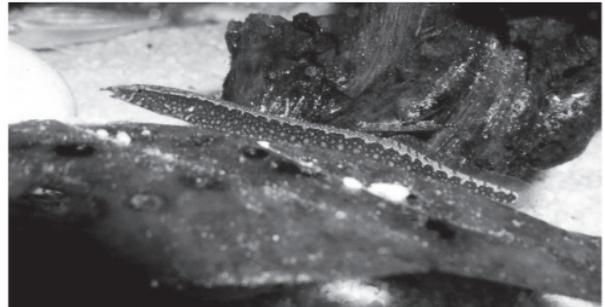


Plate 16. *Macrognathus maculatus*



Plate 17. *Mastacembelus tinwini*



Plate 18. *Betta pugnax*



Plate 19. *Channa lucius*



Plate 20. *Channa limbata*

not be a reason to allow for more land use in this forest reserve since river rehabilitation needs a longer time for recovering process.

### Fish checklist of Ulu Paip Eco-Forest Park, Kedah

#### Order Cypriniformes

##### Family Cyprinidae

#### *Barbodes* cf. *binotatus* (Valenciennes, in Cuvier & Valenciennes 1842)

##### Plate 1

**Material examined:** 3 ex., 50 – 70 mm SL, collected from the main stream in the stagnant water using a cast net, coll: M. Aqmal-Naser, 08 April 2014. UMTZC 8001

**Remarks:** The species has a broad and round snout with four barbels. Possess a black round spot below the dorsal fin base but not extended downward to mid-body and at the middle of caudal peduncle on the base of the caudal fin, somewhat similar to what has been identified by Fahmi-Ahmad *et al.* (2020) as *B. binotatus*-type B (see Table 1 in Fahmi-Ahmad *et al.*, 2020). Juveniles and some of the subadults may have 2 – 4 midlateral spots either rounded or slightly elongated (Kottelat *et al.*, 1993). Morphospecies from the northern part of Peninsular Malaysia is currently referred to as “*Barbodes* cf. *binotatus*” since the real species (*Barbodes binotatus*) is said to be restricted to Java or Java origins (Kottelat, 2013). A similar form has been reported from the state Perak (see Ng *et al.*, 2019). The species was reported as *Puntius banksi* by Ahmad and Samat (2005) from Perlis State Park and *Systemus binotatus* by Ahmad and Lim (2006) from Langkawi Island may be referring to this species. This species may form a species complex (Fahmi-Ahmad *et al.*, 2020) and could represent more than one species. Molecular works are urgently needed and are hoping to be able to resolve the taxonomic and systematic problem of this species and species with its complexity.

#### *Barbodes lateristriga* (Valenciennes, in Cuvier & Valenciennes 1842)

##### Plate 2

**Material examined:** 1 ex., 30 mm SL, from riverbank vegetation, coll: M. Aqmal-Naser. 08 April 2014. UMTZC 8002

**Remarks.** A juvenile, has modest body depth, a mid-lateral line on the posterior part of the body extended to the caudal fin, two vertical bars visible on the anterior half of the body. Body yellowish with black markings. Complete lateral line with 21 – 23 scales.

Inhabit slow-moving water or pools. Most of the juveniles were seen in this area preferring shallow and slow-flowing water but adults preferring deeper and fast-flowing waters. In all, this species has six different body markings – ‘Johor form’, ‘Selangor form’, ‘Muar River form’, ‘Pahang and Kelantan form’, ‘Perak form’, and ‘Perlis and Kedah form’ (Tweedie, 1961). The specimen from this study site belongs to the Perlis and Kedah form (Tweedie, 1961). The adult has broad vertical bars and descending low on the sides. The anterior horizontal bar is consisting of few black spots. The fish from Ulu Paip is highly similar to *B. lateristriga* from Langkawi Island (reported by Ahmad & Lim, 2006 as *Systemus lateristriga*) and highly probably similar to those reported from Perlis State Park by Ahmad and Samat (2005) as *Puntius lateristriga*. Yet again, this species might require a molecular study since this species in Peninsular Malaysia is thought to be influenced by a geographical barrier (Kamaruddin & Nor, 2010). This species is also found on large islands in Peninsular Malaysia such as Langkawi (Ahmad & Lim, 2006) and Tioman Islands where it is only the naturally existing cyprinid on the island (Tan *et al.*, 2015; Aqmal-Naser & Ahmad, 2018a). Until further studies are done, this species shows a wide distribution range in Peninsular Malaysia.

#### *Hampala macrolepidota* Kuhl & van Hasselt 1823

##### Plate 3

**Material examined:** 2 ex., 56 and 150 mm SL, collected fast flowing water in the main stream using a cast net, coll: M. Aqmal-Naser, 02 September 2014. UMTZC 8003

**Remarks.** Posses black bar between pelvic fin and anterior of the dorsal fin. Dorsal and caudal fins with distinct black submarginal longitudinal bands. The species can be found throughout the South Asian region including Thailand, Cambodia, Laos, Indonesia, and Malaysia (Peninsular Malaysia, Sabah, and Sarawak). There are four current species from the genus *Hampala* in Malaysia which are *H. macrolepidota* (in Peninsular Malaysia, Sabah and Sarawak), *Hampala bimaculata* (central and northern Sarawak, North Borneo, Sabah), *Hampala sabana* (Kinabatangan basin), and *H. ampalong* (Borneo) (Ryan & Esa, 2006). Despite it is widely distributed, the population in Sabah and Sarawak are genetically similar to that found in Peninsular Malaysia. *Hampala macrolepidota* is a common predatory species that feed on small-sized species of various groups of organisms including fish, frogs, and invertebrates. Good for sport fishing however overfishing becomes the major threat for the species.

***Ceratogarra cambodgiensis* (Tirant 1884)**

Plate 4

**Material examined:** 1 ex., 170 mm SL, collected from the fast-flowing water within the boulders in the main stream, coll: M. Aqmal-Naser, 02 September 2014. UMTZC 8004

**Remarks:** Posses rostral barbels but without maxillary barbels, dark mid-lateral line with 30 – 35 lateral scales, and absence of submarginal stripe at caudal fin (Rainboth, 1996). Possess two broad midlateral stripes, dorsal fin with two black bands, and well-developed tubercles on the snout during spawning season. The species is distributed in Thailand, Laos, Cambodia, Vietnam, and Peninsular Malaysia. Recently, the genus has been reassigned to *Ceratogarra* by Kottelat (2020) for both *G. cambodgiensis* and *G. fascicauda*. The identification of *Garra* spp. is puzzling especially in Southern Asia. *Ceratogarra fascicauda* that occur in Thailand can be further distinguished with this species by having black distal bands on its red caudal fin. *Ceratogarra cambodgiensis* is a common species and was found in the mountain streams. Algae-eater species are prone to population reduction due to logging activities that alter their food sources.

***Mystacoleucus obtusirostris* (Valenciennes, in Cuvier & Valenciennes 1842)**

Plate 5

**Material examined:** 4 ex., 45 – 70 mm SL, collected from the lower and upper stream using a cast net, coll: M. Aqmal-Naser, 02 September 2014. UMTZC 8005

**Remarks:** The species differ from its congener, *Mystacoleucus chilopteris* by having truncate or emarginate anal fin. Nearly all the scales have black crescent and have the distinct yellow color of the fins. The species has wider distribution including Myanmar, southwestern China, Thailand, Cambodia, Laos, Vietnam, Indonesia, Borneo, and Peninsular Malaysia. A common species but rarely seen in the aquarium trade. Ahmad and Samat (2005) reported this species as *Mystacoleucus marginatus* from Perlis State Park.

***Neolissochilus hendersoni* (Herre 1940)**

Plate 6

**Material examined:** 2 ex., SL 56 – 210 mm SL, mainstream in the fast-flowing water, unnamed tributaries at the upper part of the main stream, coll: M. Aqmal-Naser, 02 September 2014. UMTZC 8006

**Remarks:** The species was collected from clear water and fast-flowing water. There are three

recognized species from the genus *Neolissochilus* in Peninsular Malaysia – *Neolissochilus hendersoni*, *Neoliccochilus soro*, and *Neoliccochilus soroides* (Zakaria-Ismail *et al.*, 2019). *Neolissochilus soroides* can be distinguished by having 23 – 25 lateral line scales and 8 – 10 predorsal scale compared to *Neoliccochilus soro* which has 24 – 25 lateral line scales and 8 – 9 predorsal scales. While *Neolissochilus hendersoni* has 21 – 22 lateral line scales and 7 – 8 predorsal scale. *Neolissochilus hendersoni* were recorded in Penang Island, Kedah, and Kelantan drainages while *Neolissochilus soroides* are a common species throughout Peninsular Malaysia (Khaironizam *et al.*, 2015). It was also recorded in Java (Kottelat *et al.*, 1993), Thailand (Rainboth, 1996), and Anambas Island (Tan & Lim, 2004).

**Family Danionidae*****Brachydanio albolineata* (Blyth 1860)**

Plate 7

**Material examined:** 3 ex., 27 – 350 mm SL, main stream and all unnamed tributaries in the area, coll: M. Aqmal-Naser, 02 September 2014. UMTZC 8007

**Remarks:** Species from this genus are known as the “*Danio dangila* species group” comprised of previously known species – *Danio dangila*, *Danio rerio*, *Danio nigrofasciatus*, and *Danio albolineatus* (Fang, 2003). The species-complex of this genus and species remain to be solved. They have A-stripe on their anal fin rays, enlarged lamellar nasal, and two or more stripes on caudal-fin rays (Fang, 2003). A study by Fang *et al.*, (2009) concluded that *Danio dangila* is a sister group to all genus *Celestichthys* and *Brachydanio*, hence was not placed under genus *Brachydanio* (see Kottelat, 2013), could be two different species. According to Kottelat (2001), this species can be differentiated from other species by having an incomplete lateral line with 5 – 7 pored scales, and the rostral barbels extend beyond the eye. The type locality of this species (reported as *Danio teweediei*) is in Sungai Petani, Kedah while the type locality of specimens reported as *Nuria albolineata* is in Tenasserim, Burma (see Kottelat, 2013) and they could be two different species. The current distribution of the species is wider including Myanmar, Thailand, Laos, Cambodia, Vietnam, Peninsular Malaysia, and Sumatra until further validation of the species nomenclature and distribution. A common ornamental fish species. They inhabit small and pristine tributaries in this area. The species also has been reported from the rice field (Aqmal-Naser & Ahmad, 2018b). Reported in Langkawi as *Danio albolineatus* (Ahmad & Lim, 2006).

***Devario regina* (Fowler 1934)**

Plate 8

**Material examined:** Kedah 5 ex., 34 – 62 mm SL, main stream in all types of habitat, coll: M. Aqmal-Naser, 08 April 2014. UMTZC 8008

**Remarks:** Species from this genus have P-stripe which is extended into the mid-caudal-fin rays, with a short maxillary barbell and sometimes absent for certain species (Fang, 2003). It was suggested that genus *Devario* is for larger species whereas genus *Danio* for smaller species but not applied to all species (Kottelat, 2013). *Devario regina* has a compressed body with more than 11 branched dorsal rays. Body consists of 3 – 4 blue longitudinal bands. Frequently found in fast flowing water and usually can be seen schooling in a group more than five individuals. Abundant in the pristine streams and the distribution of this species is restricted to north-western parts of Peninsular Malaysia (including some islands) to as far north as Thailand and probably not reaching south of Sungai Perak, in Peninsular Malaysia (Ahmad & Lim, 2006).

***Rasbora vulgaris* Duncker 1904**

Plate 9

**Material examined:** 3 ex., 62 – 74 mm SL, mainstream in slow-flowing water, coll: M. Aqmal-Naser, 02 September 2014. UMTZC 8009

**Remarks:** Species from this group were moved from Sumatrana-group into the *R. paviana*-group comprising of five species namely *Rasbora paviana*, *Rasbora vulgaris*, *Rasbora notura*, *Rasbora hobelmani*, and *Rasbora dorsinotata* which were distributed in the Malay Peninsula and Indochina (Kottelat, 2005). The species from this group has a mid-lateral stripe on each side of the body and blotch at the caudal peduncle but is not circumscribed (Lumbantobing, 2014). Also, Kottelat (2005) stated that the member of this group has diamond-shaped blotch and restricted to Asia. Lumbantobing (2014) then assert that this group has high variations of the blotch, varied position, and intensity thus, should be re-classified into Sumatrana-group with a more comprehensive study to solve the taxonomic confusions. *Rasbora paviana* can be differentiated from *Rasbora vulgaris* by having a black lateral line from the operculum to the base of the caudal fin (Zakaria-Ismail *et al.*, 2019) while, *Rasbora vulgaris* in this study has a black lateral line behind the operculum and ending in front of the caudal peduncle blotch. The species can be found in various types of habitat including slow to moderate water current as well as stagnant water. The species is distributed throughout Thailand, Laos, Cambodia, Vietnam, and Peninsular Malaysia.

**Order Siluriformes****Family Sisoridae*****Glyptothorax fuscus* Fowler 1934**

Plate 10

**Material examined:** 1 ex., 40 mm SL, collected under the leaf piles however, the specimen was not retained, coll: M. Aqmal-Naser, 02 September 2014. UMTZC 8010

**Remarks:** Genus *Glyptothorax* is one of the most diverse genus in the family Sisoridae with 70 valid species (Ng & Hadiaty, 2009). Based on Shushen (1986), the author classified and divided this genus into *Superglyptothorax*, *Paraglyptothorax*, and *Glyptothorax* with special attention to the plaited skin folds on the paired fins along with dorsal spine morphology but were not embraced by most of the ichthyologist as it was not tested through phylogenetic analysis (Jiang *et al.*, 2011). Previously, some studies were using specimen labeled as *Glyptothorax major* instead of *Glyptothorax fuscus* for the specimens collected in Peninsular Malaysia and this is inaccurate because *G. major* is restricted to Borneo (Ng & Lim, 1997). *G. fuscus* has a robust body with irregular blotches and spots. The body has a rusty brown coloration with a pale mid-lateral line. Differ to its congener, *G. platypogonoides* which having a more slender caudal peduncle. A bottom species usually found beneath leaf litter, driftwood, or pebbles in flowing water. The species can be found throughout Peninsular Malaysia and Thailand.

**Family Siluridae*****Silurichthys schneideri* Volz 1904**

Plate 11

**Material examined:** 1 ex., 80 mm SL, under vegetation on the streambank, coll: M. Aqmal-Naser, 02 September 2014. UMTZC 8011

**Remarks:** The species from the genus *Silurichthys* can be found in freshwater swamps and forest streams of Southeast Asia (Sundaland) only. Some of the species also may look similar to another silurid species from the genus *Pterocryptis*, however differ by having merged anal and caudal fins (Ng & Tan, 2011). There were at least three known species of silurids in Peninsular Malaysia which are *Silurichthys hasselti*, *Silurichthys schneideri*, and *Silurichthys indragiriensis*. *Silurichthys schneideri* can be differentiated from its congener by having 56 – 68 anal fin rays while *Silurichthys hasselti* with 46 – 56 anal fin rays and *Silurichthys indragiriensis* with 45 – 46 anal fin rays. Both *Silurichthys hasselti* and *Silurichthys indragiriensis* can further be

differentiated according to the upper caudal lobe / lower caudal lobe ratio – *Silurichthys hasselti* (1:2) and *Silurichthys indragiriensis* (1:4 – 1:6). *Silurichthys schneideri* is distributed in north Peninsular Malaysia, north Sumatra, south Cambodia, and south and southeast Thailand, *Silurichthys hasselti* in south Peninsular Malaysia, Singapore, Bangka, and Java while and *Silurichthys indragiriensis* in a swamp in Peninsular Malaysia and Sumatra (Ng & Tan, 2011). This species has been reported from Langkawi Island by Ahmad and Lim (2006). Record from Perlis State Park identified as *S. indragiriensis* by Ahmad and Samat (2005) could be this species. In their paper, the species was listed as such in Table 1 (Ahmad & Samat, 2005; page 336) but in the plate given, it was labeled as *S. hasselti* and probably representing *S. schneideri*.

#### Family Clariidae

##### *Clarias leiacanthus* Bleeker 1851

Plate 12

**Material examined:** 1 ex., 120 mm SL, from stagnant water near the boulders and leaf litters, the specimen was not retained, coll: M. Aqmal-Naser, 02 September 2014. UMTZC 8012

**Remarks:** Currently, eight species of catfishes from the genus *Clarias* have been recorded in Peninsular Malaysia namely *Clarias batrachus*, *Clarias batu*, *Clarias leiacanthus*, *Clarias macrocephalus*, *Clarias meladerma*, *Clarias nieuhoofii*, *Clarias sulcatus*, and *Clarias gariepinus* (introduced species). *Clarias sulcatus* is an endemic species to Pulau Redang (Ng, 2004) while *Clarias batu* is endemic to Pulau Tioman (Lim & Ng, 1999). *Clarias leiacanthus*, (forest catfish) can be differentiated from other species which has an angular occipital process with a rounded tip. Dorsal fin rays with 70 – 74 rays while anal fin with 60 – 63 rays and not fused with caudal fin. The species can be found in clear water and flowing streams in the forest with rocky or sandy substrate. Usually found hiding beneath the rocks or roots. A common species throughout Peninsular Malaysia mainly caught for cheap protein source by the local people. Other seven catfishes found in Peninsular Malaysia has a different number of dorsal and anal fin rays as follows; *Clarias batrachus* (dorsal; 63 – 75, anal; 47 – 57), *Clarias batu* (dorsal; 67 – 75, anal; 61 – 70), *Clarias macrocephalus* (can easily be distinguished by its rounded occipital process and broadhead), *Clarias meladerma* (dorsal; 68 – 72, anal; 52 – 61) *Clarias nieuhoofii* (dorsal; 87 – 106, anal; 63 – 93) *Clarias sulcatus* (dorsal; 72 – 80, anal; 56 – 64) and *Clarias gariepinus* (dorsal; 61 – 80, anal; 45 – 65).

#### Family Bagridae

##### *Batasio fluviatilis* (Day 1888)

Plate 13

**Material examined:** 3 ex., 22 – 40 mm, from the main stream in shallow water, coll: M. Aqmal-Naser, 02 September 2014. UMTZC 8013

**Remarks:** At present, there were 18 valid species from the genus *Batasio* found in South and Southeast Asia (Plamootil, 2015). They can be differentiated by other members from family Bagridae with large sensory pores on the head and bar-like ectopterygoid (Mo, 1991). However, *Batasio fluviatilis* is the only known species that occur in Peninsular Malaysia, up to the isthmus of Kra but the distribution might be expanded to the north of the Tapi river basin (Ng & Kottelat, 2001). The species has 7 dorsal soft rays and 4 – 5 anal spines. Possess obliques black predorsal bars on the side of the body below adipose fin base. This species also might be confused as different species when they were juvenile and adult. *Batasio fluviatilis* exhibit ontogenic color changes along with their development and growth. Newly hatched fish did not have pigment but begin to have a color pattern with two dark vertical bars on the head pass through the eye and one vertical bar on the dorsum. The juvenile then will have four dark bars – 1) on the head passing the eyes, 2) running indirectly anterior on the dorsal fin, 3) anterior third of adipose fin and 4) posterior extremity at the caudal peduncle. The adult will have a dark brown spot below the anterior third of adipose fin as the bars fade following with the age (see Ng & Kottelat, 2001). This species was also found in Langkawi Island and Perlis State Park but was reported as *B. havmolleri* by Ahmad and Lim (2006) and Ahmad and Samat (2005), respectively.

##### *Hemibagrus capitulum* (Poopta 1904)

Plate 14

**Material examined:** 1 ex., 65 mm SL, main stream under vegetation on the streambank, coll: M. Aqmal-Naser, 02 September 2014. UMTZC 8014

**Remarks:** There were eight species groups for Asian bagrid catfish with 32 valid species after comprehensive revision by Ng and Kottelat (2013). The eight species group including *H. baramensis*, *H. guttatus*, *H. menoda*, *H. nemurus*, *H. olyroides*, *H. planiceps*, *H. pluriradiatus*, and *H. wyckii* species groups. In all, 11 species can be found in Malaysia; Borneo (*H. bongan*, *H. hoevenii*, *H. baramensis*, *H. sabanus*, *H. semotus*, *H. fortis*, *H. capitulum*), and Peninsular Malaysia (*H. capitulum*, *H. divaricatus*,

*H. gracilis*, *H. wyckii*) with additional one introduced species – *H. wyckioides*. In Peninsular Malaysia, three species groups were known to occur in its natural river basins namely *H. nemurus* species group (*H. capitulum*), *H. planiceps* species group (*H. divaricatus* and *H. gracilis*), and *H. wyckii* species group (*H. wyckii* and *H. wyckioides*). Most of the literature in Peninsular Malaysia misidentified *H. capitulum* as *H. nemurus* where the distribution is restricted to Java (Ng & Kottelat, 2013). *Hemibagrus capitulum* has adpressed dorsal fin reaching adipose fin origin. Forked caudal fin with both lobes rounded and rounded anal fin. For *H. planiceps* species groups, *H. divaricatus* is restricted to western Peninsular Malaysia while *H. gracilis* can be found in eastern Peninsular Malaysia (see Ng & Kottelat, 2013 for details). Another species group, *H. wyckii* is the easiest to identify by having a dark grey body with a white marginated line at its caudal fin while *H. wyckioides* has a reddish-orange caudal fin.

#### Order Beloniformes

##### Family Zenarchopteridae

###### *Hemirhamphodon pogonognathus* (Bleeker 1853)

Plate 15

**Material examined:** 3 ex., 20 – 40 mm SL, mainstream and unnamed tributaries in the shallow and stagnant water, coll: M. Aqmal-Naser, 02 September 2014. UMTZC 8015

**Remarks:** Family Zenarchopteridae consists of three genus which is *Hemirhamphodon*, *Dermogenys*, and *Nomorhampus*. Genus *Hemirhamphodon* can be distinguished from its congener which has pleural ribs that start on the 2<sup>nd</sup> vertebrate and the presence of anterior directed teeth along the jaw (Anderson & Collette, 1991). *Hemirhamphodon pogonognathus* has a lower jaw that is much longer than the upper jaw and sometimes the anterior tips are bent downwards. The species is widely distributed (Roberts, 1989) and can be found in Malay Peninsula, Singapore, Western Borneo, and Natuna. Currently, there were nine valid species from the genus *Hemirhamphodon* with a restricted range of distribution (Tan & Lim, 2013) as follows: *H. byssus* (southern Sarawak), *H. kuekenthali* (Central Sarawak), *H. kapuensis* (middle and lower Kapuas basin), *H. chrysopunctatus* (Central Kalimantan), *H. tengah* (Central Kalimantan), *H. sesamum* (South Kalimantan), *H. kecil* (lower Mahakam), *H. phaiosoma* (Banka, Western Kalimantan) and the common *H. pogonognathus*. However, *H. pogonognathus* group could have a cryptic species complex. A study by Lim *et al.* (2016)

stated that *H. pogonognathus* species complex in Peninsular Malaysia may potential has a new species since the specimen from Kelantan has separated cluster based on CO1 gene trees from the real *H. pogonognathus* group.

#### Order Synbranchiformes

##### Family Mastacembelidae

###### *Macrogathus maculatus* (Cuvier, in Cuvier & Valenciennes 1832)

Plate 16

**Material examined:** 1 ex., 50 mm SL, under leaf litters in the main stream, coll: M. Aqmal-Naser, 16 May 2014. UMTZC 8016

**Remarks:** There are three species from the genus *Macrogathus* in Peninsular Malaysia including *Macrogathus tapirus*, *Macrogathus maculatus*, and *Macrogathus circumcinctus*. *Macrogathus maculatus* is a common species, distributed in the Mekong river basin, Vietnam, Indonesia, and Malaysia. The species is always confused with its congener, *M. circumcinctus* due to their similar shape, colors, and patterns. Both species share the same 6 finger-like projection at the nostril, however can be differentiated apart where *M. maculatus* has 52 – 66 dorsal-fin rays (45 – 58 in *M. circumcinctus*) and 12 – 31 dorsal fin spines. Adult *M. maculatus* does not has bars on the body and sometimes faint in the juvenile form while the bars in the *M. circumcinctus* are always present (Rainboth, 1996).

###### *Mastacembelus tinwini* Britz 2007

Plate 17

**Material examined:** 1 ex., 100 mm SL, under leaf litters in the main stream, coll: M. Aqmal-Naser, 08 April 2014. UMTZC 8017

**Remarks:** About five species from the genus *Mastacembelus* occur in Peninsular Malaysia namely *Mastacembelus erythrotaenia*, *Mastacembelus favus*, *Mastacembelus notophthalmus*, *Mastacembelus tinwini*, and *Mastacembelus unicolor*. *Mastacembelus tinwini* has a 3 – 5 interrupted black longitudinal line, broken up in blotches on the body side. The soft dorsal anal and caudal fins have a white margin (Britz, 2007). In all, two species – *Mastacembelus favus* and *Mastacembelus notophthalmus* are likely to be confused with *Mastacembelus tinwini* due to their similar-looking patterns. *Mastacembelus favus* has a yellow broad connected network of patterns that almost extend onto its abdomen while *Mastacembelus notophthalmus* has a reticulated dark pattern which is more obvious in the ventral half of

the body, with irregular and a small light mark on the dorsal part. Ahmad and Samat (2005) reported the presence of *Mastacembelus* sp. in Perlis State Park and it could potentially be this species.

#### Order Anabantiformes

#### Family Osphronemidae

#### *Betta pugnax* (Cantor 1849)

#### Plate 18

**Material examined:** 3 ex., 34 – 65 mm SL, main stream and unnamed tributaries near the main road coll: M. Aqmal-Naser, 16 May 2014. UMTZC 8018

**Remarks:** Genus *Betta* has the most number of species in the family Osphronemidae (Britz, 2001) and in Peninsular Malaysia, 15 species had been recorded including the recently described species from blackwater swamps, *Betta omega* (Tan & Ahmad, 2018). Most of the species within this genus sharing few similarities of diagnostic characters and has been classified into 13 species group (Tan & Ng, 2005). The species group including the *Betta bellica* group, *Betta pugnax* group, *Betta akarensis* group, *Betta unimaculata* group, *Betta picta* group, *Betta splendens* group, *Betta coccina* group, *Betta waseri* group, *Betta edithae* group, *Betta foerschii* group, *Betta anabatooides* group, and *Betta albimarginata* group. Ten species groups can be found in Malaysia; Borneo – *Betta pugnax* group (*Betta lehi*), *Betta akarensis* group (*Betta akarensis*, *Betta balunga*, *Betta chini*, *Betta ibanorum*, *Betta obscura*), *Betta unimaculata* group (*Betta macrostoma*, *Betta ocellata*, *Betta gladiator*), *Betta picta* group (*Betta taeniata*), *Betta coccina* group (*Betta brownorum*) and Peninsular Malaysia – *Betta bellica* group (*Betta bellica*), *Betta pugnax* group (*Betta pugnax*, *Betta pulchra*, *Betta stigmosa*), *Betta splendens* group (*Betta imbellis*), *Betta coccina* group (*Betta coccina*, *Betta tusyae*, *Betta persephone*, *Betta livida*), *Betta waseri* group (*Betta waseri*, *Betta hipposeroides*, *Betta pi*, *Betta omega*). *Betta pugnax* possesses a lanceolate shape caudal fin with no dark edge, with iridescent greenish-blue opercle scales on its body. It can be further differentiated from other species in the group by the absence of dark mark below the postorbital stripe on its opercle, the presence of chin-bar and dorsal transverse bar, with lateral line scale of 28 – 31 and 25 – 28 anal fin rays. It is a common species, widely distributed in Peninsular Malaysia forest streams.

#### Family Channidae

#### *Channa lucius* (Cuvier, in Cuvier & Valenciennes 1831)

#### Plate 19

**Material examined:** 3 ex., SL 25 – 80 mm SL, a main stream near the riverbank under a shaded area, coll, M. Aqmal-Naser, 22 July 2014. UMTZC 8019

**Remarks:** The species from this genus are mainly used in ornamental fish trade and food. Seven species were known to occur in Peninsular Malaysia namely *Channa bankanensis*, *Channa limbata*, *Channa lucius*, *Channa maruloides*, *Channa melasoma*, *Channa micropeltes*, and *Channa striata*. According to Conte-Grand *et al.* (2017), four species groups had understudied diversity which are *Channa marulius* group, *Channa striata* group, *Channa bankanensis* group, and *Channa gachua* group. *Channa lucius* can be differentiated from other congener species by having a black spot on the operculum with a short head, convex dorsal part. Having 37 – 41 dorsal soft rays and 25 – 30 anal soft rays. The adult has black blotches that are rounded and not continuous and the belly has oblique bars. The species is widely distributed through Myanmar, Mekong river basins, Sunda islands, and Peninsular Malaysia. However, a detailed study is needed to compare the morphometric and meristematic aspect of *Channa lucius* from other populations. This also applied to *Channa striata* where there had been a deep intraspecific divergence of the species between samples from different regions. Further genetic and morphological analysis is urgently needed (Conte-Grand *et al.*, 2017).

#### *Channa limbata* (Hamilton 1822)

#### Plate 20

**Material examined:** 3 ex., 40 – 85 mm SL, main stream and unnamed tributaries near the main road, M. Aqmal-Naser, 22 July 2014. UMTZC 8020

**Remarks:** The species has a 38 – 40 lateral line scale, 31 – 35 dorsal-fin rays, and 21 – 24 anal fin rays. Juvenile usually has transverse bars but faded away as it grows. The adult male has the prominent color of orange to reddish dorsal and anal fins. Previously, the species was reported as *Channa gachua* and it is a species complex that has two separated lineages (Conte-Grand *et al.*, 2017). The true *Channa gachua* is distributed in the West Indo-Burma range – India, Bangladesh, Sri Lanka, Nepal,

and Rakhine (Myanmar) while the other lineage is distributed in the East Indo-Burma region including Vietnam, South China, Myanmar, south Indonesia, Thailand, and Malaysia. It was suggested that the species in the east region of Indo-Burma is *Channa limbata* (Conte-Grand *et al.*, 2017). All previously reported species of *C. gachua* in Peninsular Malaysia should be now known as *C. limbata* (Zakaria-Ismail *et al.*, 2019).

## CONCLUSION

Fish fauna in Ulu Paip Eco-Park Forest, Gunung Bongsu Forest Reserve, Kedah is considered low compared to another study as different methods for the fish collection were used. Most of the species collected can be found in pristine habitats and have ornamental values. As this area facing several land-use changes, proper management and conservation plans should be initiated and executed to ensure the preservation of natural habitat and ecotourism activities.

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