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Author(s)	UENO, Tatsuji
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STUDIES ON THE CYCLOPTERID FISHES FROM NORTHERN JAPAN AND ADJACENT REGIONS

I. REMARKS ON TWO GENERA, *CYCLOLUMPUS* AND *EUMICROTREMUS*

Tatsuji UENO

(Faculty of Fisheries, Hokkaido University, Hakodate)

INTRODUCTION

The cyclopterid fishes or lump-suckers distributing in colder northern seas are very interesting from the taxonomic standpoint as well as in view of their habits and curious forms. Up to the present, the cyclopterid fishes have been far from satisfactorily understood. They have chiefly been classified by their external features. But, those external features have often been subject to various individual or local variations. Actually, there is evidence of considerable variations within the species. It seems, therefore, very difficult to identify accurately these fishes from only the external features. Then, the present author has attempted a rescrutinization of this family from either some external or some internal features in order clarify the identification of the fishes.

During the progress of this study, the present author was able to examine many specimens taken from northern waters off Japan proper, Hokkaido, the Kurile Islands and Saghalin, and he found several new facts about the subject.

In this paper, a comparison of the two genera; *Cyclolumpus* and *Eumicrotremus*, and a review of the Japanese species belonging to the those two genera is presented.

ACKNOWLEDGMENTS

Many people have continually given various help during the preparation of this study. Of these, the present author wishes particularly to express heartfelt thanks to Profs. Shin-ich SATO and Saburo SAITO of the Faculty of Fisheries, Hokkaido University, and also to his former teacher, Mr. Toyoji HIKITA, who is now employed in the Muroran Aquarium, Hokkaido. They have given various instructive advice and kind permission to inspect many valuable specimens used in this study. Further, the author expresses grateful thanks to the following gentlemen for much kind and valuable assistance: Dr. Yaichiro OKADA and Mr. Tamotsu IWAI of Mie Prefectual University, Dr. Katsuzo KURONUMA of the Fresh-water Fisheries Research Laboratory, Dr. Kiyomatsu MATSUBARA of Kyoto University, and Dr. Tokiharu ABE of the Tokai Regional Fisheries Research Laboratory. Finally, acknowledgment is made of indebtedness to staff members of Kushiro and Mombetsu Branches of the Hokkaido Fisheries Experimental Station, for collecting materials.

FAMILY CYCLOPTERIDAE

At present, the family CYCLOPTERIDAE is regarded as divided into two subfamilies, viz. CYCLOPTERINAE and LIPAROPSINAE. The former has two dorsal fins, the first being

spinous while the second is rayed. That subfamily comprises the following eight genera:

Genus *Cyclopterus* LINNAEUS 1788
〃 *Eumicrotremus* GILL 1864
〃 *Cyclopteroides* GARMAN 1892
〃 *Lethotremus* GILBERT 1893
〃 *Cyclolumpus* TANAKA 1912
〃 *Cyclopteropsis* SOLDATOV & POPOV 1929
〃 *Cyclopsis* POPOV 1929
〃 *Cyclopterocottus* POPOV 1930

On the other hand, the other subfamily, LIPAROPSINAE, is characterized by the possession of only one dorsal fin. It includes the following three genera:

Genus *Aptocyclus* DE LA PYLAIE 1835 (Syn. *Cyclopterichthys* STEINDACHNER)
〃 *Liparops* GARMAN 1892
〃 *Elephantichthys* HUBBS & SCHULTZ 1934

Diagnosis

Their pelvic fins are modified to an abdominal disk and they attach themselves to rock or other objects. The skin usually is furnished with large or small conical tubercles or spiny plates hidden in the body skin. Those tubercles are armed with many minute prickles or radial ribs on their surface, and some species have smooth and naked skin. Suborbital bones are a long, thin and rather broad process extending to the preopercles. Interopercles are more blade-like than those of LIPARIDAE. Each jaw with a narrow band of simple and villi-form teeth, but vomer and palatine are toothless. Gill-opening is very narrow slit, and situated above the pectoral fin. Gill-membrance is broadly joined to the isthmus. Branchiostegals are six, gill arches are three and half in unmber. There is no slit behind the last gill arch. Pseudobranchiae are well developed.

Pharyngeal bones are armed with small teeth. An occasional one has mucous tubes or lateral pores on top of head, chin and side of body. Pyloric caeca are numerous.

Genus *Cyclolumpus* TANAKA

This genus was established by TANAKA in 1912 based on his *Cyclolumpus asperrimus*, taken from the Japan Sea, as a new genus and new species. It has hitherto been represented by only the generic type. TANAKA defined it as follows: "Body somewhat oblong, closely covered with large tubercles all over except fins, narrow posterior part of head, axil of pectoral, etc.; ventral disk smaller than in *Eumicrotremus*, a closely allied genus." However, during the progress of this study the present author newly added some remarkable characters which were overlooked by original author, viz. both pharyngeal bones are armed with well developed sharp teeth; vent is well separated from posterior margin of abdominal disk, the distance between them being about one-half of head length; first dorsal fin is enveloped by thick skin, usually being hidden in the body skin.

Further, the present author is conviced that *Eumicrotremus birulai* POPOV should properly be referred to the genus primarily because of the structure of pharyngeal teeth and the

tuberculation. Also, *Eumicrotremus derjugini* POPOV and *E. terrae-novae* MYERS & BÖHLKE, both species not yet available for examination, may very probably belong to this genus according to their tuberculation.

Cyclolumpus asperrimus TANAKA

Cyclolumpus asperrimus; TANAKA, 1912, p. 86, pl. 21, figs. 80–83, (Niigata, Japan Sea).
Materials examined:

No. 12615……Off Shin-minato, Toyama Pref.; October 13, 1937; 61 mm long.
Nos. 12616–12617……From Toyama Bay; 1938 (date is lacking); 73 and 70 mm long.
No. 12544……Off Sado Is., Japan Sea; 1940 (date is lacking); 95 mm long.
No. 12546……Off Mombetsu, Hokkaido; February 10, 1952; 94 mm long.

Body oblong, slightly elongated, not swollen in posterior part, width of body larger than the depth, caudal part of body very compressed. Head large, broad, and upper profile very steep from nape to upper lip. Eye large, circular. Interorbital space broad, slightly convex. Mouth lateral, moderate in size, posterior end of maxillary scarcely reaches to the front of orbit. Nostrils tubular, short, and the anterior larger than the posterior. A pair of mucous pores opened on the tip of short tube exist immediately before the anterior nostrils; another pair between anterior and posterior nostrils and a single pore at middle of interorbital space.

Teeth on both jaws small, conical, and forming a narrow band. Upper pharyngeal bones armed with sharp, strong and curved teeth; lower bones are spoon-like form, with a thicket of sharp and strong teeth on the anterior part of them, and similar ones arranged in two rows at side. No mucous tubes or barbels on the chin.

Body and head closely covered with conical bony tubercles, all being armed with weak prickles on their surface and a narrow, smooth area existing between them; tubercles on interorbital space smaller than those on body, and compactly disposed without definite rows; chin all over the small tubercles; pectoral axils, a narrow area behind gill-opening and pre-anal regions naked; base of all fins and first dorsal covered with small tubercles. First dorsal fin very low, and enveloped by thick skin, spines scarcely visible; both dorsals well separated, the distance between them larger than base length of first dorsal fin, and 2 tubercles on either side between first and second dorsals. Gill rakers short, conical and their tips pointed and bent, no prickles on their surface.

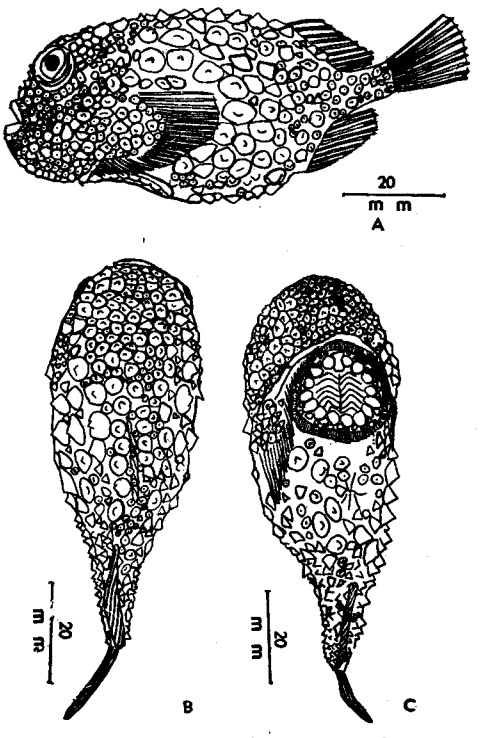

Fig. 1. *Cyclolumpus asperrimus* TANAKA
A··· Lateral view
B··· Dorsal view
C··· Ventral view

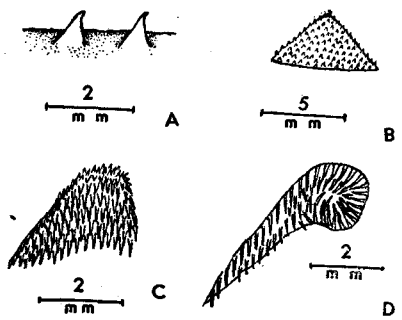

Fig. 2. Gill rakers of outer side of the first gill arch (A), tubercle on body (B), upper-pharyngeal bone of left side (C), and lower-pharyngeal bone of right side (D), of *Cyclolumpus asperrimus*

Abdominal disk is moderate in size; vent well separated from posterior margin of abdominal disk, its distance 1.5 to 2.0 times diameter of orbit.

Color of body in formalin, pale-rose; darker on back and head; abdomen pale.

Table 1. Measurements and counts of bodily parts of *C.asperrimus* used in this study

Localities	Off Shin-minato	Toyama Bay	Off Sado Island	Off Mombetsu
Date	13,X,1937	1938	1940	10,II,1952
No.	12615	12616	12544	12546
Total length (mm)	61	73	95	94
Body length	50	59	78	77
Depth of body	22.5	27	37	36
Width of head	25	25	31	37
Length of head	23	27.5	33	30
〃 snout	6.5	8	10	9.5
〃 maxillary	7	9	11	10
Depth of caudal peduncle	4.5	5	6.5	6
Diameter of orbit	7	8	8.5	8.5
Width of interorbital space	10	12	17	15
Longitudinal diameter of abdominal disk	11	13	17	14
Width of mouth-angles	12	14	19	17.5
Longest dorsal spine	5	6	7	6
〃 dorsal ray	7	8	11	14
〃 anal ray	8	10	15	13
〃 pectoral ray	9	11.5	15	14
〃 caudal ray	11	15	18	18
Distance between abdominal disk and vent	11	13	14	16
〃 between both dorsal fins	9	12	12	16
Length of first dorsal base	8	11	12	11
〃 second dorsal base	10	12	17	16.5
〃 anal base	9	9	16	13
Number of dorsal spine	VI	VI	VI	V
〃 dorsal ray	10	9	10	10
〃 anal ray	10	10	10	10
〃 caudal ray	10	10	10	10
〃 gill rakers on the first arch	9	9	10	10

Cyclolumpus birulai (POPOV)

Eumicrotremus birulai; POPOV, 1928, p. 48, pl. I, figs. 1–2, (Okhotsk Sea).

Materials examined:

No. 12542……Off Otaru, Hokkaido; August 24, 1952; 69 mm long.
No. 12543……From Musashi Bank, Northern Japan Sea; July 29, 1951; 73 mm long.
No. 12551 ……Off Wakkanai, Hokkaido; 1937 (date is lacking); 46 mm long.

Body oval, posterior part of body very swollen, caudal part under the second dorsal fin strongly compressed. Head large, its upper profile sloping from origin of first dorsal to snout, cheek strongly projecting. Eye large, circular, placed in high. Interorbital space broad, its width equal to double diameter of orbit. Nostrils tubular, the anterior ones thick and short, the posterior ones smaller. Mouth width equal to interorbital space; posterior end of maxillary does not reach to the front of eye.

Both jaws with narrow villi-form teeth bands, those of lower jaw arranged in regular 2 rows at side; there are 3 or 4 irregular rows at anterior part; in upper jaw, teeth arranged in 2 rows irregularly at posterior part, and a single row at side. Pharyngeal teeth on upper and lower bones similar to those of *C. asperrimus*, but smaller and fewer; those on lower arranged in double rows at side, a thicket of teeth on the anterior part narrower than that of *C. asperrimus*. Gill rakers very short, tubercular process, and 6 or 7 in number on the first arch.

Body and head closely covered with rough, conical tubercles; prickles on each tubercle very sharp, and so, surface of them very rough; many ones of tubercles on body subequal in size, with narrow but smooth areas between them; those on interorbital space smaller than those of body, but cover entire surface without smooth areas; chin also cloely covered with small tubercles; those on caudal region smallest.

Distinct mucous tubes on top of head and chin, those tubes very short; a pair of them immediately before and behind each anterior nostril respectively; another pair at inside of posterior nostrils; a single tube at middle of interorbital space; 5 or 6 pairs of those tubes on chin.

First dorsal fin very low, enveloped by the thick skin, but spines scarcely visible; the distance between the first and the second dorsals equal to, or slightly shorter than, the base of first dorsal fin, and only one tubercle

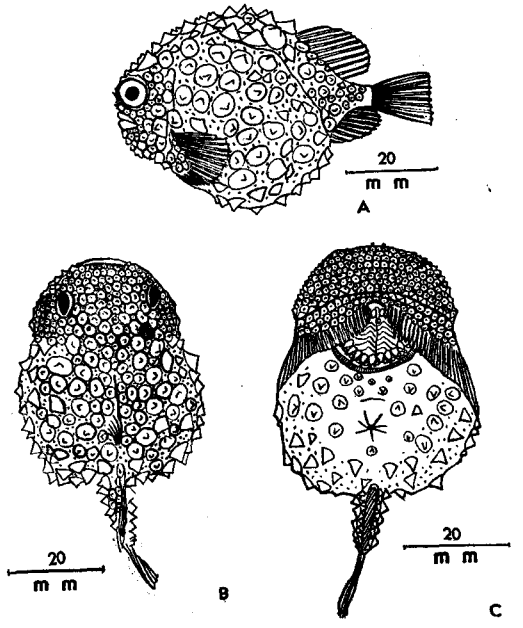

Fig. 3. *Cyclolumpus birulai* (POPOV)
A··· Lateral view
B··· Dorsal view
C··· Ventral view

Table 2. Measurements and counts of bodily parts of *C.birulai* used in this study

Localities	Off Otaru	Musashi Bank	Off Wakkanai
Date	24, VII, 1952	29, VII, 1951	1937
No.	12542	12543	12551
Total length (mm)	69	73	46
Body length	56	61	37
Depth of body	29	33	19
Length of head	24	25.5	16.5
Width of head	29.0	31.5	20.0
Length of snout	9	9	5
// maxillary	6	7	5
Depth of caudal peduncle	5	5	3.5
Diameter of orbit	8	7.5	5
Width of interorbital space	12	14	8
Longitudinal diamter of abdominal disk	12	12	9
Width of mouth-angles	12	14	11
Longest dorsal spine	6.5	6	4
// dorsal ray	8	9	5
// anal ray	10	9	5.5
// pectoral ray	11	11	6
// caudal ray	14	13	10.5
Distance between abdominal disk to vent	12	12	6.5
Width of abdominal disk	14	14	10
Number of dorsal spine	VI	VI	VI
// dorsal ray	10	10	10
// anal ray	11	10	10
// pectoral ray	26	26	25
// caudal ray	9	10	10
// gill rakers on the first arch	7	6	6

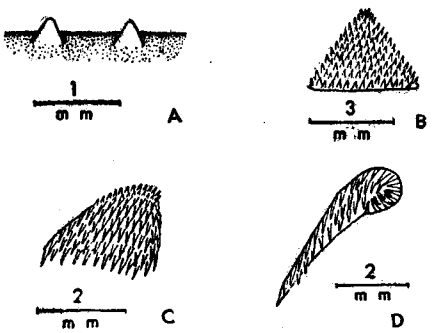

Fig. 4. Gill rakers of outer side of the first gill arch (A), tubercle on body (B), upper-pharyngeal bone of left side (C), and lower-pharyngeal bone of right side (D), of *Cyclolumpus birulai*

stands on each side between them. Abdominal disk elliptical, vent well separated from the posterior margin of disk, its distance subequal or somewhat less than double the diameter of orbit.

Color of body in formalin, dark grey in back and side, pale in belly; small black spots scattered on body.

Remarks

The present species resembles *C. asperrimus* as above mentioned, but it may be distinguished by general form, being much swollen in posterior part of trunk, by presence of distinct mucous tubes on chin, by very short, tubercular gill rakers, by dentition of lower pharyngeal teeth, by narrower distance between the first and the second dorsals, and by possession of a pair of tubercles between two dorsals, etc. Furthermore, it is easily distinguishable from another allied species, *C. derjugini*, by more numerous tubercles, by chin and pectoral base closely covered with small tubercles, by the first dorsal fin very low and hidden in the thick body skin, by smaller number of fin rays. Further, this species closely

Table 3. Comparison of four species of *Cyclolumpus* based on the presently examined specimens and original descriptions of each species

Species	*asperrimus*		*birulai*		*derjugini*	*terrae-novae*
Materials	Present specimens	Tanaka's holotype specimen	Present specimens	Popov's holo-and pala-type specimens	Popov's holo-and para-type specimens	Myers & Böhlke's holotype specimen
Number of specimen	4	1	3	5	5	1
Localities	Northern Japan	Japan Sea	Hokkaido	Okhotsk Sea	Kara and Barent Sea	North Atlantic
Standard length (mm) (body length)	50-78	92	46-73			41
First dorsal spines	V-VI	VII	VI	VI-VII	VI-VII	VII
Second dorsal rays	9-10	10	10	10-13	12	12
Anal rays	10	9	9-10	11	11-13	11
Pectoral rays	26-27	21	25-26	26	25-27	25
Caudal rays	10	10	10-11	10	10	11
Head in body length	2.14-2.57	2.50	2.24-2.39	2.03-2.20	2.36-2.74	2.81
Depth of body in body length	2.10-2.22	1.83	1.85-1.94	2.37-2.76	1.69-2.28	1.98
Width of head in body length	2.00-2.52	.....	1.85-1.94	1.86-2.22	1.96-2.85	2.14
Diameter of orbit in head length	3.29-3.88	3.00	3.00-3.40	2.47-3.38	3.31-4.00	2.47
Width of interorbital space in head length	1.94-2.30	1.75	1.82-2.06	1.90-2.32	2.00-2.36	1.74
〃 mouth in head length	1.72	.....	1.50-2.00	1.46-1.73	1.51-1.81	1.54
Depth of caudal peduncle in head length	5.00-5.50	.....	4.72-5.10	3.31-3.77	4.68-5.66	3.75
Longest dorsal spine in head length	4.58-5.00	.....	3.69-4.25	2.65-3.76	3.27-3.75	.....
〃 dorsal ray in head length	2.73-3.44	.....	2.83-3.30	.....	2.46-4.28	.....
〃 anal ray in head length	2.20-2.87	.....	2.40-3.00	.....	2.07-4.77	.....
〃 pectoral ray in head length	2.14-2.56	.....	2.18-2.75	1.51-1.78	1.41-1.95	.....
Length of first dorsal fin base in head length	2.50-2.85	.....	2.18-2.75	1.93-2.34	1.72-2.61	1.62
〃 second dorsal fin base in head length	1.82-2.20	.....	2.00-2.12	1.54-1.90	1.46-1.74	1.33
〃 anal fin base in head length	2.06-3.05	.....	2.18-2.36	1.72-2.00	1.56-1.87	1.76
Longitudinal diameter of abdominal disk in head length	1.94-2.14	1.67	1.83-2.12	1.36-1.69	1.44-1.83	1.24
Distance from abdominal disk to vent in head length	1.88-2.35	.....	2.00-2.54	3.56-4.48	2.88-3.66	.....
〃 between first and second dorsals in head length	1.87-2.75	.....	2.83-4.00	2.70-3.33	.....	.....

resembles the Atlantic species, *C. terrae-novae*, (it probably belong to this genus), but differs from it in following points. 1). First dorsal fin (according to the original figure of *terrae-novae*, the first dorsal very high and not enveloped by skin, and spines well visible). 2). Tubercles on body are subequal in size in this species, whereas, they are unequal in *terrae-novae*.

3). Only a single tubercle on each side between the first and the second dorsals in this species, but 2 on each side between them in the latter.

The lump-sucker described and figured by HIKITA and MISU (1952) as *Cyclolumpus asperrimus* is clearly equivalent to this species.

According to ANDRIASHEV (1937), *Eumicrotremus orbis* of SCHMIDT (1904, p. 151) is a synonym of the species. Further he stated as to young specimens of the species (30–40 mm) that tubercles on body are very rough, and are armed with more numerous prickles on their surface and that the eye is larger than those of adult. The smallest specimens amongst those at hand (46 mm long, taken from off Wakkanai, Hokkaido) agrees with the above description.

Genus *Eumicrotremus* GILL

This genus was founded by GILL in 1864 based on the Atlantic species, *Cyclopterus spinosus* of MÜLLER and it was separated from the genus *Cyclopteus* on account of striking difference of their tuberculation. There-after, many species have been added to this genus by many authors. However, *E. brashinikowi* of SCHMIDT and *E. phrynoides* of GILBERT and BURKE were transferred to the new genus *Cyclopterocottus* by POPOV in 1930 because having the spiny plates hidden in the body skin and no conical tubercles on the body.

Diagnosis

Body and head covered with large and small conical tubercles closely, each armed with minute prickles or radial ribs on its surface. Large tubercles of body and head are arranged in definite order as shown in the following figures.

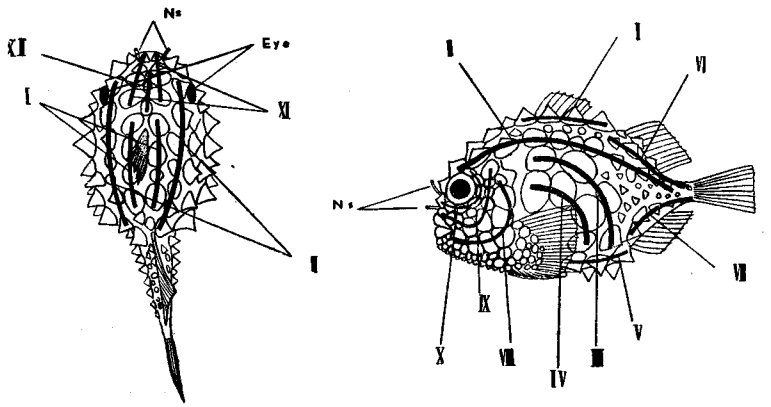

Fig. 5. Illuminative figures of typical fish of *Eumicrotremus*, showing the general series of bony tubercles: I…Dorsal series; II…Upper-lateral series; III…Mid-lateral series; IV…Lower-lateral series; V…Abdominal series; VI…Upper-caudal series; VII…Lower-caudal series; VIII…Operculo-mandible series; IX…Cheek series; X…Suborbital series; XI…Inner-interorbital series; XII…Mid-nape series.

There are usually regular four rows of small tubercles on the interorbital space. First dorsal fin free, at times, it enveloped by the skin, but if enveloped, the fin always raises up the back. Both pharyngeal bones furnished with short and blunt teeth, those on lower bone arranged in several rows at side. Chin covered with small tubercles or naked. Distinct mucous tubes on top of head and chin.

Lateral pores present. Abdominal disk large. Vent closer to the posterior margin of abdominal disk than to insertion of anal fin, the distance between abdominal disk and vent less than twice diameter of orbit or less than 20% of body length.

In this paper, three species of this genus, *E. birulai*, *E. derjugini* and *E. terrae-novae* are removed to *Cyclolumpus*, and a subspecies, *E. orbis taranetzi* PERMINOV, is regarded as an independent species by reason of the presence of remarkable characters in comparison with fhe specimens of typical *E. orbis* (GÜNTHER).

Eumicrotremus togedango KURONUMA

Eumicrotremus togedango; KURONUMA, 1943, p. 91, (Paramushir Is., Kurile's).

Materials examined:

Nos. 12535–12536……Off Shumushu Is., Kurile's; July 5, 1941; 99 and 101 mm long.

This species reaches to the largest size among all species of the genus. Body very massive, anterior part of body swollen, but the posterior part very compressed. Head large, nearly a trapezoid-shape in cross-section through the posterior part of orbit. The upper profile of head abruptly declivous from interorbital region to snout. Chin slightly projecting beyond the mouth. Eye large, its diameter equal to the length of snout. Interorbital space wide, flat, and covered with four regular rows of tubercles. Nostrils tubular, the anterior ones shorter and wider than the posterior, the former being colorless, whereas the latter are black. Mouth large, width of mouth-angles larger than that of interorbital.

Teeth on both jaws small and conical shape, arranged in 2 or 3 irregular rows at the anterior part, but becoming a single row at the posterior part on each jaw respectively. Pharyngeal teeth short and blunt, those on both pharyngeal bones arranged as shown in the figres. Gill rakers very short, tubercular, and armed with minute prickles on top.

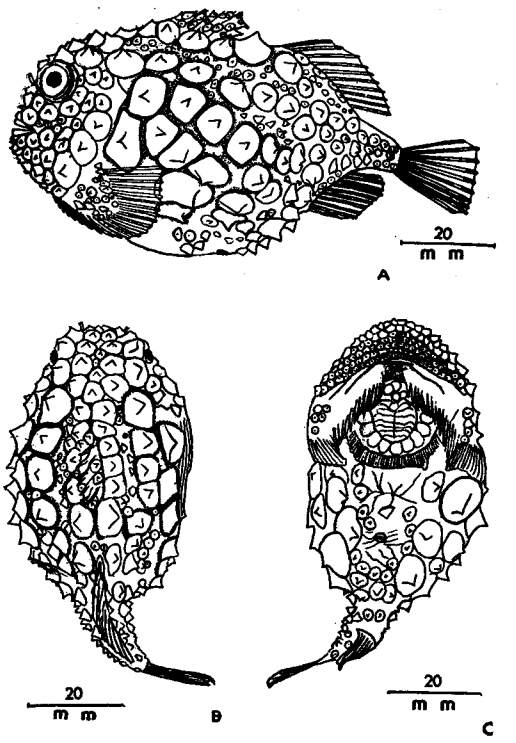

Fig. 6. *Eumicrotremus togedango* KURONUMA
A··· Lateral view
B··· Dorsal view
C··· Ventral view

Body and head entirely covered with large and small tubercles, being armed with feeble prickles; spinous dorsal, chin, pectoral base, and caudal part covered with smaller tubercles; pre-anal region and axils of pectoral fin smooth; dorsal series running along the base of the first dorsal, it ending a largest tubercle between the two dorsals, 5 to 6 in number; (upper-lateral series continued with the outer-interorbital series with a large one above the gill-opening), and running from it to the caudal fin base; inner series of interorbital tubercles not quite continuous with the dorsal series, and a short median series consists of 2 or 3 tubercles situated between the two inner series; mid-lateral series consists of 5 or 6 large tubercles, the last one keeping touch with the abdominal ones; lower-lateral ones composed of 4 or 5 large tubercles, the last one the largest among all tubercles on body; abdominal series placed immediately below the lower-lateral ones, and the last one touches its fellow of opposite side in front of anal fin; upper-caudal series continuing to the upper part of caudal base along the base of second dorsal fin, those tubercles smaller than those along the first dorsal base; lower-caudal series similar to the upper ones; there is a series of 3 to 5 small tubercles above the soft dorsal, and anal fin base; operculo-mandible series consists of 6 or 7 small tubercles; suborbital ones 6 or 7 in number; tubercles of circum-anal region smaller than those of suborbital ones, and 8 in number.

Distinct mucous tubes exist on snout, interorbital space, nape and chin; a single

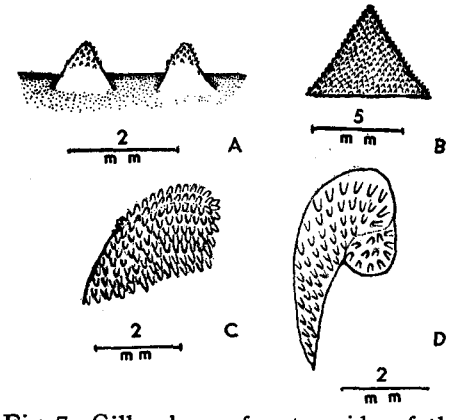

Fig. 7. Gill rakers of outer side of the first gill arch (A), tubercle on body (B), upper-pharyngeal bone of left side (C), and lower-pharyngeal bone of right side (D), of *Eumicrotremus togedango*

Table 4. Measurements and counts of bodily parts of present specimens of *E. togedango*

Locality	Off shumushu Is.	〃
Date	5, Ⅶ, 1941	〃
No.	12535	12536
Tatal length (mm)	99	101
Body length	78	83
Depth of body	40	48
Length of head	32	32.5
Width of head	35	37.5
Length of snout	10	10
〃 maxillary	11	10
Interorbital space	15.5	15
Diameter of orbit	10.5	10
Longitudinal diameter of abdominal disk	19	18
Width of mouth-angles	18	18
Depth of caudal peduncle	6.7	7
Longest dorsal spine	11	10
〃 doral ray	14	13
〃 anal ray	13	15
〃 pectoral ray	15	14.5
〃 caudal ray	20	20
Distance between disk and vent	11.5	13.5
Number of dorsal spine	6	7
〃 dorsal ray	11	11
〃 anal ray	26	26
〃 pectoral ray	10	10
〃 caudal ray	10	10
〃 gill rakers on the first arch	6	6

one at middle of interorbital space, mucous tubes on chin very long; lateral pores present, pores forming a short tube, count 9 or 10 pores along the body side.

Abdominal disk rather large, round, and its longitudinal diameter equal to the width of mouth-angles. Vent well separated from abdominal disk, the distance between them always more than 10% of body length.

First dorsal fin rather high, enveloped by thin skin, tips of spine produced as a long hair, and furnished small tubercles on the fin.

Color in formalin, dark brown on body and head, becoming lighter on the abdominal part; each tubercle surrounded by a black frame.

Eumicrotremus taranetzi PERMINOV

Eumicrotremus orbis taranetzi; PERMINOV, 1936, p. 120, fig. 2, a-b, (Karaginsky Is. & Abatcha Bay, Kamtchatka).

Materials examined:

Nos. 12540-12541……Off Ruizan of Paramushir Is., Kurile; July 4, 1941; 77 and 42 mm long.
No. 12537……Off shumushu Is., Kurile's; July 5, 1941; 71 mm long.
No. 12547……Off Mombetsu, Hokkaido; October 20, 1952; 60 mm long.
No. 12614……Off Araito Is., Kurile; July 8, 1941; 64 mm long.

This species was treated as a subspecies of *Eumicrotremus orbis* (*GÜNTHER*) by PERMINOV in 1936.

Body stout, nearly globular anteriorly, and posterior part very compressed. Head large. Snout very steep. Interorbital space slightly convex, and armed with four regular rows of tubercles. Posterior nostrils longer than the anterior ones. Mouth moderate, width of mouth-angles larger than that of interorbital space, and subequal to the longitudinal diameter of abdominal disk. Teeth on both jaws villi-form, arranged in 3 or 4 irregular rows anteriorly and 2 posteriorly. Teeth on pharyngeal bones very short, but slightly pointed; lower pharyngeal bone with a developed teeth-thicket on its anterior part, and inner ones enlarged. Gill rakers very short, tubercular, but no prickles on their tops.

Body and head closely covered with large and small tubercles, which are nearly smooth or armed with weak and few prickles. Base of large tubercles touch or are very close to each other. Chin and pectoral base covered with small tubercles. Dorsal series 3 or 4, the last one the largest and situated between the first and the second dorsals; a peculial tubercle preceded insertion of the first dorsal fin; the outer-interorbitals

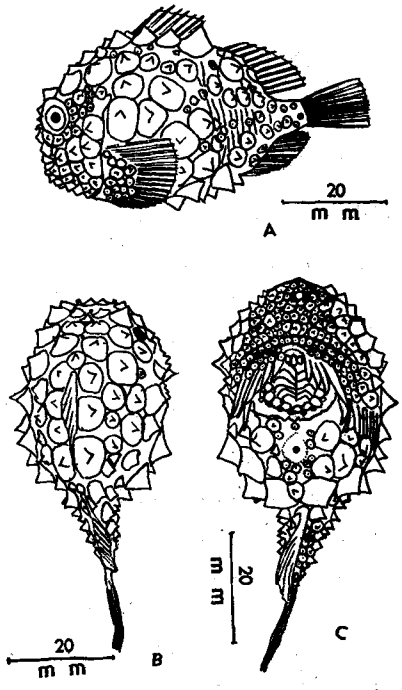

Fig. 8. *Eumicrotremus taranetzi* PERMINOV
A··· Lateral view
B··· Dorsal view
C··· Ventral view

continued with the upper-lateral series; mid-lateral series consists of 4 to 6 tubercles; lower-lateral ones always 4, and the last one the largest among all tubercles on body; the abdominals 3 on each side; inner-interorbital series obstructed by a median tubercle; a large one under the front of second dorsal fin on each side; the upper-caudal ones inconspicuous; the lower-caudals extend to the lower part of caudal fin base; the operculo-mandibles consists of 7 or 8 tubercles.

The first dorsal fin entirely free and high, tip of spines projecting from fin-membranes and with short filament, and minute tubercles scatterd on the fin.

Mucous tubes on top of head and snout very short; a pair of them at the front of snout; two pairs before and behind the nostrils; there is a pair of tubes between anterior and posterior nostrils; a single pore exists at middle of interorbital space; longer tubes on chin, which are arranged in a row on each side of it. Lateral pores present, but not so distinct as those of *E. togedango*.

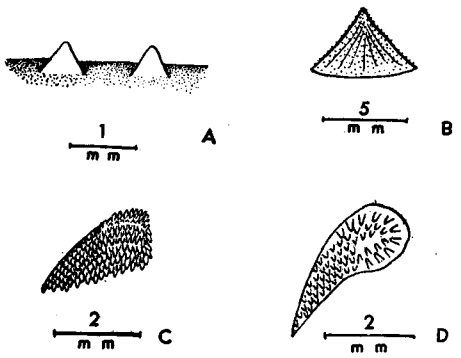

Fig. 9. Gill rakers of outer side of the first gill arch (A), tubercle on body (B), upper-pharyngeal bone of left side (C), and lower-pharyngeal bone of right side (D), of *Eumicrotremns taranetzi*

Abdominal disk moderate, its longitudinal diameter 23.2 to 26.4 % of body length. Vent very close to the abdominal disk, the distance between the posterior margin of abdominal disk to vent 7.4 to 9.5% of body length.

Color in formalin, brown or dark grey on back and side of body and head; abdomen pale; base of tubercles surrounded by a black frame.

Remarks

According to the original description of this species by PERMINOV, "... some leather-like skin folds laid between abdominal disk and vent, but those folds not serrated; no skin folds surrounding area of vent." However, of five specimens at hand only one possesses those folds, the others having none, but several skin folds are distinctly present in writer's *E. orbis*.

This species differs from typical species, *E. orbis* (GÜNTHER) in following points:

1). All tubercles are nearly smooth, having no rough prickles or radial ribs on their surface.
2). Base of large tubercles on body touch or are very close to each other.
3). Chin completely covered with small tubercles.
4). Tubercles on the interorbital spaec are always arranged regular four rows.
5). A pair of large tubercles are situated between the two dorsal fins.
6). Gill rakers are very short, tubercular process, and their tips are not destended.
7). The first dorsal fin is higher than that of *E. orbis*, and tip of spines are armed with a short filament.
8). The distance between the posterior margin of abdominal disk and the vent is somewhat larger than that of *E. orbis*, namely, it is 7.4 to 9.5% of body length in this species

whereas 6.1 to 6.9% in *E. orbis.*

9), Longitudinal diameter of abdominal disk is more than one-half of head length.

Table 5. Measurements and counts of bodily parts of *Eumicrotremus taranetzi* used in this study

Localities	Shumushu Is.	Paramushiru Is.	Paramushiru Is.	Mombetsu	Araito Is.
Date	5, VII, 1941	4, VII, 1941	〃	20, X, 1952	8, VII, 1941
No.	12537	12540	12541	12547	12614
Total length (mm)	71	77	42	60	64
Body length	60	63.5	34	47.5	54
Depth of body	32	36	19	28	26.5
Length of head	24	25	15	20.5	21
Width of head	25	26	16.5	26	24
Length of snout	9.0	10	6.0	7.5	7.5
〃 maxillary	9.0	9.5	5.5	8.0	13
Width of interorbital space	14.5	15	9.0	13	13
Diameter of orbit	8.0	8.0	5.0	6.0	6.5
Depth of caudal peduncle	5.5	6.0	4.0	5.0	5.0
Width of mouth angles	15	16	11	13	13
Longitudinal diameter of abdominal disk	14.5	15.5	9.0	11	13
Distance between posterior margin of abdominal disk to vent	5.0	6.0	3.0	4.0	4.0
Longest dorsal spine	9.0	.....	4.5	6.0	8.0
〃 dorsal ray	11	11	6.0	9.0	9.5
〃 anal ray	10	11	7.0	10	10
〃 pectoral ray	11	11	7.0	11	9.0
〃 caudal ray	12	12	9.0	12.5	12
Number of dorsal spine	VI	.....	V	V	VI
〃 dorsal ray	10	9	9	10	10
〃 anal ray	10	10	9	10	9
〃 pectoral ray	25	25	26	26	25
〃 caudal ray	10	10	10	10	10
〃 gill rakers on the first arch	7	7	6	7	7

Eumicrotremus orbis (GÜNTHER)

Cyclopterus orbis; *GÜNTHER*, 1861, p. 158, (Vancouver Is., North America).

Eumicrotremus orbis; *JORDAN & GILBERT*, 1880, p. 454.

Eumicrotremus orbis orbis, *PERMINOV*, 1936, p. 117.

Materials examined:

No. 12539……Off Ruizan of Paramushir Is., Kurile; July 4, 1941; 81 mm long.
No. 12882……Off Shisuka, Saghalin; August, 1935 (date is lacking); 74 mm long.

Body and head covered with rough conical tubercles, which are armed with weak prickles and radial ribs, and are radiating from top of cone to base, and tip of tubercles appeared as a projecting spine.

In dorsal series 5 tubercles are counted, the last 2 larger than the anterior 3 and situated between the two dorsal fins; interorbital space covered with irregular 5 to 6 rows of small tubercles except both outer-interorbital series, which completely connect with the upper-lateral ones; upper-lateral series ends under the origin of second dorsal fin; tubercles of mid-lateral series very large, and arranged somewhat irregulary, ending immediatly before the anal fin, 6 or 7 in number; lower-lateral series begins from the posterior part of pectoral fin, the first is the largest; in the area between dorsal and upper-lateral series an irregular row of small tubercles is found, and also a similar row between upper-lateral and mid-lateral series; abdominal series obsolete, or represented by only 3 or 4 very small ones; tubercles on upper- and lower-caudal series very small; many small ones scattered on area between those caudal series; operculo-mandible series developed, 7 or 8 tubercles stand in a row along the opercular margins; bases of pectoral, second dorsal, and anal fin covered with minute tubercles, but pre-anal region, axils of pectoral, and chin except margin entirely naked.

Upper and lower jaws with villi-form teeth, arranged in a single row on upper jaw posteriorly, but two on lower jaw. Upper pharyngeal teeth very short and blunt, those on lower bone longer and more sharp, and anterior ones enlarged.

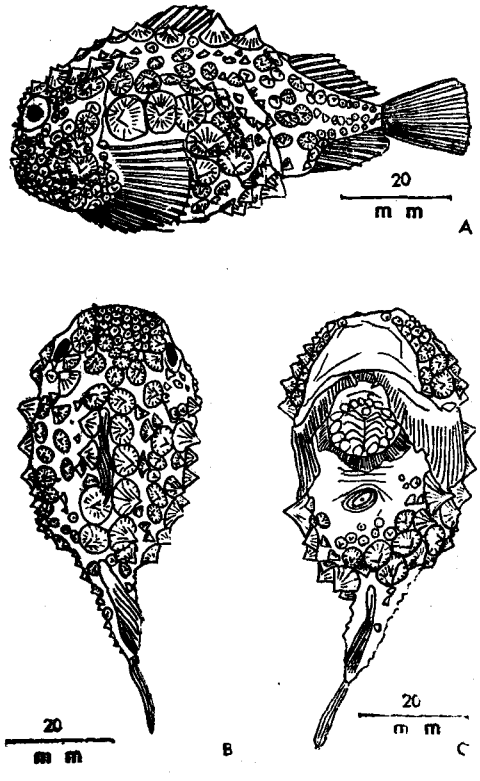

Fig. 10. *Eumicrotremus orbis* (GÜNTHER)
A··· Lateral view
B··· Dorsal view
C··· Ventral view

Gill rakers short club-like form, and their tips distended. First dorsal fin free, not enveloped by thick skin and spines easily visible. Posterior nostrils longer than the anteriors. Two pairs of short mucous tubes exist in front of anterior nostrils; a single one at middle of interorbital space, but no ones between anterior and posterior nostrils, three pairs of long tubes on each side of chin.

Abdominal disk rather small, round, and its longitudinal diameter subequal to the length of postorbital part of head. Vent closer to the posterior margin of abdominal disk than to the front of anal fin. There are five skin folds between abdominal disk and vent, but those not serrated. The distance from abdominal disk to vent only 6.1 to 6.9 % of body length. Lateral pores present, but not distinct.

Color in formalin, light brown uniformly; head darker than body and abdomen lighter; all fins uncolored.

Table 6. The following measuremnts and counts of bodily parts of *E. orbis* are based on a single specimen taken from Paramushir Island on July 4, 1941; the values are expressed in both ratio and percentage to body length (B.L) or head length (H.L)

		Ratio to B.L	*% to B.L*
Body length (mm)	65		
Depth of body	35	1.85	53.8
Length of head	25	2.31	38.5
Width of head	30	1.92	46.2
		Ratio to H.L	*% to H.L*
Length of snout	7.5	3.33	30.0
〃 maxillary	8.5	2.94	34.0
Width of interorbital space	13.0	2.11	52.0
Diameter of orbit	8.0	3.13	32.0
Depth of caudal peduncle	6.0	4.17	24.0
Longitudinal diameter of abdominal disk	12.0	2.08	48.0
Width of mouth-angles	15.0	1.61	60.0
Distance between posterior margin of disk and vent	4.5	5.56	18.0
Longest dorsal spine	6.0	4.17	24.0
〃 dorsal ray	11.0	2.27	44.0
〃 anal ray	11.5	2.17	46.0
〃 pectoral ray	12.0	2.08	48.0
〃 caudal ray	16.0	1.56	64.0
Number of first dorsal spine	V		
〃 second dorsal ray	9		
〃 anal ray	10		
〃 pectoral ray	24		
〃 gill rakers on the first arch	7		

large tubercles exist between two dorsal fins. However, the present author considers that the specimens treated here are corresponding to typical species, *E. orbis* (*GÜNTHER*), rather than to the above mentioned subspecies, *E. orbis andriashevi* in having naked chin and other features. And such differences between the two may be a local variation within one species.

Remarks

A subspecies, *E. orbis andriashevi* was characterized from typical form as *E. orbis* (*GÜNTHER*), by interorbital space being covered with four to seven irregular rows of small tubercles varying in number, by variability of the number of tubercles between the two dorsals (2 to 4 pairs), by longer distance between abdominal disk and vent (7.1 to 11.4% of body length). The writer's specimens just above described resembles this subspecies in having irregular 5 to 6 rows of small tubercles except both outer-interorbital series, and the distance between abdominal disk and vent is near that in above subspecies, but chin is entirely naked excepting the marginal part; two pairs of

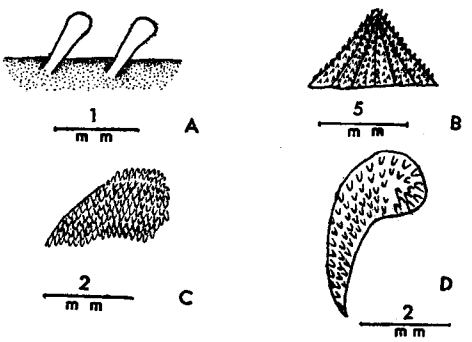

Fig. 11. Gill rakers of outer side of the first gill arch (A), tubercle on body (B), upper-pharyngeal bone of left side (C), and lower-pharyngeal bone of right side (D), of *Eumicrotremus orbis*

Eumicrotremus pacificus SCHMIDT

Eumicrotremus pacificus; SCHMIDT, 1904, p. 154, pl. 5, fig. 2, a-c, textfig. 9, (Peter the Great Bay).

Materials examined:

No. 12538……Off Ruizan of Paramushir Is., Kurile; July 4, 1941; 74 mm long.
No. 12552……Off Nemuro, Hokkaido; 1943 (date is lacking); 48 mm long.
No. 12618……Off Maoka, Saghalin; May 22, 1943; 36 mm long.
No. 12620……Off Abashiri, Hokkaido; June 25, 1934; 39 mm long.
No. 12883……Off Mombetsu, Hokkaido; February 10, 1951; 30 mm long.

Body spherical, anterior part of body strongly swollen, caudal part under the second dorsal fin rapidly compressed. Head large, broad, and round at side, nearly a quadrilateral form in cross-section through the postorbital region, upper profile of head abruptly steep from interorbital space to upper lip.

Table 7. Comparison of three species of *Eumicrotremus* based on the present specimens and Kuronuma's and Perminov's data

Species	*E. togedango*		*E. taranetzi*		*E. orbis*	
Materials	Present specimens	Kuronuma's specimens	Present specimens	Perminov's specimen	Present specimen	Perminov's specimens
Number of specimen	2	2	5	1	1	3
Standard length (mm)	78-83	74-76	42-77	72	65	
First dorsal spines	VI-VII	VII	V-VI	VII	V	VI
Second dorsal rays	11	10	9-10	10	9	11-12
Anal rays	10	9	9-10	10	10	12
Pectoral rays	26	25	25-26	25	24	24-26
Caudal rays	10	……	10	……	10	……
Number of lateral pores	9-10	9-10	……	……	……	……
Head length of body length (%)	39.2-41.0	35.1-38.2	38.8-44.1	30	38.5	27.0-28.0
Longitudinal diameter of abdominal disk of body length (%)	21.7-24.4	23.4-24.4	23.2-26.4	20	18.5	……
Distance from abdominal disk to vent of body length (%)	14.3-16.3	17.1-18.2	7.40-9.45	4.8	6.9	3.0-4.0
Longest dorsal spine of body length (%)	12.1-14.1	19.3-20.4	12.5-15.0	……	9.3	……
〃 dorsal ray of body length (%)	15.2-17.9	19.2-20.0	18.3-21.1	……	16.9	……
〃 anal ray of body length (%)	16.6-18.1	18.9-19.7	16.7-21.1	……	17.6	……
〃 pectoral ray of body length (%)	17.5-19.2	17.6-19.1	16.7-23.1	……	17.7	……
Interorbital space of body length (%)	18.1-19.8	18.2-19.7	23.8-27.3	……	20.0	……
Diameter of eye of head length (%)	27.1-30.8	……	29.2-33.4	33.5	32.0	26.6-27.0
Interorbital space of head length (%)	40.0-44.2	……	60.0-63.4	66.5	52.0	66.6-67.0
Snout of head length (%)	30.8-31.3	……	31.6-40.0	38.0	30.0	48.0-49.0

Snout broad and bluntly rounded. Eye rather small, its diameter far less than half of interorbital space, which is broad and slightly convex. Mouth large, holizontal, the width of mouth-angles greater than that of interorbital space. The pair of anterior nostrils larger than those of the posteriors. Both jaws armed with a narrow band of villi-form

teeth. Both pharyngeal bones with short and blunt teeth, lower bone comma-shaped; there are 4 or 5 irregular rows of teeth on the outer side and 2 or 3 rows on the inner side of it anteriorly, but in posterior part, teeth arranged in 3 irregular rows. Gill rakers forming blunt-tipped short process, no prickles in their surface.

Body and head covered with large and small tubercles, which are armed with weak prickles; dorsal series undeveloped, represented by only 1 or 2 small tubercles; 2 or 3 tubercles preceding the front of spinous dorsal fin along the median line of nape; interorbital space has 4 irregular rows of small tubercles, but in some individuals those rows indistinct; those of inner rows much smaller than the outer, which number 4 and are continued with the upper-lateral series; inner-interorbital ones interrupted behind the eye; the upper-laterals interrupted under the interspace of both dorsals; mid-lateral series consists of 4 large tubercles, posterior two somewhat smaller than the anterior 2; the lower-lateral ones represented by only a single large one, which stands at back the pectoral fin; abdominal series 3 in number on each side; the upper- and lower-caudals present, but very small and indistinct; area between the two caudal series smooth, or with a few minute scattered tubercles; a pair of rather large ones set on the front of second dorsal fin; the operculo-mandibles 9 or 10 in number, tubercles becoming smaller underward gradually; tubercles of suborbital ones very small, and surrounding the lower margin of orbit.

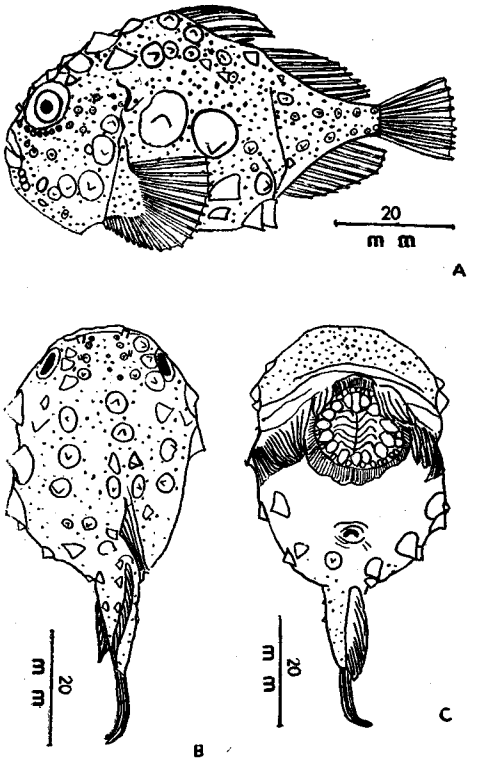

Fig. 12. *Eumicrotremus pacificus* SCHMIDT
A··· Lateral view
B··· Dorsal view
C··· Ventral view

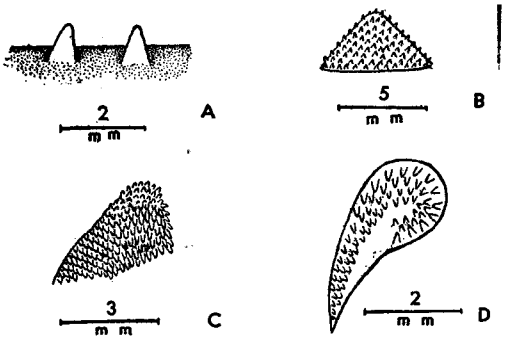

Fig. 13. Gill rakers of outer side of the first gill arch (A), tubercle on body (B), upper-pharyngeal bone of left side (C), and lower-pharyngeal bone of right side (D), of *Eumicrotremus pacificus*

First dorsal fin very long, and strongly curved backward to be sickle-shaped, its tip over the origin of second dorsal fin, the fin slightly enveloped by thin skin at base, but tip free from the skin in adult specimens; whereas in young specimens (24 to 30mm in standard length) of the writer's collection, the first dorsal fin

Table 8. Measurements and counts of bodily parts of *Eumicrotremus pacificus* used in this study

Localities	Paramushiru Is.	Off Nemuro	Off Maoka	Off Abashiri
Date	4, VII, 1941	1943	22, V, 1943	26, VI, 1934
No.	12538	12552	12618	12620
Total length (mm)	74	48	36	39
Body length	62	40	30	31
Depth of body	36	22	15	16
Length of head	24	20	13	15
Width of head	34	23	15	15
Length of snout	8	5	4.5	4
〃 maxillary	9	7	4.5	5
Width of interorbital space	15	9.5	7	7
Diameter of orbit	6.5	5.5	4.5	5
Depth of caudal peduncle	5.5	4.5	3.5	4
Width of mouth-angles	16	13	8	9
Longitudinal diameter of abdominal disk	16	12.5	9	11
Distance between abdominal disk and vent	8	7	4	4.5
Longest dorsal spine	11	8	6	7
〃 dorsal ray	11	7.5	5	6.5
〃 anal ray	11	7.5	4.5	6.2
〃 pectoral ray	12	8	5	6
〃 caudal ray	13	11	7	8
Number of dorsal spine	VI	V	V	VI
〃 dorsal ray	11	10	10	11
〃 anal ray	10	10	10	10
〃 pectoral ray	23	25	26	25
〃 caudal ray	10	10	11	10
〃 gill rakers on the first arch	7	7	6	7

entirely enveloped by thin skin. Pectoral fin shorter than one-half of head length.

Abdominal disk round, its width slightly larger than the length. Vent separated from the posterior margin of abdominal disk by distance of diameter of orbit.

Color in formalin, dark grey or greyish brown on back and side; abdomen pale; many black spots scattered on body and head, particularly side of head and chin closely scattered.

Remarks

Above description was chiefly based on the writer's larger two specimens (60 and 40mm in standard length). In young specimens as above mentioned, tubercles are very rough, and are armed with several long sharp spines on its surface. Moreover, the first dorsal fin is very long, and is enveloped by thick skin; body except abdomen uniformly colored by dark brown, and has no black spots on body and head.

Table 9. Comparison of four species of *Eumicrotremus* as discussed in this study

	E. togedango	*E. taranetzi*	*E. orbis*	*E. pacificus*
Body length (mm)	78-83	42-77	65	30-62
Depth of body in body length	1.73-1.95	1.69-2.03	1.85	1.72-2.00
Length of head in body length	2.44-2.55	2.27-2.57	2.31	2.00-2.58
Width of head in body length	2.21-2.23	1.82-2.40	1.92	1.74-2.06
Length of snout in head length	3.20-3.25	2.50-2.80	3.33	2.89-4.00
〃 maxillary in head length	2.90-3.25	2.63-3.00	2.94	2.67-3.00
Width of interorbital space in head length	2.06-2.17	1.58-1.67	2.11	1.60-2.14
Diameter of orbit in head length	3.05-3.25	3.00-3.42	3.13	2.89-3.69
Depth of caudal peduncle in head length	4.65-4.92	3.75-4.37	4.16	3.71-4.45
Length of abdomianl disk in head length	1.68-1.80	1.61-1.81	2.08	1.37-1.60
Width of mouth-angles in head length	1.77-1.80	1.36-1.61	1.61	1.50-1.65
Longest dorsal spine in head length	2.91-3.25	2.62-3.42	4.17	1.85-2.50
〃 dorsal ray in head length	2.28-2.50	2.18-2.50	2.27	2.18-2.67
〃 anal ray in head length	2.17-2.46	2.05-2.40	2.08	2.18-2.89
〃 pectoral ray in head length	2.13-2.24	1.81-2.33	2.27	2.00-2.60
〃 caudal ray in head length	1.60-1.62	1.64-2.08	1.56	1.82-1.89
Distance between abdominal disk and vent in head length	2.43-2.76	4.16-5.12	5.53	2.86-3.34
Number of dorsal spine	VI-VII	IV-VI	V	V-VI
〃 dorsal ray	11	9-10	9	10-11
〃 anal ray	10	9-10	10	10
〃 pectoral ray	26	25-26	24	23-26
〃 caudal ray	10	10	10	10-11
〃 gill rakers on the first arch	6	6-7	7	6-7
〃 specimen	2	5	1	4

KEY TO THE SPECIES OF TWO GENERA, *Cyclolumpus* AND *Eumicrotremus*. Body and head covered with large and small conical tubercles.

I.— Tubercles on body and head closely scattered without distinct patterns, and also, interorbital space covered with small tubercles having no regular rows; teeth on both pharyngeal bones well developed, long and sharp.

..... *CYCLOLUMPUS*

A.— Chin and pectoral base entirely smooth and free from tubercles.

..... (*C. derjugini*)

A′.— Chin and pectoral base covered with small tubercles.

B.— First dorsal fin very low, hidden in the body skin.

C.— Posterior part of trunk very swollen; distinct mucous tubes on chin; the two dorsals close to each other, and a large tubercle situated between them on either side; gill rakers very short, tubercular process, and 6 or 7 in number.

..... *C.birulai*

C′.— Body never swollen at posterior part of trunk; no mucous tubes on chin; the

two dorsals well separated, and 2 tubercles situated on each side between them; gill rakers conical, tips pointed, and 9 or 10 in number.

..... *C. asperrimus*

B′.— First dorsal fin free, high, and spines easily visible.

..... (*C. terrae-novae*)

II.— Tubercles on body and head arranged in definite patterns, and interorbital space usually covered with regular rows of tubercles; teeth on both pharyngeal bones short and blunt.

..... *EUMICROTREMUS*

D.— First dorsal fin very long, falci-form, when fin is depressed, its tip over the second dorsal origin; dorsal series of tubercles undeveloped, and represented by only 1 or 2 small ones; many black spots scattered on the body and head.

..... *E. pacificus*

D′.— First dorsal fin not reaching to the origin of second dorsal fin when it is depressed; dorsal series of tubercles well developed; no distinct black spots on body and head.

E.— Interorbital space except edges entirely naked; the two dorsal fins well separated, the distance between them equal to the length of first dorsal fin base; there are 3 large tubercles located between the two dorsal fins; the first dorsal fin very small, triangular; tubercles on body without prickles but armed with radiating ribs.

..... (*E. soldatovi*)

E′.— Interorbital space covered with regular rows of tubercles; distance between the two dorsal fins always less than the length of first dorsal fin base; tubercles on body more or less armed with minute prickles.

F.— Distance between posterior margin of abdominal disk and vent always more than 13% of body length; gill rakers tubercular, and with minute prickles on tops; lateral pores distinct; chin projecting beyond the mouth.

..... *E. togedango*

F′.— Distance between abdominal disk and vent always less than 13% of body length; gill rakers not armed with minute prickles.

G.— There are several stiff, distinct skin folds between abdominal disk and vent; chin usually except margin naked or having several rows of skin folds.

H.— Skin folds between abdominal disk and vent not serrated; usually two pairs of large tubercles situated on each side between the two dorsal fins; distance from posterior margin of abdominal disk to vent less than the diameter of eye; gill rakers club-like, tips distended.

..... *E. orbis*

H′.— Skin folds between abdominal disk and vent distinctly serrated; usually a single large tubercle located on each side between the two dorsals; distance from abdominal disk to vent subequal or more than the diameter of eye.

..... (*E. spinosus*)

G′.— No stiff skin folds between abdominal disk and vent; chin entirely covered with small tubercles.

I.— Tubercles nearly smooth or armed with weak prickles; each base of large tubercles on body touching or very close to other; interorbital spece covered with 4 regular rows of tubercles; first dorsal fin high, and tip of spines with a short filament; there is a large tubercle between the two dorsal fins constantly.

..... *E. taranetzi*

I′.— Tubercles armed with many strong, rough prickles; interorbital space covered with irregular 4 to 7 rows of tubercles; first dorsal fin low; there are 2 to 4 pairs of tubercles between the two dorsal fins.

..... (*E. orbis andriashevi*)

SUMMARY

In this paper, the present author deals with available species of cyclopterid fishes belonging to the two genera, *Cyclolumpus* and *Eumicrotremus*, chiefly taken from Northern Japan and adjacent regions. The following facts have newly been made clear.

(1). The genus *Cyclolumpus* is relates to *Eumicrotremus*, but is characterized and distinguishable from the latter not only by tuberculation but also by the structure of pharyngeal teeth.

(2). *Eumicrotremus birulai* POPOV should be considered to belong to the *Cyclolumpus*, and also, *E. derjugini* POPOV and *E. terrae-novae* MYERS & BÖHLKE seem probably to be included in *Cyclolumpus*.

(3). Structure of gill rakers of each species is more or less differens in every case, and so, this character can be an important mark for identification of each species.

(4). Subspecies, *Eumicrotremus orbis taranetzi* PERMINOV had better be regarded as an independent species depending upon the presence of very different characteristics between typical species, *E. orbis* (GÜNTHER).

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