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Freshwater Monogeneans of Peninsular Malaysia

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Abstract

A survey of monogeneans from freshwater fishes of Peninsular Malaysia was undertaken to investigate their diversity and host distribution patterns. Eighteen known monogenean genera and one undescribed monogenean genus belonging to five families were collected from 63 species of fishes. The eighteen known genera are *Dactylogyrus, Dactylogyroides, Dogielus, Silurodiscoides, Cornudiscoides, Bifurcohaptor, Malayanodiscoides, Notoptero discoides, Bychowskyella, Quadriacanthus, Ancyrocephalus* (s.l.), *Ancyrocephalus, Heteronchocleidus, Trianchoratus, Eutrianchoratus, Sundanonchus, Gyrodactylus* and *Paradiplozoon*. The majority of these monogeneans are restricted either to a particular host species, genus, family or even order, although some monogeneans have broader host amplitude.

Introduction

A literature review indicates the paucity of knowledge on monogeneans in Peninsular Malaysia and also in other countries of Southeast Asia. Prior to 1980 several monogeneans have been described from Southeast Asian fishes by various authors (Buschkiel 1930; Reichenbach-Klinke 1954; Bychowsky 1957; Lucky 1958, 1970; Adams 1964; Mizelle and Price 1964; Price and Berry 1966; Ha 1968, 1971; Hanek and Furtado 1973). The first monogenean to be described from Peninsular Malaysia was *Gyrodactylus fernandoi* Hanek and Furtado, 1973. Although monogeneans have been collected since then (see Leong and Ahmad 1981), proper taxonomic studies only began in the 1980s (see Lim and Furtado 1983). To date, 56 species of monogeneans have been described (Hanek and Furtado 1973; Lim and Furtado 1983, 1984, 1985, 1986a, 1986b; Lim 1986a, 1986b, 1987a; Lim and Khotenovsky 1985). However, these probably

represent only a small fraction of the actual number present in Peninsular Malaysia, indicating that the paucity of records occurring in the literature reflects the limited number of studies done rather than an actual paucity of species (Lim 1987b).

This paper presents the results of a survey conducted on the monogeneans from freshwater fishes of Peninsular Malaysia with the aim of documenting the species present, as well as providing some information about their diversity and host distribution.

Materials and Methods

Freshwater fishes were obtained using various capture methods (nets, traps) from various localities in Peninsular Malaysia and brought back to the laboratory. The fish species were identified using several taxonomic keys (e.g., Smith 1945; Brittan 1954; Inger and Chin 1962). In the laboratory the fishes were necropsied, the gills being removed and examined fresh. Monogeneans were removed and fixed as described in Lim (1986a).

In this investigation, 73 species of freshwater fishes belonging to 20 families and five orders were examined for monogeneans. This only constitutes about 33% of the estimated 226 fish species occurring in Peninsular Malaysia (see Mohsin and Ambak 1983). The higher classification of fish hosts used in this study is that of Nelson (1984), while the monogenean classification follows that of Bychowsky (1957), as modified by Gussev (1978).

Results and Discussion

Table 1 lists the families, subfamilies, genera and number of species of monogeneans collected during the course of this study, as well as the absence (-) or presence (+) of these genera in India, Africa, southern China and Vietnam (see Gussev 1978). Table 2 summarizes the total number of monogenean species assigned to the different genera, except in the cases of *Gyrodactylus* and *Paradiplozoon*, where identification work is still in progress. The number of species given in Tables 1 and 2 do not tally because of the presence of species which infect more than one host species.

Table 1. Monogenean genera, subfamilies and families found in Peninsular Malaysia (PM) (present study) and the existence of these monogeneans in India (I), Africa (A), China (C) and Vietnam (V) (taken from Gussev 1976).

	PM	I	A	C	V
Dactylogyridae Bychowsky, 1933					
Dactylogyrus Diesing, 1850	96	+	+	+	+
Dactylogyroides Gussev, 1963	2	+	+	?	?
Dogielius Bychowsky, 1936	1(?)[1]	+	-	?	?
Ancyrocephalidae Bychowsky & Nagibina, 1978					
Ancylodiscoidinae Gussev, 1961					
Silurodiscoides Gussev, 1976	23	+	+	+	+
Cornudiscoides Kulkarni, 1969	8	+	-	?	+
Bifurcohaptor Jain, 1958	4	+	-	+	-
Quadriacanthus Paperna, 1961	2(?)	+	+	+	+
Bychowskyella Akhmerov, 1952	3	+	+	+	+
Malayanodiscoides Lim & Furtado, 1986	1	?	-	?	?
Notopterodiscoides Lim & Furtado, 1986	2	?	-	?	?
Heteronchocleidinae Price, 1966					
Heteronchocleidus Bychowsky, 1957	2	+	+	+	+
Trianchoratus Price & Berry, 1966	9	+	-	-	?
Eutrianchoratus Paperna, 1969	4	?	+	-	?
Ancyrocephalinae Bychowsky, 1937					
Ancyrocephalus Creplin, 1839	3	+	+	?	?
Ancyrocephalus (s.l.) Gussev, 1976	5	+	-	-	?
New genus	2	?	-	-	?
Tetraonchoididae Bychowsky, 1951					
Sundanonchus Lim & Furtado, 1985	3	?	-	-	?
Gyrodactylidae Cobbold, 1864					
Gyrodactylus von Nordmann, 1831	+	+	+	+	+
Diplozoidae Palombi, 1949					
Paradiplozoon Akhmerov, 1974	+	+	+	+	+

[1]Question mark denotes that verification of the occurrence of the genus so indicated is required.

Table 2. Host-monogenean list.[1] (The number of species collected is given for all genera, except for *Gyrodactylus* and *Paradiplozoon*). (? denotes that verification is required; + denotes that the genus is present).

Genera	1*	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Cypriniformes:																			
Cyrpinidae:																			
Cyprininae:																			
Puntius bulu	8																		1
P. partipentazona	2																		+
P. fasciatus	4																		
P. binotatus	6																		+
P. schwanenfeldi	1																		+
P. gonionotus	1																		+
P. orphoides	3																		
P. lateristriga	2																		
Mystacoleucus marginatus	1																		+
Osteochilus hasselti	7																		
O. spirulus	1																		1
O. melanopleura	1																		
O. vittatus	5	1																	
Labiobarbus festiva	6																		
L. lineatus	6																		
L. ocellatus	3																		
Leptobarbus hoeveni	1																		+
Hampala macrelipidota	3																	1	2
Cyclocheilichthys apogon	14																		
C. heteronema	1																		
Abraminae:																			
Oxygaster oxygastroides	4	1																	+
O. hypophthalmus	3																		
Paralaubuca sp.	1																		
Rasborinae:																			
Rasbora sumatrana	4										4							+	+
R. cephalotaenia	4										1								+
R. taeniata	1										1							+	
R. trilineatus	1																		
R. dorsicellata	-										1								+
R. elegans	1										2							+	
R. einthoveni	2										1							+	
Osteoglossiformes:																			
Osteoglossidae:																			
Scleropages formosus	1																		
Notopteridae:																			
Notopterus notopterus				1			1												
N. chitala				2				2											
Cyprinidontiformes:																			
Hemiramphidae:																			
Hemiramphodon pogonognathus	1																	+	
Siluriformes:																			
Bagridae:																			
Mystus nigriceps				2	3														
M. nemurus				6	3	1													
Mystus sp.					2	2													
Siluridae:																			
Wallago miostoma				3															
Silurodes hypophthalmus				5															
Silurichthys hasselti				1					1										
Krytopterus apogon	1																		
K. bicirrhis	1																		
Clariidae:																			
Clarias batrachus									1	1								+	
C. teysmani									1	1									
Sisoridae:																			
Glyptothorax major									1										
Pangasiidae:																			
Pangasius pangasius				1															
P. sutchii				1															
Perciformes:																			
Anabantoidei:																			
Macropodinae:																			
Trichopsis vittatus														1					
Betta splendens														1					
B. pugnax																		+	
Trichogasterinae:																			
Trichogaster trichopterus														1	1			+	
T. leeri															1				
T. pectoralis																		+	

Continued

Table 2. Continued

Genera	1*	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Anabantidae:																			
Anabas testudineus															3				
Helostomatinae:																			
Helostoma temminckii															1				
Belontiinae:																			
Belontia hasselti																4			
Osphronemidae:																			
Osphronemus goramy												1	1						
Mastacembeloidei:																			
Mastacembelidae:																			
Macrognathus aculeatus												1							
Percoidei:																			
Nandidae:																			
Pristolepis fasciatus												1	1				1	+	
Nandus nebulosus												1	1				7		
Channoidei:																			
Ophicephalidae:																			
Ophicephalus striatus															1				
O. lucius															2				
O. micropeltes																	2		

1 = *Dactylogyrus* 2 = *Dactylogyroides* 3 = *Dogielius*
4 = *Silurodiscoides* 5 = *Cornudiscoides* 6 = *Bifurohaptor*
7 = *Malayanodiscoides* 8 = *Notopterodiscoides* 9 = *Bychowskyella*
10 = *Quadriacanthus* 11 = *Ancyrocephalus* (s.l.) 12 = *Ancyrocephalus*
13 = New ancyrocephalid genus 14 = *Heteronchocleidus* 15 = *Trianchoratus*
16 = *Eutrianchoratus* 17 = *Sundanonchus* 18 = *Gyrodactylus*
19 = *Paradiplozoon*

Diversity

The monogeneans collected in the present survey belong to five families, and 18 known genera and one yet to be described genus (Table 1). One hundred and fifty-eight species have been identified and of these, records for 56 species have been previously published (see Introduction). These monogeneans were collected from only 63 species of freshwater fishes (although 73 species were examined). This implies that the monogenean fauna of Peninsular Malaysia could be more diverse than indicated in the present survey, since only 33% of the total number of fish species available have been examined. The same has been noted by Gussev (1978) for Indian freshwater monogeneans, who suggested that the actual numbers of species may be 10 times higher than observed.

Dactylogyridae is the most diverse family with 98 species, followed by Ancyrocephalidae with 72 species (Table 1). There are 13 genera in Ancyrocephalidae compared to three in the Dactylogyridae (the existence of *Dogielius* in Peninsular Malaysia needs verification). Within the family Ancyrocephalidae, there are three subfamilies (Table 1) with Ancylodiscoidinae having the greatest diversity in terms of genera. The heterogeneity of the Ancyrocephalidae has been

noted by both Gussev (1978) and Paperna (1980); with more studies, the three subfamilies may eventually be given individual familial status. The most diverse genus is *Dactylogyrus* (96 species), followed by *Silurodiscoides* (23 species). This could be due to the examination of more cypriniform fishes (30 species), as compared to siluriform fishes (13 species).

Monogenean-Host Distribution Patterns

The following trends are observed for the distribution of monogeneans on the various host species (see Table 2):

1. *Dactylogyrus* spp. are mainly found on cyprinid hosts. In only two cases were they recovered from non-cyprinids which are also non-Cypriniformes. This confirms the findings of Gussev (1978), who noted that only 25% of *Dactylogyrus* are found on non-cyprinids, while only 13% occur on non-Cypriniformes.

The present study contradicts the findings of Leong and Ahmad (1981) and information presented in Kabata (1985), who noted the presence of *Dactylogyrus* on catfishes, notopterids and anabantoids; in the present study no *Dactylogyrus* spp. have been found in these host species (Table 2). The records of these authors are thus most likely based on misidentifications.

Contrary to previous observations of Gussev (1978) and Paperna (1980), *Dactylogyroides* spp. are not limited to the genus *Puntius*, but are also found on *Osteochilus* and *Oxygaster*. In fact, no *Dactylogyroides* has been collected from the eight species of *Puntius* examined so far.

2. Diplozoids *(Paradiplozoon)* are found, thus far, only on cyprinid fishes.
3. The majority of Ancylodiscoidinae, viz., *Silurodiscoides, Cornudiscoides, Bifurcohaptor, Bychowskyella* and *Quadriacanthus,* are restricted mainly to the catfishes, except for three species of *Silurodiscoides* which parasitize notopterids. *Bifurcohaptor* and *Cornudiscoides* are restricted to the Bagridae; *Bychowskyella* to Clariidae, Siluridae and Sisoridae; and *Quadriacanthus* to the Clariidae. However, two genera of Ancylodiscoidinae, *Notopterodiscoides* (two species) and *Malayanodiscoides* (one species), are found exclusively on Notopteridae.

4. *Ancyrocephalus* and another, as yet undescribed genus are found on Perciformes; while *Ancyrocephalus* (s.l.) are found on Cypriniformes (Rasborinae).
5. Heteronchocleidinae *(Heteronchocleidus, Trianchoratus* and *Eutrianchoratus)* are found on the anabantoids and ophicephalids.
6. Tetraonchoididae *(Sundanonchus)* are restricted to *Ophicephalus micropeltes* (Cuvier and Valenciennes), *Pristolepis fasciatus* (Bleeker) and *Nandus nebolusus* (Gray) (this needs to be verified with more examinations).
7. Not much can be said about *Gyrodactylus* spp. since work on this genus is still in progress.

The above results indicate that certain genera and families of monogeneans are restricted to certain groups of fishes, although there are monogeneans which are capable of infecting a wide range of hosts. This specificity has been well documented by previous studies, e.g., Gussev (1978) and Rohde (1978).

Narrow host specificity usually indicates an old and intimate relationship, implying that coevolution has taken place between the host species and its parasites (see Brooks 1986). Wide specificity, on the other hand, could also be due to the ability of host species to exchange parasites (see Leong and Holmes 1981), which is in turn dependent on the ability of these parasites to adapt to the conditions found on the new hosts.

Local Geographical Factors

In the present study, monogeneans have been observed to be restricted to certain geographical localities. For example, no *Dactylogyrus* spp. were obtained from *Hemiramphodon pogonognathus* (Bleeker) in Tasek Bera, Pahang, but a *Dactylogyrus* sp. was found on *H. pogonognathus* in streams around the Batu Tiga area of Selangor. This aspect needs more investigation.

Zoogeographical Affinities

It is not possible to do a comparative analysis of the monogenean fauna of the Oriental biogeographical region (see Darlington 1966) because of the paucity of monogenean studies in this region with the possible exceptions of India and southern China. Although some

studies have been made in Vietnam (Ha 1968, 1971) and Peninsular Malaysia (see Introduction) which allows some comparative analyses, the countries of Southeast Asia which make up the Sundaland sub-region of the Oriental region are little studied. Therefore it is not presently possible to do a comparative analysis for this region (see Introduction).

Peninsular Malaysia and India share several similar genera, except for *Mizelleus* and *Thaparogyrus* which have been found only on Indian freshwater fishes (see Gussev 1978); while *Eutrianchoratus, Malayanodiscoides, Notopterodiscoides* and *Sundanonchus* have only been reported from Peninsular Malaysia. However, since the present survey is not complete, it is difficult to conclude if the absence of certain genera is real or apparent.

Africa possesses its own enzootic genera (Gussev 1978; Paperna 1980) which are different from the genera found in Peninsular Malaysia. However, *Bychowskyella, Quadriacanthus, Dactylogyrus, Ancyrocephalus, Heteronchocleidus* and *Eutrianchoratus* are found both in Africa and Peninsular Malaysia.

Multispecies Monogenean Communities

About 66% of the 63 host species listed in Table 2 possess more than one species of monogenean. For example, on *Cyclocheilichthys apogon* Cuvier and Valenciennes there are 14 *Dactylogyrus* species, one *Gyrodactylus* species and two *Paradiplozoon* species; on *Mystus nemurus* there are six *Silurodiscoides* species, three *Cornudiscoides* species and one *Bifurcohaptor* species.

The presence of coexisting species (esp. congeners) suggests that sympatric speciation occurs more often than previously thought, since there are just too many congeners co-existing (Table 2) to be solely due to migration process alone. Increase in species numbers due to parapatric speciation rather than sympatric speciation should also be considered. The presence of co-existing congeneric species contradicts the hypothesis that competition is the main structuring force in the community, since competition does not allow similar species to co-exist.

Antiquity of some Monogenean Genera

Gussev (1978) has suggested three criteria for determining antiquity of monogenean species, viz., low diversity, high specificity,

and infection of ancient host species. Based on these criteria, *Sundanonchus, Malayanodiscoides, Notopterodiscoides* and *Cornudiscoides* could be considered ancient genera. However, such inference needs verification by more studies as the low diversity encountered could be apparent, due to low sampling frequency.

It should be noted that this survey is not complete and that an intensive survey is urgently needed because rapid environmental degradation and indiscriminate introduction of exotic fish species for aquaculture and aquarial purposes may soon make accurate determination of the native fauna impossible.

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References

Adams, J.R. 1964. A new group of dactylogyroids from Malayan labyrinth fishes, p. 541. *In* Proc. 1st. Intern. Parasitol. Congr., Rome.

Brittan, M.R. 1954. A revision of the Indo-Malayan freshwater fish genus *Rasbora*. Philipp. Inst. Sci. Techn. Monogr. 3. 244 p.

Brooks, D.R. 1986. Analysis of host-parasite coevolution, p. 291-297. *In* M. J. Howell (ed.) Parasitology - Quo vadit? Proc. Sixth Intern. Congr. Parasitol., Pergamon Press.

Buschkiel, A.L. 1930. Trematoden op de Kievwen van vischen op Java. Nederl. ind. Bladen v. Diergeneesk. 42: 121-140.

Bychowsky, B.E. 1957. Monogenetic trematodes, their systematics and phylogeny. Izdat. Akad. Nauk SSSR, Moscow. (Transl. from Russian by W. J. Hargis Jr. (ed.) Amer. Inst. Biol. Sci. Washington D. C., 1961.)

Darlington, P.J. 1966. Zoography - the geographical distribution of animals. John Wiley & Sons, Inc., New York.

Gussev, A.V. 1976. Freshwater Indian Monogenoidea. Principles of systematics, analysis of the world fauna and their evolution. Ind. J. Helminthol. 25 (for 1973) and 26 (for 1974). 241 p.

Gussev, A.V. 1978. Monogenoidea of freshwater fishes. Principles of systematics, analysis of world fauna and its evolution. Parazitol. Sb. 38: 96-198. (In Russian).

Ha Ky. 1968. New species of monogeneans from freshwater fishes of North Vietnam. Pt. 1. Parasitologiya 2: 297-301. (In Russian).

Ha Ky. 1971. New species of monogeneans from freshwater fishes of North Vietnam. Pt. 2. Parasitologiya 5: 429-440. (In Russian).

Hanek, G. and J.I. Furtado. 1973. *Gyrodactylus fernandoi* sp. n. (Monogenea: Gyrodactylinae) from *Clarias batrachus* L. in Malaysia. Zool. Anz. 191: 196-198.

Inger, R.F. and P.K. Chin. 1962. The freshwater fishes of North Borneo. Chicago Nat. Hist. Mus. Fieldiana, Zoology 45.

Kabata, Z. 1985. Parasites and diseases of fish cultured in the tropics. Taylor and Francis, London.

Leong, T.S. and S. Ahmad. 1981. Parasites of freshwater fish from Alor Star and Sungei Petani fish markets, Kedah. Malay. Nat. J. 34: 135-141.

Leong, T.S. and J.C. Holmes. 1981. Communities of metazoan parasites in open water fishes of Cold Lake, Alberta. J. Fish Biol. 18: 693-713.

Lim, L.H.S. 1986a. Five new species of *Silurodiscoides* Gussev 1976 (Ancylodiscoidinae: Monogenea) from the freshwater catfish *Silurodes hypophthalmus* (Bleeker). Malay. Nat. J. 39: 265-278.

Lim, L.H.S. 1986b. New species of *Trianchoratus* Price & Berry 1966 (Ancyrocephalidae) from Malayan anabantoid fishes. Parasitol. Hung. 19: 31-42.

Lim, L.H.S. 1987a. Six new species of *Cornudiscoides* Kulkarni 1969 (Monogenea: Ancyrocephalidae) from two *Mystus* species (Bagridae) of Peninsular Malaysia. Folia Parasitol. 34: 107-114.

Lim, L.H.S. 1987b. Distribution and diversity of monogeneans in freshwater fishes of Peninsular Malaysia. Univ. Malaya, Kuala Lumpur. Ph.D. Thesis.

Lim, L.H.S. and J.I. Furtado. 1983. Ancylodiscoidins (Monogenea: Dactylogyridae) from two freshwater fish species of Peninsular Malaysia. Folia Parasitol. 30: 377-380.

Lim, L.H.S. and J.I. Furtado. 1984. Nine new dactylogyrids from three species of *Osteochilus* Gunther (Cyprinidae) in Peninsular Malaysia. Folia Parasitol. 31: 291-301.

Lim, L.H.S. and J.I. Furtado. 1985. *Sundanonchus* g. n. (Monogenea: Tetraonchoididae) from two Malaysian freshwater fishes. Folia Parasitol. 32: 11-19.

Lim, L.H.S. and J.I. Furtado. 1986a. Sixteen new species of *Dactylogyrus* from the genus *Puntius* Hamilton (Cyprinidae). Folia Parasitol. 33: 21-34.

Lim, L.H.S. and J.I. Furtado. 1986b. Five new species of ancylodiscoidins (Monogena: Ancylodiscoidinae) from *Notopterus chitala* (Hamilton) and *Notopterus notopterus* (Pallas) in Peninsular Malaysia. Folia Parasitol. 33: 315-325.

Lim, L.H. and I.A. Khotenovsky. 1985. *Paradiplozoon malayense* sp. n. and *Paradiplozoon magnum* sp. n. from freshwater fish of Peninsular Malaysia, p. 119-121, 130-132. *In* Khotenovsky (ed.) Monogenea. Suborder Octomacrinea Khotenovsky. (Fauna USSR. H. C. No. 132, Monogenea). 263 p. Izdat. Akad. Nauk SSSR, 263 p. (In Russian).

Lucky, Z. 1958. Befund der monogenetischen Trematoden *Dactylogyrus baueri* Gussev 1955 and *Heteronchocleidus buschkieli* Bychowsky 1957 bei den Fischen in den Tachenchososlowakischen Aquaria. Sb. Vys. Sk. Zemed. Lesn. v. Brno. 6: 271-275.

Lucky, Z. 1970. *Dactylogyrus sekerai* n. sp. on the gills of *Puntius schubertii*. Acta Vet. Brno. 39 (Suppl. 1): 7-11.

Mizelle, J.D. and C.E. Price. 1964. Studies on monogenetic trematodes XXVII. Dactylogyrid species with the proposal of *Urocleidoides* gen. n. J. Parasitol. 50: 579-584.

Mohsin, A.K.M. and M.A. Ambak. 1983. Freshwater fishes of Peninsular Malaysia. Univ. Pertanian Malaysia Press, Serdang.

Nelson, J.S. 1984. Fishes of the world. Wiley-Interscience Publ. Paperna, I. 1980. Parasites, infections and diseases of fish in Africa. CIFA (Comm. Inl. Fish. Africa) Tech. Pap. 7.

Paperna, I. 1980. Parasites, infections and diseases of fish in Africa. CIFA (Comm. Inl. Fish. Africa) Tech. Pap. 7.

Price, C.E. and W.S. Berry. 1966. *Trianchoratus*, a new genus of Monogenea. Proc. Helm. Soc. Wash. 33: 201-203.

Reichenbach-Klinke, H. 1954. Weitere Mitteilung uber din kiemenparasiten *Diplozoon barbi* Reichenbach-Klinke (Trematoda, Monogenea). Z. Parasitenk. 16: 373-387.

Rohde, K. 1978. Latitudinal differences in host-specificity of marine Monogenea and Digenea. Mar. Biol. 47: 125-134.

Smith, H.M. 1945. The freshwater fish of Siam or Thailand. U.S. Natl. Mus. Bull. 188. 622 p.