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MORPHOLOGICAL COMPARISONS BETWEEN *PUNTIUS EUGRAMMUS* SILAS, 1956 AND *PUNTIUS LINEATUS* (DUNCKER, 1904) (PISCES: CYPRINIDAE) IN PENINSULAR MALAYSIA

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ABSTRACT. - Morphological comparisons between the cyprinid fish *Puntius eugrammus* and *P. lineatus* found in Peninsular Malaysia are presented. The two species can be distinguished not only by the presence or absence of barbels and the number of gill rakers, but also by the number of abdominal vertebrae, being higher in *P. eugrammus* (12-13 vs. 10-11).

INTRODUCTION

Puntius eugrammus and *P. lineatus* are two strikingly similar cyprinid fish. Both species have four to six dark longitudinal stripes on the body sides. *Puntius eugrammus* was originally described from Banka and Sumatra by Bleeker (1853) as *Barbus fasciatus*. Earlier, Jerdon (1849) had described *Cirrhinus fasciatus* from India. Both species were placed in the genus *Puntius* by Silas (1956) and *P. fasciatus* (Bleeker, 1853) became a junior homonym of *P. fasciatus* (Jerdon, 1849). Silas (1956) proposed *P. eugrammus* as a replacement name for Bleeker's species.

Puntius lineatus has had an interesting taxonomic history. Duncker (1904) described *Barbus lineatus* from the Muar River (southern Peninsular Malaysia). At the end of his original description, he remarked that the newly described species could possibly be only a local variety of *Barbus fasciatus* of Bleeker. All subsequent records of the species were only based on Duncker's record or his specimens (Fowler, 1938; Alfred, 1963, 1971). Mizuno and Furtado (1982) listed *P. fasciatus* and *P. eugrammus* from Tasek Bera of the Pahang drainage. It is not certain if their *P. fasciatus* refers to *P. lineatus* which is also present in the area.

In his monograph of the fishes of the Kapuas River basin, Roberts (1989) pointed out differences between the two sepcies in the number of gill rakers, color patterns of juvenile specimens, and the presence/absence of barbels. This paper compares some selected morphometrics between specimens of the two species found in Peninsular Malaysia.

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METHODS AND MATERIALS

Methods of measurements follow the standard procedures as outlined by Hubbs and Lagler (1964), and conform to their definitions. They were consistently made on the left side of the body. All fish lengths are standard length (SL) unless otherwise stated. Orbit diameters are the distance of the bony rim of eye measured horizontally.

Vertebrae and fin rays were counted on specimens stained with alizarin following the procedure as suggested by Ford (1937). Total gill rakers were counted on the leading edge of the first gill arch. Predorsal scales are those scales between the origin of the dorsal fin and the nape. Precaudal vertebra, the first vertebra that has a much reduced and immovable ribs, was used to separate the caudal and abdominal vertebrae (Karnasuta, 1981). All vertebrae anterior to this (including those of the Weberian complex) are abdominal. The caudal vertebrae include the hypural plate that supports the tail. Principal caudal rays are those rays that reach the posterior margin of the upper and lower lobes of the caudal fin.

A multi-response permutation procedure (MRPP) statistical technique (Zimmerman *et al.*, 1985) was used to compare data of the two species. The specimens examined are those deposited at the Department of Ichthyology, California Academy of Sciences (CAS) including the Stanford University collection (CAS-SU), and the Department of Zoology, University of Malaya (UMKL). In the material examined section, the following information is given: locality, institutional acronym with catalogue number, number of specimens examined, and SL or range of SL (both in brackets).

TAXONOMY

Puntius eugrammus Silas, 1956
(Fig. 1)

Barbus fasciatus Bleeker, 1853: 190 (original description; type locality: Marawan, Pulau Banka and Muara Kompeh, Sumatra, Indonesia).

Puntius fasciatus - Herre & Myers, 1937: 63 (checklist, in part; Ayer Hitam, Johore); Mizuno & Furtado, 1982: 324 (checklist; Tasek Bera, Pahang drainage); Mohsin & Ambak 1983: 68 (description; Subang Lake, Selangor).

Puntius eugrammus Silas, 1956: 194 (Replacement name for *Barbus fasciatus* Bleeker, 1853, preoccupied in *Puntius* by *Cirrhinus fasicatus* Jerdon, 1849).

Material examined. - Peninsular Malaysia: Benut drainage, Ayer Hitam, Johore, CAS-SU 31096 (16, 48.8-79.6 mm SL); Pahang drainage, Tasek Bera, UMKL 38 (5, 53.5-58.4 mm SL), UMKL 39 (1, 53.3 mm SL), UMKL 40 (12, 48.9-63.4 mm SL), UMKL 41 (1, 59.8 mm SL), UMKL 114 (9, 47.6-66.8 mm SL), UMKL 206 (10, 43.5-55.8 mm SL), UMKL 208 (5, 48.1-60.7 mm SL); Bernam drainage, UMKL 42 (1, 80 mm SL); Selangor, no exact locality, UMKL 209 (4, 51.2-64.3 mm SL). Borneo: Kapuas drainage, CAS 49262 (2, 43.2-47.8 mm SL), CAS 49264 (2, 76.2-76.7 mm SL); Sarawak, Lambir Hill National Park, UMKL 51 (10, 48-105 mm SL).

Description. - *Puntius eugrammus* is a relatively large *Puntius*. Although Roberts (1989) stated that they may reach 100 mm in standard length, my largest specimen is only 80.8 mm.

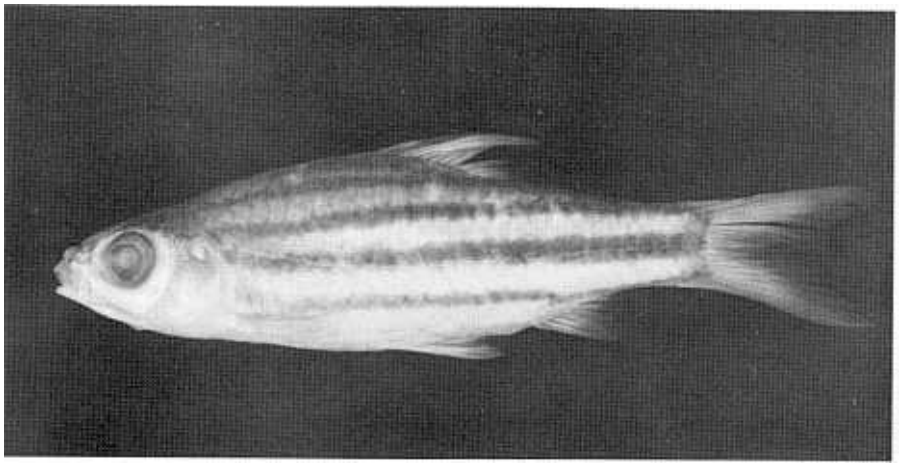

Fig. *Puntius eugrammus*, 53.5 mm SL, Tasek Bera of the Pahang drainage (UMKL 38).

Both pairs of barbels are well developed; the maxillary ones are longer than the rostral barbels. Proportional measurements are shown in Table 1. Scales on the lateral-line and the predorsal regions are 25-27 and 9-11, respectively. Gill rakers are weakly developed, ranging from 7 to 11 (Table 2). The body is relatively robust, heavy-set, with about 4-6 longitudinal stripes. The lateral line stripe is the most prominent one, but its width is not uniform; the band tapers slightly on both ends. *Puntius eugrammus* undergoes a remarkable colour change as illustrated by Taki *et al.* (1978). Young individuals may have four to five broad vertical bars with no indication of longitudinal stripes, characteristic of adults, until they are about 30 mm long. However, this character was not seen in the material examined because all of them are larger than 30 mm SL.

Puntius lineatus (Duncker, 1904)
(Fig. 2)

Barbus lineatus Duncker, 1904: 180 (original description; type locality: Tubing [=Tebing] Tinggi, Muar drainage); Fowler, 1938: 61, 244 (checklist; Tebing Tinggi, Muar drainage); Alfred, 1963: 166 (comments on Duncker's type specimens), Alfred, 1971: 70 (type specimen in the Zoological Reference Collection, former National Museum of Singapore).

Puntius lineatus - Roberts, 1989: 65 (description and new combination; Tasek Bera, Pahang drainage).

Puntius fasciatus - Herre & Myers, 1937: 63 (checklist and misidentification, in part; Tasek Bera, Pahang drainage).

Material examined. - Peninsular Malaysia: Pahang drainage, Tasek Bera, CAS-SU 31097 (2, 38.6-42.1 mm SL), UMKL 43 (3, 41.2-49.5 mm SL), UMKL 44 (2, 43.2-51.7 mm SL), UMKL 45 (7, 20.2-52.2 mm SL), UMKL 46 (3, 41.0-49.9 mm SL), UMKL 113 (1, 48.2 mm SL), UMKL 207 (8, 27.1-48.3 mm SL). Borneo: Kapuas drainage, CAS 49266 (3, 34-35.4 mm SL).

Description.- A relatively small *Puntius*, with the largest known specimens of only 53.0 mm SL. In the original description of the species, Duncker (1904) stated that all barbels are absent in the types. Examinations of the Peninsular Malaysian specimens reveal that the rostral barbels are invariably absent but the maxillary ones are present, although they are very minute. This character is similar with the Kapuas material as reported by Roberts (1989). The head is

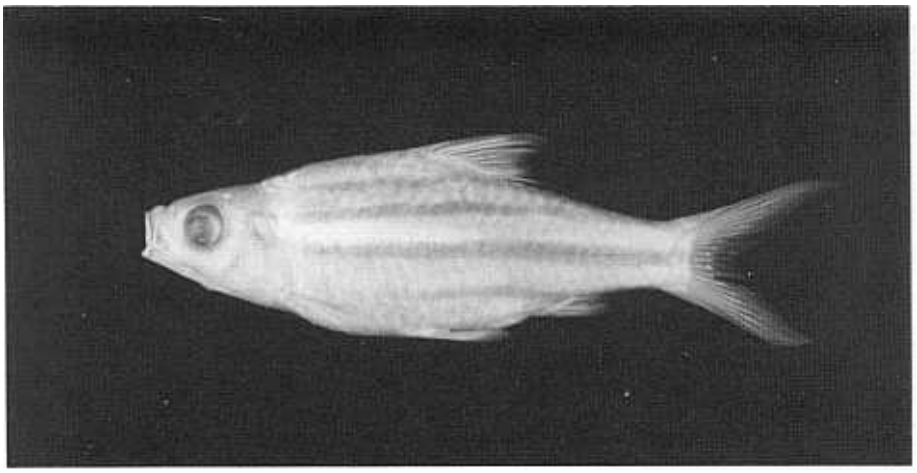

Fig. 2. *Puntius lineatus*, 48.2 mm SL, Tasek Bera of the Pahang drainage (UMKL 1l3).

relatively long and the snout is pointed. Table 1 shows the proportional measurements of the species. The lateral line has 25-27 scales, while 10-13 scales are on the predorsal region. The gill rakers are well developed, moderately elongate, about 17-20 (Table 2). The body is relatively slender, not heavy-set with about 4-5 longitudinal stripes. Unlike *P. eugrammus* which has a broad lateral-line stripe tapering on both ends, the median stripe of *P. lineatus* is thinner, very much uniform in width throughout its length. The species is sexually dimorphic. Breeding tubercles are found on the dorsal surface of the pectoral fin of male individuals (Roberts, 1989). However, this characteristic was not observed in the specimens examined.

DISCUSSION

Morphological observations on specimens of *P. eugrammus* and *P. lineatus* found in Peninsular Malaysia provide additional evidence that the two species are not closely related (Roberts, 1989). Although both species have iv/8 rays in the dorsal fin, the last one split to the base, anal and caudal fin formulae are iii/5 and 10+9, respectively, morphometric measurements of the two species are very distinct. The preanal, postdorsal, and postpelvic lengths are shorter in *P. lineatus*, while the head, postorbital and snout are shorter in *P. eugrammus* (see Table 1).

Other than differences in the number of gill rakers and the development of barbels as reported by Roberts (1989), the two species can also be differentiated by the number of abdominal vertebrae. These vertebrae are 10 to 11 in *P. lineatus* as compared to 12 to 13 in *P. eugrammus* (see Table 2). However, the caudal vertebrae range between 13 and 14 for both species.

In Tasek Bera, Peninsular Malaysia, both species occur sympatrically; but *P. eugrammus* always appears to be more abundant than *P. lineatus*. It is uncertain whether the apparent dominance of *P. eugrammus* is due to the presence of well-developed maxillary and rostral barbels which enable the species to find food more efficiently and thus become more successful than *P. lineatus*, differences in their ecological niches or simply due to sampling selectivity. Further ecological studies on the two species in Tasek Bera have to be carried out to resolve this question.

Table 1. Proportional measurements of *Puntius eugrammus* (N=29) and *P. lineatus* (N=22). Means and ranges, except the standard length which is in millimeter are percent of standard length.

	P. eugrammus			*P. lineatus*			
	Range	Mean	S.D.	Range	Mean	S.D.	P-value
Standard length (mm)	47.6-80.8			34.0-52.2			
Head length	27.1-30.5	28.6	0.010	29.3-34.4	32.1	0.012	0.0001
Postorbital head length	10.7-12.8	11.8	0.006	11.4-14.3	12.6	0.008	0.0004
Snout length	6.5-9.0	8.0	0.006	8.8-11.4	10.0	0.007	0.0001
Eye length	7.5-11.3	9.7	0.009	8.7-11.5	10.2	0.007	0.0631
Interorbital	7.7-11.1	9.5	0.007	8.5-10.9	9.7	0.006	0.1672
Body depth at dorsal	29.5-38.1	34.4	0.020	26.2-34.6	31.5	0.022	0.0001
Preanal length	71.2-76.6	73.6	0.012	67.3-74.4	71.5	0.017	0.0001
Predorsal length	49.0-55.3	52.6	0.012	50.7-56.9	54.5	0.014	0.0001
Prepelvic length	49.0-53.8	51.5	0.013	48.7-54.1	51.9	0.016	0.2542
Postdorsal length	52.0-55.4	53.7	0.011	49.3-53.6	50.9	0.011	0.0001
Postpelvic length	49.5-55.7	52.7	0.017	48.5-52.7	50.8	0.011	0.0001
Postanal length	27.3-31.6	28.7	0.013	20.8-31.9	29.0	0.022	0.2160
Caudal peduncle length	16.8-21.4	19.4	0.012	18.9-21.8	20.2	0.008	0.0035
Caudal peduncle depth	12.0-14.3	13.2	0.007	10.9-13.2	12.0	0.007	0.0001

Table 2. Frequency distribution of occurrence of abdominal vertebrae, caudal vertebrae, and gill rakers in *P. eugrammus* and *P. lineatus*. Vertebrae were counted from alizarin stained specimens.

	Abdominal vertebrae				Caudal vertebrae		Gill rakers									
	10	11	12	13	13	14	7	8	9	10	11	..	17	18	19	20
P. eugrammus			7	3	2	8	2	13	8	5	1					
P. lineatus	3	8			1	10							3	6	9	4

The southern part of Peninsular Malaysia is the northernmost distribution limit of *P. lineatus* which is known only from the Muar River, Johore and Tasek Bera, Pahang. It has been found also in Jambi, Sumatra (Kottelat, pers. comm.) and the Kapuas River, Borneo (Roberts, 1989). On the other hand, *P. eugrammus* has a wider distribution range. It is present in southern Thailand (Kottelat, pers. comm.), Sumatra, and Lambir Hill National Park, Sarawak and Kapuas, Mahakam, and Barito (Roberts, 1989) and Mentaya (Kottelat, 1982) drainages, Kalimantan. In Peninsular Malaysia, *P. eugrammus* is known to occur in Kurau (Bukit Merah Reservoir; Kottelat, pers. comm.), Pahang (Tasek Bera and Tasek Chini), Bernam, Selangor (on the way to Batang Berjuntai), Muar, Sedili (near Kota Tinggi) and Benut (near Ayer Hitam and Layang-Layang; Ng, pers. comm.) river basins.

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