Japanese Journal of Ichthyology
Vol. 26, No. 3 1979

魚類学雑誌
26巻3号 1979年

Notes on the Morid Fish Genera *Lotella* and *Physiculus* in Japanese Waters

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(Received April 4, 1979)

Abstract *Lotella* Kaup has the upper jaw with an outer row of larger teeth, separate from an inner band of smaller ones; it lacks a ventral light organ. *Physiculus* Kaup has equal sized upper jaw teeth or lacks a sharp discontinuity between large and small ones; it has a ventral light organ. *Physiculus tosaensis* Kamohara is transferred to *Lotella*; its known range is extended from Japan to the South China Sea. Brief descriptions are presented for *Lotella phycis* (Temminck et Schlegel) (type-species of *Lotella*) and *L. tosaensis* (Kamohara). *Lotella maximowiczi* Herzenstein is transferred to *Physiculus*, where it is perhaps a junior synonym of *P. japonicus* Hilgendorf.

The objectives of this paper are to distinguish from each other the morid genera *Lotella* Kaup, 1858 and *Physiculus* Kaup, 1858 in Japanese waters, to transfer *Physiculus tosaensis* Kamohara, 1936 to *Lotella*, and to transfer *Lotella maximowiczi* Herzenstein, 1896 to *Physiculus*.

Lotella Kaup

Lotella Kaup, 1858: 88 (type-species by monotypy *Lota phycis* Temminck et Schlegel, 1846).

This genus is distinguished among morid genera by its distinctive dentition, the upper jaw having an outer row of relatively large, widely spaced, sharp pointed teeth and an inner band of smaller teeth.

Some species of *Physiculus* have larger outer jaw teeth and have been misidentified as *Lotella* in many fish collections in Japan and elsewhere and probably in the literature as well. However, those *Physiculus* with some enlarged jaw teeth do not show the sharp discontinuity in size between large and small teeth demonstrated in the upper jaw of *Lotella* (Fig. 1).

Lotella does not have a ventral light organ. I have examined the type-specimens of *Lotella phycis*, and they lack this structure. Fish identified as *Lotella phycis* were described by Haneda (1951) as having a light organ. They must have been *Physiculus*. Although other genera of Moridae have a ventral light organ, *Physiculus* is the only one found in Japanese waters.

Two species of western North Pacific morids, *L. phycis* and *Physiculus tosaensis* Kamohara,

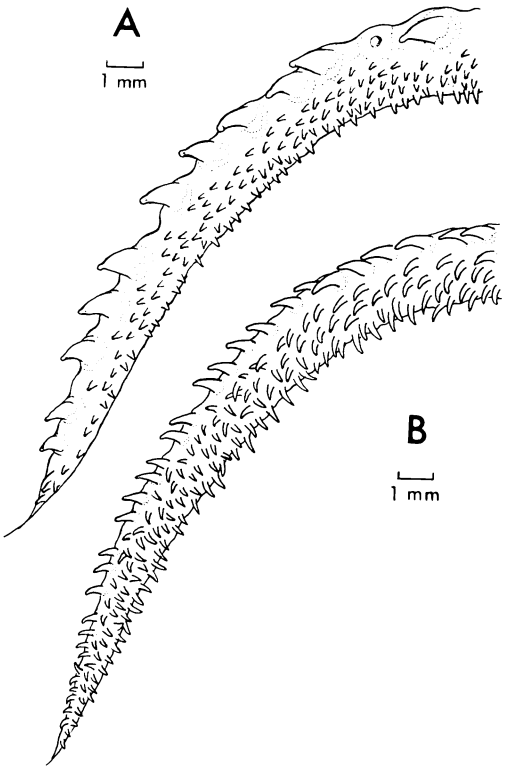

Fig. 1. Ventral view of right premaxilla showing teeth. A: *Lotella phycis*, BMNH 1939.7.20.12. B: *Physiculus japonicus*, U.S. National Museum of Natural History 149511. Drawn by Keiko Hiratsuka Moore.

may be referred to *Lotella*. They are compared in Table 1. Both are rare in collections, and descriptive data are presented here for each. *Lotella* is known to occur also in temperate waters of the eastern and western South Pacific; however, there never has been a revision, and names cannot be correctly assigned at this time. *Lotella maxillaris* Bean was described from the Gulf Stream off the east coast of the United States. Norman (1937) questioned its placement in *Lotella*; my own unpublished work has shown that it is most probably a young *Laemonema*.

Table 1. Distinguishing characters for *Lotella phycis* and *L. tosaensis*.

Character	*L. phycis*	*L. tosaensis*
Lateral line	Extends to end of body	Ends near mid-length of body
Oblique scale rows between 1st dorsal and lateral line	17	6
Lateral scale rows	About 200	75~80
2nd dorsal fin rays	57~67	46~48
Anal fin rays	53~57	43~44
Pectoral fin rays	23~25	19~21
Caudal fin rays	30~33	24~25

Lotella phycis (Temminck et Schlegel)

A good illustration is presented by Svetovidov (1936).

Selected counts and measurements are given in Table 2. Some counts are presented in the following description.

Body rather stocky, depth at anus 4.1 to 4.4 in standard length (5.4 in smallest specimen). Caudal peduncle slender, depth 5.6 to 6.1 in body depth (4.1 in smallest).

Head 4.0 to 4.6 in standard length, slightly depressed. Snout rather blunt in lateral view, rounded when seen from top. Chin barbel prominent. Orbit diameter 3.4 to 4.7 in head length. Nostrils closer to eye than to tip of snout, the anterior with a slightly raised rim and a prominent flap on posterior margin, the posterior a simple pore immediately behind.

Upper jaw 1.8 to 2.1 in head length, ending close to level of rear margin of orbit. Lower jaw included. Upper jaw with 5 to 12 enlarged teeth on each side, overlain with a curtain of fleshy papillae that fringe margin

Table 2. Selected counts and measurements in mm of *Lotella phycis*. See text for other counts. [1] Including all rays; [2] Ural centra not included; [3] Including rudiments.

Character	RMNH 3449 Lectotype	RMNH 1388 Dry specimen	RMNH 1389 Dry specimen	ZUMT 14357	FAKU W539	BMNH 1939. 7.20.12	SU 30606	BPBM 22416
Dorsal rays	6+60	6+59	6+?	6+	6+57	6+59	6+58	6+61
Anal rays	—	53	—	55	56	55	53	57
Pectoral rays	24	23	24	25	25	24	24	25
Caudal rays[1]	—	30	—		30	33	33	32
Vertebrae[2]	—	—	—		14+29=43	14+32=46	14+32=46	14+31=45
Gill rakers[3]	3+6	—	—	3+8	3+1+6	2+8	2+1+6	2+1+6
Standard length	222	210	196	209	204	203	171	60.4
Preanal length	100	86.2	82.6	88.0	76.4	82.9	77.0	22.7
Predorsal length	52.5	54.6	58.8	—	59.2	53.0	48.4	16.6
Body depth at anus	—	—	—	49.8	49.8	48.0	38.8	11.2
Body depth at caudal peduncle	7.9	6.5	7.7	8.9	8.5	7.8	6.7	2.7
Head length	52.0	45.8	44.5	52.7	47.7	49.0	41.9	14.5
Orbit diameter	13.8	12.0	12.4	11.3	11.2	10.4	9.4	4.3
Interorbital width	11.2	8.6	—	10.9	11.0	11.5	9.3	4.1
Snout length	11.7	10.6	10.0	12.3	10.7	13.3	10.6	3.6
Upper jaw length	27.5	24.7	24.7	24.9	22.6	24.7	20.2	7.1
Barbel length	13.7	—	—	12.5	13.6	12.5	10.9	4.0
Ventral fin length	27.1	31.5	24.6	33.5	24.6	32.2	26.7	9.3
Pectoral fin length	34.2	35.7	—	36.3	32.3	32.6	28.3	8.5

of lip (not shown in Fig. 1); an inner band of smaller rather villiform teeth 4 to 5 teeth wide anteriorly, tapering to a single tooth wide posteriorly. Lower jaw has a row of large teeth, and along most of jaw similar but smaller teeth which are placed between and exterior to larger ones; at jaw tip a broader band of smaller teeth interior to large ones. Vomerine and palatine teeth absent.

Gill rakers short, stubby, compressed tubercles, except in smallest specimen, in which they are more elongate. Pseudobranch apparently absent. Branchiostegal rays 7.

Head pores are difficult to count on most specimens; however, on the smallest one I find the supraorbital canal with 3 pores, the most anterior medial to the nostrils, the other 2 above the eye; infraorbital pores 9; preoperculomandibular pores 10, of which 6 are arranged along the mandible. The lateral line extends along the entire length of the body, originating above the opercular opening; it rises slightly following the dorsal contour of the body and then descends gradually to the midline slightly anterior to the caudal peduncle. The lateral line gives off about 40, short, dorsal and ventral branches with a pore at the end of each (seen only on BMNH).

Oblique scale rows between first dorsal and lateral line about 17. Scale rows along the body side are difficult to count, and although I have not been able to obtain consistent results, there appear to be about 200 or more.

First dorsal fin lacking an extended filament, the first ray a tiny splint. Second dorsal and anal fins each with a posterior lobe. Dorsal fin base extending slightly farther posteriorly than does anal fin base. Caudal fin rounded. Pectoral fin extending posteriorly to about the anal fin origin; dorsal section of fin with longer rays than ventral section. Ventral fin originating anterior to pectoral fin, falling short of anal fin origin; with 9 rays, the outer 2 longer and stronger than the others, number 2 the longest, about two times the length of number 3.

Preserved specimens brown. Several have the posterior rays of the first dorsal with a dark blotch. In life reported as reddish. A color photograph of a fresh specimen (the smallest one, BPBM) given to me by Dr. J. Randall shows a reddish brown fish with darker vertical fins rimmed with a narrow white margin; a somewhat darker blotch is present on the first dorsal and on the posterior lobes of the second dorsal and the anal. The ventral fin and the barbel are white.

Study material: See acknowledgments for abbreviations. RMNH 3449 (lectotype designated by Boeseman, 1947), vicinity of Nagasaki; RMNH 1388, 1389 (paralectotypes, dry specimens), vicinity of Nagasaki; ZUMT 14357, off Misaki, Kanagawa Prefecture; FAKU W539, Sea of Japan, western Wakasa Bay, about 200 m, Danish seiners, Oct. 1977; BMNH 1939.7.20.12, Noto; SU 30606, Kobe; BPBM 22416, Miyake-jima, off N end of island, Izu Islands, 37 m, rotenone collection, June 1978.

Lotella tosaensis (Kamohara)

Illustrations are given by Kamohara (1936, 1938, 1952).

Selected counts and measurements are given in Table 3. Some counts are presented in the following description.

Body rather short, depth at anus 3.8 to 4.5 (5.1 in smallest specimen). Caudal peduncle slender, depth 5.1 to 6.3 (4.0 in smallest).

Head 3.6 to 4.0 in standard length, slightly depressed. Snout rounded from lateral and dorsal aspects. Chin barbel prominent. Orbit diameter 3.4 to 3.8 in head length. Posterior nostril a simple pore immediately in front of anterior margin of eye, the anterior nostril immediately in advance, with a short, thin tube.

Upper jaw 1.8 to 2.2 in head length, ending close to level of rear margin of orbit. Lower jaw included. Upper jaw with 10 to 20 sharp teeth in a single row and an inner band of smaller teeth 3 to 4 teeth wide anteriorly and tapering to a single tooth at rear of jaw. Dentary with a narrow irregular row of about 20 teeth, single over most of its length, 2 or 3 teeth wide anteriorly (in the largest CAS specimen double and 3 or 4 teeth wide anteriorly). Vomerine and palatine teeth absent.

Gill rakers short and stubby. A prominent pseudobranch with 5 or 6 filaments is visible through the transparent membrane lining the inner surface of the branchial cavity. Bran-

chiostegal rays 7 (8 on one side of the largest CAS specimen).

Head pores tiny and difficult to count, supraorbital canal 3 or 4; infraorbital ? 7 or 8; mandibular 7, plus at least 2 on preopercle; lateral ? 3 or 4. Lateral line arching up slightly after originating above the gill opening, and following the dorsal contour of the body, becoming obsolete slightly beyond mid-length, not descending to the midline.

Oblique scale rows between the first dorsal fin and the lateral line 6. Scale rows along the body side 75 to 80.

First dorsal fin lacking an extended filament, the first ray a tiny splint. Caudal fin rounded. Pectoral reaching to or slightly beyond anus. Ventral fin reaching anus in most specimens, with 9 rays (10 in largest CAS), the outer 2 longer and stronger, number 2 the longest.

Body light colored, vertical fins with darker margins.

Probably a small species, as BSKU 9693 is a nearly ripe female at 105 mm standard length.

The original holotype, now destroyed, was trawled at about 80 fms.

Until now caught only in Japanese waters from Mie to Kochi (Kamohara, 1964); however, the three CAS specimens reported on in this paper constitute a range extension of approximately 2800 km to the South China Sea.

Study material: BSKU 9694 (neotype selected by Kamohara, 1961), Mimase; BSKU 9693, ? Mimase; FAKU 1583, ?; CAS, NAGA Expedition register no. 2077, 3 specimens, sta. no. 60-61, 15°40′N, 109°25′30″E, 60～108 fms, February, 1960.

Physiculus Kaup

Physiculus Kaup, 1858: 88 (type-species by monotypy *Physiculus dalwigki* Kaup, 1858).

Lotella maximowiczi Herzenstein, 1896 (described from a specimen taken at Hakodate) should be placed in *Physiculus*. I have examined the holotype and find that it has a ventral light organ and does not have the distinctive *Lotella* pattern of upper jaw dentition described above and illustrated in Fig. 1A. In *L. maximowiczi* the upper jaw dentition consists of a brushlike band 4 to 5 teeth wide, which grades to larger teeth along the outer margin. In addition, *L. maximowiczi*

Table 3. Selected counts and measurements in mm of *Lotella tosaensis*. See text for other counts.
[1] Including all rays; [2] Ural centra not included; [3] Including rudiments.

Character	BSKU 9694 Neotype	BSKU 9693	FAKU 1583	CAS Naga 2077	CAS Naga 2077	CAS Naga 2077
Dorsal rays	6+47	5+48	6+48	6+47	6+47	6+46
Anal rays	43	44	44	43	44	44
Pectoral rays	21	21	20	19	20	20
Caudal rays[1]	24	24	24	24	24	25
Vertebrae[2]	13+28=41	14+28=42	14+28=42	14+27=41	14+27=41	14+28=42
Gill rakers[3]	2+1+5	2+1+6	2+6	2+6	3+1+5	3+6
Standard length	108	105	111	97.5	78.1	75.0
Preanal length	45.1	47.6	43.9	42.0	34.9	32.0
Predorsal length	31.0	31.5	32.3	28.7	22.4	23.0
Body depth at anus	26.9	27.5	24.4	24.2	18.2	14.7
Body depth at caudal peduncle	4.3	4.6	4.8	4.4	3.0	3.7
Head length	27.5	26.5	27.5	26.7	21.7	20.0
Orbit diameter	7.5	6.9	7.2	7.7	6.4	5.4
Interorbital width	6.5	6.8	7.3	6.6	5.4	5.3
Snout length	6.0	5.4	5.3	4.4	4.1	4.7
Upper jaw length	14.5	13.0	15.0	14.0	10.5	9.1
Barbel length	7.3	5.3	7.5	5.6	5.1	4.8
Ventral fin length	18.6	21.1	22.6	20.3	18.1	15.8
Pectoral fin length	19.9	18.5	19.5	18.7	15.6	14.4

Table 4. Selected counts and measurements on holotypes of *Physiculus japonicus* and *P. maximowiczi*. [1] Including all rays; [2] Ural centra not included; [3] Including rudiments.

Character	*P. japonicus* ZMHU 10624		*P. maximowiczi* ZIL 9689	
Dorsal rays	9+67		9+70	
Anal rays	77		76	
Pectoral rays	25		24	
Ventral rays	7		6	
Caudal rays[1]	—		34	
Vertebrae[2]	—		16+41=57	
Gill rakers[3]	3+8		3+9	
Branchiostegal rays	7		—	
Oblique scale rows between 1st dorsal and lateral line	—		About 9	
	mm	% SL	mm	% SL
Standard length	228		276	
Preanal length	—	—	88.4	32.0
Predorsal length	58.6	25.7	76.0	27.5
Body depth at anus	37.7	16.5	49.8	18.0
Body depth at caudal peduncle	6.2	2.7	7.6	2.7
Head length	49.3	21.6	64.9	23.5
Orbit diameter	12.7	5.6	14.1	5.1
Interorbital width	11.2	4.9	17.1	6.2
Snout length	10.4	4.6	16.1	5.8
Upper jaw length	23.8	10.4	30.0	10.9
Barbel length	7.3	3.2	10.6	3.8
Ventral fin length	25.8	11.3	33.2	12.0
Pectoral fin length	—	—	38.8	14.1

has otoliths that are characteristic of *Physiculus* rather than *Lotella* (Karrer, 1971).

The question arises as to whether *P. maximowiczi* is a valid species in the genus *Physiculus*. Previous authors (see for example Svetovidov, 1936; Matsubara, 1955) have considered it as a species of *Lotella*. Matsubara (1955) lists five species of *Physiculus* from Japan: *japonicus*, *tosaensis*, sp., *jordani*, and *inbarbatum*. Taking these in reverse order, the last two lack chin barbels and have tiny granular jaw teeth; *P. inbarbatum* and *P. jordani* are not at all close to *P. maximowiczi*. *Physiculus* sp. is a light-colored fish with a more elongate ray in the first dorsal fin and can be excluded. The next species, *P. tosaensis*, I have shown to be a *Lotella*. The remaining species, *P. japonicus*, may be identical with *P. maximowiczi*. I have examined the holotype of *P. japonicus* Hilgendorf, 1879 and in Table 4 present a comparison with the holotype of *P. maximowiczi*. The two are rather similar. In addition, *P. japonicus* has similar upper jaw dentition, with a band of teeth 4 to 5 teeth wide, the outer ones somewhat larger. The two holotypes agree in one other character that is helpful in the taxonomy of *Physiculus*; the dark, scaleless patch that serves as a window for a light organ is posterior to a line between the bases of the ventral fins.

While studying in several Japanese fish collections I found at least two (possibly more) other species of Japanese *Physiculus* that I cannot identify. There are more than 20 named species of *Physiculus* around the world, and the genus never has been revised. Japanese species, whether named or not, may be identical with species named from other parts of the world. For the present I can only note that the holotypes of *P. japonicus* and *P. maximowiczi* are quite similar and probably represent one and the same species. Confirmation will be provided by the study of additional material.

Acknowledgments

I am grateful to the following individuals who allowed me to examine specimens in their collections or helped me in other ways. T. Abe, Department of Zoology, University Museum, University of Tokyo (ZUMT); M. Boeseman, Rijksmuseum van Natuurlijke Historie, Leiden (RMNH); W. Eschmeyer, California Academy of Sciences (CAS, SU= Stanford University collection at CAS); C. Karrer, then of Zoologisches Museum der Humboldt Universität, Berlin (ZMHU); I. and R. Nakamura, Marine Laboratory, Kyoto University, Maizuru (FAKU); O. Okamura, Kochi University (BSKU); J.E.Randall, Bernice P. Bishop Museum, Honolulu (BPBM); A. N. Svetovidov, Zoological Institute, Leningrad (ZIL); T. Uyeno, National Science Museum, Tokyo; E. Fujii, Nippon Luther Shingakudaigaku, Tokyo; A. Wheeler, British Museum (Natural History), London (BMNH). The manuscript was read by B. Collette and O. Okamura.

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日本産チゴダラ科，チゴダラ属およびイソアイナメ属の魚類

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イソアイナメ属 *Lotella* は，上顎外側に1列の大きな歯があり，小さな歯からなる内側の歯帯と分離し，発光器が無い．チゴダラ属 *Physiculus* の上顎歯は大きさが一様（大小の歯が分離しない）で，腹部発光器が有る．ホソダラはイソアイナメ属に移され，南支那海まで分布域が拡大された．イソアイナメ *L. phycis*（属の模式種）と，ホソダラ *L. tosaensis* の簡単な記載を行った．エゾイソアイナメ *Physiculus maxmowiczi* はチゴダラ属に移され，多分チゴダラ *P. japonicus* の junior synonym である．

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