

# Fishes of a Conserved Peat Swamp Forest in an Oil Palm Plantation

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## ABSTRACT

Peat swamps are known to be important habitats for fish fauna that have narrow niches and restricted range. As peatland is being utilised for agriculture, biodiversity conservation plays an essential role as one of the criteria for defining sustainable agriculture. In an oil palm production landscape which is located at Tinbarap Estate in Miri, Sarawak, a total of 210.63 ha of peat swamp forest have been set aside as the Tinbarap Conservation Area (TCA) for conservation efforts. This study documents the fish fauna of Sungai Kulak which flows through the conservation area. Sampling was conducted in April 2016 and November 2016, from which a total of 106 fishes representing 13 species and seven families were recorded. In terms of the number of individuals caught, 78.30% were from the family Cyprinidae, 8.49% from Siluridae, 4.72% from Channidae, 3.77% from Osphronemidae, 1.89% from Anabantidae, 1.89% from Bagridae and 0.94% from the family Helostomatidae. The dominant species was *Desmopuntius johorensis* which accounted for 47.17% of the total fishes recorded. The dominance of Cyprinidae in TCA was similar to that in other peat swamp habitats. The results of our present study provide useful information on the diversity of fishes in Sungai Kulak which in the future could be valuable in conservation planning of the aquatic environment in TCA of Tinbarap Estate.

## ABSTRAK

Paya gambut dikenali sebagai habitat penting bagi jenis ikan yang hanya terhad mendiami habitat-habitat tertentu. Oleh sebab pertanian juga dijalankan di tanah gambut, pemuliharaan biodiversiti memainkan peranan penting sebagai salah satu kriteria untuk menjamin pertanian lestari. Di landskap penanaman sawit yang terletak di Ladang Tinbarap di Miri, Sarawak, sejumlah 210.63

ha hutan paya gambut telah diwartakan sebagai Kawasan Pemuliharaan Tinbarap (TCA), untuk tujuan usaha pemuliharaan. Kajian ini bertujuan untuk mengenal pasti dan menyenaraikan spesies ikan yang terdapat di Sungai Kulak di TCA. Kerja persampelan telah dijalankan pada April 2016 dan November 2016; hasilnya sejumlah 106 ikan yang diwakili oleh 13 spesies dan tujuh famili telah direkodkan. Daripada keseluruhan individu yang direkodkan, 78.30% terdiri daripada famili Cyprinidae, 8.49% Siluridae, 4.72% Channidae, 3.77% Osphronemidae, 1.89% Anabantidae, 1.89% Bagridae dan 0.94% daripada famili Helostomatidae. Spesies dominan ialah *Desmopuntius johorensis*, yang mewakili 47.17% daripada jumlah ikan yang tercatat. Dominasi oleh Cyprinidae di TCA serupa dengan habitat di paya gambut lain. Hasil kajian ini memberikan maklumat tentang kepelbagaian ikan di Sungai Kulak pada masa hadapan yang dapat digunakan dalam perancangan pemuliharaan persekitaran akuatik TCA di Ladang Tinbarap.

**Keywords:** fish fauna, oil palm plantation, peat swamps.

## INTRODUCTION

The freshwater habitat of peat swamp (or blackwater) has been known as a habitat for diverse and interesting fish fauna that have narrow niches and restricted range. Blackwater is characterised by its black appearance or tea-coloured water, acidity and low level of dissolved oxygen (DO). Thus, it has been regarded as an extreme and inhospitable habitat. Most of the fishes that inhabit the peat swamp system are those species that are tolerant to low oxygen conditions and acidic water that is rich in decaying organic matter (Rahim and Esa, 2006). In Malaysia, a total of 198 fish species are resident in peat swamp ecosystems (Sule *et al.*, 2016).

As forest conversion for agriculture affects biodiversity richness and composition (Peh *et al.*; 2006, Fayle *et al.*, 2010; Mercer *et al.*, 2014), it is therefore essential to find strategies that can sustain biodiversity, especially within the monoculture crop landscape (Giam *et al.*, 2015). Retaining forest

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patches in an oil palm production landscape is one of the strategies for biodiversity conservation and for promoting sustainable agriculture. In line with this, a total of 210.63 ha of the peat swamp forest have been set aside for conservation, and are collectively known as the Tinbarap Conservation Area (TCA). It is located in Tinbarap Estate in Miri, Sarawak. This area is surrounded by oil palm plantations. TCA is an initiative for studying how to minimise the impact of oil palm plantations on biodiversity as well as to preserve the biodiversity of the peat swamp forest.

This study assesses the fish fauna in the oil palm conservation area in peatland to generate a primary database on fish diversity and abundance in Sungai Kulak which flows through TCA. The data will contribute to better knowledge on fish diversity in TCA of Tinbarap Estate, which can also be one of the tools in conservation planning of the aquatic environments.

## MATERIALS AND METHODS

### Study Site

Sampling was conducted in April 2016 and November 2016 along a 1-km stretch of Sungai Kulak (Figure 2) that flows through TCA. Six sampling stations were selected, namely, Station 1 (with coordinates N 04° 03.872' E 114° 13.060'), Station 2 (N 04° 03.770' E 114° 13.123'), Station 3 (N 04° 03.689' E 114° 13.163'), Station 4 (N 04° 03.598' E 114° 13.231'), Station 5 (N 04° 03.512' E 114° 13.248') and Station 6 (N 04° 03.455' E 114° 13.266') (Figure 1). Each station was located approximately 200 m from one another. Water flow along this river was slow to moderate, and the water was black in appearance. The bottom substrate was mainly peat with submerged logs and branches. Water depth of Sungai Kulak ranged from 1.33 m to 1.83 m. Water temperature ranged from 28.36°C to 29.21°C, while dissolved oxygen (DO) was low, ranging from 2.62 to 3.33 mg litre<sup>-1</sup>. pH was also low, ranging from pH 3.74 to 3.90, indicating the acidic conditions of the river. All the above parameters are typical characteristics of peat water.

### Fish Sampling

Fishes were sampled using a 3-layer gill net, a monofilament gill net (mesh size of 5.5 cm and 2.5 cm), a hook and line, and a scoop net. Sampling gear were deployed for a period of 3 days and 2 nights. All sampling methods were used at all the stations. The fish species caught were identified *in situ*, and measured for standard length, total length and wet weight. Fish identification was carried out by referring to Kottelat *et al.* (1993), Inger and

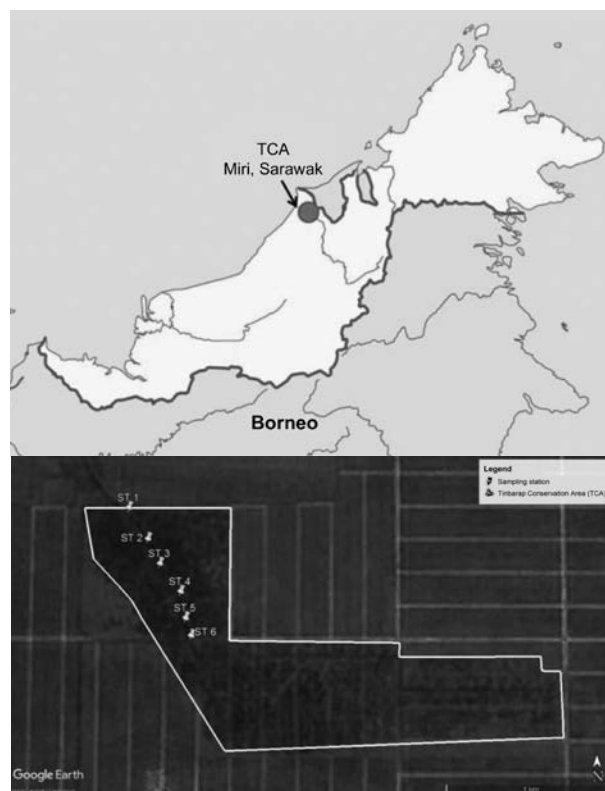


Figure 1. Map showing the sampling stations (ST 1 – ST 6) along Sungai Kulak in the Tinbarap Conservation Area (TCA).

Chin (2002) and Froese and Pauly (2016). For water properties, temperature, dissolved oxygen (DO) and pH were measured at a depth below 15 cm from the water surface using YSI 6600 V2-2 Multi-parameter Water Quality Sonde.

## RESULTS AND DISCUSSION

A total of 13 fish species comprising seven families were recorded from Sungai Kulak inside TCA during the study period (Table 1). Cyprinidae was the dominant fish family constituting 78.30% of the total fishes recorded (Figure 3). Other families represented less than 30% of the total fishes sampled, and these included Siluridae (8.49%), Channidae (4.72%), Osphronemidae (3.77%), Anabantidae (1.89%), Bagridae (1.89%) and Helostomatidae (0.94%). The dominance of Cyprinidae was similar to that recorded in other peat swamp habitats, such as Maludam River in Sarawak (Nyanti and Bali, 2004), Paya Beriah Peat Swamp Forest in North Perak (Shah *et al.*, 2006), both in Malaysia, and in Tripa Peat Swamp Forest in Indonesia (Muchlisin *et al.*, 2015). Osphronemidae and Anabantidae are able to adapt to the low oxygen conditions of peat water by getting oxygen from the air through their labyrinth-like respiratory organ (Kottelat *et al.*, 1993).

In terms of species, Sungai Kulak was dominated by *Desmopuntius johorensis* (Figure 5),

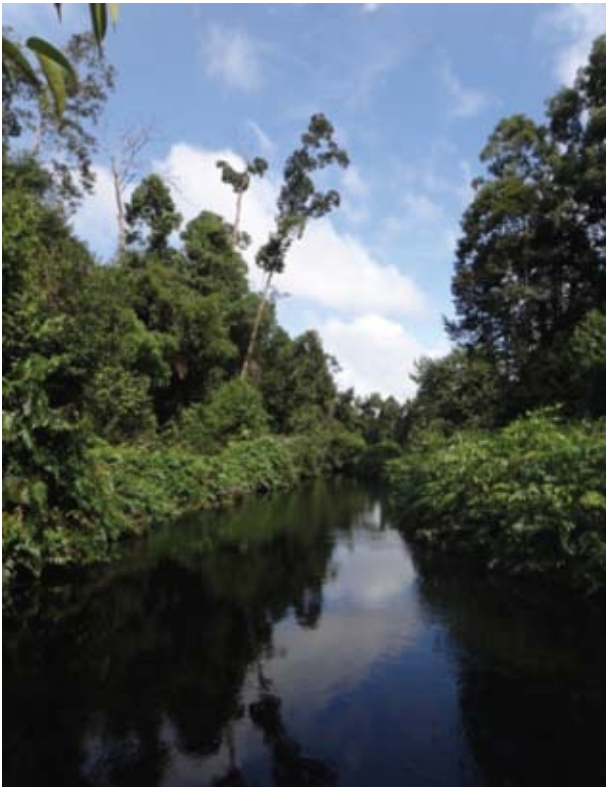


Figure 2. General condition of Sungai Kulak which runs through the Tinbarap Conservation Area (TCA).

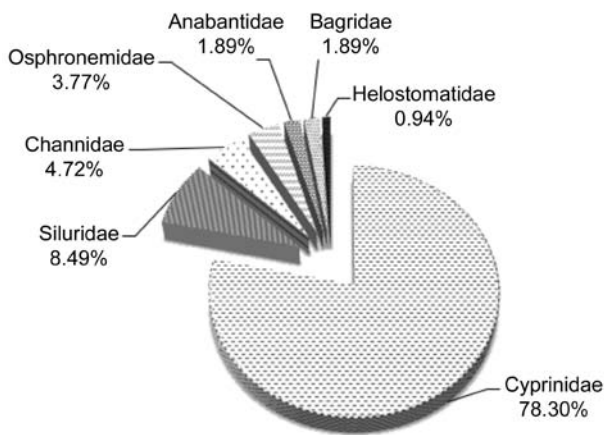


Figure 3. Percentage of fish by family recorded at Sungai Kulak in TCA.

which accounted for 47.17% of the total fishes recorded (Figure 4). *Rasbora cephalotaenia* (Figure 5), which was the second most dominant species accounted for 16.04% of the total fishes recorded. The remaining 36.79% was represented by other species which were present in smaller numbers. The smallest fish was *Rasbora kalbarensis* with an average weight of 0.93 g, while the largest was *Wallago leerii* (at 1882.43 g).

Fishes inhabiting the man-made drains in TCA were also collected during the second sampling

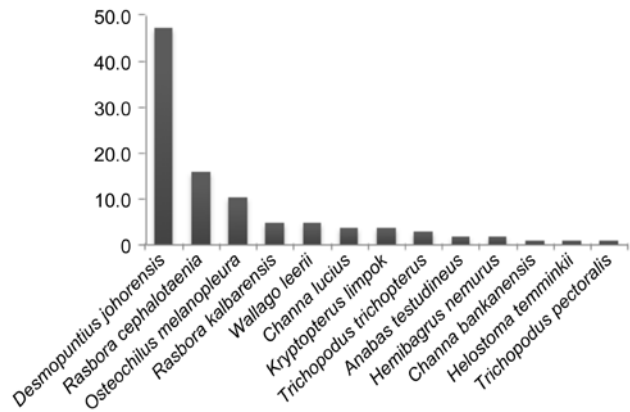


Figure 4. Relative species abundance of fishes recorded at Sungai Kulak of the Tinbarap Conservation Area (TCA).

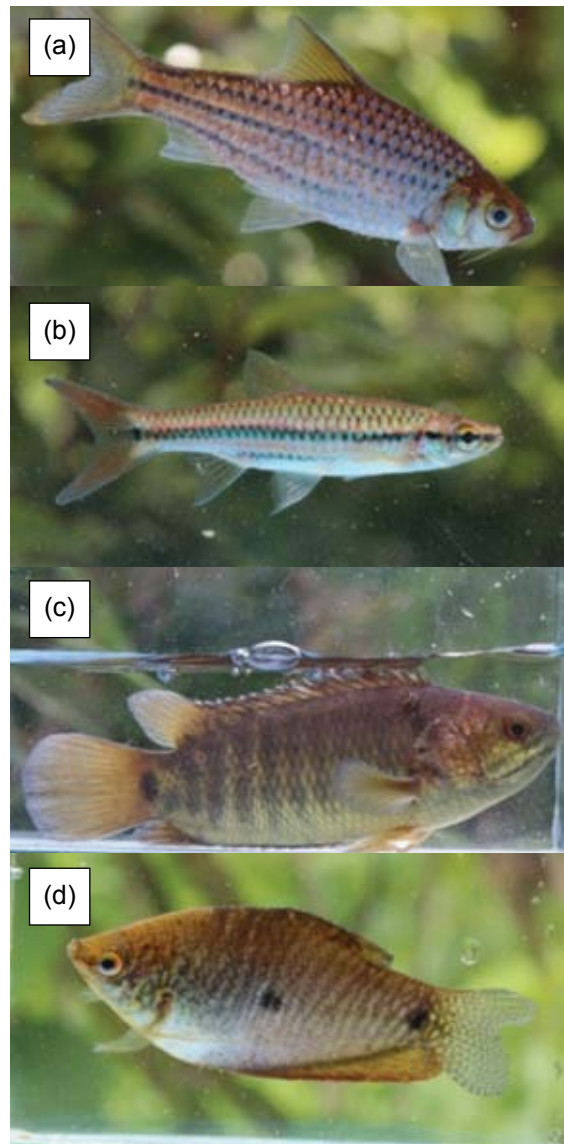


Figure 5. Fishes of Sungai Kulak of the Tinbarap Conservation Area (TCA): (a) *Desmopuntius johorensis*, the dominant species, (b) *Rasbora cephalotaenia*, the second most dominant species, (c) *Anabas testudineus*, and (d) *Trichopodus trichopterus*.

**TABLE 1. SPECIES LIST AND BODY MEASUREMENTS OF FISH RECORDED FROM SUNGAI KULAK OF THE TINBARAP CONSERVATION AREA (TCA)**

Family	Species	Common/ local name	N	Body measurements		
				Mean $\pm$ SD		
				SL (cm)	TL (cm)	WT (g)
Anabantidae	<i>Anabas testudineus</i>	Climbing perch/ Puyu/ Betok	2	11.50 $\pm$ 0.00	14.15 $\pm$ 0.21	53.55 $\pm$ 5.16
Bagridae	<i>Hemibagrus nemurus</i>	Asian redbtail catfish/ Baung	2	20.60	29.10	173.00
Channidae	<i>Channa bankanensis</i>	Beluduk	1	23.70	28.30	223.00
	<i>Channa lucius</i>	Runtuk	4	19.50 $\pm$ 3.76	23.58 $\pm$ 4.22	139.15 $\pm$ 90.04
Cyprinidae	<i>Osteochilus melanopleurus</i>	Kelabau	11	16.13 $\pm$ 2.99	21.17 $\pm$ 4.00	119.11 $\pm$ 69.70
	<i>Desmopuntius johorensis</i>	Striped barb/ Engkarik	50	8.63 $\pm$ 1.02	10.81 $\pm$ 1.31	18.83 $\pm$ 7.37
	<i>Rasbora cephalotaenia</i>	Seluang	17	6.73 $\pm$ 0.52	8.46 $\pm$ 0.61	4.97 $\pm$ 1.03
	<i>Rasbora kalbarensis</i>	Seluang	5	3.95 $\pm$ 0.70	4.88 $\pm$ 0.81	0.93 $\pm$ 0.43
Helostomatidae	<i>Helostoma temminckii</i>	Kissing gourami/ Biawan	1	6.00	7.80	8.40
Osphronemidae	<i>Trichopodus pectoralis</i>	Snakeskin gourami	1	13.00	16.10	63.70
	<i>Trichopodus trichopterus</i>	Three spot gourami/ Sepat	3	6.67 $\pm$ 0.12	8.67 $\pm$ 0.21	9.23 $\pm$ 0.90
Siluridae	<i>Kryptopterus limpok</i>	Long-barbel shea + fish/ Lais kera	4	17.23 $\pm$ 2.37	20.40 $\pm$ 2.52	27.67 $\pm$ 9.68
	<i>Wallago leerii</i>	Tapah	5	53.10 $\pm$ 8.85	61.18 $\pm$ 9.63	1882.43 $\pm$ 861.11
<b>7</b>	<b>13</b>		<b>106</b>			

Note: \*N = number of individuals, SL = standard length, TL = total length, WT = weight.

**TABLE 2. SPECIES LIST AND BODY MEASUREMENTS OF FISH RECORDED FROM MAN-MADE DRAINS OF THE TINBARAP CONSERVAION AREA (TCA)**

Family	Species	Common/ local name	N	Body measurements		
				Mean $\pm$ SD		
				SL (cm)	TL (cm)	WT (g)
Channidae	<i>Channa lucius</i>	Runtuk	1	5.80	6.70	2.20
	<i>Channa striata</i>	Haruan	1	4.90	5.80	1.40
Cyprinidae	<i>Desmopuntius johorensis</i>	Striped barb/ Engkarik	1	7.80	9.60	11.60
Siluridae	<i>Kryptopterus macrocephalus</i>	Striped glass catfish	3	10.17 $\pm$ 0.15	11.67 $\pm$ 0.29	11.70 $\pm$ 0.72
	<i>Wallago leerii</i>	Tapah	3	36.87 $\pm$ 3.78	43.00 $\pm$ 4.36	687.6 $\pm$ 310.18
<b>3</b>	<b>5</b>		<b>9</b>			

Note: \*N = number of individuals, SL = standard length, TL = total length, WT = weight.

in November 2016. A total of nine individuals represented by five species and three families were recorded (Table 2). Two species, namely *Channa striata* and *Kryptopterus macrocephalus*, which were not recorded in the river were caught in the drains.

## CONCLUSION

The results of our present study provide useful information on the fish fauna of a set aside forest in an oil palm production landscape sited on peatland.

This information can in the future be valuable in conservation planning of the aquatic environment in TCA of Tinbarap Estate.

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