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RESEARCH ARTICLE

Freshwater fishes of Universiti Malaysia Kelantan, Jeli Campus: a preliminary checklist

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ABSTRACT

The fish fauna was surveyed in Sungai Buloh and Sungai Lachang which flow through the Universiti Malaysia Kelantan (UMK) Jeli Campus area. Both rivers are tributaries of the Sungai Golok drainage, which runs through Kelantan state and serves as a major border between Malaysia and Thailand. The objectives of this study were to document fish species checklist distribution within Universiti Malaysia Kelantan Jeli Campus and access the conservation status of freshwater fishes, according to the IUCN Red List of Threatened Species. The fish sampling was conducted in February and May 2022 in two sampling points inside the UMK Jeli Campus area. During the survey, 40 native fish species from 18 families were identified and documented. Family Cyprinidae recorded the highest number of total species with 25% of total species followed by family Danionidae, 10% and family Balitoridae, 10%. The introduced species, Oreochromis niloticus, was not observed during the survey, although the species is commonly used for aquaculture activities on campus.

1. INTRODUCTION

Freshwater fishes serve a significant role in ecology, serving as key bioindicators for the health of freshwater ecosystems and communities. Their distinct responses to the degradation highlight their critical importance in conservation efforts aimed at preserving aquatic environments (Bakar et al. 2023). Freshwater accounts for less than 1% of the earth's surface area. This might contribute to the greater threats faced by freshwater species as compared to terrestrial species (Radinger et al. 2019). Anthropogenic activities such as deforestation pose a hazard to terrestrial and aquatic species. As a result, greater research and conservation efforts are required because freshwater is home to fish and other captures that supply nutrients to most people, particularly populations living near rivers. Malaysia's freshwater area is estimated to be 549,000 km^2 and includes everything from streams to estuaries (Ahmad et al., 2018a). A total of 289 native species from 43 families of fish were recorded in Peninsular Malaysia (Zakaria-Ismail et al. 2019) but, fish composition especially in the small streams in Peninsular Malaysia, are not commonly studied thus, the data on the fish distribution is still incomplete.

In Kelantan, the major river drainages of Sungai Kelantan which their ichthyofaunas had been surveyed include the Sungai Pergau drainages (Ambak and Zakaria, 2010: Alias et al. 2019: Zakeyuddin et al. 2020), Sungai Galas drainages (Ambak and Zakaria, 2010: Hashim et al. 2015), Sungai Lebir drainage (Ambak and Zakaria, 2010) and Sungai Nenggiri drainages (Ambak and Zakaria, 2010). However, there is a lack of information regarding the freshwater fishes on Sungai Golok drainage in Kelantan State, especially in Jeli. Only a part of streams in Jeli has been explored, as reported by Khaironizam et al. (2015), who mentioned the study regarding the *Neolissochilus hendersoni* species, Halim et al. (2024) on preliminary study on icthyofaunal diversity at Lata Keding and Aweng et al. (2021), who conducted a study on *Corbicula fluminea* at Sungai Golok drainage in Jeli district. Meanwhile, fish fauna in both Sungai Buloh and Sungai Lachang are tributaries that flow into Sungai Ayer Lanas and then into Sungai Golok at Kampung Jenub, Bukit Bunga, Tanah Merah (Sidek et al. 2022) is relatively unknown.

Sungai Buloh and Sungai Lachang that flows within the confinement of the Universiti Malaysia Kelantan Jeli

Campus potentially exposes the freshwater fish habitat towards disturbances. The ongoing construction of numerous buildings and practical farming areas for research and educational purposes at the university may contribute to the habitat alteration. Inadequate data on the health status and information of Sungai Buloh and Sungai Lachang in Jeli, Kelantan, has resulted in a limited understanding of their conditions and hampered recognition of their inherent qualities. The study of fish diversity, especially in Sungai Buloh and Sungai Lachang, is essential to provides better appreciation toward the conservation of the freshwater ecosystem. Consistent updates on the current species richness of freshwater fishes are important for encouraging conservation efforts for freshwater ecosystems and the life underneath them. Therefore, the objectives of this study are to document fish species checklist of freshwater fishes in Sungai Buloh and Sungai Lachang, within Universiti Malaysia Kelantan Jeli Campus and assess their conservation status, according to the IUCN Red List of Threatened Species.

2. MATERIALS AND METHODS

2.1. The study area

Sungai Buloh and Sungai Lachang flow and connected with Sungai Ayer Lanas, passing through Kampung Lakota, Kampung Gemang, and Kampung Wakaf Zing. These streams are further connected to Sungai Golok, which flows towards the South China Sea and acts as the national boundary between Malaysia and Thailand. Two sampling points were selected, characterised by shallow water with narrow width and slow to moderate moving water current. The bottom substrates comprised gravel, pebbles, and coarse to fine sand. The Sungai Buloh sampling point was labelled as Sampling Point A (coordinate: 5°44'45" N 101°52'00" E) and is surrounded by university buildings. The Sungai Lachang sampling point, labelled as Sampling Point B (coordinate: 5°44'50" N 101°52'20" E), is situated in an area surrounded by agriculture research practical work areas and secondary dipterocarp forests (Figure 1 to Figure 4).

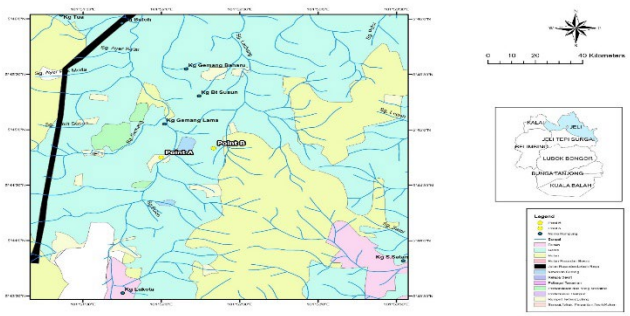

Figure 1: Map of sampling point A (Sungai Buloh) and point B (Sungai Lachang)

Figure 2: Sampling points A and B from Google Earth view accessed on 06 September 2023

Figure 3: Sampling point A (Sungai Buloh)

Figure 4: Sampling site B (Sungai Lachang)

2.2 Fish sampling and identification

The sampling was conducted in February and May 2022, with a sampling distance set at 100 m – 150 m by moving upstream. Scoop nets and cast nets were used to catch the fish. The collected samples in the net were transferred into a plastic bag and brought back for the sorting process. All live specimens were euthanized using an overdose of MS-222 or by placing them in iced water. They were then fixed in 10% formalin for at least two weeks, soaked in water for three days, and finally transferred to 70% alcohol. Fish species were identified according to their morphological characteristics, such as the general body shape, head, trunk and caudal regions, fins, and scales and tubercles according to the taxonomic keys and description from Zakaria-Ismail et al. (2019). The conservation status of each species was referred to the International Union for Conservation of Nature's (IUCN) Red List of Threatened Species.

3. RESULT AND DISCUSSION

A total of 40 species from 18 families were recorded in the Sungai Buloh and Sungai Lachang streams at two sampling points inside the Universiti Malaysia Kelantan Jeli Campus. The family Cyprinidae dominant with 25% of the captured species (10 species), followed by the family Danionidae and Balitoridae, representing 10% of the captured species (4 species each). In addition, family Cobitidae, Nemacheilidae, Bagridae, Clariidae, Mastacembalidae, Osphronemidae and Channidae represented 5% of the captured species (2 species each). On the other hand, the families Botidae, Sisoridae, Siluridae, Syngnathidae, Synbranchidae, Anabantidae, Belonidae, and Zenarchopteridae recorded only a single species for each, representing 2.5% of the captured species for each family, respectively (Figure 6). Table 1 represents the list of occurrences of freshwater fish species, at two sampling points, their IUCN status and common names in both English and Malay inside Universiti Malaysia Kelantan Jeli Campus.

Cyprinidae was the most prevalent fish family in this study. Sungai Buloh and Sungai Lachang have a clear water river stream that is suitable habitat for Cyprinidae. According to Ahmad et al. (2018a), the species richness of Cyprinidae in local waters may be related to habitat quality and food resource abundance. Halim et al. (2024) reported that 91% from 128 individuals of the fish caught at Lata Keding, Jeli was from Cyprinidae family. Furthermore, two studies from Aqmal-Naser and Ahmad (2021) and Ahmad et al. (2018b) reported that the Cyprinidae family is the dominant species compared to other families in a clear water river stream at Ulu Paip Eco Forest in Kedah and Ulu Kenas Forest Reserve in Perak. Moreover, Cyprinidae also the most dominant fish species in freshwater ecosystems of Peninsular Malaysia (Zakaria-Ismail et al. 2019). Besides that, the sampling techniques used also are affecting the dominance of Cyprinidae family from the fish catches as only scoop net and cast net are used to catch the fish.

All 40 fish species sampled from Sungai Buloh and Sungai Lachang are categorised as Least Concern (LC), Near Threatened (NT) for *S. beauforti* and Data Deficient (DD) for *Microphis martensii* and *Betta apollon*. The status of *S. beauforti* was reported that there was no detailed information is known about potential threats to *S. beauforti* in the Mekong basin or the freshwater system of the Peninsular Malaysia, however as these areas are adjacent to the known river basins it is assumed to be similar in land use and environmental threats to that of the Chao Phraya and Mekong basins Jenkins et al. (2009). Lheknim (2020) reported that *S. beauforti* was only collected once at Thale Noi, a freshwater swamp situated as a part of Songkhla Lagoon's system, located in the southern part of Thailand. Besides that, Froese and Pauly (2006) stated that *S. beauforti* is known to be intolerant of nitrates, rapidly disappearing from areas where fertilisers are applied to crops. Moreover, *S. beauforti* is occasionally seen in fish markets, and is also sold for the aquarium trade. As no breeding farming of *S. beauforti* was known, 100% wild harvest is assumed, as reported by Jenkins et al. (2009)."

On the other hand, two species that were categorised as DD were *M. martensii* and *B. apollon*. The status of *M. martensii* was labelled as DD because of the threats and dangers to *M. martensii* are little understood. It is most likely threatened by deforestation and degradation of riparian habitat, which is widespread in the region and is worsening as a result of palm oil plantations (Margono et al. 2014). It might also be intentionally sought out for use in the aquarium trade or caught as bycatch, but this happens infrequently (Vincent et al. 2011). Lim et al. (2011) reported that other species of the same genus as *M. martensii* are hunted, caught as bycatch, and later trafficked for use in aquariums, traditional remedies, and as collectibles. This species' offtake rates and methods of capture are unclear. On the other hand, the status of *B. apollon* was labelled as DD because of unknown threats exist for this species and future impacts on this species could result from agricultural activity near the habitat region (Low, 2019a). Current trends in the population of *B. apollon* are unknown. The species, however, has been shown to be widespread in hill stream environments in Narathiwat, Thailand (Monvises et al. 2009) and Sungai Golok basin in Kelantan (Zakaria-Ismail et al. 2019).

It is worth noting that the introduced freshwater species, *Oreochromis niloticus*, was extensively utilised for aquaculture studies in both classroom and research environments within the university's aquaculture pond sector. However, there were no sightings or captures of *O. niloticus* during the sampling activities in Sungai Buloh and Sungai Lachang. In addition, there is also no other alien or non-native species are found during the sampling activities were conducted. The location of Sungai Lachang and Sungai Buloh which are at the upstream area of Sungai Golok make it less accessible to non-native species. The study on fish species composition inside Universiti Malaysia Kelantan Jeli Campus is important to provide preliminary information for long term conservation and sustainable management planning inside the university especially on building and agricultural practical development. According to the current knowledge, there is no any flagship species that has been recognised in the university area. Therefore, potential species that could be considered as flagship species based on findings in this study is *S. beauforti*. This species is being selected as the flagship species because of it has localised distribution in Peninsular Malaysia from Golok River drainage only (Zakaaria-Ismail et al. 2019) hence

the freshwater habitat in Universiti Malaysia Kelantan Jeli Campus should be rehab and preserved for native fish species. Furthermore, all of the fish species recorded in the study are categorised as food, ornamental and sport fish as shown in Table 1, as the diversity of native fish species can be more valuable toward habitat conservation especially within the Universiti Malaysia Kelantan Jeli Campus. Future research needs to consider the peripheral habitat in order to obtain a complete picture of ichthyofauna diversity of for research development, attraction and uniqueness of Universiti Malaysia Kelantan Jeli Campus. The current findings would be useful for future conservation management of freshwater biodiversity and drainages within the university's compound.

Table 1: Freshwater fish occurrences at two sampling points inside Universiti Malaysia Kelantan Jeli Campus, IUCN status, common name in English and Malay and the uses of fish species.

Species	Sampling points		IUCN Status	Common Name (English)	Common Name (Malay)	Uses of Fish Species
	A	B				
Botidae						
Syncrossus beauforti	+	-	NT	Chameleon Loach	Ikan Lali Babi	Ornamental
Cobitidae						
Acantopsis dialuzona	+	-	LC	Horse Face Loach	Ikan Pasir Kuda	Ornamental
Acanthopsoides molobrion	+	-	LC	Sarawak Sand Loach	Ikan Pasir Sarawak	Ornamental
Balitoridae						
Balitoropsis zollingeri	+	+	LC	Lizard Loach	Ikan Puting Beliung Jawa	Ornamental
Homaloptera parclitella	+	+	LC	Clown Torrent Loach	Ikan Puting Beliung Sekayu	Ornamental
Homalopteroides nebulosus	+	-	LC	Kelantan Lizard Loach	Ikan Puting Beliung Kelantan	Ornamental
Pseudohomaloptera leonardi	+	-	LC	Pahang Lizard Loach	Ikan Puting Beliung Pahang	Ornamental
Nemacheilidae						
Nemacheilus masyae	+	+	LC	Arrow Loach	Ikan Pasir Tompok	Ornamental
Nemacheilus selangoricus	+	+	LC	Grey Banded Loach	Ikan Pasir Belang	Ornamental
Cyprinidae						
Barbodes rhombeus	+	+	LC	Spotted Barb	Ikan Tebal Sisik	Ornamental, Food
Ceratogarra cambodgiensis	+	-	LC	Siamese Stone Lapping Fish	Ikan Susur Batu	Ornamental, Food
Cyclocheilichthys apogon	+	+	LC	Beardless Barb	Ikan Temperas	Ornamental, Food
Hampala macrolepidota	+	-	LC	Hampala Barb	Ikan Sebarau	Ornamental, Food, Sport
Labiobarbus leptocheilus	+	-	LC	Thin Lips Barb	Ikan Kawan	Ornamental, Food
Lobocheilos rhabdoura	+	-	LC	Thick Lips Barb	Ikan Peridung	Ornamental, Food
Mystacoleucus obtusirostris	+	-	LC	Minnow Barb	Ikan Sia	Ornamental, Food
Osteochilus vittatus	+	-	LC	Bony Lips Barb	Ikan Terbul	Ornamental, Food
Osteochilus waandersii	+	+	LC	Waandersii Hard Lips Barb	Ikan Rong Ekor Merah	Ornamental, Food
Poropuntius deauratus	+	+	LC	Leaf Barb	Ikan Daun	Ornamental, Food
Danionidae						
Danio albolineatus	-	+	LC	Pearl Danio	Ikan Seluang Bunga Air	Ornamental
Raiamas guttatus	+	-	LC	Malayan Trout	Ikan Sikang	Ornamental, Food, Sport
Rasbora myersi	+	+	LC	Putussibau Rasbora	Ikan Seluang Putussibau	Ornamental, Food
Rasbora paviana	+	+	LC	Side Stripe Rasbora	Ikan Seluang Jalur Sisi	Ornamental, Food
Bagridae						
Batasio fluviatilis	+	-	LC	Bagrid Catfish	Ikan Baung Kecil	Ornamental
Hemibagrus capitulum	+	-	LC	Malayan River Catfish	Ikan Baung Sungai	Food, Sport
Sisoridae						
Glyptothorax fuscus	+	-	LC	Sisorid Catfish	Ikan Kenderap Kecil	Ornamental
Siluridae						
Ompok siluroides	-	+	LC	Ompok Catfish	Ikan Tapah Bemban	Ornamental

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Clariidae						
Clarias batrachus	-	+	LC	Walking Catfish	Ikan Keli Kayu	Food
Clarias leiacanthus	-	+	LC	Forest Catfish	Ikan Keli Dacing	Food
Syngnathidae						
Microphis martensii	+	-	DD	Long Snouted Pipefish	Unduk-unduk Sungai	Ornamental
Mastacembalidae						
Macrognathus circumcinctus	-	+	LC	Half Banded Spiny Eel	Ikan Tilan Paya	Ornamental
Mastacembelus favus	+	-	LC	Tire Track Spiny Eel	Ikan Tilan Tayar	Ornamental Food
Synbranchidae						
Monopterus javanensis	+	-	LC	Asian Swamp Eel	Ikan Belut	Food
Anabantidae						
Anabas testudineus	+	+	LC	Climbing Perch	Ikan Puyu	Ornamental Food
Osphronemidae						
Betta apollon	-	+	DD	Narathiwat Fighting Fish	Ikan Laga Narathiwat	Ornamental
Trichopodus trichopterus	+	+	LC	Three Spot Gourami	Ikan Sepat Ronggeng	Ornamental Food
Channidae						
Channa limbata	+	+	LC	Dwarf Snakehead	Ikan Haruan Kedak	Ornamental
Channa striata	+	+	LC	Common Snakehead	Ikan Haruan	Food, Sport
Belonidae						
Xenentodon canciloides	+	-	LC	Indochinese Needle Fish	Ikan Todak Sungai	Ornamental
Zenarchopteridae						
Hemirhamphodon pogonognathus	-	+	LC	Forest Halfbeak	Ikan Jejulung Hutan	Ornamental

NT: Near Threatened, LC: Least Concern, DD: Data Deficient;

Supplement Materials: Notes on freshwater fishes in Universiti Malaysia Kelantan Jeli Campus

Family: Botidae

Syncrossus beauforti (Smith, 1931)

Common name: Chameleon Loach ("Ikan Lali Babi")

Notes: *Syncrossus beauforti* is a demersal species that lives in small and medium-sized rivers with clear water, rapid currents, and stony to rocky ground (Jenkins et al. 2009).

Figure 7: *Syncrossus beauforti*

Family: Cobitidae

Acantopsis dialuzona (van Hasselt, 1823)

Common name: Horse Face Loach ("Ikan Pasir Kuda")

Notes: *Acantopsis dialuzona* favours sandy bottom environment and can be found downstream of many headwater streams, primarily in swift moving and clear water (Allen and Daniels, 2020).

Figure 8: *Acantopsis dialuzona*

Acanthopsoides molobrion (Richardson, 1848)

Common name: Sarawak Sand Loach ("Ikan Pasir Sarawak")

Notes: *Acanthopsoides molobrion* is often found in slow-flowing, clear-water rivers with sand, fine gravel, or mud substrates. This species can be found in freshwater swamp-lake systems as well (Daniels and Allen, 2020).

Figure 9: *Acanthopsoides molobrion*

Family: Balitoridae

Balitoropsis zollingeri (Bleeker, 1853a)

Common name: Lizard Loach ("Ikan Puting Beliung Jawa")

Notes: *Balitoropsis zollingeri* lives in pure streams with fast flowing water, high dissolved oxygen levels, and rocky substrate. It favours habitats containing pebbles, rocks, boulders, or bedrock that is soaked with algae (Ahmad, 2019a).

Figure 10: *Balitoropsis zollingeri*

Homaloptera parclitella (Tan & Ng, 2005)
Common name: Clown Torrent Loach ("Ikan Puting Beliung Sekayu")
Notes: *Homaloptera parclitella* is found in streams in woods, where the water is clear and the current is swift, and it is generally linked with submerged trees, wood debris, stones, and broadleaved flora (Ahmad, 2019b).

Figure 11: *Homaloptera parclitella*

Homalopteroides nebulosus (Alfred, 1969)
Common name: Kelantan Lizard Loach ("Ikan Puting Beliung Kelantan")
Notes: There is little known about the species, however it is said to favor clear, fast-flowing water with sandy or rocky substrates. It can also be found in riverbank plants or wood debris (Chua and Ahmad, 2019).

Figure 12: *Homalopteroides nebulosus*

Pseudohomaloptera leonardi (Hora, 1941)
Common name: Pahang Lizard Loach ("Ikan Puting Beliung Pahang")
Notes: This benthic species lives in fast-flowing streams and rivers on bedrock, boulder, and cobble substrates. It prefers fresh, cold water. This species was taken at Bukit Bakar Forest Reserve in Kelantan from mildly muddy streams shaded by riparian vegetation (Ahmad, 2020a).

Figure 13: *Pseudohomaloptera leonardi*

Family: Nemacheilidae

Nemacheilus masyae (Smith, 1933)

Common name: Arrow Loach ("Ikan Pasir Tompok")

Notes: *Nemacheilus masyae* lives in rivers and streams with slow currents and sandy bottoms. It favors shallow, clean water that is cold vegetation (Ahmad, 2020b).

Figure 14: *Nemacheilus masyae*

Nemacheilus selangoricus (Duncker, 1904)

Common name: Grey Banded Liach ("Ikan Pasir Belang")

Notes: *Nemacheilus selangoricus* prefers fast-flowing forest streams with clear water and a sand-gravel bottom. It can also be found in conditions with acidic water, such as the North Selangor Peat Swamp Forest (Ahmad, 2020c).

Figure 15: *Nemacheilus selangoricus*

Family: Cyprinidae

Barbodes rhombeus (Valeciennes, in Cuvier & Valeciennes, 1842)

Common name: Spotted Barb ("Ikan Tebal Sisik")

Notes: *Barbodes rhombeus* is found in streams ranging from lowland to submontane (Ahmad and Chua, 2019).

Figure 16: *Barbodes rhombeus*

Ceratogarra cambodgiensis (Tirant, 1884)
Common name: Siamese Stone Lapping Fish ("Ikan Susur Batu")
Notes: *Ceratogarra cambodgiensis* prefers rocky rapids in submontane to hill streams, bigger rivers, and, on rare occasions, lowland rivers (Vidthayanon and Ahmad, 2019).

Figure 17: *Ceratogarra cambodgiensis*

Cyclocheilichthys apogon (Valeciennes, in Cuvier & Valeciennes, 1842)
Common name: Beardless Barb ("Ikan Temperas")
Notes: *Cyclocheilichthys apogon* is a benthopelagic large-sized carp that appears to inhabit the lower, middle, and upper reaches of the river basin, while its lateral movement during flooding causes it to inhabit a variety of riverine habitats ranging from mainstream tributaries up to submontane streams, as well as lowland swamps or marshlands. The species can also be found in lakes or reservoirs, ditches, canals, and slow moving/still bodies of water. It travels into flooded forests as well as non-forested floodplains (Lumbantobing and Vidthayanon, 2020a).

Figure 18: *Cyclocheilichthys apogon*

Hampala macrolepidota (Kuhl & van Hasselt, in van Hasselt, 1823)
Common name: Hampala Barb ("Ikan Sebarau")
Notes: *Hampala macrolepidota* is found primarily in clean rivers or streams with flowing water and sandy to muddy bottoms. It can be found in most bodies of water, with the exception of small creeks, torrents, and shallow marshes. It is a migratory species that can be found in flooded woodlands (Ahmad, 2019c).

Figure 19: *Hampala macrolepidota*

Labiobarbus leptocheilus (Valeciennes, in Cuvier & Valeciennes, 1842)
Common name: Thin Lips Barb (“Ikan Kawan”)
Notes: *Labiobarbus leptocheilus* is a benthopelagic medium-sized carp that appears to be tolerant of multiple river basins, as found in the upper, middle, and lower river basins. This fish lives in mainstream rivers; it enters flooded fields and riverine forest to spawn during the early wet season and returns to the rivers during the dry season which was known as 'White' river migration pattern (Lumbantobing and Baird, 2020).

Figure 20: *Labiobarbus leptocheilus*

Lobocheilos rhabdoura (Fowler, 1934)
Common name: Thick Lips Barb (“Ikan Peridung”)
Notes: Fast-flowing rivers and streams with shady gravel to rocky bottoms are home to *Lobocheilos rhabdoura*. Found near the bottom of large and medium-sized streams. It usually lives in fast-flowing streams with rapids (Vidthayanon, 2012a).

Figure 21: *Lobocheilos rhabdoura*

Mystacoleucus obtusirostris (Valeciennes, in Cuvier & Valeciennes, 1842)
Common name: Minnow Barb (“Ikan Sia”)
Notes: *Mystacoleucus obtusirostris* can be found in small to big running water streams as well as impoundments. It was obtained in locations with a gravel, rock, and sand substrate. It also lives in streams that have driftwood and branches (Ahmad, 2020d).

Figure 22: *Mystacoleucus obtusirostris*

Osteochilus vittatus (Valeciennes, in Cuvier & Valeciennes, 1842)
Common name: Bony Lips Barb ("Ikan Terbul")
Notes: *Osteochilus vittatus* can be found in a variety of environments, including lowland marshlands, peat swamps, rivers and tributaries, and hill streams. The fish migrates to floodplains seasonally and is well adapted to dammed waters (Lumbantobing and Vidthayanon, 2020b).

Figure 23: *Osteochilus vittatus*

Osteochilus waandersii (Bleeker, 1853b)
Common name: Waandersii Hard Lips Barb ("Ikan Rong Ekor Merah")
Notes: *Osteochilus waandersii* is benthopelagic species carp of medium to large size that lives in submontane streams to highland waterfalls (the upper sections of rivers) with clear, fast-flowing water over gravelled to bouldered terrain. In bigger river systems, the species appears to be migratory (Lumbantobing and Vidthayanon, 2020c).

Figure 24: *Osteochilus waandersii*

Poropuntius deauratus (Smith, 1931)
Common name: Leaf Barb ("Ikan Daun")
Notes: *Poropuntius deauratus* lives in both permanent and seasonal rivers in lowland to submontane hill streams with sandy or boulder substrates (Ahmad, 2020e).

Figure 25: *Poropuntius deauratus*

Family: Danionidae

Danio albolineatus (Blyth, 1860)

Common name: Pearl Danio ("Ikan Seluang Bunga Air")

Notes: *Danio albolineatus* lives in big schools in submontane to hillstreams with leaf litter and extensive riparian vegetation (Vidthayanon, 2012b).

Figure 26: *Danio albolineatus*

Raiamas guttatus (Day, 1870)

Common name: Malayan Trout ("Ikan Sikang")

Notes: *Raiamas guttatus* is a large, highly pelagic minnow that appears to be suited to various riverine habitat types, as evidenced by records from the upper, middle, and lower portions of river basins. The majority of individuals have been discovered in shaded places and muddy bottoms of deep hill streams. Adults are typically found in clear water with moderate to rapid currents, whereas youngsters are found in quieter pools further downstream. The fish can be found in medium to large rivers, flooded meadows, and fast-flowing mountain streams (Lumbantobing and Vishwanath, 2020).

Figure 27: *Raiamas guttatus*

Rasbora myersi (Brittan, 1954)

Common name: Putussibau Rasbora ("Ikan Seluang Putussibau")

Notes: Rasbora myersi a pelagic moderate-sized minnow, can be found in the middle and lower portions of the basin in a variety of riverine habitat types (Lumbantobing, 2021).

Figure 28: *Rasbora myersi*

Rasbora paviana (Tirant, 1885)
Common name: Side Stripe Rasbora (“Ikan Seluang Jalur Sisi”)
Notes: *Rasbora paviana* is a medium-sized pelagic minnow that lives in streams, marshlands, peat swamps, floodplains, and rivers. (Lumbantobing and Vidthayanon, 2020d).

Figure 29: *Rasbora paviana*

Family: Bagridae
Batasio fluviatilis (Day, 1888)
Common name: Bagrid Catfish (“Ikan Baung Kecil”)
Notes: *Batasio fluviatilis* prefers streams with a moderate to quick current and a rocky bottom, though it can be found in slower-flowing streams with a muddy bottom (especially in very young fish) (Ng, 2020a).

Figure 30: *Batasio fluviatilis*

Hemibagrus capitulum (Popta, 1906)
Common name: Malayan River Catfish (“Ikan Baung Sungai”)
Notes: *Hemibagrus capitulum* can be found in a wide range of lotic and lentic habitats, including disturbed areas (Ng, 2020b).

Figure 31: *Hemibagrus capitulum*

Family: Sisoridae

Glyptothorax fuscus (Fowler, 1934)

Common name: Sisorid Catfish ("Ikan Kenderap Kecil")

Notes: Throughout its distribution, *Glyptothorax fuscus* is often found in lower elevation hillstreams and streams draining the foothills. Typically, such streams have a moderate to quick current, a sandy bottom, and heavy flora on the banks (Ng, 2019a).

Figure 32: *Glyptothorax fuscus*

Family: Siluridae

Ompok siluroides (La Cepède, 1803)

Common name: Ompok Catfish ("Ikan Tapah Bemban")

Notes: *Ompok siluroides* is found in a wide range of lotic and lentic habitats (Ng, 2019b).

Figure 33: *Ompok siluroides*

Family: Clariidae

Clarias batrachus (Linnaeus, 1758)

Common name: Walking Catfish ("Ikan Keli Kayu")

Notes: *Clarias batrachus* prefers lowland freshwater habitats like as rivers, lakes, ponds, and reservoirs. While there is little knowledge about the biology and ecology of this species due to recent taxonomic revisions, close congeners are abundant in ponds and rivers, have been discovered in all types of waters but especially in derelict, marshy waters, and have also been documented from rice fields (Ng and Low, 2019).

Figure 34: *Clarias batrachus*

Clarias leiacanthus (Bleeker, 1851)
Common name: Forest Catfish (“Ikan Keli Dacing”)
Notes: Clarias leiacanthus can be found in a wide range of lentic and lotic habitats, such as rivers, forest streams, and freshwater swamp forests. (Ng, 2019c).

Figure 35: *Clarias leiacanthus*

Family: Syngnathidae
Microphis martensii (Peters, 1868)
Common name: Long Snouted Pipefish (“Unduk-unduk Sungai”)
Notes: *Microphis martensii* can be found in freshwater riverine habitats with overhang grass (Zakaria-Ismail et al. 2019).

Figure 36: *Microphis martensii*

Family: Mastacembalidae
Macrognathus circumcinctus (Hora, 1924)
Common name: Half Banded Spiny Eel (“Ikan Tilan Paya”)
Notes: *Macrognathus circumcinctus* can be found in lowland to montane streams, peat swamp forests, medium to large rivers, and flooded fields (Vidthayanon and Daniels, 2020a).

Figure 37: *Macrognathus circumcinctus*

Mastacembelus favus (Hora, 1923)
Common name: Tire Track Spiny Eel (“Ikan Tilan Tayar”)
Notes: *Mastacembelus favus* lives in rivers, marshes, and vegetative water basins, with localized movement from still to flowing waters. It is most frequently seen on gravel substrates, where it buries itself throughout the day (Vidthayanon and Daniels, 2020b).

Figure 38: *Mastacembelus favus*

Family: Synbranchidae
Monopterus javanensis (La Cepède, 1800)
Common name: Asian Swamp Eel (“Ikan Belut)
Notes: *Monopterus javanensis* can be found in rivers, lakes, ponds, rice paddies, marshes, swamps, and drains, as well as in freshwater and brackish waters. It is resistant to both contaminated water and low oxygen levels. It is an air-breathing fish that can move across short stretches of dry land by breathing air efficiently. It may also withstand drought if buried in damp earth holes (Sayer, 2020).

Figure 39: *Monopterus javanensis*

Family: Anabantidae
Anabas testudineus (Bloch, 1792)
Common name: Climbing Perch (“Ikan Puyu”)
Notes: Freshwater habitats for *Anabas testudineus* include rivers, canals, lakes, ponds, wetlands, estuaries, and paddy fields. It is mostly a lowland fish in Sri Lanka. Adults can be found in medium to large rivers, brooks, flooded fields, and stagnant water bodies, including slow-flowing canals, and it is frequently seen in densely forested places. It can withstand extremely harsh water conditions and is commonly associated with murky, sluggish, and heavily contaminated environments. They are a common species found in the city's waterways (Ahmad et al. 2019).

Figure 40: *Anabas testudineus*

Family: Osphronemidae

Betta apollon (Schindler & Schmidt, 2006)

Common name: Narathiwat Fighting Fish ("Ikan Laga Narathiwat")

Notes: *Betta apollon* is found in cold, clear-water forested hill streams and has been taken in shallow waters among riparian roots, plants, and submerged leaf litter, as well as in faster-flowing stream sections among stones. (Low, 2019a).

Figure 41: *Betta apollon*

Trichopodus trichopterus (Pallas, 1770)

Common name: Three Spot Gourami ("Ikan Sepat Ronggeng")

Notes: *Trichopodus trichopterus* can be found in a variety of environments, such as freshwater marshes, ponds, lakes, peatlands, slow-moving streams, floodplains, rice fields, irrigation canals, and ditches by the side of the road. It prefers broad, slow-moving habitats with dense growths of submerged plants, and it can withstand some anthropogenic disturbance and pollution (Low, 2019b).

Figure 42: *Trichopodus trichopterus*

Family: Channidae

Channa limbata (Cuvier, in Cuvier & Valeciennes, 1831)

Common name: Dwarf Snakehead ("Ikan Haruan Kedak")

Notes: *Channa limbata* can be found in clean, clear streams with stony substrates that run through forested areas (Zakaria-Ismail et al. 2019).

Figure 43: *Channa limbata*

Channa striata (Bloch, 1793)
Common name: Common Snakehead ("Ikan Haruan")
Notes: *Channa striata* prefers stagnant muddy waters and grassy tanks and lives in swamps, freshwater ponds, streams, and tanks in the plains. This species is mostly found in wetlands, but it can also be found in lowland rivers. It is, however, more prevalent in quite deep (1-2 m) calm water and is extremely common in freshwater plains. It can also be found in medium to large rivers, brooks, flooded fields, and stagnant waters, such as slow-flowing canals (Chaudhry et al. 2019).

Figure 44: *Channa striata*

Family: Belonidae
Xenentodon canciloides (Bleeker, 1854)
Common name: Indochinese Needle Fish ("Ikan Todak Sungai")
Notes: *Xenentodon canciloides* can be found in freshwater lakes, big and medium-sized rivers and their tributaries, and flooded fields. It is frequently seen near the surface of clear water, on smooth rocks and pebbles (Ahmad and Hadiaty, 2020).

Figure 45: *Xenentodon canciloides*

Family: Zenarchopteridae
Hemirhamphodon pogonognathus (Bleeker, 1853c)
Common name: Forest Halfbeak ("Ikan Jejulung Hutan")
Notes: Throughout its range, *Hemirhamphodon pogonognathus* is found in lowland forest streams, blackwater in peat swamps, and lakes. It flourishes in small low-gradient streams with logs and leaf litter in the Kapuas basin of Kalimantan, and it favours slow flowing or stagnant water such as in the Sungkai Wildlife Reserve of Malaysia (Daniels and Allen, 2020b).

Figure 46: *Hemirhamphodon pogonognath*

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