

Postlarvae and juveniles of the gempylid fish, *Neopinnula orientalis* (GILCHRIST and VON BONDE), from the North Arabian Sea

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Abstract

Forty-two postlarval and juvenile gempylid specimens referable to *Neopinnula orientalis* were collected from the North Arabian Sea, off Pakistan by the R/V Shoyo Maru during the survey cruise for the Indian Ocean Programme by FAO. Meristic and morphological features of these specimens as well as their changes with growth are described. Postlarvae and juveniles of *N. orientalis* are generally characterized by having two lateral lines, small canine teeth on the vomer, well-developed black pigments on the membrane of dorsal fin, a large black spot on body surface above the anus and, especially in smaller specimens, finely serrated dorsal and pelvic spines and well-developed spination of the preopercle.

Introduction

Fishes of the family Gempylidae, previously regarded as a rather rare group, are now known to occur widely in the tropical and temperate waters of the Indo-Pacific and Atlantic Oceans. At present, 15 species of 14 genera of this family are recognized (PARIN and BECKER, 1972), although revisional work on genera of Gempylidae is highly needed.

Postlarvae and juveniles of several members of this family have been reported, *e. g.*, *Lepidocybium flavobrunneum* (SMITH), *Promethichthys prometheus* (CUVIER) and *Rexea prometheoides* (BLEEKER) by GORBUNOVA (1977), *Nealotus tripes* JOHNSON by NAKAMURA and PAXTON (1977) and STRASBURG (1964), *Gempylus* sp. and *Nesiarchus nasutus* JOHNSON by VOSS (1954), *Diplospinus multistriatus* MAUL by STRASBURG (1964) and YEVSEYENKO and SEREBRYAKOV (1974) and *Thyrsites atun* (EUPHRASEN) by Anonymous (1978). However, little is known on the postlarvae and juveniles of *Neopinnula orientalis* (GILCHRIST and VON BONDE) except a specimen of 30.5 mm SL (Standard Length) reported by GORBUNOVA (1977).

Since the original description was given to Natal coast, South Africa (GILCHRIST and VON BONDE, 1924), *N. orientalis* is known from various areas: the east coast of Africa (BARNARD, 1927; SMITH, 1949; Far Seas Fish. Res. Lab., 1976), the Gulf of Mexico, the Caribbean Sea, off North, East Brazil (MEAD, 1951; GREY, 1953, 1960), the Pacific coast of Japan (KAMOHARA,

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1938, 1942; MATSUBARA and IWAI, 1952, 1958; GREY, 1953), around the Philippines (HERRE, 1950) and Western Australia (Anonymous, 1976), and extensively by the Soviet trawling surveys from the Timor Sea, off southern Java, in the Indian side of the North Arabian Sea, off the east coast of Africa (PARIN and BECKER, 1972), off the west coast of India (SHUBNIKOV and TOKAREVA, 1973a), in Bay of Bengal, in the Andaman Sea (SHUBNIKOV and TOKAREVA, 1973b) and in the northwestern coast of Mindanao (PARIN, 1976). Although GREY (1953) recognized three subspecies of *N. orientalis*, it is beyond our scope to discuss the validity of the subspecies in this paper.

This paper describes the postlarval and juvenile forms referable to *N. orientalis* collected from the North Arabian Sea in the Indian Ocean.

Materials and methods

Specimens examined were obtained from the North Arabian Sea, off Pakistan by the R/V Shoyo Maru (1381.8 GT) of Fisheries Agency of Japan during the survey cruise carried out as a part of the Indian Ocean Programme by FAO, between October 1975 and January 1976. Horizontal tows of the larval mid-water trawl net were operated at about 2.5 knots for 20 minutes. At 12 stations of total 25 trawl net stations (Fig. 1), 42 specimens referable to *N. orientalis*, ranging from 6.5 to 115.9 mm SL were obtained at various depths from 23 to 150 m (Table 1).

Immediately after capture, these specimens were preserved in 10% formalin and then transferred to 70% alcohol for later examination. Measurements and counts were made accord-

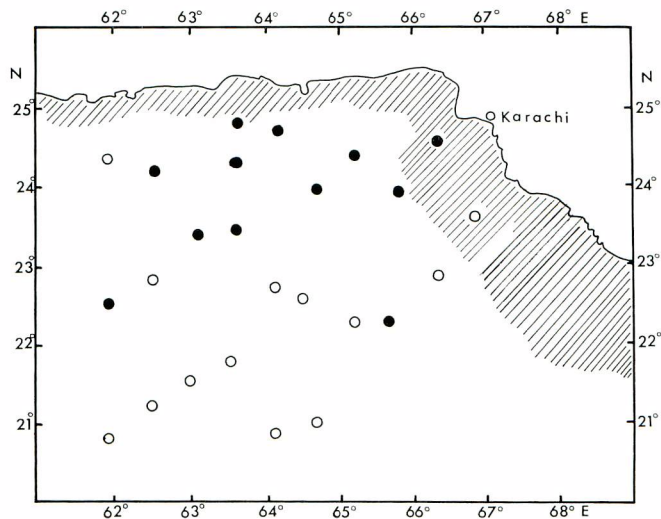


Fig. 1. Location of stations for larval mid-water trawl net tows. Closed circles represent locations where postlarvae and juveniles of *Neopinnula orientalis* were taken. Shaded part indicates area shallower than 200 meters.

Table 1. Records of collection for juveniles of *Neopinnula orientalis*.

St. No.	Date	Time	Locality		No. Sp.	Size range (mm in SL)	Surface WT (°C)	Maximum depth of tow (m)
			Lat. (N)	Long. (E)				
2	1975 11-17	20:18-20:38	22°-33'.6"	62°-06'.0"	1	22.99	26.1	50
4	1975 11-18	20:23-20:43	24°-14'.0"	62°-37'.3"	13	9.25- 24.89	25.9	83
8	1975 11-20	20:16-20:36	23°-25'.0"	63°-12'.9"	2	7.68- 10.21	26.2	58
9	1975 11-21	08:46-09:06	24°-49'.7"	63°-42'.6"	1	14.00	—	45
10	1975 11-21	13:12-13:32	24°-14'.2"	63°-45'.8"	1	6.74	—	135
11	1975 11-21	20:14-20:34	23°-29'.5"	63°-43'.0"	1	26.94	26.2	50
15	1975 11-23	20:18-20:38	24°-44'.0"	64°-15'.0"	5	12.40- 98.00	26.1	—
16	1975 11-24	20:18-20:38	24°-08'.4"	64°-47'.3"	13	12.90-115.87	26.3	55
20	1975 11-26	20:08-20:28	24°-24'.2"	65°-20'.0"	3	41.55- 45.24	26.2	70
22	1975 11-28	08:08-08:28	22°-19'.0"	65°-47'.3"	1	15.99	25.9	150
24	1975 11-29	08:15-08:30	24°-36'.3"	66°-24'.0"	1	6.45	25.3	23

ing to the methods of HUBBS and LAGLER (1949) except preopercular spines as given in Fig. 2. Measurements were made with the steel slide caliper and dial caliper for larger specimens and with the micrometer under a binocular microscope for smaller specimens. All measurements and counts were made on the left side of specimens. Specimens were cleared in 4% solution of potassium hydroxide and stained with alizarin red by the Holister's technic modified by CLOTHIER (1950) for counting the preopercular and fin spines and vertebrae. Vertebral counts were also made by soft X-rays.

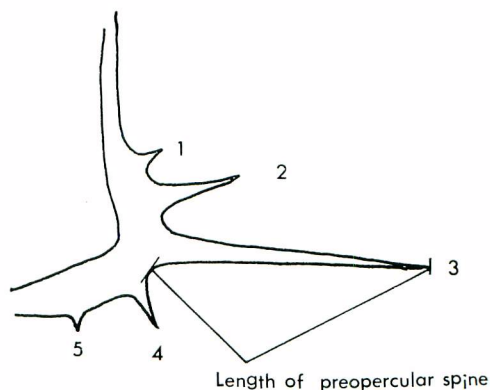


Fig. 2. Showing the method of measurement of preopercular spine length and number of each spine.

Identification

The specimens referable to *N. orientalis* are divided into two size groups, 6.5-45.2 mm SL (postlarvae) and 83.9-115.9 mm SL (juveniles). No specimens of median size between the two groups were collected. All measurements and counts of specimens are given in Appendix Table 1.

The counts and measurements examined as well as external features distinguish these specimens from the previously reported species of gempylid postlarvae and juveniles: *L. flavobrunneum*, *P. prometheus*, *R. prometheoides*, *N. tripes*, *N. nasutus*, *D. multistriatus* and *T. atum*. They also differ from the other species of Gempylidae such as *Thyrsitops lepidopoidea* CUVIER, *Rexea solandri* (CUVIER), *Thyrsitoides marleyi* FOWLER (= *Mimasea taeniosoma*

KAMOHARA), *Gempylus serpens* CUVIER and *Paradiplospinus gracilis* (BRAUER) in the number of vertebrae and the other counts. Remaining species in the family are *Ruvettus pretiosus* COCCO, *Epinnula magistralis* POEY and *N. orientalis* which have all 32 vertebrae. Among them, *R. pretiosus* is easily distinguished from the present species by having fewer dorsal spines, single lateral line and two dorsal and anal finlets. Finally, the present species is most likely *N. orientalis* or *E. magistralis*. According to MATSUBARA and IWAI (1952, 1955), the adult fish of *N. orientalis* is distinguished from *E. magistralis* in the following points: 1) vomer toothed; 2) two lateral lines beginning together above upper angle of gill opening; 3) dorsal fin inserted behind upper end of gill opening; 4) inner surface of gill raker at angle of first arch armed with 2 rows of minute spines; and 5) vertebral formula 16+16. Our observation proved that two small canine teeth on vomer appear in specimens larger than 13.1 mm SL and two lateral lines are discernible in specimens larger than 22.4 mm SL. It is, therefore, easy to distinguish *N. orientalis* from its closely related species, *E. magistralis* in specimens larger than about 13 mm SL. So that larger specimens of the present species than 13 mm SL are identified with *N. orientalis*. There seems to be a little difficulty in the identification of the specimens smaller than 13 mm SL between *N. orientalis* and *E. magistralis*. However, the specimens smaller than 13 mm SL have the same number of fin rays and vertebrae and similar body pigmentation as larger specimens. Judging from above mentioned points, the specimens of these two size groups of gempylid fish are recognized as *N. orientalis*. The number of all fin rays of these specimens shows the full adult complement, although that of caudal fin ray shows a little fewer count in specimens smaller than 23 mm SL.

Description

Forms of postlarval and juvenile *N. orientalis* are described in detail, based on six specimens representing different stage of early development. The postlarvae and juveniles of this species are characterized by the following points: 1) black pigments on spinous dorsal fin are well developed and there is a conspicuous large black spot on the body above the anus; 2) body height is rather deep in the very early stage and becomes slender with growth; 3) dorsal and pelvic spines are large and finely serrated and 4) preopercular spination is conspicuous.

1. Specimen No. 38, 6.45 mm in standard length (Fig. 3)

Counts: D. XVI, I, 18; A. III, 18; P₁. 14; P₂ I, 5

Body deep, slightly elongate and rather compressed. Tail fairly short, its length about equal to head length except snout. Depth of body at pectoral fin base about 34% of standard length. Snout short. Mouth large and slightly oblique, end of upper jaw reaching below front edge of pupil. Lower jaw slightly projected from tip of snout. Nostril single, large triangular in shape. Eye large and nearly rounded, length of orbit about equal to that of snout. Interorbital width narrower than length of orbit. Five enlarged spines on hind margin of preopercle; spine at posterior lower angle longest, being about equal to length of orbit. Both edges of longest preopercular spine serrated. Pterotic region armed with two small spines.

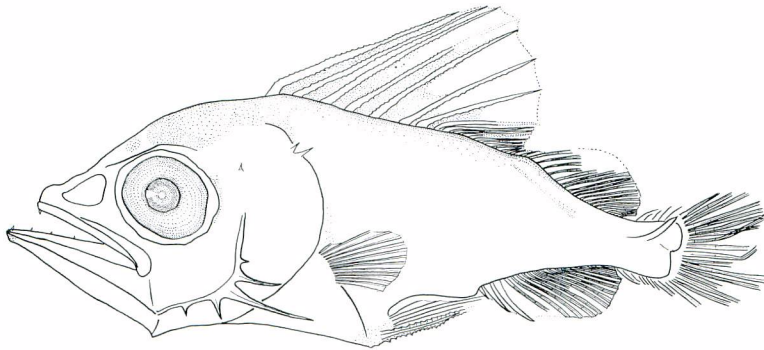


Fig. 3. Postlarval specimen, 6.45 mm in standard length, specimen No. 38.

One upward spine on postorbital region. Supraorbital crest with feebly serrated margin. Dorsal fin inserted above upper part of gill opening, spinous and soft dorsal fins connected by membrane. Dorsal spines relatively long and slightly flattened with serrated edges. Soft dorsal fin preceded by a small spine. Pectoral fin rather long, situated relatively low and its tip reaching below 6th or 7th dorsal spine. Pelvic fin originating below middle of pectoral fin, comprising a long serrated and flattened spine and 5 soft rays. Anal fin situated below 14th dorsal spine. Length of anal fin base rather short, about $1/3$ of that of dorsal base. Anus located just in front of anal fin origin.

Black pigments on forbrain, midbrain and upper part of body along dorsal fin base. This pigmented area, however, not extending to caudal peduncle. Eye quite darkly pigmented. Spinous dorsal fin membrane heavily pigmented. A few black pigments on tip of lower jaw, base of pelvic fin and above pectoral fin origin.

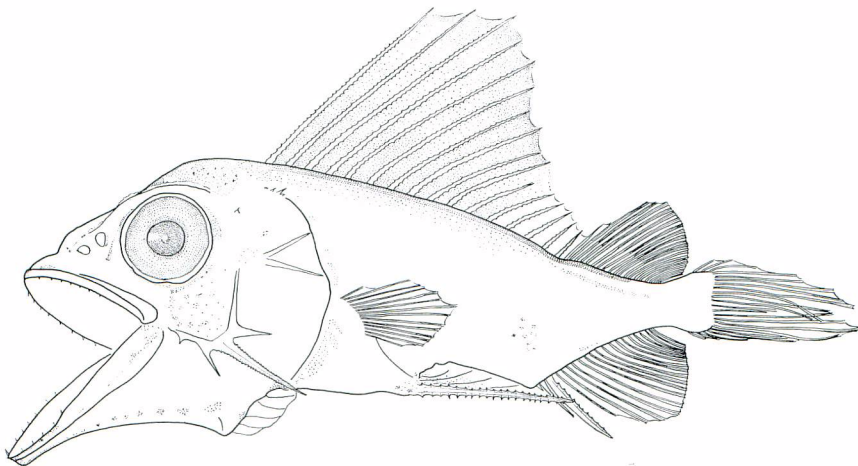


Fig. 4. Postlarval specimen, 9.25 mm in standard length, specimen No. 34.

2. Specimen No. 34, 9.25 mm in standard length (Fig. 4)

Counts: D. XVI, I, 18; A. III, 17; P₁. 14; P₂. I, 5

General shape of body resembling specimen No. 38. Interorbital region slightly concave. Nostril more specialized, already divided into two apertures. Two feeble spines on opercle. Pelvic spine provided with about 20 minute serrations on both edges. Tip of pelvic spine reaching 3rd anal spine. Caudal fin with about 22 distinct rays.

Black pigments on spinous dorsal fin membrane well developed and mostly concentrated on its lower half and spread toward margin. Black pigments newly appearing on tip of upper jaw, around eye, in front of anterior nostril, at hind edge of posterior nostril, in preopercle, on posterior part of lower jaw, on throat and on middle part of anal fin base. Seven chromatophores appearing along ventral edge of lower jaw. Several black pigments concentrated on body surface above anus.

3. Specimen No. 32, 13.44 mm in standard length (Fig. 5)

Counts: D. XVI, I, 18; A. III, 18; P₁ 14; P₂ I, 5

Body more elongate and slender than two specimens described above. Two small canine teeth on vomer. A single row of canine teeth on palatine. Lateral line not discernible in this size.

Black pigmentation on body and head developed more intensely and extensively. Spinous dorsal fin membrane pigmented. Pigments on body surface above anus conspicuous, increasing in number. Pigmentation on caudal region more extensive.

4. Specimen No. 16, 25.77 mm in standard length (Fig. 6)

Counts: D. XVI, I, 18; A. III, 18; P₁. 14; P₂. I, 5

Body more elongate. Body depth about 22% of standard length. Three feeble spines on opercle. A pair of fangs near tip of lower jaw, and five fangs near tip of upper jaw. Eleven canine teeth on lateral side of lower jaw, and 16 or more canine teeth on lateral side of upper jaw. Canine teeth on lower jaw larger than those on upper jaw. In a slightly larger specimen (28.1 mm SL, Sp. No. 15), lateral teeth on both jaws increasing in number; 26 (left) and 22 (right) on upper jaw, and 17 (left) and 18 (right) on lower jaw. No spine on postorbital region. Last five dorsal spines slightly compressed as compared with others.

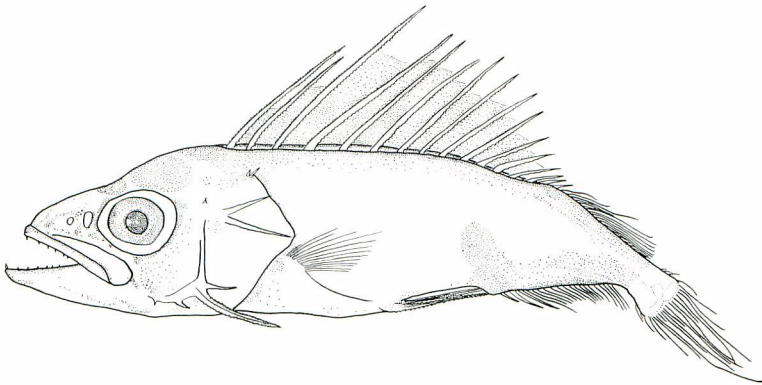


Fig. 5. Postlarval specimen, 13.44 mm in standard length, specimen No. 32.

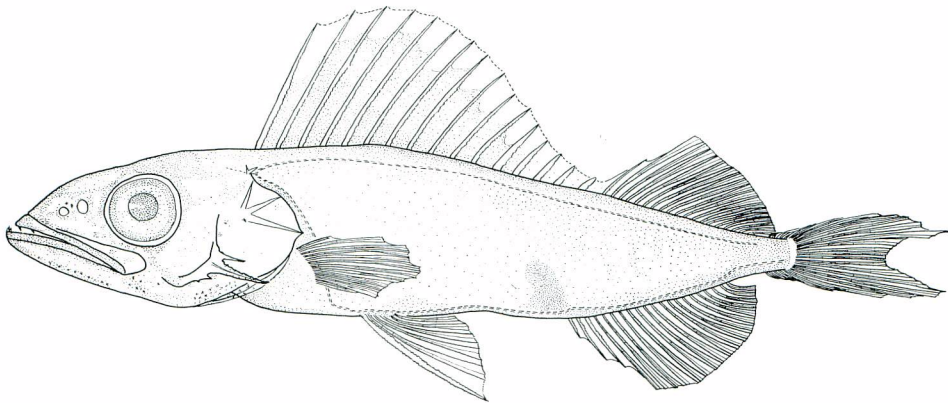


Fig. 6. Postlarval specimen, 25.77 mm in standard length, specimen No. 16.

Third dorsal spine longest and a little shorter than body depth. Caudal fin with 32 rays, showing a sign of fork. Lateral lines characteristic of this species discernible. Two lateral lines beginning above upper corner of gill opening. Upper lateral line passing along dorsal fin base, terminating to a little posterior end of its base. Lower one descending obliquely from junction to below 4th dorsal spine, then running backward along ventral median line to caudal fin origin, with a slight rise near end of anal fin base.

Black pigmentation on body and head more advancing. Spinous dorsal fin membrane pigmented. Pigmentation in caudal region more developed than in trunk. A fairly conspicuous blotch consisting of numerous black pigments concentrated on ventral side of body above anus.

5. Specimen No. 12, 41.66 mm in standard length (Fig. 7)

Counts: D. XVI, I, 18; A. III, 18; P₁. 13; P₂. I, 5

Body elongate and compressed. Feeble spines on opercle reduced to two. Preopercular spination very reduced and length of 3rd preopercular spine only 2.4% of standard length. No spines on pterotic region. Dorsal spines relatively short and height of spinous dorsal fin low. Pelvic spine rather short, tip of it reaching midway between end of pelvic base and anal fin

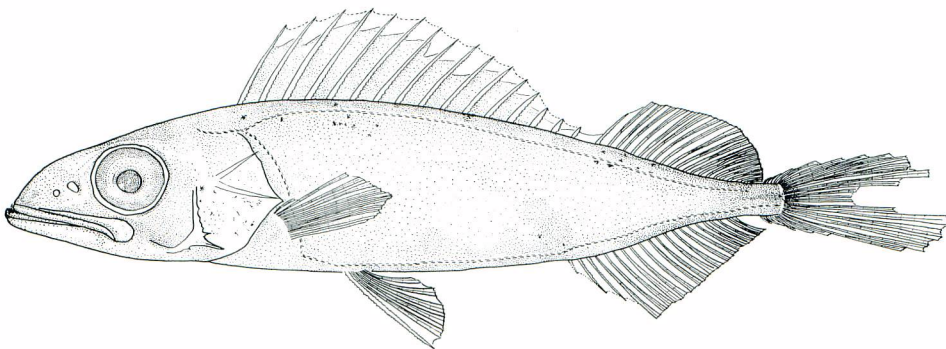


Fig. 7. Postlarval specimen, 41.66 mm in standard length, specimen No. 12.

origin. Cephalic sensory canal developed.

Body and head dark brown in alcohol preserved specimens. Spinous dorsal fin membrane pigmented. A large black spot above anus still noticeable.

6. Specimen No. 1, 113.57 mm in standard length (Fig. 8)

Counts: D. XVI, I, 19; A. III, 18; P₁. 14; P₂. I, 5

Shape of body essentially similar to adult. Body elongate and compressed. Head moderate in size. Opercular spines become faint. Preopercular spines completely reduced. Interorbital region slightly concave. Snout rather obtuse. Six fangs near tip of upper jaw, three of which smaller than others. A pair of fangs on tip of lower jaw. Lateral canine teeth on both jaws, and those of lower jaw larger than those of upper jaw (Fig. 9). Cephalic sensory canal beginning at junction of lateral lines, extending to below occipital region. All dorsal spines feeble and slender, with smoothed edges. Spinous dorsal fin high anteriorly, becoming gradually low posteriorly. Fifth dorsal spine longest. Edges of pelvic and anal spines smooth. Caudal fin forked. Body and head uniformly dark brown in alcohol preserved specimens.

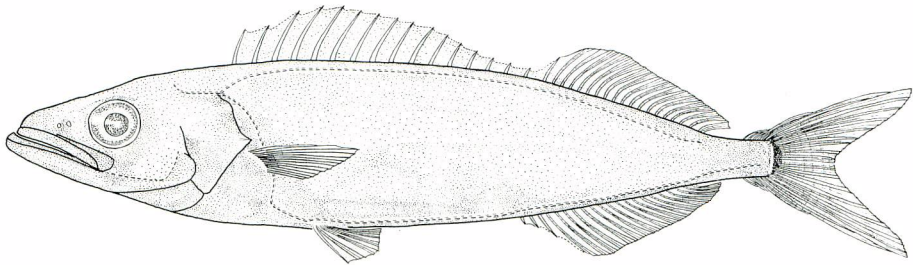


Fig. 8. Juvenile specimen, 113.57 mm in standard length, specimen No. 1.

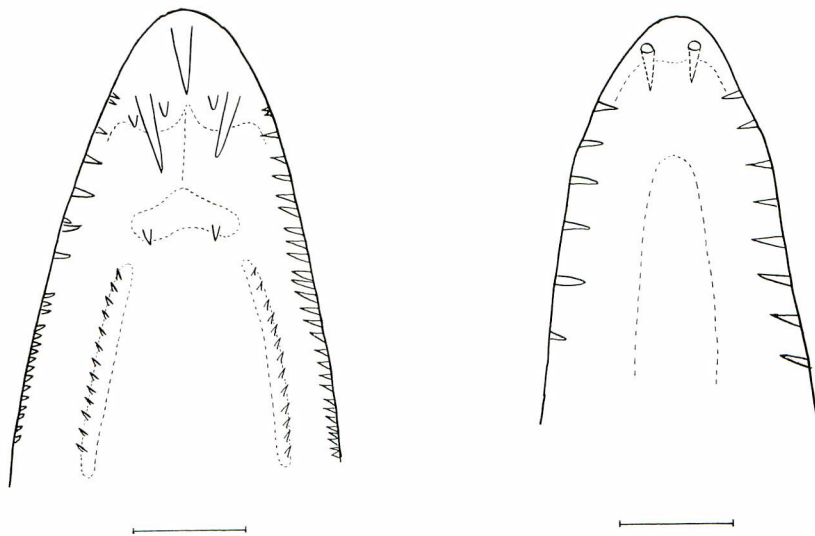


Fig. 9. Inside of upper (left) and lower (right) jaws. Scales equal to 3 mm.

Changes in some particular characters with growth

1. Pigmentation

At the very early stage (6–7 mm SL), the black pigments appear on the forebrain, mid-brain, dorsal part of body, spinous dorsal fin, tip of lower jaw, pelvic fin base and above pectoral fin origin. The black pigments on spinous dorsal fin are very well developed. When postlarvae attain 7–9 mm SL, a few black pigments appear on the body above the anus, and the number of pigments in this region increases with growth until they finally form a conspicuous large black spot at about 13 mm SL. This spot still persists in postlarvae of 45 mm SL. From 13 to 40 mm SL, the pigmentation on caudal region becomes more intense. The black pigments on the head and body increase in number with growth. Especially, the dorsal part of body and caudal region are considerably pigmented. In the later stage (40–116 mm SL), the pigmentation is rather uniform, sometimes several black blotches appear on limited part of body and the black pigments on lower part of body gradually increase in number.

As mentioned above, dense pigments on the spinous dorsal fin membrane and a large black spot on the body above the anus are most conspicuous features of the pigmentation in postlarvae from 6 to 45 mm SL. Especially, the latter is an important character to distinguish *N. orientalis* from postlarvae of close relatives.

2. Body proportion

As noted previously, the shape of body changes remarkably as the development proceeds. Fig. 10 shows the relations of the length of six selected parts of body to the standard length.

In the small specimens, 6–13 mm SL, the head length is 40–46% of the standard length, but this decreases gradually with growth to as low as nearly 30% when juveniles attain 100–120 mm SL (Fig. 10d). After this size, the ratio is nearly constant up to the adult stage. The ratio of both the distance from snout to pelvic fin origin and the distance from snout to anus to the standard length decreases with growth in the stage up to at least about 50 mm SL (Fig. 10 e and f). This indicates that the tail region of the body is rapidly developed compared to the growth of the trunk. The ratio of the body depth to the standard length decreases with growth in the stage up to about 50 mm SL (Fig. 10 a).

3. Spination

The dorsal and pelvic spines are well developed in the stage less than about 50 mm SL. These spines bear numerous minute serrations on both edges. The ratio of the length of these spines to the standard length is shown in Fig. 10 b and c. For the longest dorsal spine, this ratio decreases rapidly with growth up to about 50 mm SL, and then becomes nearly constant (Fig. 10 b).

The shape and length of pelvic spine shows a change which is characteristic of the postlarval stage of 6–42 mm SL (Fig. 11). It is flattened and bears 20 or more fine serrations on both edges. The ratio of the spine length to the standard length decreases as growth proceeds (Fig. 10 c), and, at the same time, the marginal serrations increase in number. In the

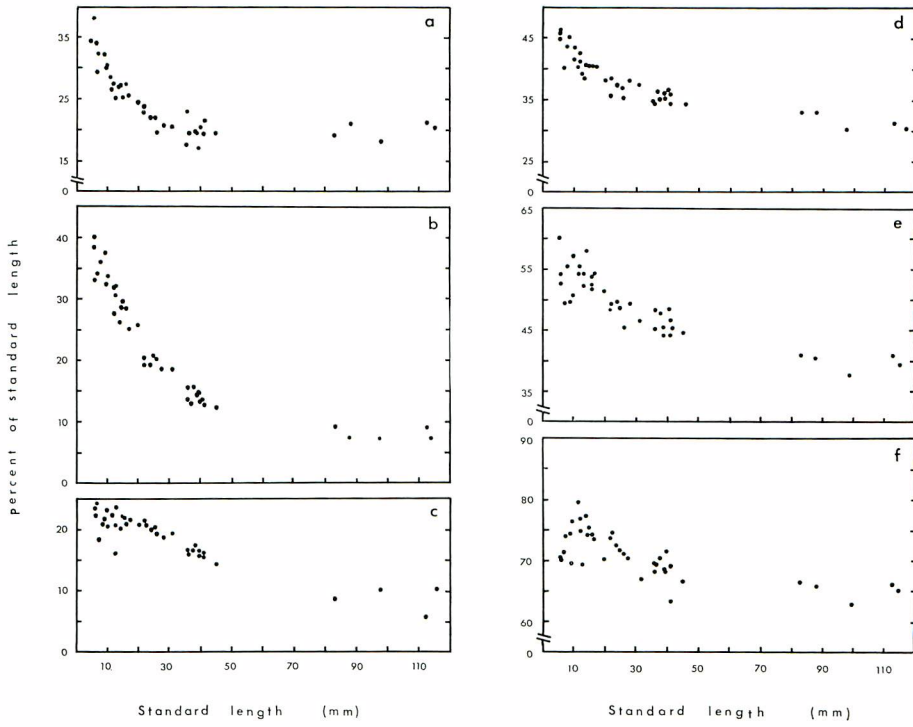


Fig. 10. Relative length for six body parts are expressed as percent of standard length. a: depth of body, b: longest dorsal spine, c: pelvic spine, d: length of head, e. distance from snout to pelvic fin origin, f: distance from snout to anus.

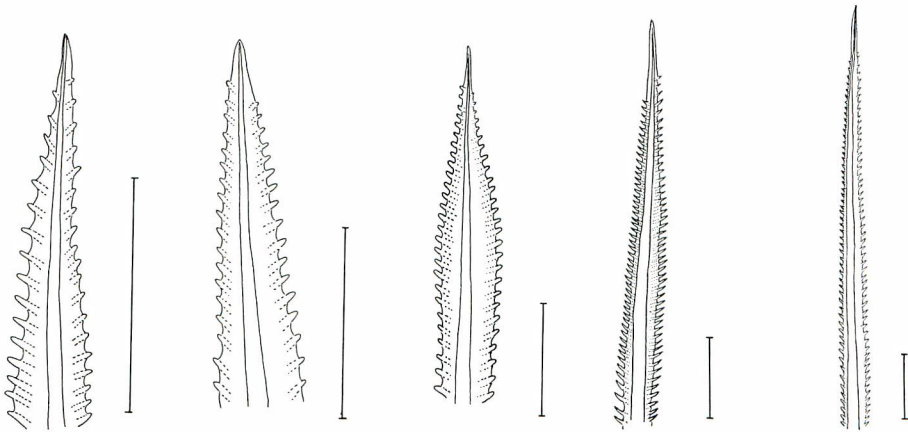


Fig. 11. Development of pelvic spine. Scales equal to 1 mm. From left to right: 6.51 mm SL, 10.21 mm SL, 13.13 mm SL, 28.10 mm SL, 41.55 mm SL.

specimen about 42 mm SL, the pelvic spine has as many as 55 serrations on both edges. The pelvic spine becomes slender in the later stage, 84–120 mm SL, when it takes a normal shape with smooth edges as seen in the adult. A similar change is observed in the dorsal and anal

spines.

The preopercular spines impart one of the most important characters to the postlarval stage. The postlarvae of this species have 4 to 5 enlarged spines on the hind margin of the preopercle (Fig. 12). Postlarvae smaller than 12 mm SL are all provided with 5 preopercular spines and those larger than 15 mm SL with 4 spines without exception. From 12 to 15 mm SL, there are specimens having 5 and 4 preopercular spines (Table 2). The preopercular spines are arranged the 3rd, 2nd, 4th and 5th spines in order of length (1st one is lost) in 4-spined pattern, while the 3rd, 2nd, 4th, 1st and 5th spines in 5-spined pattern. The ratio of the 3rd preopercular spine to the standard length decreases noticeably with growth (Fig. 13). The hind margin of the preopercle is smooth in the juvenile larger than about 80 mm

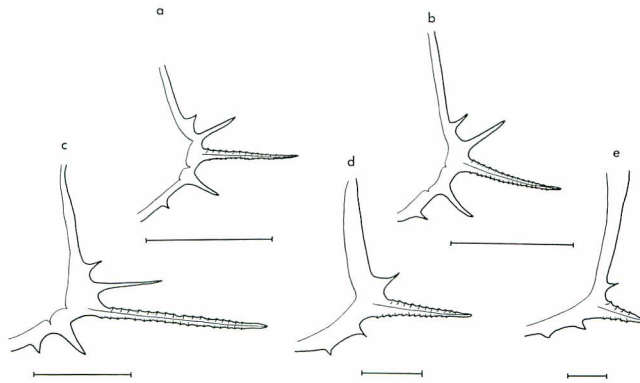


Fig. 12. Development of preopercular spination. Scales equal to 1 mm.
a: 6.51 mm SL b: 10.21 mm SL c: 13.13 mm SL d: 28.10 mm
e: 40.16 mm SL

Table 2. Number of preopercular spines in postlarval and juvenile stages of *N. orientalis*.

Size (mm in SL)	Number of specimens examined	Number of preopercular spines	
		4	5
6.00- 8.99	6	0	6
9.00-11.99	3	0	3
12.00-14.99	5	2	3
15.00-17.99	4	4	0
18.00-20.99	1	1	0
21.00-23.99	2	2	0
24.00-26.99	2	2	0
27.00-29.99	1	1	0
30.00-32.99	1	1	0
33.00-35.99	0	0	0
36.00-38.99	4	4	0
39.00-41.99	5	5	0
42.00-44.99	0	0	0
45.00-47.99	1	1	0

SL. The size at which the preopercular spines disappear is not definitely known due to lack of intermediate specimens between 46 and 80 mm SL. It is assumed that the preopercular spines probably disappear in the specimens between about 60 and 80 mm SL (Fig. 13).

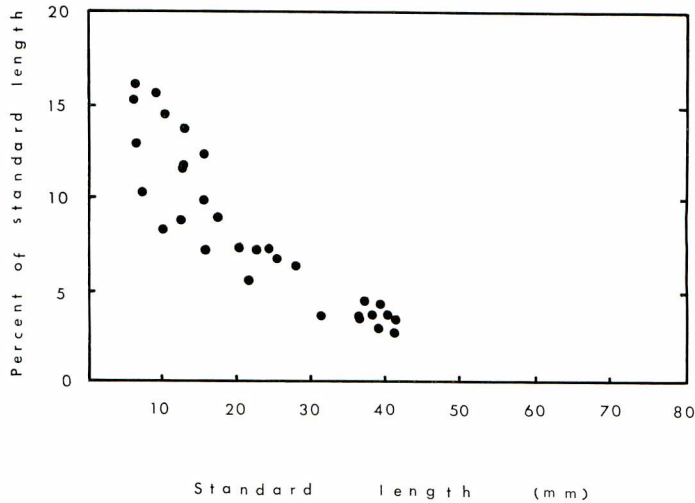


Fig. 13. Relative length of longest preopercular spine (3rd spine) expressed as percent of standard length.

Conclusion

Postlarvae and juveniles of *N. orientalis* have some features common to those of the other species of Gempylidae as seen in the well-developed finely serrated spines of the dorsal, pelvic and preopercle, but differ from the other members of this family in the following characters: i. e., the dense black pigments on the spinous dorsal fin and a large black spot on the body above the anus which is especially conspicuous at size less than 30 mm SL.

The specimen of 30.5 mm SL reported by GORBUNOVA (1977) differs slightly from our specimens in the number of spines and soft rays of the dorsal, anal and pelvic fins (D. XVI, I, 21; A. II, I, 20; P₂. 5 in her specimen) and in the body pigmentation (a large black spot on the body above the anus is discernible so far as her drawing is concerned).

Our specimens from the North Arabian Sea agree well with the description on the Indian Ocean specimens by PARIN and BECKER (1972) in the meristic counts and morphological features.

This species have been known to occur in the tropical and temperate waters in the world's oceans. Locations of the capture of this species so far reported as well as our specimens from the Arabian Sea are shown in Fig. 14. From this figure, it is apparent that *N. orientalis* is rather coastal deep water species and not distributed very far into the high seas.

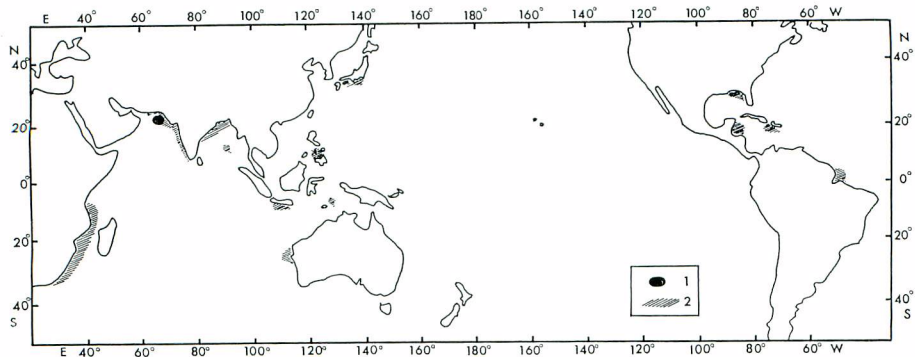


Fig. 14. Schematic chart of the distribution of *Neopinnula orientalis* 1. The place where present specimens were obtained. 2. The place where literatures were recorded.

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北部アラビア海から得られたトウヨウカマス, *Neopinnula orientalis*
(GILCHRIST and VON BONDE) の仔稚魚

西 川 康 夫・中 村 泉

摘 要

FAO による IOP (インド洋計画) 調査航海の間に水産庁所属調査船照洋丸によってパキスタン沖合の北部アラビア海からトウヨウカマス, *Neopinnula orientalis* とと思われる仔稚魚 42 個体が採集された。これら標本個体の計数計測形質および成長に伴う形態の変化について検討し, 記載した。検討の結果これらの仔稚魚は *N. orientalis* と同定された。

トウヨウカマスの仔稚魚は 2 条の側線を有すること, 鋤骨に歯を有すること, 背鰭棘条部に黒色素がよく発達していること, 肛門上方の体上に大きな 1 黒色斑を有することおよび特に発育初期においては背鰭棘, 腹鰭棘および臀鰭棘の縁辺部に鋸歯をそなえることならびに前鰓蓋骨に鋸歯をそなえた棘がよく発達していることにおいて特長的である。

Appendix Table 1. Measurements and counts made on

Size (SLmm)	Sp. No.	Counts					Measurements						
		D	A	P ₁	P ₂	V	a	b	c	d	e	f	g
6.45	38	XVI, I, 18	III, 18	14	I, 5		46.36	34.11	11.63	9.30	14.26	23.26	15.66
6.51	39	XVI, I, 18	III, 18	—	I, 5		45.16	38.40	—	9.22	13.06	18.43	15.36
6.74	36	XVI, I, 18	III, 18	14	I, 5		46.00	34.72	15.58	8.31	13.65	22.55	14.99
7.68	37	XVI, I, 19	III, 19	14	I, 5		40.36	29.30	14.32	7.81	11.98	19.01	13.15
8.90	40	XVI, I, 18	III, 18	13	I, 5	16+16	43.82	32.58	12.70	7.30	11.80	19.66	14.16
9.25	34	XVI, I, 18	III, 17	14	I, 5		45.41	32.43	9.19	7.35	13.73	19.89	13.51
10.21	31	XVI, I, 19	III, 18	14	I, 5	16+16	41.63	30.36	10.28	6.37	11.26	17.24	12.24
10.30	35	XVI, I, 18	III, 18	14	I, 5		43.60	30.29	10.00	6.31	14.08	21.36	13.59
12.40	30	XVI, I, 18	III, 18	14	I, 5		40.32	28.63	10.48	6.45	12.18	16.85	12.90
12.90	29	XVI, I, 18	III, 18	13	I, 5		42.25	26.82	12.25	6.90	9.69	—	12.40
13.13	27	XVI, I, 18	III, 18	14	I, 5	16+16	39.22	27.72	9.29	6.09	11.81	18.58	11.96
13.44	32	XVI, I, 18	III, 18	14	I, 5		41.22	25.30	9.82	5.95	10.86	18.23	11.16
14.48	25	XVI, I, 18	III, 18	14	I, 5		38.67	27.35	7.80	6.22	10.36	17.27	12.09
15.94	26	XVI, I, 18	III, 18	14	I, 5		40.78	27.60	8.66	5.96	12.80	16.94	12.55
15.99	33	XVI, I, 18	III, 18	14	I, 5		40.96	25.33	10.57	6.25	13.01	17.70	11.32
16.12	24	XVI, I, 18	III, 18	14	I, 5		40.94	27.30	10.05	6.58	13.65	18.61	10.86
17.94	22	XVI, I, 18	III, 18	14	I, 5	16+16	40.69	25.64	8.75	5.85	13.60	16.56	10.65
20.61	23	XVI, I, 18	III, 18	14	I, 5		38.09	24.50	8.64	6.07	12.23	17.08	11.01
22.43	17	XVI, I, 18	III, 18	14	I, 5		35.40	23.05	10.16	5.39	10.25	17.34	9.59
22.99	19	XVI, I, 17	III, 17	13	I, 5		38.63	23.92	9.13	4.83	9.79	15.27	9.57
24.89	21	XVI, I, 17	III, 17	14	I, 5		37.44	22.06	9.48	5.02	10.65	13.74	10.12
25.77	16	XVI, I, 18	III, 18	14	I, 5		37.10	22.08	8.77	5.04	11.49	16.61	9.66
26.94	18	XVI, I, 18	III, 18	14	I, 5	16+16	35.49	19.64	7.83	5.83	10.88	15.85	9.73
28.10	15	XVI, I, 18	III, 18	14	I, 5	16+16	38.29	20.75	9.32	5.09	11.64	15.05	9.64
31.37	28	XVI, I, 19	III, 18	14	I, 5		37.58	20.53	8.03	5.48	11.13	15.88	10.07
36.71	20	XVI, I, 18	III, 18	14	I, 5		34.98	23.15	8.23	5.18	10.11	13.65	9.67
36.84	11	XVI, I, 17	III, 18	14	I, 5		34.64	17.70	6.95	5.00	10.29	14.96	9.55
37.65	9	XVI, I, 18	III, 18	14	I, 5		36.52	19.84	7.54	5.18	10.15	15.30	8.55
38.04	8	XVI, I, 18	III, 19	14	I, 5		35.09	19.85	7.10	5.34	11.62	14.80	9.75
39.13	10	XVI, I, 18	III, 18	14	I, 5		36.11	19.68	8.61	5.11	10.22	15.10	9.12
39.28	6	XVI, I, 17	III, 17	14	I, 5		35.21	17.18	9.04	5.88	12.35	16.04	9.37
40.16	7	XVI, I, 19	III, 17	14	I, 5	16+16	36.98	20.22	7.80	5.13	11.58	15.34	9.41
41.55	14	XVI, I, 18	III, 18	14	I, 5		36.05	19.49	8.42	4.65	12.30	16.00	8.18
41.66	12	XVI, I, 18	III, 18	13	I, 5		34.57	21.80	10.15	5.16	10.25	13.87	9.67
45.24	13	XVI, I, 19	III, 18	13	I, 5	16+16	34.39	19.69	9.46	4.69	10.74	14.50	8.75
83.93	3	XVI, I, 18	III, 17	14	I, 5		33.48	19.16	9.64	5.43	9.94	13.84	7.35
88.28	5	XVI, I, 17	III, 18	15	I, 5	16+16	33.19	21.21	10.38	5.46	10.00	13.62	7.29
98.00	4	XVI, I, 18	III, 17	14	I, 5		30.29	18.05	9.45	5.26	9.02	12.46	7.04
113.57	1	XVI, I, 19	III, 18	14	I, 5		31.47	21.27	9.49	5.84	9.33	13.29	6.73
115.87	2	XVI, I, 19	III, 18	14	I, 5	16+16	30.59	20.65	10.57	6.28	9.71	12.70	7.21

D: dorsal fin, A: anal fin, P₁: pectoral fin, P₂: pelvic fin, V: vertebrae.

a: head length, b: body depth, c: body width, d: least depth of caudal peduncle, e: snout percular spine, j: length of pelvic spine, k: length of longest dorsal spine, l: length of longest p: distance from snout to dorsal fin origin, q: distance from snout to pectoral fin origin, r: distance from snout to dorsal fin origin, u: distance from snout to anus. SL: standard length.

Neopinnula orientalis

(as percent of standard length)													
h	i	j	k	l	m	n	o	p	q	r	s	t	u
11.63	15.35	24.81	33.33	13.18	14.00	55.81	18.60	43.41	42.64	54.26	73.64	25.28	70.54
11.53	12.90	23.66	38.40	11.52	—	59.14	18.13	44.09	43.78	52.84	76.50	26.11	—
11.87	16.17	22.26	40.21	11.13	14.84	56.38	17.06	41.10	44.51	60.09	70.47	14.84	70.03
11.72	10.29	18.49	34.38	9.77	16.28	58.33	15.63	39.71	40.76	49.48	72.92	24.09	71.61
10.56	—	21.35	36.00	12.02	—	55.96	19.66	37.64	42.47	55.62	79.78	25.28	74.16
9.73	15.57	21.62	37.84	11.89	17.41	59.03	19.46	38.92	47.14	49.73	76.00	17.30	74.59
7.35	8.23	20.57	32.91	7.35	—	56.81	15.67	36.43	39.18	50.93	70.81	26.05	69.93
9.71	14.56	23.40	33.98	10.49	16.70	56.50	21.36	37.09	41.26	57.28	78.16	25.24	76.70
7.66	8.87	16.13	27.82	—	16.13	57.66	17.10	35.48	40.16	55.56	80.08	21.77	79.84
8.14	11.63	22.87	32.17	11.47	17.21	58.53	19.00	36.43	39.15	54.26	78.29	25.97	77.13
8.53	13.86	23.99	32.37	—	15.99	61.69	18.20	36.94	41.13	54.15	78.14	24.30	75.10
8.71	11.91	20.83	30.51	5.95	16.74	64.36	17.71	33.48	39.43	52.08	71.80	20.46	69.57
7.80	—	20.37	26.31	—	15.88	60.43	17.96	32.46	41.44	58.01	79.42	24.52	77.35
6.97	12.30	22.27	29.80	11.29	15.68	63.05	15.06	34.94	40.21	53.95	77.60	23.53	74.34
8.44	9.88	22.20	28.77	9.38	16.26	65.04	18.20	34.71	40.03	52.53	77.24	26.02	75.67
7.44	7.13	21.09	28.85	11.17	16.13	62.03	17.74	35.67	38.46	52.11	78.78	25.74	74.44
7.36	8.92	21.19	25.08	9.75	17.28	63.82	16.72	34.28	40.41	54.18	76.92	23.69	73.86
7.23	7.28	20.96	25.96	—	14.31	64.05	18.53	33.28	35.95	51.43	70.65	20.86	70.35
6.24	5.60	21.04	19.04	8.91	14.49	62.42	18.23	31.83	33.53	48.37	75.26	28.22	73.83
6.70	7.18	21.53	20.36	10.00	13.75	69.77	17.36	32.10	36.45	49.24	76.47	27.23	74.51
6.02	7.23	20.05	19.37	—	15.07	65.05	20.81	32.14	34.59	79.74	75.29	25.23	72.84
6.40	6.75	20.37	20.53	8.38	13.58	64.03	18.94	31.86	36.20	48.70	72.60	26.54	72.18
6.76	5.23	19.15	20.16	9.32	—	66.67	20.36	30.99	36.67	45.36	73.79	24.80	71.27
6.51	6.23	18.40	18.51	8.72	13.84	63.56	20.53	33.59	36.90	49.40	73.74	23.42	70.78
6.38	3.51	19.45	18.68	8.51	15.52	63.28	20.31	33.31	36.53	46.61	69.24	23.78	67.17
6.35	3.41	16.15	15.66	7.35	14.71	63.77	19.97	30.78	32.74	45.14	71.37	24.27	68.37
6.24	3.66	16.88	13.90	6.65	17.45	61.07	20.36	31.35	33.28	48.07	71.74	27.31	69.63
5.71	4.52	16.60	13.15	6.91	14.87	63.40	19.95	31.87	33.89	45.21	70.17	24.89	69.40
6.81	3.68	17.48	15.77	7.62	17.46	62.91	20.43	32.15	34.83	47.53	73.05	27.87	70.29
6.75	2.94	16.69	14.57	7.62	15.46	62.54	21.70	29.90	35.34	45.47	70.66	25.68	68.59
3.26	4.25	15.94	14.59	6.24	15.15	64.87	21.66	32.08	34.00	44.40	70.62	26.02	68.71
6.50	3.61	13.37	13.35	6.85	13.42	63.45	21.26	32.46	36.98	48.38	74.28	30.88	71.97
6.02	3.59	16.13	13.43	7.82	13.62	62.09	20.82	31.82	35.50	46.64	67.53	20.79	63.66
6.12	2.41	15.84	13.30	8.52	14.40	64.47	21.60	31.30	32.38	44.10	72.01	27.17	69.01
5.84	2.92	14.35	12.31	6.70	13.67	62.62	22.02	31.10	32.94	44.61	70.67	27.50	66.85
6.15	—	8.98	9.19	4.34	15.31	63.30	21.88	31.60	31.40	41.32	70.42	29.10	66.87
5.88	—	5.88	7.89	4.28	15.24	62.95	21.41	30.15	30.92	40.24	69.45	30.21	66.01
5.41	—	10.32	7.39	3.88	13.78	58.67	20.63	29.81	29.60	37.79	65.58	27.95	63.24
6.39	—	6.37	9.01	5.19	14.31	64.01	22.99	29.93	30.04	41.10	69.78	28.90	66.44
6.79	—	10.37	7.68	4.07	13.85	68.15	25.96	29.54	28.77	39.35	68.58	30.21	65.11

length f: length of upper jaw, g: length of orbit, h: interorbital width, i: length of pre-anal spine, m: length of pectoral fin, n: length of dorsal fin base, o: length of anal fin base, tance from snout to pelvic fin origin, s: distance from snout to anal fin origin, t: distance from