

An update to the Inland Fishes of Pulau Tioman, Malaysia

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Abstract. Sixty-two species of inland fishes are recorded from Pulau Tioman, Malaysia, representing an increase of 14 species (29%) since the last published checklist in 1999. Nine native species are recorded for the first time, viz., *Neotrygon kuhlii* (Dasyatidae), *Chanos chanos* (Chanidae), *Lates calcarifer* (Latidae), *Selaroides leptolepis* (Carangidae), *Kraemeria cunicularia*, *Mangarinus waterousi*, *Mugilogobius chulae*, *Pandaka pygmaea*, and *Stiphodon multisquamus* (Gobiidae). An additional five introduced species are also recorded for the first time, viz., *Barbonymus schwanenfeldii* (Cyprinidae), *Hypsibarbus* sp. (Cyprinidae), *Poecilia reticulata* (Poeciliidae), *Oreochromis* hybrid (Cichlidae), and *Channa striata* (Channidae); their likely modes of introduction and potential impacts of the introduced species are briefly discussed. Additional distributional data and natural history observations are also included.

Key words. Biodiversity, Pulau Tioman, Southeast Asia, inland fishes, alien species

INTRODUCTION

Pulau Tioman, located about 45 km off the east coast of Peninsular Malaysia is the country's largest island in the South China Sea. This mainly granitic (western part) and volcanic (eastern part) island is drained by many swift flowing hill streams (see Yang et al., 1999, for a detailed map of Pulau Tioman with named drainages), which are mainly subterranean above 600 m asl. In the narrow and flatter coastal plains, the streams become broader and more meandering and swamps occur (Bullock & Medway, 1966). The inland fish fauna of Tioman mainly comprises anadromous, secondary division freshwater forms, and these are concentrated in the lower stretches and associated estuaries of the drainages (Alfred, 1966; Lim, 1993; Ng et al., 1999).

The inland ichthyofauna of Pulau Tioman had been first enumerated by Alfred (1966) and later by Lim (1993). However, both lists were based on collections from only a few locations. Ng et al. (1999) subsequently listed 48 species, based on more survey sites and observations from various team efforts from 1996 to 1997. The present updated list is based on mainly further observations in Paya and Juara Bays between 1999 and 2015.

MATERIAL AND METHODS

Fish species were mainly observed in-situ from bridge or river bank, snorkelling and during class excursions usually conducted between the months of June to September 1999 to 2014. Observations were made with a telephoto lens mounted on a digital single lens reflex camera or a waterproof digital camera. Some fish species were obtained with push nets, scoop nets and cast nets. These fish species were then identified using various references: Kottelat et al. (1993), Carpenter & Niem (1998, 1999a–d) and Allen & Erdmann (2012). Abbreviations used include: Sg. = Sungai (meaning river), Kg. = Kampung (meaning village), SL = standard length, and TL = total length.

RESULTS

A total of 62 species from 34 families are now recorded from the inland waters of Pulau Tioman (see Annex 1). Fourteen species are recorded here for the first time in the inland waters of Pulau Tioman, which comprise eight native species and five introduced species. The eight native species are: *Neotrygon kuhlii* (Dasyatidae), *Chanos chanos* (Chanidae), *Lates calcarifer* (Latidae), *Selaroides leptolepis* (Carangidae), *Kraemeria cunicularia*, *Mangarinus waterousi*, *Mugilogobius chulae*, *Pandaka pygmaea*, and *Stiphodon multisquamus* (Gobiidae), with the last goby species being described by Chen & Tan (2005) but synonymised under *S. multisquamus* recently by Maeda et al. (2015). The additional five introduced species are: *Barbonymus schwanenfeldii* (Cyprinidae), *Hypsibarbus* sp. (Cyprinidae), *Poecilia reticulata* (Poeciliidae), *Oreochromis* hybrid (Cichlidae) and *Channa striata* (Channidae). Previously, only one introduced species, *Trichopodus trichopterus* (Osphronemidae), had been recorded from Pulau Tioman by Alfred (1966) and Lim (1993).

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Fig. 1. *Barbonymus schwanefeldii* (ca. 40 mm SL) in-situ in Sg. Keliling (2014).



Fig. 2. *Channa striata* in-situ (ca. 100 mm SL) in stagnant stream near Sg. Keliling (2014) (Photograph by: THH).

Expanded distributional ranges are noted for the following species (see Appendix 1 for more details): *Megalops cyprinoides* (Megalopidae), *Barbodes lateristriga* (Cyprinidae), *Clarias batu* (Clariidae), *Macrognathus maculatus* (Mastacembelidae), *Zenarchopterus gilli* (Zenarchopteridae), *Atherinomorus lacunosus* (Atherinidae), *Moolgarda seheli* (Mugilidae), *Fimbramia amboinensis*, *Yarica hyalosoma* (Apogonidae), *Ambassis urotaenia* (Ambassidae), *Monodactylus argenteus* (Monodactylidae), *Toxotes jaculatrix* (Toxotidae), *Sillago sihama* (Sillaginidae), *Gerres filamentosus* (Gerreidae), *Lutjanus argentimaculatus* (Lutjanidae), *Abudefduf sordidus*, *Pomacentrus taeniometopon* (Pomacentridae), *Exyrias puntang*, *Glossogobius aureus*, *Periophthalmus argentilineatus* (Gobiidae), and *Siganus guttatus* (Siganidae).

The following drainages contain more than 20 species each, viz. Sg. Paya (26), Sg. Mentawak (25), Sg. Keliling (23) and Sg. Baharu (22). This merely reflects the intensity of survey and observations, and does not reflect the true diversity of the individual river. This update is by no means exhaustive as lesser drainages have not been sampled of recent, and smaller cryptic species may not be easily observed. For a more comprehensive survey, other fish capture techniques should be deployed, e.g., electro fishing and trapping.

DISCUSSION

Potential impacts of introduced fish species in Pulau Tioman. Cyprinidae – *Barbonymus schwanefeldii* (Fig. 1) and *Hypsibarbus* sp.: both species were sighted in Sg. Keliling in 2014, in completely freshwater zone. Both species present appear to be recent introductions (not sighted in 2013 or anytime previously) as most individuals sighted were juveniles (less than 80 mm SL), although a larger individual of *B. schwanefeldii* (around 200 mm SL) was sighted. A small school of *B. schwanefeldii* was also sighted in a tributary of Sg. Baharu, all individuals being 50 mm SL and smaller. Both *Barbonymus* and *Hypsibarbus* are typically inhabitants of large riverine habitats, and thus not naturally occurring in small hill streams (Kottelat et al., 1993). These barbs are popular ornamental/aquarium

species, and may have been brought in to the island as pets, and possibly intentionally released.

Poeciliidae – *Poecilia reticulata*: several individuals of differing size (indicating an established breeding population) were sighted in an elevated hill stream (around 370 m asl) draining into Sg. Ayer Besar, next to the Juara-Tekek road. This is a popular ornamental fish often introduced for mosquito control (Lever, 1996).

Cichlidae – *Oreochromis* hybrid: these pink Tilapia hybrid fish, which were sighted in the tidal zone of the Paya mangroves in 2008, could have been escapees or intentional introductions. Other sightings were in artificial ponds located in Paya and Juara bays. This species was probably introduced for aquaculture purposes (Lever, 1996). At the same time, there are also a number of small garden or landscape ponds in the villages around the island that contain Tilapias as ornamental fish.

Osphronemidae – *Trichopodus trichopterus*: collected by Alfred in 1966 and observed by Lim in 1993. There had been no recent sightings of this fish since. This is a popular ornamental/aquarium species, and may have been introduced as escapees or releases.

Channidae – *Channa striata*: this newly recorded non-native fish species was recorded from a stagnant stream near Sg. Keliling in 2014 (Fig. 2), and was also observed in a dammed stream at Kg. Air Batang (J H Liew pers. comm. 2014). Several individuals were sighted, ranging from 10 cm to 30 cm TL, which may indicate an established population at the stagnant stream near Sg. Keliling. This is a popular food and angling species (Courtenay & Williams, 2004), thus it is not surprising that it has been introduced.

Of the six above listed non-native fishes, *Channa striata* exhibits the highest potential for impacts on native fish fauna due to its predatory nature. This species also tolerates stagnant anoxic waters due to its air breathing capability, is able to traverse short distances overland and exhibits parental care for eggs and fry (Courtenay & Williams, 2004). Though it



Fig. 3. *Speonectes tiomanensis* (ca. 40 mm SL) in-situ within cave near summit of Gunung Kajang (1999) (Photograph by: THH).

prefers slow flowing waters with vegetation cover, Tioman's waterways are not typical habitat for this species, except in the coastal plains. Both non-native cyprinid species (*Barbonymus schwanenfeldii* and *Hypsibarbus* sp.) will probably compete with the native cyprinid (*Barbodes lateristriga*) over food and niche resources.

Public awareness and education should be implemented to reduce further non-native species introductions. There should be monitoring programmes to be put in place to either eradicate or reduce the spread of already present non-native species.

Field notes on selected species. Dasyatidae – *Neotrygon kuhlii*: this species was sighted on more than three occasions in the mangrove creek near the mouth of Sg. Baharu (B Y Lee, pers comm. 2014). Shallow sandy pits (around 30–60 cm across) observed at the mouth of Sg. Baharu could also be caused by the feeding activity of this species.

Chanidae – *Chanos chanos*: three large individuals (about 50–60 cm TL) with deeply forked caudal fins were sighted during high tide at a bridge over Sg. Baharu (under tidal influence).

Nemacheilidae – *Speonectes tiomanensis*: the taxonomy of this species has recently been updated by Kottelat (2012) and shown to be distinct from *Sundoreonectes*, which is restricted to Borneo. This species is listed as Vulnerable by the IUCN Red List (<http://www.iucnredlist.org/details/summary/21168/0>) due to its highly restricted distributional range. This cave dwelling species was sighted in 1999 and 2000 from within a low ceiling cave near the summit of Gunung Kajang (Fig. 3). Around 15 individuals were sighted in the shallow waters (THH, pers. obs.). The fish was not sensitive to light disturbance from observers' torch lights, but reacted to physical disturbances in the water.

Mastacembelidae – *Macrognathus maculatus*: thus far, this species has been found only in Sg. Asah, a southward drainage. The present record from Sg. Mentawak (Fig. 4) suggests that this elusive species is more widespread, but maybe restricted to southward and eastward drainages.



Fig. 4. *Macrognathus maculatus* (ca. 150 mm TL) in-situ in Sg. Mentawak cascades (2012) (Photograph by: THH).



Fig. 5. *Kraemeria cunicularia* (ca. 25 mm SL) from Paya river mouth (2003), a new record for the South China Sea region (Photograph by: THH).

Zenarchopteridae – *Dermogenys collettei*: this halfbeak species occurs in both brackish and freshwater zones, and it can be located in the lower stretches of the hill stream habitats. This species exhibits a disrupted distribution in Pulau Tioman, where it is present in the western drainages and absent in the eastern drainages (i.e., absent in the rivers draining into Juara Bay). This is also corroborated by *Cerberus schneiderii* (Homalopsidae), a snake species typically found in mangroves from western drainages, viz. Kg. Air Batang, Kg. Berjaya, Kg. Lalang, Kg. Tekek and Sg. Paya (Grismer, 2011).

Latidae – *Lates calcarifer*: an individual (around 30 cm TL) was sighted at night in a deep pool in Sg. Paya drainage. There were also two individuals of *Megalops cyprinoides* (Megalopidae) sighted within the same pool. Both species differed in swimming style and profile. *Lates calcarifer* tend to swim more slowly and stick to deeper waters, whereas *M. cyprinoides* swims faster and nearer the water surface.

Gobiidae – *Kraemeria cunicularia*: this tiny gravel dweller (Fig. 5), which is not larger than 30 mm SL, typically occurs in zones where freshwater enters the sea, with coarse gravel and sand base. This species was sighted in Paya river mouth in 2002 and 2003, however, owing to habitat alteration in subsequent years, it appears to be locally extirpated. This represents the first record for the South China Sea region (Kottelat, 2013).

Gobiidae – *Mangarinus waterousi*, *Mugilogobius chulae* and *Pandaka pygmaea*: all these species were sighted in tidal pools during low tide in the Paya mangroves (Figs. 6,



Fig. 6. *Mangarinus waterousi*, prey item of *Cerberus schneiderii* from Paya mangroves (2015) (Photograph by: THH).



Fig. 7. Top – *Mugilogobius chulae* (ca. 25 mm SL); Bottom – *Pandaka pygmaea* (ca. 12 mm SL) from Paya mangroves (2010) (Photograph by: THH).

7). The former species was photographed as a prey item of *Cerberus schneiderii* (Homalopsidae; Fig. 6). These latter two species are examples of small cryptic fish species easily missed out in fish surveys.

Gobiidae – *Stiphodon multisquamus*: *Stiphodon aureorostrum* was described by Chen & Tan in 2005 and presumed to be an island endemic. Chen & Tan (2005) had access to very few specimens of *S. multisquamus* for comparison. Recently, Maeda et al. (2015) had access to a large series of *S. multisquamus* for comparison and discovered that characters

used to differentiate *S. aureorostrum* from *S. multisquamus* all lie within the natural variation range of *S. multisquamus*. Thus, *S. aureorostrum* is a synonym of *S. multisquamus*.

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APPENDIX

Appendix 1. Updated list of inland fishes of Pulau Tioman (+: previous record, ND: new distributional record, NS: new species record; species name in bold represent new record; species name in capitals represent a re-identification; * represents introduced species) [adapted from Ng et al. 1999]

BAYS	SALANG	MONKEY	TEKEK			PAYA		GENTING	NIPAH	ASAH	MUKUT	JUARA				DUNGUN	KAJANG
SPECIES	Sg. Salang	Monkey Bay	Kg. Air Batang	Sg. Ayer Besar	Sg. Tekek	Sg. Paya	Sg. Durian Kallang/Pasal	Sg. Ayer Rajah	Sg. Nipah	Sg. Asah	Sg. Raya	Sg. Mentawak	Sg. Kelling	Sg. Ayer Dalam	Sg. Baharu	Teluk Dungun	Gunung Kajang cave
DASYATIDAE																	
<i>Neotrygon kuhlii</i>															NS		
MEGALOPIDAE																	
<i>Megalops cyprinoides</i>						ND							+	ND			
CHANIDAE																	
<i>Chanos chanos</i>															NS		
CYPRINIDAE																	
<i>Barbodes lateristriga</i>				+	ND	+	+	+		+	+	ND	+	+	+		
<i>Barbonymus schwanefeldti</i> *													NS	NS			
<i>Hypsibarbus</i> sp.*													NS				
NEMACHEILIDAE																	
<i>Speonectes tiomanensis</i>																	+
CLARIIDAE																	
<i>Clarias batu</i>				+		+	+	+	+	+			ND	ND	+	+	
<i>Clarias leiocanthus</i>													+		+		
SYNBRANCHIDAE																	
<i>Monopterus albus</i>													+				
MASTACEMBELIDAE																	
<i>Macrogynathus maculatus</i>										+		ND					
APLOCHEILIDAE																	
<i>Aplocheilus panchax</i>	+																
POECILIIDAE																	

BAYS	SALANG	MONKEY	TEKEK			PAYA		GENTING	NIPAH	ASAH	MUKUT	JUARA				DUNGUN	KAJANG
	Sg. Salang	Monkey Bay	Kg. Air Batang	Sg. Ayer Besar	Sg. Tekek	Sg. Paya	Sg. Durian Kallang/Pasal	Sg. Ayer Rajah	Sg. Nipah	Sg. Asah	Sg. Raya	Sg. Mentawak	Sg. Keliling	Sg. Ayer Dalam	Sg. Baharu	Teluk Dungun	Gunung Kajang cave
DRAINAGE SPECIES				NS													

BAYS	SALANG	MONKEY	TEKEK			PAYA		GENTING	NIPAH	ASAH	MUKUT	JUARA				DUNGUN	KAJANG
SPECIES	Sg. Salang	Monkey Bay	Kg. Air Batang	Sg. Ayer Besar	Sg. Tekek	Sg. Paya	Sg. Durian Kallang/Pasal	Sg. Ayer Rajah	Sg. Nipah	Sg. Asah	Sg. Raya	Sg. Mentawak	Sg. Keliling	Sg. Ayer Dalam	Sg. Baharu	Teluk Dungun	Gunung Kajang cave
<i>Selaroides leptolepis</i>												NS					
GERREIDAE																	
<i>Gerres filamentosus</i>						ND									+		
LUTJANIDAE																	
<i>Lujanus argentimaculatus</i>	+					+					+	+	+		ND	+	
HAEMULIDAE																	
<i>Plectorhynchus gibbosus</i>												+					
POMACENTRIDAE																	
<i>Abudefduf sordidus</i>												+	ND		+		
<i>Pomacentrus taeniotometopon</i>												+			ND		
CICHLIDAE																	
<i>Oreochromis hybrid*</i>						NS											
BLENNIIDAE																	
<i>Istiblennius edentulus</i>					+												
ELEOTRIDAE																	
<i>Butis gymnopomus</i>												+					
<i>Eleotris melanosoma</i>												+	+	+			
<i>Eleotris oxycephala</i>															+		
<i>Giuris margaritacea</i>													+				
<i>Ophiocara porocephala</i>					+	+					+		+				
GOBIIDAE																	
<i>Exyrias puntang</i>						+						+	ND				
<i>Glossogobius aureus</i>					+	+			+			+	ND				
<i>Glossogobius biocellatus</i>					+	+			+			+					
<i>Glossogobius ilimus</i>					+	+					+	+	+	+			

BAYS	SALANG	MONKEY	TEKEK			PAYA		GENTING	NIPAH	ASAH	MUKUT	JUARA				DUNGUN	KAJANG	
	Sg. Salang	Monkey Bay	Kg. Air Batang	Sg. Ayer Besar	Sg. Tekek	Sg. Paya	Sg. Durian Kallang/Pasal	Sg. Ayer Rajah	Sg. Nipah	Sg. Asah	Sg. Raya	Sg. Mentawak	Sg. Keliling	Sg. Ayer Dalam	Sg. Baharu	Teluk Dungun	Gunung Kajang cave	
DRAINAGE SPECIES	<i>Istigobius ornatus</i>		+															
	<i>Kraemeria cunicularia</i>					NS												
	<i>Lophogobius bleekeri</i>											+						
	<i>Mangarinus waterousi</i>					NS												
	<i>Mugilogobius chulae</i>					NS												
	<i>Pandaka pygmaea</i>					NS												
	<i>Periophthalmus argentilineatus</i>			+		+	ND					+	+	+	ND			
	<i>Pseudogobius javanicus</i>		+						+									
	<i>Redigobius balteatus</i>					+												
	<i>Redigobius bikolanus</i>						+		+	+	+		+	+	+	+		
	<i>Stiphodon atropurpureus</i>													+				
	<i>Stiphodon multisquamus</i>						+							+				
	<i>Yongeichthys nebulosus</i>												+					
	MICRODESMIDAE																	
	<i>Parioglossus raoi</i>						+											
	SIGANIDAE																	
	<i>Siganus guttatus</i>						ND						+			ND		
OSPHRONEMIDAE																		
<i>Trichopodus trichopterus*</i>											+							
CHANNIDAE																		
<i>Channa striata*</i>			NS										NS					
TETRAODONTIDAE																		
<i>Arothron immaculatus</i>															NS			
Number of species per drainage	4	2	3	3	12	26	2	4	5	4	6	25	23	9	22	3	1	