

Morphological Comparison among Striped *Puntius* (Pisces: Cyprinidae) from Indonesia

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ABSTRACT

The striped *Puntius* consisting of four species, these are *P. johorensis*, *P. gemellus*, *P. trifasciatus*, and *P. lineatus*. This group marked by longitudinal stripe on body, and these varieties. The three species first of them have four long barbells, originally describe by *Puntius eugrammus*, and the last species has barbells 0-2 (short when present). The strange species was described from Central Mahakam areas, East Kalimantan. It's named by *Puntius* sp., predicted new species but specifically study is needed. This species differ from its congener by the half stripe (+1) above the midlateral stripe on the anterior half of the body.

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Keywords: striped *Puntius*, morphology, color pattern, truss morphometric.

INTRODUCTION

The *Puntius fasciatus* include striped *Puntius* group was recognized by Weber and de Beaufort (1916). Then Roberts (1989) and Kottelat et al. (1993) explained two species of striped *Puntius*, these are *P. lineatus* and *P. eugrammus*. The former species has 0-2 barbells (short when present), rostral barbells absent, 18-19 gill rakers on first gill arch, and 4-5 stripes on the body in both juveniles and adults. The last species was originally described by Bleeker (1853) with *Barbus fasciatus*, it replaced by Weber and de Beaufort (1916) by *P. fasciatus*, and has been replaced by *P. eugrammus* by Silas (1956), and also Eschmeyer (1998) used it. It has long barbells, 4-6 dark stripes in adults, juveniles (about 20 mm SL) have five broad vertical bars which start to break up at about 25 mm SL, and become replaced by stripes, 10 gill rakers on first gill arch.

Presently the striped *Puntius* divide to four species by Kottelat (1996); these are *P. johorensis*, *P. gemellus*, *P. trifasciatus*, and *P. lineatus*. The origin three species first of them are *P. eugrammus*. They are described based on color pattern of body. The color pattern is main character for describe species of striped *Puntius*, because the morphometric and meristics not successful for identification three species of them (Kottelat, 1996).

Museum Zoologicum Bogoriense (MZB) is accidentally has all species of striped *Puntius* from Indonesia, also the strange species that marked by distinct of color pattern and named *Puntius* sp. This study will be compare of striped *Puntius* based on color pattern and truss morphometric.

MATERIALS AND METHODS

Specimens are deposited in the Museum Zoologicum Bogoriense (MZB) or Division Zoology, Research Center for Biology, The Indonesian Institute of Sciences (LIPI) in Cibinong, Bogor.

Traditional measurements used in ichthyology and counts follow Hubbs and Lagler (1949); Mohsin and Ambak (1983); also Inger and Chin (1962). Measurements of bilateral characters, such as pectoral and pelvic fin length, were made on the left side of the body. A modified box truss/truss morphometric (Figure 1.) was employed to examine shape variation among species. It method similar with Ehlinger (1991) and Humpries et al. (1981), the modification by taken 10 point of homolog, then jointed result 18 characters; the measurement is used digital caliper. The analysis refer to Morrison (1978); Kendall (1975); also Kevin et al. (2000).

Data were analyzed using the Canonical variant (discriminant function) analysis (DFA). These characters are: **SPH** (snout – upper part of posterior head), **PHPB** (posterior head – pectoral fin base), **SPB** (snout – pectoral

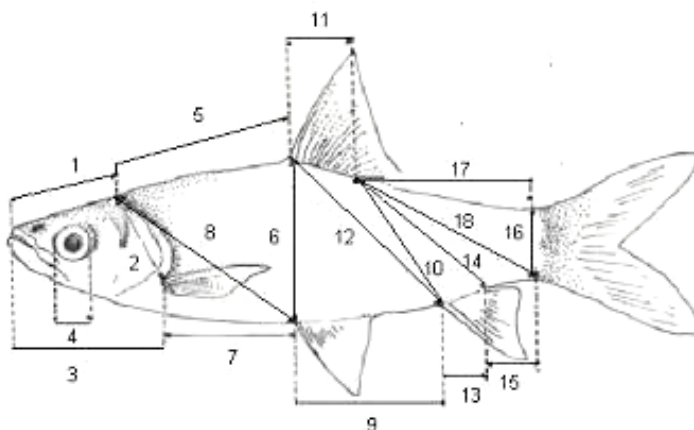


Figure 1. A schematic of truss morphometric (box truss) of striped *Puntius*.

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Table 1. Measurement (in mm) of striped *Puntius* by truss morphometric.

	<i>Puntius</i> sp.	<i>P. johorensis</i>	<i>P. gemellus</i>	<i>P. trifasciatus</i>	<i>P. lineatus</i>
1. SPH	12.03±1.39	15.27±2.42	10.11±2.28	12.58±2.49	9.30±1.44
2. PHPB	11.36±0.84	16.09±2.45	10.10±2.64	11.60±2.45	8.14±1.09
3. SPB	15.55±0.87	21.08±2.79	14.34±3.25	16.64±4.09	12.92±1.81
4. ED	4.21±0.21	5.83±0.79	3.87±0.59	4.53±0.60	3.62±0.42
5. PHDB	16.21±2.25	23.94±3.82	15.10±4.13	18.34±5.07	12.15±1.15
6. DBVB	17.68±1.29	25.58±4.57	16.11±4.54	17.36±4.72	11.80±1.63
7. PBVB	13.42±1.15	17.92±3.24	12.73±3.48	14.82±4.05	7.52±1.05
8. PHVB	21.45±1.35	29.67±4.62	19.96±5.41	23.21±5.58	14.07±1.54
9. VBAB	13.27±0.81	17.96±3.02	11.67±3.55	14.43±4.00	8.26±1.35
10. PDAB	14.84±1.21	20.23±3.32	12.73±3.92	14.62±3.64	9.17±1.42
11. DBL	8.48±0.89	12.15±2.20	8.30±3.33	8.69±2.18	5.32±0.89
12. ADAA	20.35±1.38	29.26±4.69	18.12±5.32	21.32±5.69	13.12±1.75
13. ABL	4.87±0.76	6.78±1.15	4.13±0.97	5.13±1.17	3.36±0.49
14. PDPA	14.93±0.94	20.22±3.02	12.96±3.91	15.45±4.45	9.05±1.21
15. CPL	9.89±1.06	13.12±2.16	7.57±2.06	9.95±1.67	6.85±0.67
16. CPD	6.88±0.69	10.04±1.77	6.30±1.79	7.02±1.49	4.58±0.51
17. PDUCP	19.26±1.32	26.70±4.13	17.51±4.43	21.20±4.65	13.14±1.54
18. PDLCP	21.45±1.34	26.92±9.74	19.02±4.51	22.68±4.94	14.16±1.30

fin base), **ED** (eye diameter), **PHDB** (posterior head – anterior dorsal fin base), **DBVB** (anterior dorsal fin base – ventral fin base), **PBVB** (pectoral fin base – ventral fin base), **PHVB** (upper part of posterior head – ventral fin base), **VBAB** (ventral fin base – anterior anal fin base), **PDAB** (posterior dorsal fin base – anterior anal fin base), **DBL** (dorsal fin base length), **ADAA** (anterior dorsal fin base – anterior anal fin base), **ABL** (anal fin base), **PDPA** (posterior dorsal fin base – posterior anal fin base), **CPL** (caudal peduncle length), **CPD** (caudal peduncle depth), **PDUCP** (posterior dorsal fin base – upper caudal peduncle), **PDLCP** (posterior dorsal fin base – lower caudal peduncle).

The result measure by truss morphometric method showed in Table 1. The traditional methods (morphometric and meristic) was be done, with selected characters such as explained by Kottelat (1996). The result of measure and count showed in Table 3.

The numbering scheme for stripes follows Kottelat (1996), thus stripe 0 is midlateral, in general, follows the lateral line scale row; stripe +1 is the first stripe above the midlateral stripe, stripe +2 is the second stripe above the midlateral stripe, stripe –1 is the first stripe below the midlateral stripe and stripe –2 is the second stripe below the midlateral stripe.

A longitudinal dark mark are numbered as follow: row 0 is the row bearing the lateral line canals, row +1 is the row immediately above it, row –1 is the row immediately below it; the next rows are +2 and –2 respectively, etc. Stripes are numbered the same way.

RESULTS AND DISCUSSION

Body shape of striped *Puntius* (*P. johorensis*, *P. gemellus*, *P. trifasciatus*, *P. lineatus*, and *Puntius* sp.) are similar, but the color pattern of them are varied depend on its species (Figure 2.).

The color pattern of *P. johorensis*, there are usually 6 narrow stripes on a reddish brown background. Stripe 0 on row 0, except on anterior most scales where it is between rows 0 and –1. Stripe +1 is between rows +1 and +2, except on anterior scales where it is on row +1. Stripe +2 is between rows +2 and +3; it ends at the beginning of the caudal peduncle. Stripe +3 is between rows +3 and +4, it is absent in the smallest specimens (about 40 mm SL). Stripe –1 is between rows –1 and 2, except on caudal peduncle where it is on row –2. Stripe –2 is on row –3, between pectoral and anal bases. Stripe +1 and –1 are on rows +2 and –2 respectively on the caudal peduncle and the dorsal and ventral midlines have the general background color of the body (Figure 2A.). Distribution in Indonesia: Jambi, Riau, East Kalimantan, and Central Kalimantan.

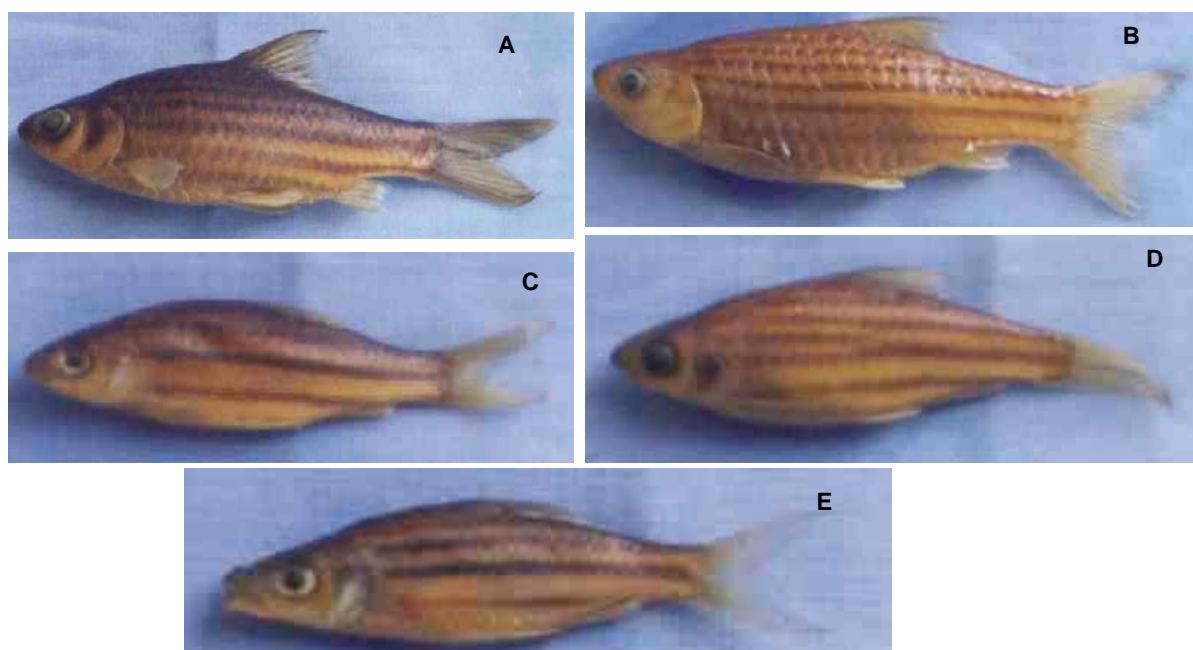


Figure 2. The diversity of striped *Puntius* in Indonesia: *P. johorensis* (A), *P. gemellus* (B), *P. trifasciatus* (C), *Puntius* sp. (D), and *P. lineatus* (E).

P. gemellus, there are usually 6 narrow stripes on pale brown background. Stripe 0 is on row 0, except on anterior most scales where it is between rows 0 and -1. Stripe +1 is between rows +1 and +2, except on anterior scales where it is on row +1. Stripe +2 is on row +3, except anteriorly where it is between rows +2 and +3; it ends at the beginning of the caudal peduncle. Stripe +3 is on row +4, except anteriorly where it is on row +3; it extends to end of dorsal base; it is absent in small specimens (less than 26 mm SL). The stripes on the back (especially stripes +2 or +3) may be somewhat irregular or connected. Stripe -1 is between rows -1 and -2, except caudal peduncle where it is on row -2. Stripe -2 is on row -3, between pelvic and anal origins. Stripes +1 and -1 are on rows +2 and -2 respectively on the caudal peduncle (Figure 2B.). Distribution in Indonesia: Jambi, Riau, Bangka, Belitung, and South Kalimantan.

P. trifasciatus, stripe 0 is broad, extending on the whole row 0 and part of rows -1 and +1 at the beginning and the end of lateral line; in the median area, it is over rows 0 and +1. Stripe +1 is on row +3 or between rows +3 and +4, except anteriorly where it is slightly lower, on the caudal peduncle; it is on row +3. Stripe +2 is on row +4 or between +4 and +5; it extends between nape and the posterior extremity of dorsal base; it is usually not present in specimens less than about 60 mm SL. Stripe -1 is between rows -1 and -2 above the pelvic, on row -2 in front, and on row -3 on the caudal peduncle (Fig 2C). Distribution in Indonesia: South Kalimantan, West Kalimantan, and East Kalimantan

P. lineatus, is distinguished from the other four species of striped *Puntius* in Indonesia by having only 0-1 pair of barbells, much shorter than eye (vs. 2 pairs of long barbells), $\frac{1}{2}$ 5 scales rows between dorsal origin and lateral line (vs. $\frac{1}{2}$ 4) and 4 between lateral line and pelvic origin (vs. 3); 17-20 gill rakers on anterior gill arch (vs. 7-11), mouth sub inferior (vs. terminal), and especially by its fleshy lower lip forming a continuous post labial groove in specimens larger than about 20 mm SL, a character unique among Indonesian *Puntius*. It is smaller species, not known to grow larger than 53 mm SL. The color pattern, stripe 0 is on row 0, except in the middle area of flank where it is between rows 0 and +1. Stripe +1 is on row 2, except in the middle where it is between row +2 and +3. Stripe +2 is on row +3 anteriorly, going progressively to row +4 posteriorly; it ends at about posterior extremity of dorsal base. Stripe -1 is on row -2, except in the middle where it is between rows -1 and -2. Stripe -2 is on row -3 and extends between pectoral and anal origin; it is usually weak or even absent (Figure 2E.). Distribution in Indonesia: Jambi and West Kalimantan.

Puntius sp., differ from all other known striped congeners by the half stripe above the midlateral stripe on the anterior half of the body. It's based on 6 specimens and predicted as the new species. The complete descriptions are general body shape and appearance as shown in Figure 2D. Its body long and compressed, head pointed; color pattern, there are 5 narrow stripes on pale brown background; on the upper half of the body the reticulate pattern is well defined, formed by pigmentation at the edges of the exposed part of scales. Stripe 0 is on row 0, except on anterior most scales where it is between rows 0 and -1. Stripe +1 anterior part have 11-13 scales, it is ends lower of middle dorsal fin; posterior part stripe (+2) on row between +2 and +3, beginning scale 5-6th

from operculum with position above the anterior most, continued to caudal peduncle. The stripe +1 and +2 are differ from other species its congeners. Stripe +3 beginning at back of operculum on row +3 and +4, its end of dorsal part of caudal peduncle. Stripe -1 on row -1 and -2, beginning at base of pectoral fin, its end at lower part of caudal peduncle. Stripe -2 is on row -3, between pelvic and anal origins, it is present in all specimens examined, the stripe thin and not continued to caudal peduncle (Figure 2D.). Distribution in Indonesia: East Kalimantan.

The truss morphometric was examined by canonical discriminant analysis with two steps. First step was examined all characters, and second of them only examined selected characters (6 characters). The selection of characters following value of Wilk's Lambda, and the result of important character such as: ED, PBVB, CPL, DBVB, PDUCP, and CPD. A plotting of selected characters by function 1, 2, and 3 explained variation each 58.24%, 25.43%, and 12.63% (Table 2.), and a joined these function explained 93.48%. This result showed separation between species of a striped *Puntius* (Figure 3.). A plotting between function 1, 2, and function 3 that *Puntius* sp. is distinct from *P. johorensis*, *P. gemellus*, *P. trifasciatus*, and *P. lineatus*. It's closer with *P. trifasciatus* and *P. gemellus*.

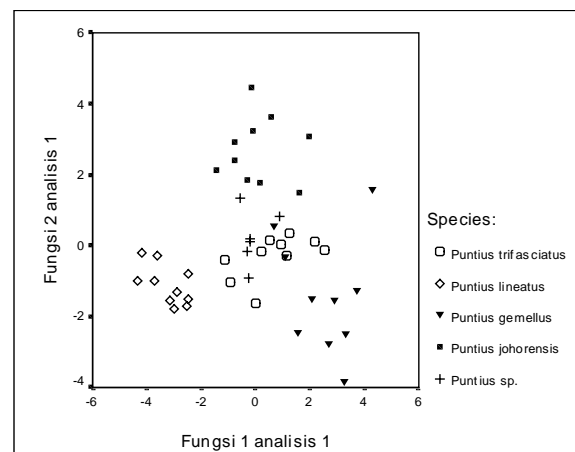


Figure 3. A Plotting of striped *Puntius* with function 1 and 2.

If compare with *P. trifasciatus* (vs. 3 stripes with complete). The other characters for compare with used Table 3., such as: total length, predorsal length, preanal length, body width, upper caudal lobe length, and middle caudal rays length are less than *P. trifasciatus*, and another characters (body depth, interorbital width, anal fin base length) are larger than it.

If compare with *P. gemellus* (vs. 5-6 stripes with complete). It also has total length, predorsal length, prepelvic length, preanal length, head depth, body depth,

Table 2. Selected caharcters, Canonical variate function coefficient for five species of striped *Puntius*.

Characters	Value of Wilk's Lambda	Function 1	Function 2	Function 3
1. ED	0.31682	0.211 (0.365)	1.215 (2.100)	-0.476 (-0.023)
2. PBVB	0.14531	-2.770 (-0.893)	1.269 (0.409)	1.0281 (0.332)
3. CPL	0.08176	0.910 (0.543)	0.943 (0.563)	-1.431 (-0.854)
4. DBVB	0.04610	1.601 (0.416)	-3.220 (-0.837)	0.714 (0.186)
5. PDUCP	0.03115	-1.572 (-0.397)	1.557 (0.393)	-0.416 (-0.105)
6. CPD	0.02207	1.940 (1.375)	-0.999 (-0.708)	1.186 (0.840)
Variation explained (%)		58.24	25.43	12.63
Constant		-4.212	-7.855	0.918

Annotation: standardized values followed by (in brackets) unstandardized values.

Table 3. Selected morphometric (in mm) and meristic data of *Puntius* sp., *P. gemellus*, *P. johorensis*, *P. lineatus*, and *P. trifasciatus*.

Standard length	<i>Puntius</i> sp.		<i>P. gemellus</i> *)	<i>P. johorensis</i> *)	<i>P. lineatus</i>	<i>P. trifasciatus</i> *)
	MZB 8146 H	n = 6	MZB. 5939 H	CMK. 11141	MZB 8098 (n=5)	MZB. 5940 H
Presented of standard length	56.4	55.2	60.0	73.9	40.97	74.0
1. Total length	129.2	128.8 **)	131.8	133.3	131.50	130.0
2. Head length	25.5	29.4	26.9	31.8	34.39	29.5
3. Predorsal length	51.8	51.9 **)	52.3	55.3	54.20	53.1
4. Prepelvic length	52.0	50.6	51.8	53.5	51.19	51.4
5. Preanal length	73.3	72.0 **)	78.2	76.0	70.52	74.6
6. Head depth	21.1	17.5	18.6	22.7	20.97	19.9
7. Body depth	31.9	33.0	35.1	37.2	30.55	31.1
8. Depth of caudal peduncle	13.6	12.9	12.2	14.3	11.86	12.8
9. Length of caudal peduncle	20.4	21.3	20.6	20.4	19.55	21.1
10. Snout length	8.9	8.6	7.4	9.2	10.04	8.4
11. Body width	13.9	14.4 **)	15.2	19.4	14.27	15.8
12. Eye diameter	7.7	8.1	7.7	8.0	10.38	7.7
13. Interorbital width	10.8	10.1	9.2	11.2	9.85	9.6
14. Length of dorsal fin base	16.3	15.7	14.8	15.6	14.81	14.1
15. length of anal fin base	9.2	9.3	8.5	9.7	10.21	7.8
16. Length of pelvic fin	18.4	19.7	17.7	20.0	22.21	19.5
17. Length of pectoral fin	20.1	20.6	19.4	21.0	20.69	20.8
18. Length of upper caudal lobe	28.1	29.5 **)	30.9	32.5	32.79	30.0
19. Length of middle caudal rays	9.1	11.0 **)	15.2	15.2	17.99	12.0
20. Length of lower caudal lobe	32.5	29.3	31.7	31.4	33.48	31.5
Presented of head length						
21. Snout length	32.1	31.5 **)	27.4	28.9	29.21	28.4
22. Eye diameter	27.7	28.1	28.6	25.1	30.20	27.7
23. Interorbital width	38.9	34.0	34.3	35.3	28.65	32.5
Meristic						
24. Pectoral rays	15	14-16	15	16	16	17
25. Lateral line scales	25+2	25+2	26+2	26+2	25+2	25+2
26. Predorsal scales	10	10	11	10	12	10

Annotation: *) Kottelat (1996), **) differ from others species.

body width, upper and middle caudal rays length are less than *P. gemellus*, and another characters (snout length, interorbital width, dorsal fin base length, anal-fin base length, and pectoral fin length) are larger than it.

If compare with *P. lineatus* (vs. 4-5 narrow stripes). The majority of morphometric characters of *Puntius* sp. less than *P. lineatus*, such as total length, head length, predorsal length, prepelvic length, head depth, snout length, eye diameter, length of anal fin base, length of pelvic fin and lobes of caudal fin. The lips of *P. lineatus* is differs from other stripe *Puntius*.

Compare with *P. johorensis* (vs. 6 narrow stripes on reddish brown background). The stripe narrower, the morphometric result is almost all characters less than *P. johorensis*. The comparison in the above showed are *Puntius* sp. more close to *P. trifasciatus* than *P. gemellus* and *P. johorensis*. Therefore suggested are the four specimens examined differ from it, mainly on number of stripe, color pattern, selected characters and truss morphometric.

CONCLUSION

The stripe *Puntius* marked by longitudinal band and differentiated mainly by 6 selected characters fiz ED, PBVB, CPL, DBVB, PDUCP, and CPD. The *Puntius* sp. from Central Mahakam, East Kalimantan differs from its congeners by the half stripe above the midlateral stripe on the anterior half of body; based on truss morphometric also different, therefore predicted as new species.

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