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LARVAE OF THE SMOOTH LUMPSUCKER, *APTOCYCLUS VENTRICOSUS* (PALLAS), WITH DISCUSSION ON REVISION OF THE TAXONOMY OF THE SPECIES

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So far as the present author knows, there is no published information concerning the larvae and young of smooth lumpsuckers except only one reference by Scheffer ('59) who reported a young of *Elephantichthys copeianus*? measuring 25 mm in total length from the Aleutian waters. Though Popov ('33) reported a larvae of 9.2 mm from Avatcha Bay on the southern coast of the Kamchatka peninsula as *Cyclopterichthys ventricosus* (PALLAS), it seems to be sure that the specimen may not belong to the species from the statement that the specimen had a projecting first dorsal fin. In this paper, the present author intends to describe three larvae of *Aptocyclus ventricosus* (PALLAS), one obtained by incubation in the laboratory and two collected from the surface layer in Aleutian waters (Fig. 1).*

While studying the young of the species, the author noticed that some of taxonomically important external characters change with growth and differ by

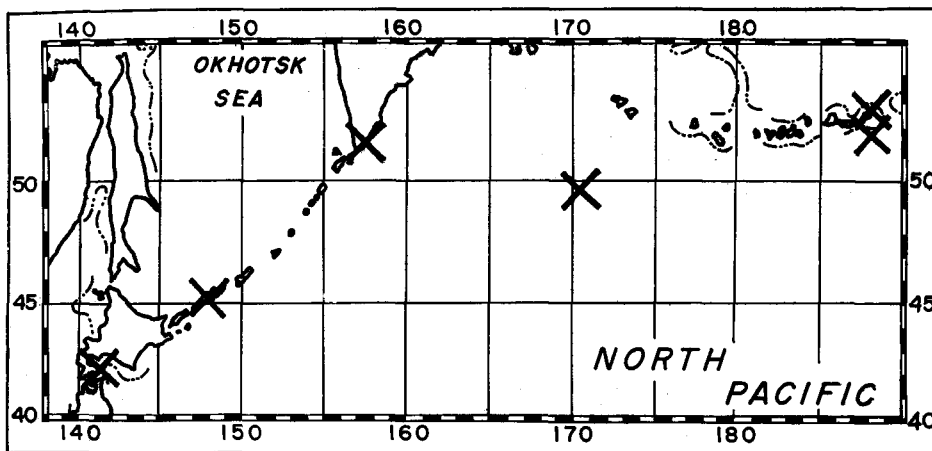


Fig. 1. Collection localities of larvae, young and adults of the smooth lumpsucker, *Aptocyclus ventricosus* (PALLAS)

* See Data Record of Oceanographic Observations and Exploratory Fishing, Hokkaido Univ. No. 1, 4.

sex. Therefore, the taxonomy of the present and the allied species will be reviewed in this paper after the descriptions of the larvae.

Before going further, the author wishes to express cordial thanks to Prof. Shun Okada of the Faculty of Fisheries, Hokkaido University, under whose guidance and criticism this work was done. Sincere thanks are also offered to Mr. Tatsuji Ueno who is now studying at British Columbia University for his various sorts of advice and to Capt. Takeji Fujii, officers, crew and research members of the training ship "Oshoro Maru" of the Hokkaido University, to Prof. Ikuzo Hamai, Dr. Ken-ichiro Kyushin and members of the Laboratory of Science of Fish Stock, Faculty of Fisheries, Hokkaido University, and to Mr. Nakamichi of the Hakodate Branch, Hokkaido Fisheries Scientific Institution for their valuable help in the collection and offer of the specimens.

External observations of the larvae

Three specimens were subjected to external observations.

"A" Total length 6.0 mm

One specimen among about 10 days larvae after hatching in a glass butt of water temperature 6.0°C on 4th to 6th May in the Laboratory of Science of Fish

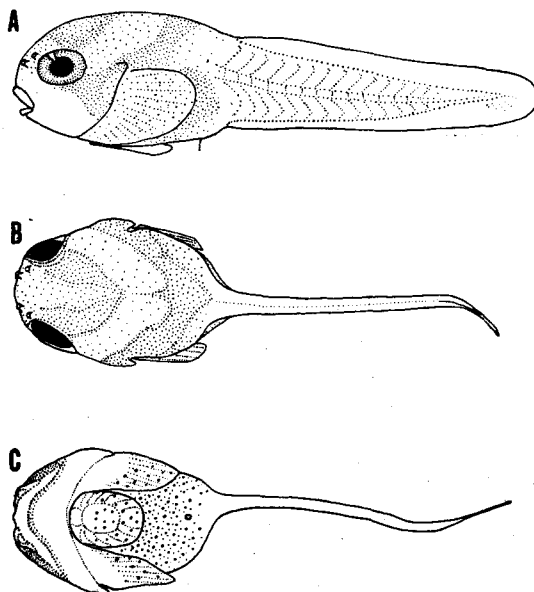


Fig. 2. Newly hatched larvae of the smooth lumpsucker, *Aptocyclus ventricosus* (PALLAS), Total length 6.0 mm
A: Lateral view; B: Dorsal view; C: Ventral view

Stock. The hatching occurred about fifty days after artificial fertilization. The mature fishes for the fertilization were obtained off Shikabe, southern Hokkaido, on March 14th, 1961 by a set net (popular name; "Gokko Ami").

The specimen was of prelarval stage in shape. Body proper except the tail which was rather elongate, showed a small globular form. The distance from the tip of the snout to the anus measured about 2.0 mm. The depth and width of body were about 1.5 mm respectively. Head was about 1.0 mm long, eye being large and about 0.5 mm in diameter. Fin rays of the dorsal and anal fins were still not developed, but in the pectoral fin about 15 rays were counted. In the lower lobe of the caudal fin some rays were also developed. The notochord extended to the tip of caudal part in a straight line. About 16 myotomes were counted in the tail. Gill opening was large and slit-like, not a small pore as in adults.

According to observation of the specimen immersed in formalin, blackish brown spots were distributed on the anterior part of body and three pairs of dark bands existed on each side of head and body proper. The first band ran from the upper margin of eye to occiput where it met with that of the other side. The second and third bands started from the lower margin of eye, the former meeting with that of the other side at the part of the first dorsal fin which was buried under skin and the latter ending at the edge of the sucking disk. The tail part was colorless (Fig. 2).

"B" Total length 9.9 mm (Specimen No. L-1668)

The specimen was collected from the surface layer of the waters of 52°50'N, 172°00'W, at 8 p.m. June 29th 1959 (Fig. 1). The water temperature at the collected point was about 18°C.

Body length 8.3 mm. Head and depth of body were 42.1% of body length respectively. Body proper was globular in form. The distance from the tip of the snout to the anus was 66.9% of body length. Caudal peduncle was compressed in shape, its depth being 12.0% of body length. Fin rays were still not perfectly developed, being counted 11 in dorsal, 8 in anal, 17 in left pectoral, 18 in right pectoral and 12 in caudal fins. Length of the bases of dorsal and anal fins was 21.6% and 18.0% of body length respectively, the dorsal origin being situated anteriorly from the anal origin. Diameter of eye was 13.2% of body length, being equal to the length of gill opening. Two nostrils had developed, the anterior being larger than the posterior. Some pores of sense-organ were observed on the suborbital. Some blunt teeth developed on the upper and lower jaws. Sucking disk was large in size, attaining to 25.3% of body length in diameter and having

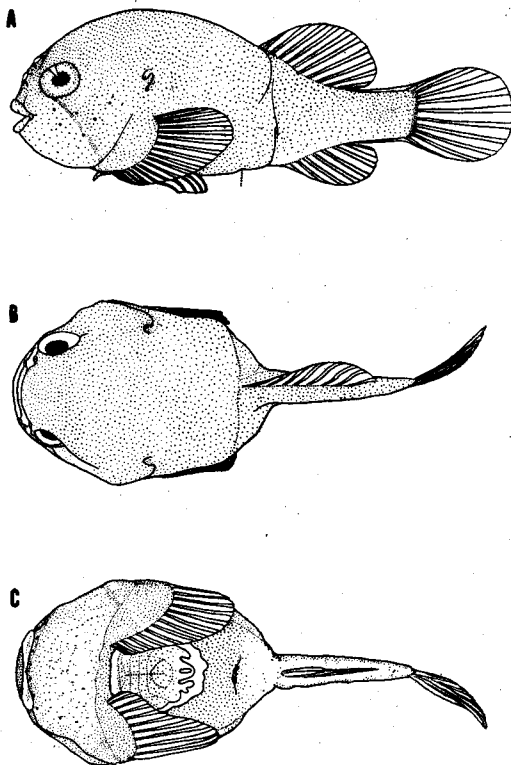


Fig. 3. A larva of the smooth lumpsucker, *Aptoicyclus ventricosus* (PALLAS), Total length 9.9 mm
A: Lateral view; B: Dorsal view; C: Ventral view

5 rays on each of left and right sides. The distance from the posterior margin of the disk to the anus was 10.8% of body length.

By observation after two years in formalin immersion, many brown pigments are seen to be distributed over the body surface, especially on the dorsal part of dark color and on the pale throat. There is a dark blackish brown band extending diagonally from the eye to the disk. The fins are colorless (Fig. 3).

“C” Total length 12.9 mm (Specimen No. L-167)

The specimen was collected at the surface layer of the waters of 51°50'N, 172°00'W, at 10 p.m. August 13th, 1956 (Fig. 1). The water temperature at the collection point was about 11°C.

Body length 10.0 mm. Head 46.0% of body length. Depth of body 52.0% of body length. Width of body was almost equal to the depth of body. Body proper was globular in form. The distance from the tip of the snout to the anus 72.0% of body length. Caudal peduncle compressed in shape and its depth 14.0% of body

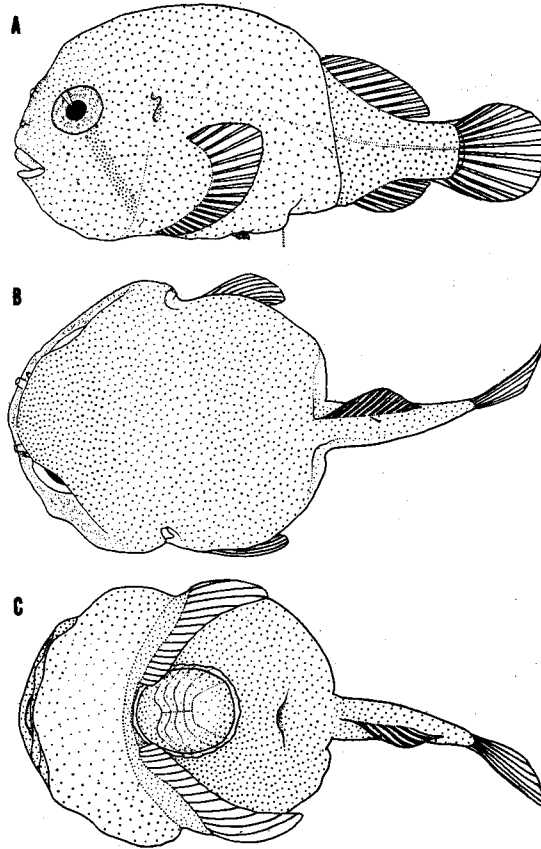


Fig. 4. A larva of the smooth lump sucker, *Aptocyclus ventricosus* (PALLAS), Total length 12.9 mm

A: Lateral view; B: Dorsal view; C: Ventral view

length. Fin rays were perfectly developed to full number in adults, being counted 11 in dorsal, 7 in anal, 20 in each pectoral and 12 in caudal fins. The segments were observed in the caudal rays. The first dorsal fin could not be observed, being buried under the skin. Length of bases of dorsal and anal fins was 26.0% and 18.0% of body length respectively, the dorsal origin being situated anteriorly from the anal origin. Diameter of eye 14.0% of body length, being somewhat larger than that of the disk. Two nostril tubes developed, the anterior being larger than the posterior. Some pores of sense-organ were observed on the sub-orbital. Some blunt teeth developed on the upper and lower jaws, but the vomer and palatines were toothless. Sucking disk large in size, attaining to 24.0% of body length in diameter and having 5 rays on each the left and right sides. The distance from posterior margin of the disk to the anus was 11.0% of body length.

Vertebrae were counted 28 in number by means of a radiograph.

By observation after four years in formalin immersion, many brown pigments are seen to be distributed over the body surface except a pale part of the throat. There are two blackish lines running parallel to the lateral line in the tail and a dark blackish brown band running diagonally from the post-lower margin of orbit to the disk. The width of the latter is the same as the diameter of the eye. The fins are colorless (Fig. 4).

External observations of the young and adults

Nineteen specimens of young and adults were used for external observations.

Table 1. Measurements and counts on the young and adults with the data by Hubbs & Schult

Locality	Shirikishinai	North-western Pacific	Kamchatka	Itrop	Shikabe
Sex or Species	♂	♂	♂	♂	♂
Number of specimens	1	1	1	2	2
Total length (mm)	112	151	210	210~264	270~300
Body length (mm)	90	122	168	160~206	215~245
Ratio to B. L. (%)					
Depth of body	47.7	45.9	29.7	33.9~42.5	46.9 (N=1)
Width of body	56.6	32.8	39.8	44.1~45.6	51.6 (N=1)
Length of head	42.2	39.3	30.9	32.5	33.0~33.5
Length of snout	16.6	12.3	12.5	11.1~15.0	11.4~13.0
Length of maxillary	18.8	12.3	15.4	14.0~17.5	13.4~14.8
Interorbital width	26.6	21.3	20.8	18.9~23.7	20.0~20.4
Diameter of orbit	8.8	6.5	7.7	5.3~ 8.1	6.5~ 6.9
Depth of caudal peduncle	10.0	9.2	9.5	10.1~11.8	9.3~10.7
Distance from tip of snout to anal origin	75.5	79.5	79.1	79.3~81.0	70.2~74.4
Distance from tip of snout to anterior edge of disk	25.5	25.4	16.6	14.5~16.8	14.0~17.9
Diameter of disk	15.5	18.3	29.1	29.1~31.2	28.5~32.2
Distance from posterior edge of disk to auns	25.5	33.6	14.8	9.3~16.9	10.6~17.7
Distance from anus to anal origin	25.5	13.9	14.8	14.5~15.6	9.3~11.2
Number of 1st. D.	V	V	VI	V	V (N=1)
Number of 2nd. D.	12	12	12	12	11 (N=1)
Number of A.	9	9	10	9	8 (N=1)
Number of P.	20	20	20	20	20
Number of pyloric appendages	26	21	35	16	18 (N=1)
Number of gill rakers					
Number of vertebrae		25		26	

Among them, ten specimens measuring 310~353 mm in total length were obtained from Hakodate, southern Hokkaido, four measuring 270~367 mm from Shikabe, southern Hokkaido, two measuring 210~264 mm from Itrop, South Kurile Islands, one measuring 210 mm from the Kamchatka peninsula, one measuring 151 mm from the north-western Pacific and one measuring 112 mm from Shirikishinai, southern Hokkaido (Fig. 1). The measurements and counts on body parts of all the specimens are given in Table 1.

These specimens show that the external figures which have been considered as specific characters change with growth and vary by sex. In mature specimens from Shikabe and Hakodate, the depth of body is 32.6~46.9% of body length in of the smooth lump sucker, *Aptocyclus ventricosus* (PALLAS), ('34) and Lindberg & Legeza ('55)

Hakodate	Shikabe	Hakodate	Hubbs & Schultz ('34)		Lindberg & Legeza ('55)	
♂	♀	♀	<i>E. copeianus</i>	<i>A. ventricosus</i>	<i>C. glaber</i>	<i>A. ventricosus</i>
4	2	6	10	4	4	1
310~353	286~367	310~353			212~275	262
265~295	230~305	254~295	149~230	126~252	162~223	215
32.6~37.2	19.0~29.5	25.4~38.2	36~48	52~66	33.2~37.8	55.7
25.2~40.6	40.3~50.4	25.4~43.7	39~49	52~68	43.1~47.0	58.5
28.0~32.5	23.6~29.5	21.8~26.5	35~45	26~45	33.2~40.0	40.5
8.4~10.7	8.8~10.0	8.4~11.2	11~14	8~15	10.7~14.2	14.8
10.1~12.5	11.1~12.1	9.3~12.2				
14.9~18.5	14.0~16.5	14.2~17.5	5~6	4~7		
5.2~5.9	5.2~6.0	3.3~6.3	7~9	5~9		
7.5~10.0	8.5~10.0	7.4~10.5			8.2~10.2	9.3
72.4~75.0	77.7~87.0	72.7~82.0			52.6~64.0	65.5
11.5~17.5	10.8~16.3	7.4~15.6			20.2~21.7	19.5
21.0~26.8	19.0~20.0	17.5~20.3	30~37	20~23	22.8~35.8	22.3
20.0~27.7	26.2~42.1	25.4~40.2	6~16	27~39	5.8~9.1	38.0
11.2~13.2	18.2~18.6	12.2~20.5	12~20	15~23	11.1~15.9	25.0
IV~V	V (N=1)	V	V	V		
12	12 (N=1)	11~12	9~11	9~11	10~11	10
9	8 (N=1)	8~9	7~8	7~8	8~9	8
19~20	19~20	20	19~21	19~21	19~21	21
19~21	12~14	11~19				
0+8 (N=1)		0+6~7(N=3)				
24 (N=1)		23~26(N=3)				

the males and 19.0~38.2% in the females, showing difference by sex. However, the factors of the depth and width of body are not always exact because the specimens are considerably transformed in formalin immersion.

The size of sucking disk changes with growth in thirteen male specimens as follows:

	Young	Immature adult	Mature adult
Body length (mm)	90~122	160~206	215~295
$\frac{\text{Diameter of disk}}{\text{Body length}} \times 100$	15.5~18.3	29.1~13.2	21.0~32.2

It is noted that, the young males measuring 90~122mm in body length from the north-western Pacific and Shirikishinai have a smaller disk than that of the adult males which range 160~295 mm in body length. This is probably related to the matter that the young may be swimming in the surface layer of the waters. As a matter of fact, the specimen from the north-western Pacific was collected in the surface layer. There is no collection data on the specimen from Shirikishinai. The three immature males measuring 160~206 mm in body length from the Kamchatka peninsula and the South Kurile Islands have larger disks than that of the young. This suggests that the life pattern may be changed to sedentary from at the stage of about 200 mm in total length. On the females, there are no data to describe the growth of sucking disk as even one specimen was not obtained. In the mature specimens, however, the size of sucking disk clearly differs by sex as follows:

Sex	Male	Female
Body length (mm)	215~295	230~305
$\frac{\text{Diameter of disk}}{\text{Body length}} \times 100$	21.0~32.2	17.5~20.3

That is to say, a mature male has a larger disk than that of a mature female. This is well known by fishermen to distinguish females from males as the former having eggs are more valuable than the latter in business (Plates I, II, III.).

In connection with the size of sucking disk, the distance from the posterior margin of disk to anus gets short with growth in the male specimens and varies by sex in the mature specimens as follows:

Sex	Young male	Immature male	Mature male	Mature female
Body length (mm)	90~122	160~206	215~295	230~305
$\frac{\text{Distance from the posterior margin of disk to anus}}{\text{Body length}} \times 100$	25.5~33.6	9.3~16.9	10.6~27.7	25.4~42.1

The skin is thick and wrinkled in the six mature males measuring 270~353 mm in total length. On the contrary, it is thin and smooth in the eight mature females measuring 286~367 mm. The two immature males measuring 210~264 mm have also a thick skin with wrinkles, but the three young and immature males measuring 112~210 mm have thin and smooth skin. It is probable that the skin gets thick and wrinkled in males after the stage of about 200 mm length.

Body color in adults is grayish purple with irregular blackish speckles. Variations in the color of dorsal part such as green or brown are observed in fresh specimens. That may be related to life environment or to variation in individuals, not to difference by sex. The young specimens less than 210 mm. are dark brown in body color, having no speckles on body.

Discussion and conclusion

The observations on the external characters of the three larvae are summarized as follows.

A specimen measuring about 6.0 mm in total length soon after hatching has a small globular form in the body proper, with an elongated tail. A larva measuring 9.9 mm is also globular in form in the body proper while it has a smaller tail than the specimen of 6.0 mm. The first dorsal fin cannot be observed from the outside even in the specimen of 12.9 mm as it is still buried under the skin. Though Popov ('33) reported the existence of the projecting first dorsal in the specimen of 9.2 mm, it seems certain that the specimen may not belong to the present species. Fins are completed except the first dorsal fin. Fin rays perfectly develop to full adult number in the specimen of 12.9 mm. Sucking disk is large in the larval stages, especially in the larva soon after hatching. It served to hold the specimens to the wall of glass butt during the life time.

Color pattern is distinct in the larval stages as shown in the figures 2, 3 and 4. The larva soon after hatching has three dark blackish brown bands; from eye to occiput, to the part of dorsal fin buried under skin and to disk. The larvae of 9.2 mm and 12.9 mm have a dark blackish brown band of which the width is equal to the diameter of eye, running diagonally from the post-lower margin of orbit to disk. This is characteristic in the young and larval stages of the species, having been described by Scheffer ('59) with a young of about 25 mm.

Spawning season is perhaps during the period from February to March in southern Hokkaido, because mature fishes were collected from Shikabe and Hako-date in this season. The ovarian eggs were counted to the number of 65,000 in a mature female of 32.0 mm. This agrees with the observation by Lindberg &

Legeza ('55) who counted 45,310~63,940 eggs in three mature females of 305~405 mm.

Hitherto, taxonomic studies on smooth lumpsuckers have been presented by many investigators. Two species among them, *Aptocyclus ventricosus* (PALLAS) and *Cyclopterichthys glaber* STEINDACHNER have been long known from the North Pacific. Jordan & Gilbert (1882) and Garman (1892), however, regarded as *C. ventricosus*=*C. glaber*. Later Hubbs & Schultz ('34) recorded a new species, *Elephantichthys copeianus*, in addition to *A. ventricosus*. Taranetz ('37) supported the opinion of Hubbs & Schultz ('34) and included the new species in the genus *Aptocyclus*. Lindberg & Legeza ('55) reviewed the specimens under this group and finally accepted the two species, *A. ventricosus* and *C. glaber* previously proposed by Jordan & Gilbert (1882), regarding *E. copeianus* as synonym of the latter.

While studying on the larvae of the smooth lumpsucker, the author noticed that the size of the sucking disk and the external properties of the skin which had been considered as important specific characters clearly varied with growth and by sex in the present species.

Hubbs & Schultz ('34) and Lindberg & Legeza ('55) differentiated the two species, *A. ventricosus* and *E. copeianus* syn. *C. glaber* by the difference that the former was thin and smooth in the skin and had a small sucking disk while the latter was thick and deeply wrinkled in the skin and had a large sucking disk. However, these external characters vary with growth and by sex in the present species. That is to say, the mature female possesses thin and smooth skin and has a small sucking disk while the mature male possesses thick and wrinkled skin and has a large sucking disk, though in the immature males the skin is thin and smooth and the sucking disk is small.

Accordingly, the specific confusion as to the taxonomy in the past was perhaps induced from the identification without consideration of growth and sex. The author would like to emphasize that all the species mentioned above should be consolidated under *A. ventricosus*.

Summary

- (1) The external observations on three larvae and nineteen young and adults of the smooth lumpsucker, *Aptocyclus ventricosus* (PALLAS), were described and a taxonomic review on the species was offered in the present paper.
- (2) A larva measuring 6.0 mm in total length soon after hatching has a rather elongated tail and the body proper except the tail is a small globular form. In

the larvae measuring 9.9 mm and 12.9 mm, the tail becomes small and the body proper is distinctly globular. A dark blackish-brown band running diagonally from the post-lower margin of orbit to sucking disk is a characteristic in the larval stages.

(3) The mature females have thin and smooth skin and a small sucking disk. On the contrary, the mature males have thick and deep wrinkled skin and a large sucking disk. But the young males' skins are thin and not wrinkled and their sucking disks are small. It seems certain that the young have a small sucking disk because they are swimming in the surface layer of the waters.

(4) The specific confusion as to the taxonomy in the past of the two species, *Aptocyclus ventricosus* (PALLAS) and *Cyclopterichthys glaber* STEINDACHNER syn. *Elephantichthys copeianus* HUBBS & SCHULTZ was induced by the identification without considerations on growth and sex. The author would like to emphasize that the species mentioned above should be consolidated under the species name, *Aptocyclus ventricosus* (PALLAS).

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Explanation of Plates

PLATE I

A young of the smooth lumpsucker, *Aptocyclus ventricosus* (PALLAS),
Total length 112 mm (No. 13058)

A: Lateral view; B: Dorsal view; C: Ventral view