

Short Communication

## An Updated Checklist of Fish Species in the Sultan Idris Shah Forestry Education Centre, Puchong, Selangor, with Notes on the Occurrence of Invasive Species

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### ABSTRACT

This study presents an updated fish checklist of the Sultan Idris Shah Forestry Education Centre (SISFEC), Puchong, Selangor, Malaysia. Fish samples were collected using gill nets, cast nets, scoop nets, baited lines, and electrofishers at eight sites within SISFEC, including Rasau River, Bohol River,

and several lentic water bodies. There are 29 fish species, representing 13 families of freshwater fish, with the family Danionidae (six species) dominating the list. Of the 29 species recorded, six were non-native, including *Oreochromis niloticus*, *Barbonymus gonionotus*, *Puntigrus tetrazona*, *Pterygoplichthys disjunctivus*, *Oreochromis* sp. (red), and *Poecilia reticulata*. In addition to the non-native species recorded, the Australian red claw crayfish, a non-native invasive invertebrate, was also encountered. Despite the increase in recorded native species compared to past reports, potential threats from invasive species remain a concern. Regular

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monitoring and strict regulation are recommended to ensure the conservation and sustainable use of SISFEC's aquatic biodiversity.

*Keywords:* Aquatic conservation; ecosystem health; environmental management; fish biodiversity; freshwater fish; introduced species

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## INTRODUCTION

The freshwater biodiversity crisis is a global issue characterized by the rapid decline in the biodiversity of naturally rich freshwater ecosystems like lakes, rivers, streams, and wetlands, which provide essential services to human societies and other living organisms (Albert et al., 2021). Human activities, such as agriculture, industrialization, and urban development, are accelerating the degradation of these ecosystems, posing significant threats to their ecological integrity and benefits (Reid et al., 2018). Emerging threats such as climate change, invasive species, infectious diseases, pollution, and habitat modification exacerbate the vulnerability of freshwater biodiversity and lead to ecosystem-level changes that disrupt ecological balances and diminish the services they provide (Ottoni et al., 2023).

The Sultan Idris Shah Forestry Education Centre (SISFEC), also known as Ayer Hitam Forest Reserve (AHFR), Puchong, Selangor, which falls under research and education, is a permanent forest reserve that was granted to Universiti Putra Malaysia (UPM). It covers an area of 1182 hectares (Faculty of Forestry and Environment, 2024). It is a reduction from the previous area of 4271 hectares with a total of 22 compartments in the year 1906 (Hussein et al., 2020). SISFEC has a river system that may be classified as having an upstream portion, where the gradients are quite steep with fast-flowing water, and it is made up of a network of interconnecting rapids and waterfalls. Two significant rivers, the Rasau River on the southern half and the Bohol River on the northern side, divide the SISFEC (Nuruddin et al., 2007). Many development projects have already been finished in the area surrounding the SISFEC, and these circumstances most likely had an impact on the SISFEC's fish population and stock (Awang et al., 2007; Hussein et al., 2020). Fortunately, the limited exploitation of its resources, which is guaranteed by its status as a protected area, may have increased the replacement rate in the population. Apart from Abit et al. (2012), who reported 11 fish species from the SISFEC over 15 years ago, no research has updated the checklist and diversity of fish species in the protected area (Table 1). This study has two main goals: (1) to present a preliminary checklist of fish species in the SISFEC's riverine system and (2) to report on the occurrence of non-native invasive species in SISFEC.

Table 1

List of fish species recorded from the study area in a previous study (Abit et al., 2012). \* = species that are also recorded in this study

S/N	Family	Species
1	Cyprinidae	<i>Puntius binotatus</i> (Valenciennes 1842) *
2		<i>Clupeichthys</i> sp.
3		<i>Rasbora einthovenii</i> (Bleeker 1851) *
4		<i>Rasbora heteromorpha</i> (Duncker 1904) *
5		<i>Rasbora sumatrana</i> (Bleeker 1852) *
6	Hemiramphidae	<i>Hemiramphodon pogonognathus</i> (Bleeker 1853) *
7	Luciocephalidae	<i>Luciocephalus pulcher</i> (Gray 1830) *
8	Anabantoidei	<i>Sphaerichthys osphromenoides</i> Canestrini 1860 *
9		<i>Betta pugnax</i> (Cantor 1849) *
10	Gobiidae	<i>Glossogobius giuris</i> (Hamilton 1822)
11	Clariidae	<i>Clarias macrocephalus</i> Günther 1864

## MATERIALS AND METHODS

### Study Area

The SISFEC, Puchong, Selangor, is a secondary disturbed forest logged a few times since the 1930s. The forest is a production forest belonging to the lowland dipterocarp (Awang et al., 2007). The SISFEC is located between 15 m and 233 m above sea level, with the forest slopes between 10% and 20% (Aditya et al., 2020; Top, 2016). The SISFEC is one of Selangor's few remaining lowland forest reserves. It was leased to UPM through a memorandum of understanding signed in 1996, which gives "custody" of the reserve for 80 years for use in education and research (Awang et al., 2007).

In SISFEC, the central terrain appears to be a haven for many wildlife species, particularly small mammals and birds. It is also a location that offers the people of the Klang Valley a green space for outdoor enjoyment in the forest. Land development, however, has seriously harmed the forest's aquatic biodiversity. During the dry season, the water's color usually changes to a yellowish emerald; during the wet season, it turns bluish-turquoise (Hussein et al., 2020).

### Sampling Site

The sampling site was mainly divided into two categories: lotic and lentic ecosystems. Fish sampling was conducted for three days, specifically from 29th to 31st May of 2023, at eight sites within the SISFEC, including Rivers Rasau, Bohol River, and lentic water bodies (pond and swampy area) (Figure 1 and Table 2).

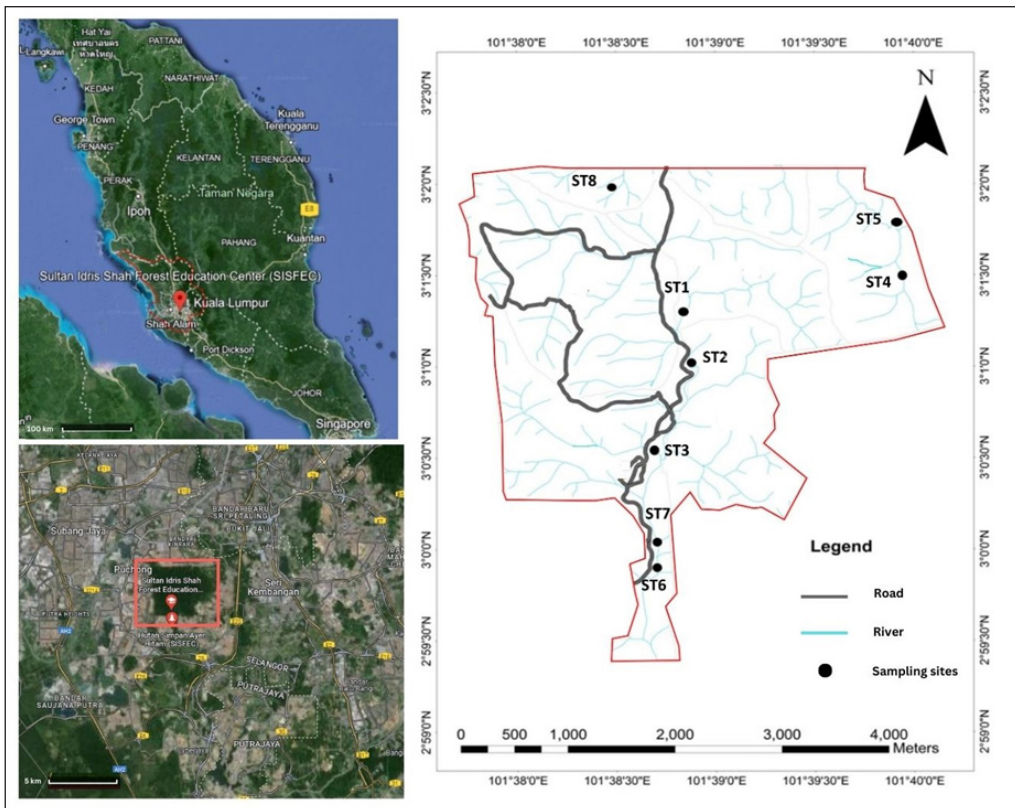


Figure 1. Map of Peninsular Malaysia showing the Sultan Idris Shah Forestry Reserve Education Centre (SISFEC), Puchong, Selangor, and the fish sampling sites within SISFEC

Table 2  
Coordinates of sampling sites within SISFEC, Puchong, Selangor

Site	Sampling site	Coordinates
Rasau River and its tributary	ST1	3°01'14.5" N, 101°38'48.9" E
	ST2	3°01'02.2" N, 101°38'51.9" E
	ST3	3°00'33.2" N, 101°38'38.6" E
	ST6	2°59'50.6" N, 101°38'39.9" E
Swamp	ST7	3°00'16.8" N, 101°38'39.4" E
Bohol River and its tributary	ST4	3°01'29.1" N, 101°39'56.5" E
	ST5	3°01'48.7" N, 101°39'53.4" E
Lake	ST8	3°02'04.4" N, 101°38'32.1" E

Stations 1, 2, and 3 in the Rasau River are characterized by shallow, slow-moving streams with natural structures and a dense canopy, promoting aquatic plant growth. Station 4 in the Bohol River's upstream section is narrower with a clear water stream and is



influenced by human disturbances such as jungle trekking. Downstream, Station 5 showed murky, contaminated water with debris and foul odors influenced by human disturbances such as fishing and residential areas. Station 6 on the downstream Rasau River had rapid water movement, influenced by human activities from nearby residential areas. Station 7 in the Rasau River swamp had a serene environment with slow-moving, stagnant water, a dense canopy, and natural structures. Station 8, in a lake, had stagnant water with vast open areas and depths but was vulnerable to human disturbance due to submerged tree structures and illegal fishing activities. A pictorial overview of the habitats in the SISFEC is provided in Figure 2. The Faculty of Forestry and Environment, Universiti Putra Malaysia, approved the accessibility and sample collection (Reference number: UPM.FHAS.SSA.100-3/5).



Figure 2. Photographs of the sampling sites within SISFEC

### Fish Sampling and Identification

A combination of a fish electro-shocker (Model EFGI 650, BSE Bretschneider, Chemnitz, Germany), scoop nets, gill nets, cast nets, and baited lines equipped with hooks were used for fish sampling, depending on the habitat suitability in each sampling site. During the sampling, efforts were made to promptly identify and release fish back into their habitat whenever feasible and two effort hours were spent in each sampling site. A representative sample of each fish species was preserved in a 10% formalin solution and subsequently transferred to 70% alcohol for long-term preservation. All specimens were cataloged in the fish collection of the Zoology Museum, Department of Biology, Faculty of Science, Universiti Putra Malaysia (UPMZM F).

Taxonomic identification of all captured fish was conducted up to the species level using established taxonomic keys referenced from Kottelat et al. (1993), Rainboth (1996)

and Zakaria-Ismail et al. (2019), while the systematic arrangement of fish followed by Kottelat (2013) and Lann et al. (2014). The taxonomic classification followed Fricke et al. (2024a, b), and species names and authors were confirmed with Fricke et al. (2024b). The International Union for Conservation of Nature (IUCN) status for all fish species was based on The IUCN Red List of Threatened Species (IUCN, 2023).

For the fish invasion risk, we referred to previous studies that designated introduced species in Malaysia as having a high, medium, or low risk of invasion based on the outcome of the Fish Invasiveness Screening Kit (FISK) and the Aquatic Species Invasiveness Screening Kit (AS-ISK) (Saba et al., 2020a, 2021).

## RESULTS

A total of 29 fish species representing 13 families of freshwater fish were recorded in SISFEC (Table 3 and Figure 3). The family Danionidae (six species) dominated the list of fish species in SISFEC, followed by Oshphronemidae (five species), Channidae (four species), and Cyprinidae (four species). Only one species was encountered in each of the following families: Loricariidae, Siluridae, Clariidae, Synbranchidae, Nandidae, Poeciliidae, Zenarchopteridae, and Pristolepididae. *Hemirhamphodon pogonognathus* was the most occurring species recorded in seven sampling sites. This species exhibited a notable prevalence, suggesting a robust presence within the aquatic ecosystem of SISFEC. It is followed by *Rasbora vulgaris* and *Betta pugnax*, recorded at six sampling sites, while *Barbodes sellifer* was recorded at five sites. Fish species belonging to the family Gobiidae were reported in a previous study but were not encountered in the current study.

Non-native species, including *Oreochromis niloticus*, *Barbonymus gonionotus*, *Puntigrus tetrazona*, *Pterygoplichthys disjunctivus*, *Oreochromis* sp. (red), and *Poecilia reticulata* were recorded. In addition to the recorded non-native fish species, the non-native Australian red claw crayfish, *Cherax quadricarinatus*, was also encountered.

## DISCUSSION

This study provides an updated checklist of fish species in the SISFEC, Puchong, Selangor and additional information on the occurrence of invasive species in the protected area. Among the families recorded in this study, Danionidae was the most abundant, as opposed to Cyprinidae, which is reportedly the most dominant fish family in most of Malaysia's freshwater bodies (Azahar et al., 2021; Cheok & Soo, 2022; Khaironizam et al., 2021; Sharir et al., 2019). Previously, Danionidae was considered a subfamily under the Cyprinidae based on the old classification for fish species (Cheok & Soo, 2022). Therefore, many species previously classified as belonging to the Cyprinidae now belong to the Danionidae.

Table 3  
 A checklist of fish species was recorded in Sultan Idris Shah Forestry Education Centre, Puchong, Selangor, including the IUCN Red List Status of the species. ST1 – ST8 = Sampling stations, \* = introduced fish species, # = sighted species (not captured), + = sampling sites with occurrence of introduced fish species, NA = Not available, DD = Data deficiency, LC = Least concern.

No.	Species	Local name	Catalog number	IUCN Red List Status	ST1	ST2	ST3	ST4	ST5	ST6	ST7	ST8
<b>Order Cypriniformes</b>												
<b>Family Cyprinidae</b>												
1	<i>Barbodes sellifer</i> Kottelat & Lim 2021	Tebal sisik	UPMZM F 101-1107	NA	+	+	+	+	+	+	+	+
2	<i>Barbonyminus gonionotus</i> (Bleeker 1849)*	Lampam Jawa	UPMZM F 1108	LC					+			
3	<i>Hampala macrolepidota</i> Kuhl & van Hasselt 1823#	Sebarau		LC				+				
4	<i>Puntigrus tetrazona</i> (Bleeker 1855)*#	Pelampung Jaring Palembang	UPMZM F 1109	LC								+
<b>Family Danionidae</b>												
5	<i>Esomus metallicus</i> Ahl 1924	Seluang Janggut	UPMZM F 1110	LC			+					
6	<i>Rasbora bankanensis</i> (Bleeker 1853)	Seluang Bangka	UPMZM F 1111	LC				+				
7	<i>Rasbora einthovenii</i> (Bleeker 1851)	Seluang Sambas	UPMZM F 1112 - 1114	LC			+				+	
8	<i>Rasbora vulgaris</i> Duncker 1904	Seluang Malaysia	UPMZM F 1115 - 1121	LC		+	+	+	+	+	+	
9	<i>Trigonopoma gracile</i> (Kottelat 1991)	Seluang Pinyuh	UPMZM F 1122 - 1124	LC					+			
10	<i>Trigonoistigma heteromorpha</i> (Duncker 1904)	Seluang Semenyih	UPMZM F 1125 - 1127	LC		+	+					

Table 3 (continue)

<b>Order Siluriformes</b>						
<b>Family Loricariidae</b>						
11	<i>Pterygoplichthys disjunctus</i> (Weber 1991)*	Bandaraya	UPMZM F 1128 - 1129	LC	+	+
<b>Family Siluridae</b>						
12	<i>Silurichthys hasseltii</i> Bleeker 1858	Tapah Bemban Jawa	UPMZM F 1130	LC	+	
<b>Family Clariidae</b>						
13	<i>Clarias leiacanthus</i> Bleeker 1851	Keli Sambas	UPMZM F 1131	LC	+	
<b>Order Synbranchiformes</b>						
<b>Family Synbranchidae</b>						
14	<i>Monopterus javanensis</i> Lacepède 1800	Belut Jawa	UPMZM F 1132	LC	+	
<b>Order Anabantiformes</b>						
<b>Family Osphronemidae</b>						
15	<i>Betta pugnax</i> (Cantor 1849)	Laga Pulau Pinang	UPMZM F 1132	LC	+	+
16	<i>Luciocephalus pulcher</i> (Gray 1830)	Tembok Tebing Malaya	UPMZM F 1132	LC	+	
17	<i>Sphaerichthys osphronoides</i> Canestrini 1860	Gorami Coklat Indonesia	UPMZM F 1132	DD	+	
18	<i>Trichopodus trichopterus</i> (Pallas 1770)	Sepat Indonesia	UPMZM F 1132	LC	+	
19	<i>Trichopsis vittata</i> (Cuvier 1831)	Karim Jawa	UPMZM F 1132	LC		+



Table 3 (continue)

<b>Family Channidae</b>									
20	<i>Channa limbata</i> (Cuvier 1831)	Haruan Jawa	UPMZM F 1145	NA					+
21	<i>Channa lucius</i> (Cuvier 1831)	Bujuk Jawa	UPMZM F 1146	LC					+
22	<i>Channa melasoma</i> (Bleeker 1851)	Haruan Sambas	UPMZM F 1147 - 1148	LC			+		
23	<i>Channa striata</i> (Bloch 1793)	Haruan Tharangambadi	UPMZM F 1149 - 1150	LC				+	+
<b>Family Nandidae</b>									
24	<i>Nandus nebulosus</i> (Gray 1835)	Daun Kering Indonesia	UPMZM F 1151 - 1153	LC			+		+
<b>Family Pristolepidae</b>									
25	<i>Pristolepis fasciata</i> (Bleeker 1851)#	Patung Banjarmasin		LC					+
<b>Order Cichliformes</b>									
<b>Family Cichlidae</b>									
26	<i>Oreochromis niloticus</i> (Linnaeus 1758)*	Tilapia Hitam	UPMZM F 1154 - 1155	LC			+		
27	<i>Oreochromis</i> sp. (red)*#	Tilapia Merah		NA					+
<b>Order</b>									
<b>Cyprinodontiformes</b>									
<b>Family Poeciliidae</b>									
28	<i>Poecilia reticulata</i> Peters 1859*	Gapi	UPMZM F 1156	LC					+
<b>Order Belontiiformes</b>									
<b>Family Zenarchopteridae</b>									
29	<i>Hemirhamphodon pogonognathus</i> (Bleeker 1853)	Jolong-Jolong Merawan	UPMZM F 1157 - 1163	LC			+		+

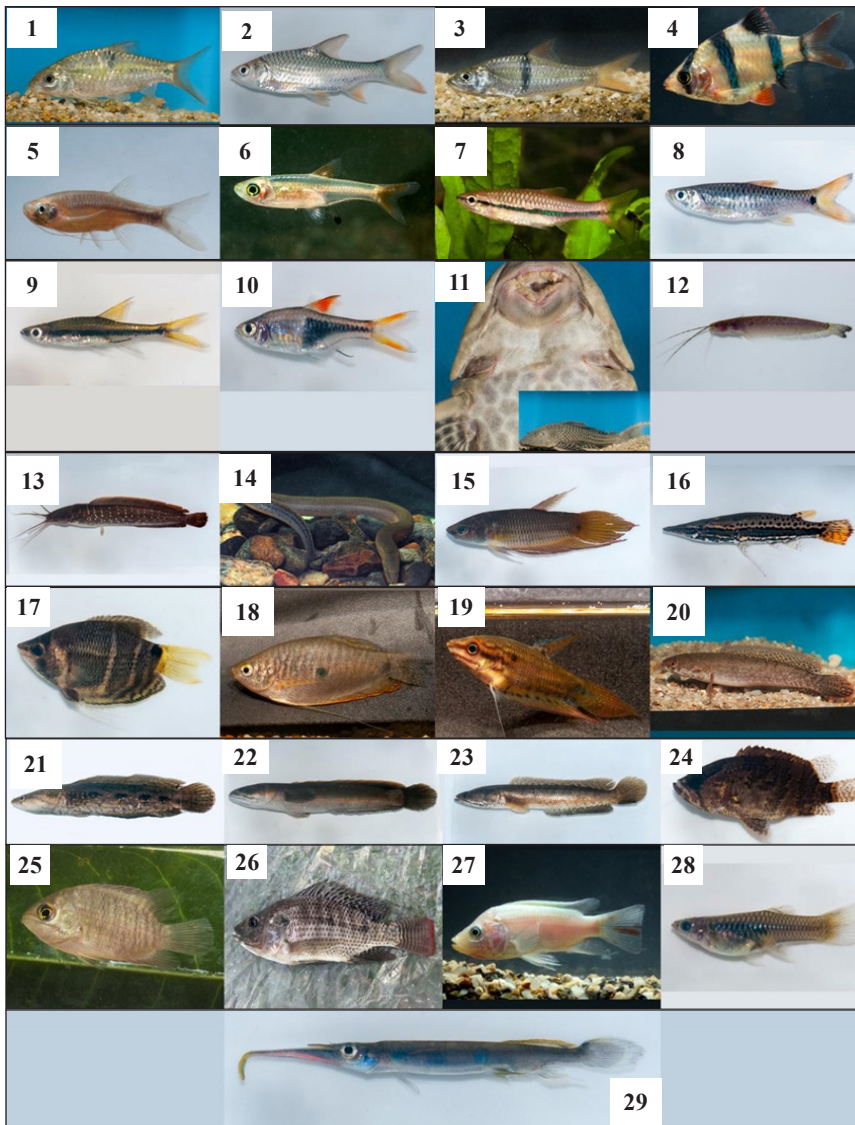


Figure 3. Freshwater fishes recorded in SISFEC. (1) *Barbodes sellifer*, 43.2 mm SL; (2) *Barbonymus gonionotus*, 103.5 mm SL; (3) *Hampala macrolepidota*, 63.6 mm SL; (4) *Puntigrus tetrazona*, 28.1 mm SL; (5) *Esomus metallicus*, 37.1 mm SL; (6) *Rasbora bankanensis*, 14.2 mm SL; (7) *Rasbora einthovenii*, 23.7 mm SL; (8) *Rasbora vulgaris*, 34.1 mm SL; (9) *Trigonopoma gracile*, 16.4 mm SL; (10) *Trigonostigma heteromorpha*, 12.8 mm SL; (11) *Pterygoplichthys disjunctivus*, 238.31 mm SL; (12) *Silurichthys hasseltii*, 61.2 mm SL; (13) *Clarias leiacanthus*, 81.3 mm SL; (14) *Monopterus javanensis*, 192.7 mm SL; (15) *Betta pugnax*, 54.6 mm SL; (16) *Luciocephalus pulcher*, 88.5 mm SL; (17) *Sphaerichthys osphromenoides* 25.2 mm SL; (18) *Trichopodus trichopterus*, 47.1 mm SL; (19) *Trichopsis vittata*, 40.6 mm SL; (20) *Channa limbata*, 63.3 mm SL; (21) *Channa lucius*, 201.3 mm SL; (22) *Channa melasoma*, 227.1 mm SL; (23) *Channa striata*, 237.1 mm SL; (24) *Nandus nebulosus*, 30.2 mm SL; (25) *Pristolepis fasciata*, 42.1 mm SL; (26) *Oreochromis niloticus*, 183.5 mm SL; (27) *Oreochromis* sp. (red), 49.6 mm SL; (28) *Poecilia reticulata*, 20.1 mm SL; (29) *Hemirhamphodon pogonathus*, 52.7 mm SL

The number of recorded species from this study is 29, higher than the previous report with 11, where *Clupeichthys* sp. had been recorded in SISFEC (Abit et al., 2012). It may have been a miss-identified species because fish belonging to the genus *Clupeichthys* usually inhabit the habitat of large rivers, and in Peninsular Malaysia, it is only recorded in the Perak River and Pahang River (Zakaria-Ismail et al., 2019). Advancements in science and technology, especially in taxonomy, have led to updates in species names. *Puntius binotatus*, previously reported in SISFEC, is now known as *Barbodes sellifer*, as *Barbodes binotatus* is restricted in Java Island (Kottelat & Lim, 2021). Meanwhile, *Rasbora sumatrana* is only found in Sumatra, and the species that occurs in SISFEC is *Rasbora vulgaris*. The old literature frequently listed the harlequin rasbora as *Rasbora heteromorpha*, but it is now known as *Trigonostigma heteromorpha*.

Approximately 70% of the previously reported species were recorded in the current study. The increase in the number of fish species in the SISFEC, as presented in this study compared to the previous report, shows that the ecosystem has been well preserved. It may also be due to the efficiency of the sampling technique (fish electro shocker) and the number of fish sampling sites in this study. However, the occurrence of non-native species, with three of them (*P. disjunctivus*, *O. niloticus*, and *Poecilia reticulata*) known to be of high invasion risk, shows that there is a threat of future invasion of these water bodies. It is also indicative of the possibility of anthropogenic impacts on the forest through aquarium releases of alien fish (Saba et al., 2020a).

Several routes of translocation include the release and/or escape from fish farms, the use of non-native fish as fish bait, and the dumping of unwanted aquarium fish for specific reasons such as unmanageable size and, in some cases, religious purposes may have contributed to the spread of non-native fish species into Malaysian aquatic ecosystems (Rahim et al., 2013; Saba et al., 2020b). In addition, the use of some non-native species, like *Poecilia reticulata*, for mosquito control is more harmful than beneficial to the ecosystem (Azevedo-Santos et al., 2016).

Tilapia (*Oreochromis* spp.) is well known to compete with its native counterparts for food, while sailfin catfish are known to disrupt and dominate the river environment (Kang et al., 2023; Hossain et al., 2018). Based on the previous fish invasion risk assessments for Peninsular Malaysia, *P. disjunctivus*, *O. niloticus*, and *Poecilia reticulata* were confirmed to be invasive (high risk), while *Puntigrus tetrazona* and *Barbonymus gonionotus* were reported to be of medium invasion risk (Saba et al., 2020a; 2021).

None of the species encountered was under any form of threat based on the IUCN's list of endangered species. In this study, more intensive sampling may increase the chances of the discovery of additional fish species. In the Ulu Muda Forest Reserve, Kedah, Khaironizam, et al. (2021) reported four introduced species, *Barbonymus gonionotus*, *Pangasianodon hypophthalmus*, *O. niloticus* and *Toxabramis houdemeri* with *O. niloticus*

being the most dominant. Ahmad et al. (2020) also reported the dominance of *O. niloticus* from selected freshwater bodies in Selangor after recording a total of 15 species, with five of them being non-native. Notably, in this study, the non-native fish are recorded at sites located nearby or next to human settlements (Stations 4, 5, 6, 7, and 8) and not in the middle of the forest—indicating the importance of human interference in the non-native fish species problems.

The Australian red claw crayfish has been reported to have established populations in West and East Malaysia. It is supported by the reports of studies on Benut River in Johor and Suai River in Sarawak and drainage systems in Felda Tenang, Besut, Terengganu (Naquiddin et al., 2016). Norshida et al. (2021) suggested that red claw crayfish in certain locations are likely due to releases by aquarium hobbyists rather than aquaculture practices. Like other recorded invasive fish species, it is crucial to develop strong mitigation plans to prevent the further introduction of red claw crayfish to the SISFEC aquatic ecosystem.

In this study, it is unclear how these non-native species got into the SISFEC tributaries. Still, aquarium releases are suspected as the non-native fish are recorded from sites close to human settlement, indicating the high possibility of human influence in introducing non-native fish species.

## CONCLUSION

This study gave a comprehensive list of fish species, an update to the existing species list published over 15 years ago. Future research should consider a comprehensive assessment of the fish community structure in this forest spanning the different seasons. It could provide a more detailed insight into the community dynamics of SISFEC. Besides, the presence of invasive species necessitates continuous monitoring of the fish community to avoid the possibility of expansion of their population.

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