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SPECIES COMPOSITION AND ABUNDANCE OF PEAT SWAMP FISHES IN SELECTED AREAS OF SELANGOR, MALAYSIA

MUHAMMAD FAHMI AHMAD and ABDULLAH SAMAT*

School of Environmental and Natural Resource Sciences,
Faculty of Science and Technology, Universiti Kebangsaan Malaysia,
43600 UKM Bangi, Selangor, Malaysia
**E-mail: nature5283@gmail.com*

ABSTRACT

A total of 22 species of freshwater fish representing 10 families were collected from peat swamp area of Kuala Langat and Sungai Dusun in Selangor. Five families, comprised of 16 species were found in Kuala Langat and 15 species belonging to 10 families in Sungai Dusun peat swamp areas. Osphronemidae was the dominant group of fishes at both areas. Higher species diversity was recorded at Sungai Dusun (H' = 1.75) than Kuala Langat (H' = 1.42) peat swamp. Independent t-test based on H' values mean [$t(18) = 2.764$; $p < 0.05$] showed there are statistically difference in diversity index between areas. Species diversity was unaffected by monsoon season as precipitation occurred all year around. Dissolved oxygen is the only physical parameter measured that shows positive correlation with species diversity of fish at both areas.

Key words: Freshwater fish; species diversity; peat swamp

INTRODUCTION

The Malay Peninsula is one of the five zoogeographic regions of freshwater fishes in Southeast Asia (Zakaria-Ismail, 1994). The composition of freshwater fish species in Malay Peninsula is a mix of Indochinese and Sundaic fauna that is predominantly Cyprinidae (Yap, 2002). Freshwater fish in this region covered extensive range of aquatic habitat; from small streams to estuarine, highly acidic ecosystems and alkaline waters (Ahmad and Khairul-Adha, 2007). It is reported that there are about 278 species of freshwater fish native to Peninsular Malaysia and 22 of them are endemic (Lim and Tan, 2002).

Among freshwater habitats found in this region, peat swamp is the most interesting habitat in terms of natural resources due to its poorly understood species diversity. Peat swamp is naturally an acidic ecosystem with pH ranging from 4.5 to 6.5 and it is because of the releasing of tannins and organic acids into the water by plant detritus on its substrate (Ng *et al.,* 1992). Tropical peat swamp ecosystems are mainly found in Southeast Asia and are well-represented in Borneo (Phua *et al.,* 2007). These habitats were considered as wasteland with low biodiversity value and have been target for logging, agriculture, housing and industrial development purposes (Zakaria *et al.,* 1999). The remaining peat swamps in Peninsular Malaysia were restricted to northern Selangor, central Terengganu, and parts of Pahang while in Johor only had small pockets of old peat swamp remains (Ng *et al.,* 1994).

In the past, studies on freshwater fish were confined to major streams, main river basin, and accessible habitats only until recently. Researchers have started to conduct studies in areas previously inaccessible and areas that were believed to have lower diversity especially peat swamp. Intensive survey conducted by Ng *et al.* (1994) in North Selangor Peat Swamp Forest (NSPSF) had successfully recorded 47 species with several species that are new to science *inter alia Betta hipposideros, Lepidocephalichthys tomaculum, Encheloclarias curtisoma, Bihunichthys monopteroides, Chendol keelini* and *Nagaichthys filipes*. Zakaria *et al.* (1999) and Shah *et al.* (2006) studies in Beriah River freshwater and Ulu Sedili peat swamps successfully recorded 24 and 32 species respectively. While study in Pondok Tanjung Swamp Forest also show the high number of fish species composition with 42 species collected (Mansor *et al.,* 1999).

In order to thoroughly understand the dynamic of freshwater fish in peat swamp, certain measurements need to be taken to observe how they react

* To whom correspondence should be addressed.

to changes in environment. Peat swamp has been facing threat from human exploitation in the needs from agriculture sector. Conversion of peat swamp into agriculture purpose could contribute into degradation of its biota (Kobza *et al*., 2004). Besides natural fires associated with El Nino or Southern Oscillation also caused the loss of peat swamp forest (Phua *et al.,* 2007). The challenge here is to be able to document the fauna and its basic ecological information before it becomes extinct and to increase the effectiveness in conservation efforts. This study evaluates species composition and abundance of fishes and its relationship with water physical parameter in peat swamps in Selangor.

MATERIALS AND METHODS

Data collection

Swampy areas at Sungai Dusun (NSPSF) and Kuala Langat Peat Swamp Forest (KLPSF) in Selangor were selected for the study (Fig. 1). Sungai Dusun peat swamp is located along the road that connects Sungai Besar in Selangor and Tanjung Malim in Perak. This peat swamp forest is irrigated by a blackwater stream. The water was highly acidic with pH reading of 3.14±0.23. The substrate was peat, with submerged logs and at some parts gravels with leaves and branches from the trees cover the bottom surface. Vegetation such as *Pandanus* sp. and *Macaranga* sp. were dominant in the area. The second peat swamp was located near to Kuala Langat Peat Swamp Forest (KLPSF). A major part of the area has been converted into an oil palm plantation and other agriculture purposes. The canal in the plantation area received water from the forest. The water was black in color, slow flowing and highly acidic (3.04±0.34). Generally, the bottom parts were peat, decomposed materials from tree branches and leaves, and submerge vegetation.

Five methods were employed to collect fish. The selection of the gears is based on habitat characteristics and target species. The methods used for wadeable water with hard bottoms were gill net and fish traps, and supported with a backpack electro-fisher (model 15-D Smith Root, Inc.). Hand-held scoop and seine nets were primarily used where the water was deep (depth > 1.0 m) with soft bottoms and submerge vegetation. Caught fishes were preserved in 10% formalin in the field and were transferred into 75% ethanol for storage. Identification of fish to the species level was done based on Kottelat *et al.* (1993) and Rainboth (1996) methods.

Fig. 1. Map showing the Sungai Dusun and Kuala Langat Peat Swamp areas.

Dissolved oxygen, total pH, temperature and dissolved solids were measured in-situ using a Multi-parameter Prop YSI Model-556. Those parameters were selected because they are among the prime importance in fish life (Wynes and Wissing, 1981; Deacon and Mize, 1997). Measurements of the parameters were done before fish sampling activities taken place. Sampling of fish and water quality parameters were conducted for 10 consecutive months between October 2009 and July 2010 at each of the sampling area.

Data analysis

Species diversity was calculated from abundance data for each area using Shannon's species diversity index (H'). The H' values were compared between areas using the independence t-test. Box and whiskers plot analysis was used to show graphically any differences between areas. Rank abundance curve was used to examine the species distribution between rainy and dry season. Relationship between the four physical water quality parameters and H' values were analyzed using multiple regression analysis. All statistical procedures were performed using Microsoft Excel 2003 except box-plot analysis was performed using PAST software (Hammer *et al.,* 2001).

RESULTS AND DISCUSSION

A total of 22 species representing 10 families were collected from both areas (Table 1). There were 16 species and five families of fishes recorded from Kuala Langat peat swamp and 15 species from 10 families from Sungai Dusun peat swamp. Higher species diversity was recorded at Sungai Dusun (H' = 1.75) than Kuala Langat (H' = 1.42) peat swamp. It was found that species diversity between Kuala Langat and Sungai Dusun peat swamp was statistically different (Fig. 2). It was indicated by the independent t-test based on H' values mean [$t(18) = 2.764$; $p < 0.05$].

Kuala Langat and Sungai Dusun peat swamps are typical blackwater areas which fishes such as *Channa bankanensis* and *Mystus bimaculatus* that inhabit this types of habitat are stenotopic species (narrowly adapted to definite environmental factors such as high acidity of water) (Kottelat *et al.,* 2006). Sungai Dusun peat swamp was much more shady and dense with mates of submerged aquatic plants compared to the peat swamp at Kuala Langat. Such habitat condition had provided suitable niches for fishes like *Rasbora kalochroma* and *Betta hipposideros* (Ng *et al.,* 1994). It is noted that *B. hipposideros* is a threatened species of fish, and is

Table 1. The occurrence and relative abundance of fish species from Kuala Langat and Sungai Dusun peat swamp areas

Family	Species	Peat swamp area	
		Kuala Langat	Sungai Dusun
Cyprinidae	*Puntius hexazona*	11.9	5.4
	Rasbora einthovenii	48.5	0.0
	Rasbora kalochroma	0.2	27.0
Bagridae	*Mystus bimaculatus*	0.0	1.7
Siluridae	*Silurichthys hasselti*	0.0	1.7
Clariidae	*Clarias leiacanthus*	0.4	3.1
	Clarias macrocephalus	0.5	0.0
	Clarias nieuhoffi	0.5	0.0
Synbranchidae	*Monopterus albus*	0.0	0.6
Mastacembelidae	*Macrognathus circumcinctus*	0.0	2.3
Anabantidae	*Anabas testudineus*	0.2	2.6
Helostomatidae	*Helostoma temminckii*	0.0	6.3
Osphronemidae	*Belontia hasselti*	0.9	0.9
	Betta bellica	1.1	9.9
	Betta coccina	1.8	0.0
	Betta hipposideros	5.2	27.8
	Betta livida	0.7	0.0
	Betta sp.	8.0	0.0
	Luciocephalus pulcher	0.0	2.3
	Sphaerichthys osphromenoides	19.1	5.4
	Trichopodus trichopterus	0.5	0.0
Channidae	*Channa bankanensis*	0.5	3.1

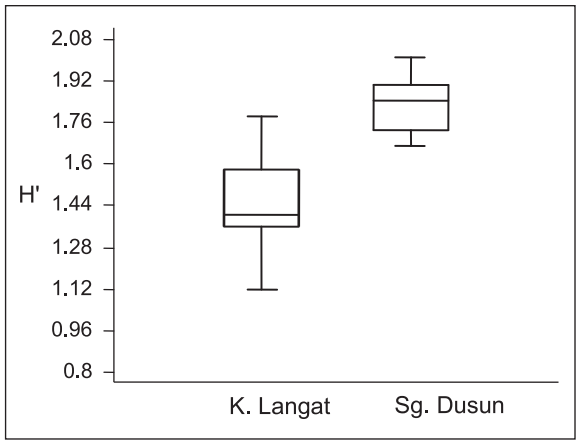

Fig. 2. A box-plot based on the Shannon's diversity index, H' value calculated for each month. There is a significant differences in H' values between the area [$t(18) = 2.764$; $p < 0.05$].

endemic to Malaysia (IUCN, 2011). The used of fertilizer in oil palm plantation and other agriculture activity in Kuala Langat peat swamp also effect the fish composition and abundance. Eutrophication could interfere the aquatic equilibrium thus caused the loss of fish species (FAO, 1996).

The different habitat preferences have built various type of niche in the swamp habitats and this had showed their high taxonomic diversity. Habitat plays a major role in determining the diversity level of fishes. For example, habitats with wood have many more fish than without wood and contain higher number of rare species (Wright and Flecker, 2004). The woods in peat swamp act as refuge for the fishes also provide foods and at the same time could help to increase their survivorship. Low dissolved oxygen in swamp habitat also had made them exploited by a community of fishes which vary in their tolerance to deoxygenated waters. For example, clariid catfish whose have air breathing capabilities can exploit the anoxic waters of the dense interior of many swamps, while area with moderate level of oxygen is richer with non-air breathing species (Chapman *et al.,* 1996).

From 16 species collected in Kuala Langat peat swamp, 13 species were found during dry and 12 species in rainy period. *Rasbora einthovenii* was the most dominant species which appeared in both periods with the highest abundance (Fig. 3). While at Sg. Dusun peat swamp, *Rasbora kalochroma* and *Betta hipposideros* were the most dominant species here. Fish species were evenly distributed in both period and all 15 species that were collected in this swamp can be found during dry period (Fig. 4). Even during dry period, species richness is still high in both areas because peat could act as buffer and retain some isolated pools with clean water for fish refuge (Kottelat *et al.,* 2006).

Independence t-test showed that there is no significance difference in species diversity (H') between rainy and dry period in Kuala Langat [$t(8) = 0.18$; *ns*] and Sungai Dusun [$t(8) = 0.02$; *ns*]. That is mainly because of the nature of the tropical climate which is dominated by precipitation throughout the years (Moss, 1998).

Off the four water physical parameters measured in this study for both areas, only dissolved oxygen showed a positive correlation with species diversity (H'). In contrast, a negative correlation was observed between pH and species diversity (H') (Table 2). Temperature and total dissolved solids were found to be negatively correlated with species diversity (H') at Kuala Langat peat swamp area. However, these two parameters were positively correlated with species diversity at Sungai Dusun peat swamp area. The unconsistant results regarding water quality suggesting that there could be very site specific

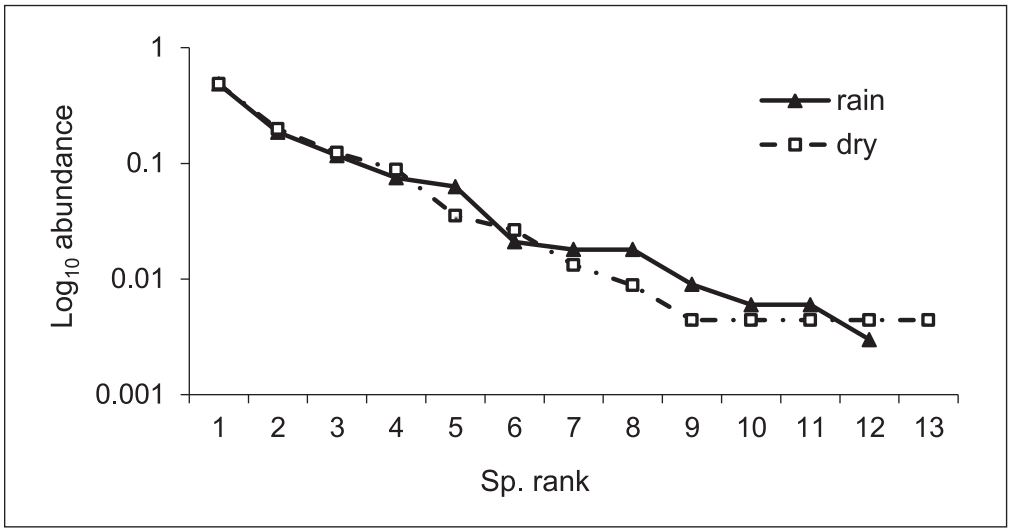

Fig. 3. Rank abundance curves for Kuala Langat peat swamp fishes during rainy and dry season.

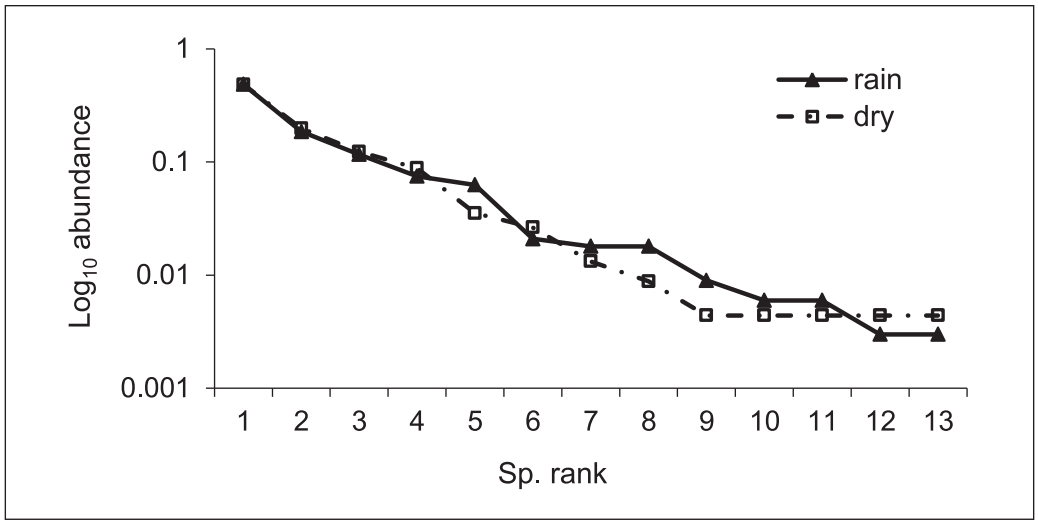

Fig. 4. Rank abundance curves for Sungai Dusun peat swamp fishes during rainy and dry season.

Table 2. Summary of the selected physical water quality parameters recorded during the study

Parameters	Peat swamp area	
	Kuala Langat	Sungai Dusun
pH	3.04 ± 0.34	3.14 ± 0.23
Temperature (°C)	27.17 ± 0.44	26.90 ± 0.70
Dissolved Oxygen (mg/l)	1.34 ± 0.03	2.08 ± 0.24
Total Dissolved Solids (g/l)	0.09 ± 0.01	0.05 ± 0.01

Table 3. Results of multiple regression analyses between selected water parameter and fish diversity (Shannon's H' value)

Parameters	Peat swamp area	R^2	P-value	Linear relationship
pH	Kuala Langat	0.147	0.274	y= -0.23x+2.11
	Sungai Dusun	0.193	0.204	y= -0.19x+2.46
Temperature (°C)	Kuala Langat	0.117	0.333	y= -0.15x+5.61
	Sungai Dusun	0.058	0.502	y= 0.05x+0.51
Dissolved Oxygen (mg/l)	Kuala Langat	0.021	0.692	y= 1.04x+0.02
	Sungai Dusun	0.030	0.630	y= 0.35x+1.13
Total Dissolved Solids (g/l)	Kuala Langat	0.524	0.018	y= -13.73x+2.59
	Sungai Dusun	0.437	0.037	y= 4.25x+1.64

factor(s) occurred, none of which taken into account in this study.

Fishes are in close contact with their environment, water quality and presence of contaminants are probably the most critical aspects of the environment for fish welfare (Huntingford *et al.,* 2006). The influence of the characteristics of the habitats is relative to community parameters such as species richness, evenness, and species abundance (Suarez *et al.,* 2004). Different fish have specific requirement for dissolved oxygen and pH level. In this study, the low concentration of dissolved oxygen in peat swamps allowed species from family Osphronemidae to dominate since they have the labyrinth organ. The labyrinth-like respiratory organ helped them to directly get oxygen from the air instead breathing in the water using their gills (Kottelat *et al.,* 1993). Preferences toward pH concentration also influence fish species composition in peat swamp environment. Most of

the fish species found in this study are under stenotopic acid blackwater category e.g. *B. hipposideros, M. bimaculatus, C. bankanensis, R. kalochroma*. A little change in environment or habitat destruction can caused a total loss in this high value endemic species.

CONCLUSION

It is revealed that peat swamp ecosystem harbors great species richness of fish and most of them are acidic stenotopic species. Parameter like dissolved oxygen in peat swamp water play a major role in determining fish species composition and abundance. Diversity of species was unlikely affected by monsoon season as precipitation occurred all year around. However, conservation of the peat swamp forest area is critically important because there is no literally undisturbed one left in Selangor to prevent the loss of high value of its biological and economical resources.

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