

A detailed morphological measurement of the seventh specimen of the Indonesian coelacanth, *Latimeria menadoensis*, with a compilation of current morphological data of the species

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ABSTRACT — Seventh specimen of Indonesian coelacanth, *Latimeria menadoensis* POUYAUD *et al.*, 1999 was caught off Sulawesi, Indonesia on November 5, 2014. This specimen is a female, 1276 mm in standard length. Counts and measurements on the external morphology of the specimen was carried out by a team of Japanese and Indonesian researchers, providing the most comprehensive data on the morphology of this species. All available data on morphology of *L. menadoensis* is compiled together to provide insights into the biology and taxonomy of extant coelacanths.

INTRODUCTION

Discovery of a living coelacanth, *Latimeria chalumnae*, SMITH 1939 from south western Africa was a major milestone for biology and paleontology in the twentieth century (SMITH, 1939a, b, c). This was followed by yet another major discovery, that of a second species, Indonesian coelacanth, *L. menadoensis* POUYAUD *et al.*, 1999 from the Manado island, Indonesia (POUYAUD *et al.*, 1999). Seven specimens of *L. menadoensis* were caught to date.

POUYAUD *et al.* (1999) described *L. menadoensis* based on a single specimen caught on July 30, 1998 (ERDMANN *et al.*, 1998). They conducted comparison of DNA of *L. menadoensis* and *L. chalumnae*, concluding that the two are different species belonging to the same genus. However, POUYAUD *et al.* (1999) provided little information on the morphology of *L. menadoensis*. POUYAUD *et al.* (1999) provided some morphological differences between the two species based on measurements expressed as percentages (%) of standard length, such as head size, placement of first dorsal fin, body depth, length of caudal peduncle (caudal fin lobe) and length of caudal fin. However, basic morphological information of the holotype specimen, such as meristic counts and morphological measurement data such as standard length, total length, head length, body height were not provided in their paper. Therefore, we must refer to ERDMANN *et al.* (1999) for meristic counts and some

morphological measurements of the holotype. Even with these two papers combined, counts and measurements available of the holotype does not provide enough detailed information on the morphology of *L. menadoensis*. A diagnosis of *L. menadoensis* based on morphology is not available.

Lack of detailed morphological data of *L. menadoensis* is a great loss to the scientific community in general, especially for ichthyology, paleontology, developmental biology and evolutionary biology. Lack of such information is a potential threat for conservation and protection of extant coelacanths and their habitats. Extant coelacanths are heavily protected by the local governments and their international trade is strictly prohibited and monitored by CITES. In order to carry out a truly effective monitoring and prevention of illicit international trade of extant coelacanth in a timely and effective manner, presence of diagnostic character based on morphology distinguishing the two extant coelacanth is of utmost importance. This is because DNA analysis require time and money, and must be carried out by trained professionals in a well-equipped laboratory. There still remain much to be studied on the taxonomy of *L. menadoensis*.

This paper provides the first detailed morphological measurement of *L. menadoensis*, made on the seventh specimen of the species. Morphological information currently available on *L. menadoensis* is compiled together to provide additional information on the morphology of the species as a

first step for a re-description of this species.

MATERIALS AND METHODS

The seventh specimen of *L. menadoensis*, CCC No. 299 (Figs. 1, 2)

The specimen was captured on November 5, 2014, off the coast of Gangga Island near Sulawesi Indonesia, by a bottom gill net with 400 m rope attached. CCC No. 299 is a female, 129.6 mm in Standard Length, weighing 22 Kg. Immediately after capture, it was refrigerated and was later frozen. It was transported to Aquamarine Fukushima (AMF), Iwaki, Japan, as part of an ongoing joint research project between AMF and Indonesian LIPI. On November 3, 2016, it was thawed and on the next day (November 4, 2016) dissected. After initial dissection, the specimen was fixed in 10% formalin. Preservation fluid was later transferred from 10% formalin to 50% Isopropanol and was placed on public display at AMF, together with *L. chalumnae*. This was the first exhibit in the world where the two species of extant *Latiemria* were displayed simultaneously.

Abbreviations of institutions

AMF: Aquamarine Fukushima. CCC: Coelacanth Conservation Council. LIPI: Indonesian Institute of Sciences (Indonesian: Lembaga Ilmu Pengetahuan Indonesia).

Counts and Measurements

In the present study, names of fins follow that of FOREY (1998) which differ from UYENO (1991). Dorsal lobe of caudal fin, ventral lobe of caudal fin and supplementary lobe of caudal fin in FOREY (1998) are 3rd dorsal fin, 2nd anal fin and caudal fin of UYENO (1991), respectively. Fin names are abbreviated in the tables as follows. A₁: Anal fin. A₂: Ventral lobe of caudal fin. C: Supplementary lobe of caudal fin. D₁: First dorsal fin. D₂: Second dorsal fin. D₃: Dorsal lobe of caudal fin. P₁: Pectoral fin. P₂: Pelvic fin. Measurements are abbreviated as follows. HL: Head length. SL: Standard length. TL: Total length.

On May 31, 2017, a detailed morphological measurement of the specimen was conducted at AMF. Second measurement, focusing mainly on the cephalic region, was conducted on December 19, 2017 by the first and second authors.

A point to point measurement was made, with the tip of the snout and posterior most edge of caudal lobe as two datum points. A simple jig made from plywood, aluminum tube and carbon rod were secured to the measuring table at these points (Fig. 3). Measurements were made to the nearest 1 mm using either a steel tape measure, stainless steel ruler or a dial caliper where it suited the most.

Head length was measured in two ways, to make comparison possible with both fossil and extant species. From tip of snout to posterior tip of operculum (2 in Fig. 2A) and

from snout to posterior tip of fleshy flap of operculum (3 in Fig. 2A).

Fin area was measured using the following procedures. Outline of each fin was transferred onto A4 sized clear OHP sheet. Then fin outline was copied onto 157 g/m² card stock using carbon paper. Each fin was then cut out, weighed and the weight was converted to area in cm².

Comparative data of *L. menadoensis* was obtained from literature (ERDMANN *et al.*, 1999; POUYAUD *et al.*, 1999) as well as unpublished data accumulated by the authors.

RESULTS AND DISCUSSION

A list of all seven specimens of *L. menadoensis* is provided in Table 1. Photos of 6 specimens currently registered and preserved are shown in Fig. 4. The very first *L. menadoensis*, caught on September 18, 1997, which led to the discovery of the species was lost (ERDMANN, 1999). Only two other specimens, CCC No. 175 and 299 are fixed and well preserved for detailed morphological study. The other specimens are on display as stuffed specimens and are kept in several institutions such as at Sam Ratulangi University, Sea World Indonesia.

Images of the seventh specimen are shown in Fig. 1. Meristic counts are listed in Table 2. Measurements made on the fin and fin rays are presented in Tables 3 and 4 respectively. Body measurements are listed in Tables 5 and 6. Together with data, each length are expressed as percentage (%) of SL, TL and HL (to posterior tip of operculum and to posterior tip of fleshy operculum flap). See Fig. 2A, B for details. In order to facilitate future comparisons with published morphological data of *L. chalumnae*, measurements made according to FOREY (1998) are presented in Table 7.

A compilation of available meristic information of all seven specimens are provided in Table 8. There are some differences in the meristic counts made on the holotype (CCC 175) between ERDMANN *et al.* (1999) and POUYAUD *et al.* (1999), so both data are listed. All other counts were made by the authors.

Tables 9–11 provide body proportion of *L. menadoensis* specimens expressed as percentage of SL, TL and HL, respectively.

The seventh specimen has the highest counts in the pectoral, pelvic, anal and caudal fin rays. All other values are close to average values calculated from available data. The number of lateral line scales exceed the holotype by 15. This may indicate miscount of scales by ERDMANN *et al.* (1999) because scales on the caudal lobe are very small and could have been missed.

The seventh specimen possess a smaller head (measured to posterior tip of operculum) compared to other specimens. However, this is not so apparent when head length measured to the posterior tip of fleshy operculum flap is compared (Tables 9, 10). This comparison is based on three individuals which are

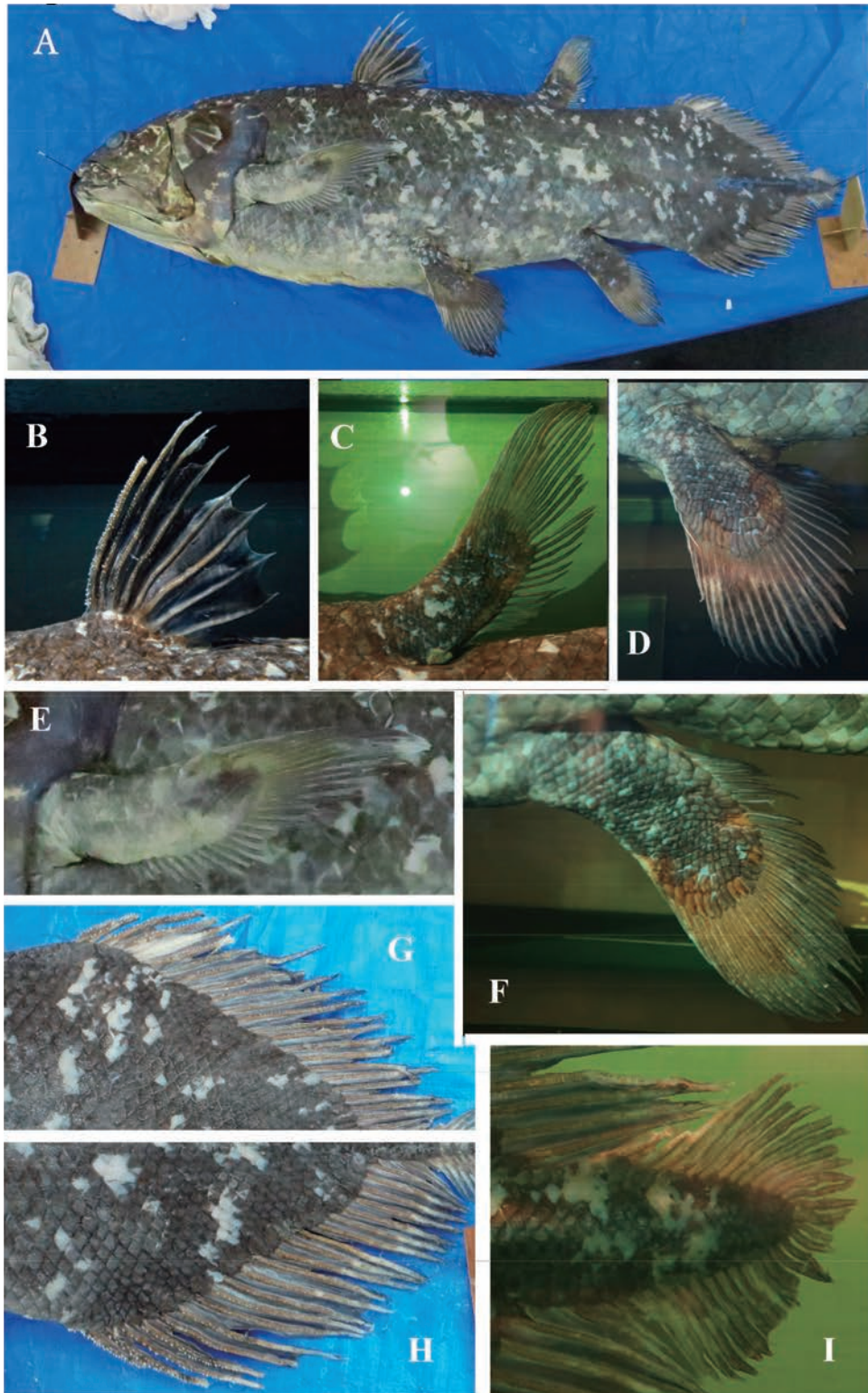


Fig. 1. Seventh specimen of Indonesian coelacanth, *Latimeria menadoensis*, CCC No. 299. A, Left side of body. B, First dorsal fin (D_1). C, Second dorsal fin (D_2). D, Pelvic fin (P_2). E, Pectoral fin (P_1). F, Anal fin (A_1). G, Dorsal lobe of the caudal fin (D_3). H, Ventral lobe of caudal fin (A_2). I, Supplementary lobe of caudal fin (C).

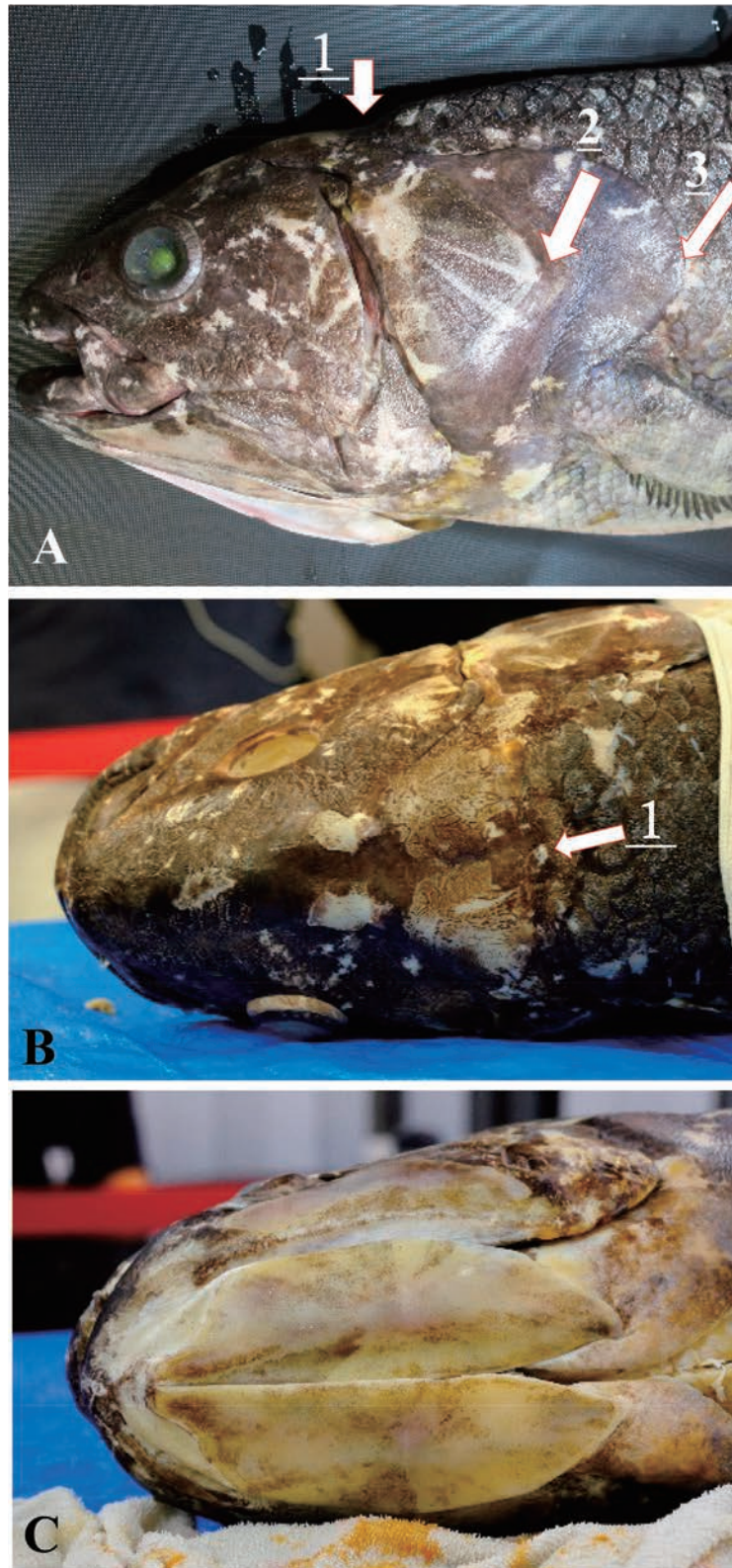


Fig. 2. Cephalic region of Indonesian coelacanth, *Latimeria menadoensis*, CCC No. 299. A, Left lateral view. 1: Dorsal tip of head. 2, Posterior tip of operculum. 3, Posterior tip of fleshy operculum flap. B, Dorsal view. 1, Dorsal tip of head. C, Gular plates.

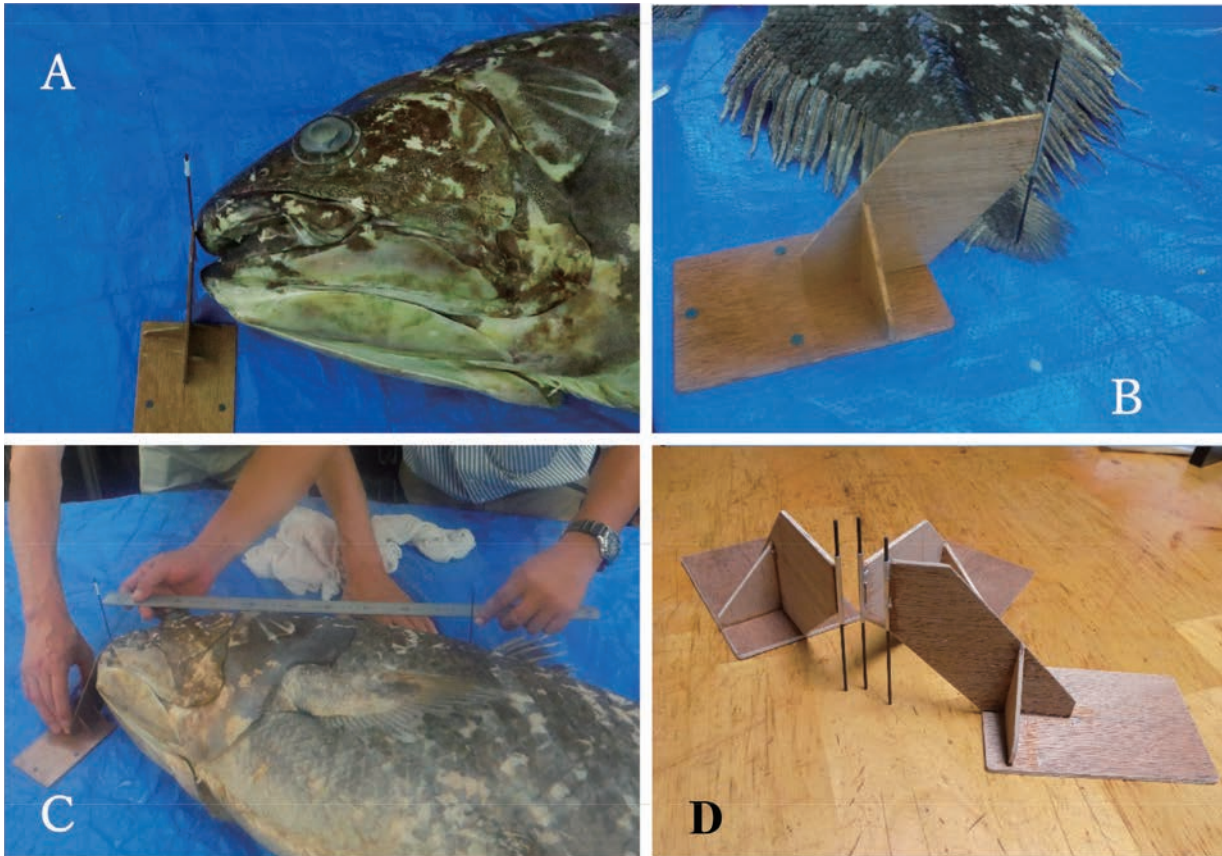


Fig. 3. Jig used for measurement. A, Jig secured to the measurement table at the snout. B, Jig secured to the measurement table at the distal tip of the caudal lobe. Note the offset of the neck of the jig and how bottom of the carbon fiber rod is touching the distal tip of caudal lobe. C, How measurement was made, point to point. D, Three jigs made for measurement.

Table 1. A list of *Latimeria menadoensis* specimens known to date together with sampling data.

No.	1	2	3	4	5	6	7
CCC No.	174	175	215	225	254	287	299
Date	September 18, 1997	July 30, 1998	May 19, 2007	November 25, 2008	September 16, 2009	July 21, 2011	November 5, 2014
Locality	Manado	Manado, Tua Island	Manado	Talise Island	Talise Island	Amurang	Gangga Island
Gear	Gill net	Gill net	Hooks	Gill net	Gill net	Hooks	Gill Net
Sex	unknown	F	F	M	M	M	F
TL (cm)	130*	124	129	110	116	105	130
BW (kg)	30*	29.2	51.0	20	27.0	13.1	22
Status	lost	Holotype #MZB10003 Fixed and preserved.					On loan to AMF. Preserved in Isoplopanol.
Remark		3 eggs	25 eggs			Plastic debris in stomach.	
Reference	*: Approximate value from ERDMANN (1999)	ERDMANN <i>et al.</i> (1999)	This study	This study	This study	This study	This study

all females, and two females with shorter fleshy operculum flap are reported to have had eggs. This may indicate morphological change related to maturation in females.

Among the seven *L. menadoensis* specimens reported, three males and females are known. The sex of remaining individual is not recorded. This brings the sex ratio to 1:1. Males are smaller than females. Average male TL was 110.3 cm and had a range of 105 to 116 cm TL. Females were larger with average TL of 127.7 cm and range of 124 to 130 cm TL. This

indicates possible sexual dimorphism in size of the species.

Of seven known specimens of *L. menadoensis*, only two, holotype and the seventh specimen mentioned in this study are available for detailed morphological study because others were either lost or are now stuffed specimens. This paper is the first account of a truly detailed morphological counts and measurements made on the species. Because there are some discrepancies in published counts and measurements made on the holotype, it is necessary to conduct a detailed re-examination

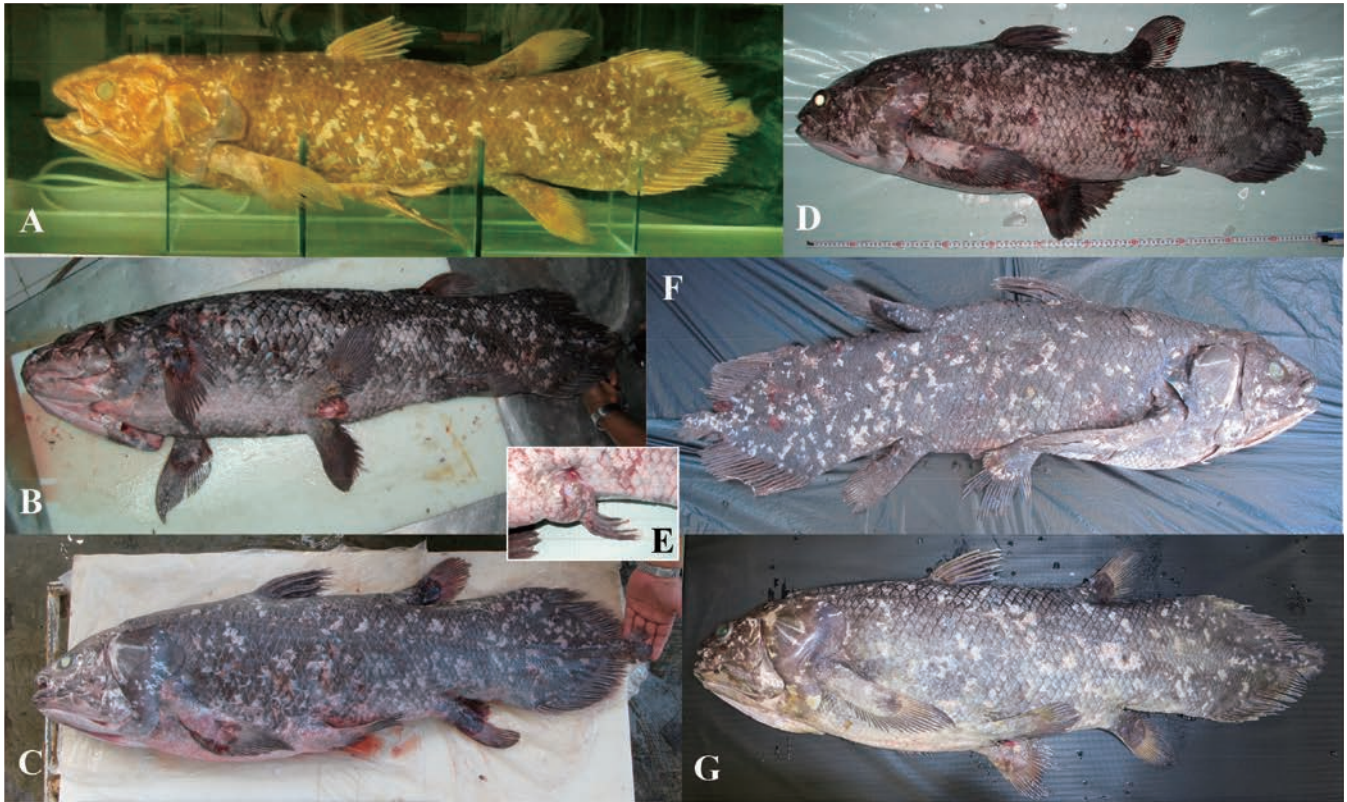


Fig. 4. Images of Indonesian coelacanth *Latimeria menadoensis* specimens. See Table 1 for details of each specimen. A, Holotype. #MZB10003, CCC No. 175. Female, 124 cm TL. B, CCC No. 215. Female, 129 cm TL. C: CCC No. 225. Male, 114 cm TL. D, CCC No. 254. Male, 116 cm TL. E, Pelvic fin of CCC No. 254. F, CCC No. 287. Male, 105 cm TL. G, CCC No. 299. Female, 130 cm TL.

Table 2. Merisitic characters of seventh specimen of *Latimeria menadoensis*. CCC 299.

Fin	Counts
D ₁	8
D ₂	27
D ₃	22
P ₁	
Left	32
Right	30
P ₂	
Left	36
Right	35
A ₁	31
A ₂	21
C	
Upper lobe	15
Lower lobe	19
Scales	
Lateral line	97
Transverse scales	
D ₁ origin	26
D ₂ origin	22
A ₁ origin	23

and measurement of the holotype, leading to a re-description of *L. menadoensis* with diagnosis of *L. menadoensis*. Already, there are numerous detailed monographs published on *L. chalumnae* (SMITH, 1940; MILLOT, 1954; FOREY, 1998) providing comparative data and information. Similar works are waiting to be conducted on *L. menadoensis*. Diagnosis of *Latimeria* species is vital for conservation and management of the two most precious marine organisms. We have just reached a starting point of *L. menadoensis* research.

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Table 3. Fin measurements on the seventh *Latimeria menadoensis* specimen. CCC299. in mm.

	P ₁ *	P ₂ *	D ₁	D ₂	D ₃	A ₁	A ₂	C
Width of lobe or base of fin	54.01	60.66	91	51.46	226.5	54.34	199.5	43
length of whole fin	250	200.5	165	209.5		201.5		109
lobe	140	111.88		112.08		117.78		86.7
Area of whole fin	in cm ²							
lobe	182	170	193	151	151	135	143	68
fin	67	90		58		65		29
	103	92		92		70		40

*: Left fin

Table 4. Length of each fin ray of seventh specimen of *Latimeria medoensis*. CCC299. in mm.
Fin rays of A₁ were not measured.

	P ₁	P ₂	D ₁	D ₂	D ₃	A ₂	C upper lobe	C lower lobe
1	14.8	4.7	Broken	7.0	32.1	54.5	Broken	43.0
2	19.7	9.7	169.0	24.5	Fused	Broken	Broken	Broken
3	49.0	11.0	161.0	46.7	to 1	Broken	Broken	Broken
4	58.5	24.8	151.0	Broken	Broken	Broken	38.6	34.5
5	77.0	Broken	148.0	80.1	Broken	Broken	42.1	37.9
6	95.0	49.4	133.0	85.2	91.4	105.0	Broken	40.0
7	111.0	69.5	115.0	86.9	Broken	Broken	35.3	38.0
8	121.0	76.7	100.0	87.4	Broken	99.9	Broken	36.3
9	117.0	83.2	Broken	94.2	102.3	Broken	36.1	33.3
10	113.0	84.8	Broken	98.0	Broken	94.4	26.9	33.8
11	112.0	86.8	Broken	96.8	88.0	Broken	30.3	Broken
12	96.5	85.7	Broken	Broken	95.7	Broken	30.0	Broken
13	87.0	84.6		Broken	Broken	Broken	27.5	Broken
14	79.0	85.7		85.0	Broken	Broken	25.4	25.7
15	74.0	89.7		81.8	Broken	Broken	22.0	25.1
16	65.0	91.2		Broken	86.8	Broken		Broken
17	60.0	89.4		Broken	Broken	73.2		Broken
18	Broken	76.8		Broken	Broken	66.6		19.3
19	Broken	74.1		Broken	76.7	66.6		20.6
20	Broken	67.0		Broken	Broken	64.8		
21	Broken	65.2		48.2	Broken	63.6		
22	Broken	60.7		40.3	67.1			
23	Broken	56.1		41.5	66.3			
24	Broken	Broken		43.2				
25	Broken	47.5		39.5				
26	Broken	42.9		28.5				
27	Broken	34.4		Broken				
28	Broken	28.6		37.5				
29	Broken	25.4						
30	23.0	26.3						
31	13.0	25.4						
32		20.6						
33		16.2						
34		18.2						
35		18.7						
36		15.9						
37		Broken						

Table 5-1. Body measurements of the seventh specimen of *Latimeria menadoensis*. CCC No. 299 in mm. % of each part against SL, TL and HL are also listed.

	Data	% of SL	% of TL	% of HL*	% of HL**
Total length	1296	101.6	100.0	520.5	369.2
Standard length	1276	100.0	98.5	512.4	363.5
Head length to posterior tip of operculum	249	19.5	19.2	100.0	70.9
Head length to posterior tip of fleshy flap of operculum	351	27.5	27.0	140.8	100.0
Snout to					
D ₁ origin	481	37.7	37.1	193.0	136.9
D ₂ origin	750	58.7	57.8	301.0	213.5
D ₃ origin	1007	78.9	77.7	404.4	286.9
distal tip of D ₃	1200	94.0	92.6	481.9	341.9
P ₁ insertion	322	25.2	24.8	129.3	91.7
Tip of P ₁	562	44.0	43.3	225.5	160.0
P ₂ insertion	579	45.4	44.7	232.5	165.0
Anus	632	49.5	48.7	253.6	179.9
A ₁ origin	814	63.8	62.8	326.7	231.8
A ₂ origin	1016	79.6	78.4	408.0	289.5
distal tip of A ₂	1194	93.6	92.1	479.5	340.2
Length between each point to tip of caudal lobe					
D ₁ origin	833	65.2	64.2	334.3	237.2
D ₂ origin	561	43.9	43.2	225.1	159.7
D ₃ origin	307	24.1	23.7	123.3	87.5
distal tip of D ₃	61	4.7	4.7	24.3	17.2
P ₁ insertion	962	75.4	74.2	386.1	273.9
Tip of P ₁	712	55.8	54.9	285.9	202.8
P ₂ insertion	724	56.7	55.8	290.6	206.1
Anus	682	53.4	52.6	273.7	194.2
A ₁ origin	490	38.4	37.8	196.8	139.6
A ₂ origin	289	22.6	22.3	116.1	82.3
distal tip of A ₂	85	6.6	6.5	33.9	24.1
distal tip of head	926	72.5	71.4	371.7	263.7
Depth of caudal lobe	36	2.8	2.8	14.3	10.2

*: Length from snout to posterior tip of operculum. **: Length from snout to posterior tip of fleshy flap of operculum.

Table 5-2. Body measurements of the seventh specimen of *Latimeria menadoensis*. CCC No. 299 in mm. % of each part against SL, TL and HL are also listed.

	Data	% of SL	% of TL	% of HL*	% of HL**
Length between					
D ₁ origin to D ₂ origin.	213	17	16	85	61
D ₂ origin to D ₃ origin	213	17	16	85	61
Anus to A ₁ origin	152	12	12	61	43
A ₁ origin to A ₂ origin	178	14	14	71	51
Body depth at					
D ₁ origin	339	27	26	136	97
D ₂ origin	289	23	22	116	82
D ₃ origin	256	20	20	103	73
P ₁ insertion	297	23	23	119	84
Tip of P ₁	332	26	26	133	95
P ₂ insertion	325	25	25	130	92
Anus	319	25	25	128	91
A ₁ origin	246	19	19	99	70
Dorsal tip of head	206	16	16	83	59

*: Length from snout to posterior tip of operculum. **: Length from snout to posterior tip of fleshy flap of operculum.

Table 6-1. Measurements made around the cephalic region of the seventh specimen of *Latimeria menadoensis*. CCC No. 299. in mm.

	Data	% of SL	% of TL	% of HL*	% of HL**
Head length to posterior tip of operculum	249	19.5	19.2	100.0	70.9
Head length to posterior tip of fleshy flap of operculum	351	27.5	27.1	141.0	100.0
Head depth	351	27.5	27.1	141.0	100.0
Gape	61	4.8	4.7	24.4	17.3
Snout length	78	6.1	6.0	31.3	22.2
Upper jaw length	114	8.9	8.8	45.8	32.5
Lower jaw length	108	8.4	8.3	43.2	30.6
Lower tip of eye to upper jaw	23	1.8	1.8	9.4	6.6
Posterior margin of eye to					
Preoperculum	86	6.8	6.7	34.7	24.6
Operculum	162	12.7	12.5	65.1	46.2
Fleshy tip of operculum	238	18.6	18.3	95.4	67.7
Body width at fleshy tip of operculum	305	23.9	23.5	122.5	86.9
Head depth at tip of operculum	277	21.7	21.4	111.2	78.9
Diameter of					
Eye					
Vertical	47	3.7	3.6	18.9	13.4
Horizontal	46	3.6	3.6	18.6	13.2
Iris					
Vertical	35	2.8	2.7	14.1	10.0
Horizontal	33	2.6	2.5	13.2	9.4
Proximal (lower) nares	7	0.6	0.6	3.0	2.1
Distal (upper) nares	8	0.6	0.6	3.1	2.2
Interorbital width	93	7.3	7.2	37.5	26.6

*: Length from snout to posteriro tip of operculum. **: Length from snout to posterior tip of fleshy flap of operculum.

Table 6-2. Measurements made around the cephalic region of the seventh specimen of *Latimeria menadoensis* CCC No. 299. in mm.

	Data	% of SL	% of TL	% of HL*	% of HL**
Length from snout to					
Proximal (lower) nares	60	4.7	4.6	24.0	17.0
Posterior tip of proximal nares	60	4.7	4.6	24.0	17.0
Distal (upper) nares	67	5.3	5.2	26.9	19.1
Posterior tip of distal nares	73	5.7	5.6	29.3	20.8
Anterior tip of gular plate	65	5.1	5.0	26.1	18.5
Posterior tip of gular plate	235	18.4	18.1	94.4	67.0
Dorsal tip of supratemporal	191	15.0	14.7	76.7	54.4
Abdominal tip of supratemporal	193	15.1	14.9	77.5	55.0
Posterior tip of supratemporal	199	15.6	15.4	79.9	56.7
Posterior tip of operculum	274	21.5	21.1	110.0	78.1
Abdominal tip of operculum bottom	220	17.2	17.0	88.4	62.7
Dorsal tip of operculum	238	18.7	18.4	95.6	67.8
Anterior tip of operculum	211	16.5	16.3	84.7	60.1
Dorsal tip of suboperculum	202	15.8	15.6	81.1	57.5
Abdominal tip of suboperculum	226	17.7	17.4	90.8	64.4
Anterior tip of angular	77	6.0	5.9	30.9	21.9
Posterior tip of angular	194	15.2	15.0	77.9	55.3

*: Length from snout to posteriro tip of operculum. **: Length from snout to posterior tip of fleshy flap of operculum.

Table 6-3. Measurements made around the cephalic region of the seventh specimen of *Latimeria menadoensis* CCC No.299. in mm.

	Data	% of SL	% of TL	% of HL*	% of HL**
Supratemporal					
Height (transvers)	25	2.0	2.0	10.2	7.2
Width (sagittal)	10	0.8	0.8	4.1	2.9
Operculum					
Height (transvers)	109	8.5	8.4	43.7	31.0
Width (sagittal)	89	6.9	6.8	35.5	25.2
Antero-dorsal margin	34	2.7	2.6	13.6	9.7
Postero-dorsal margin	77	6.0	5.9	30.8	21.9
Antero-abdominal margin	102	8.0	7.9	41.1	29.2
Postero-abdominal margin	80	6.2	6.1	31.9	22.6
Preoperculum					
Length (sagittal)	53	4.1	4.1	21.2	15.1
Width anterior of notch	20	1.6	1.6	8.1	5.7
Width posterior of notch	20	1.6	1.5	8.0	5.6
Depth of notch	3	0.2	0.2	1.0	0.7
Width of notch	17	1.3	1.3	6.7	4.8
Anterior tip to notch	32	2.5	2.5	12.9	9.1
Posterior tip of notch to posterior tip of plate	13	1.0	1.0	5.3	3.8
Suboperculum					
Height (transvers)	50	3.9	3.8	19.9	14.1
Width (sagittal)	5	0.4	0.4	1.8	1.3
Postero-dorsal margin	47	3.7	3.6	19.0	13.5
Postero-abdominal margin	37	2.9	2.8	14.7	10.4
Depth of notch on anterior side	5	0.4	0.4	1.8	1.3
Angular					
Length (sagittal)	125	9.8	9.6	50.1	35.5
Maximum width (transverse)	38	3.0	2.9	15.3	10.8
Antero-dorsal margin	64	5.0	4.9	25.6	18.1
Postero-dorsal margin	78	6.1	6.0	31.3	22.2
Gular plate					
Length	187	14.7	14.4	75.1	53.3
Width	60	4.7	4.6	24.0	17.1
Notch length	50	3.9	3.8	20.0	14.2
Notch depth	7	0.5	0.5	2.8	2.0

*: Length from snout to posterior tip of operculum. **: Length from snout to posterior tip of fleshy flap of operculum.

Table 7. Measurements on seventh specimen of *Latimeria menadoensis* using method described in FOERY, 1998. in mm.

SL	1198
PD ₁	448
PD ₂	726
HL	278
HD	277
PV	555
PA	810
Snout to A ₂ origin*	812
TL (D ₃ origin to origin of caudal lobe)	89
Body width at posterior end of head*	305

*: Not measured in FOERY, 1998.

Table 8: Meristic counts of *Latimeria menadoensis*. Only specimen with data is listed.

CCC no.	175	215	254	299	mean	minimum	maximum	n
Total length (cm)	124	129	116	130	125	116	130	4
Lateral line scales	82			97	90	82	97	2
P ₁	30	30	30	32	31	30	32	4
P ₂	33	35	33	36	34	33	36	4
D ₁	8	8	8	8	8	8	8	4
D ₂	28	27	25	28	27	25	28	4
D ₃	24	23	23	22	23	22	24	4
A ₁	30	28	5	31	24	5	31	4
A ₂	33	24*	23	22	21	21	33	4
C		30**	29	31	34	29	34	3
Reference	ERDMANN <i>et al.</i> (1999)	POUYAUD <i>et al.</i> (1999).	This study	This study	This study			

*: Rays on ventral caudal lobe of POUYAUD *et al.* (1999). **: Rays on supplementary caudal lobe of POUYAUD *et al.* (1999).

Table 9. Body proportion of *Latimeria menadoensis* expressed as % of SL. Only specimen with data are listed.

CCC No.	175	215	254	299				
Sex	F	F	M	F				
Standard length (cm)	119	127	108	128				
	% of SL	% of SL	% of SL	% of SL	mean	minimum	maximum	n
Total length	104.2	106.7	107.4	101.6	105.0	101.6	107.4	4
Head length to posterior tip of operculum	21.8	23.0	27.8	19.5	23.0	19.5	27.8	4
Head length to posterior tip of fleshy flap of operculum	27.7	26.9		27.5	27.4	26.9	27.7	3
Snout length		7.2		6.1	-	6.1	7.2	2
Upper jaw length		10.2		8.9	-	8.9	10.2	2
Lower jaw length		16.0		8.5	-	8.5	16.0	2
Eye diameter	3.4	3.7	4.2	3.6	3.7	3.4	4.2	4
Interdorsal distance (D ₁ origin to D ₂ origin)		22.0		16.6	-	16.6	22.0	2
Maximum body depth at D ₁ origin	21.0		31.0	26.6	26.2	21.0	31.0	3
Depth of head at dorsal tip of head		17.7		16.1		16.1	17.7	2
Maximum caudal peduncle depth (D ₃ origin to A ₂ origin)		19.8	19.0		-	19.0	19.8	2
Length of caudal lobe		6.0		6.8	-	6.0	6.8	2
Depth of caudal lobe		3.0		3.4	-	3.0	3.4	2
Snout to								
P ₁			26.9	25.2	-	25.2	26.9	2
P ₂ insertion		49.6	46.3	45.4	47.1	45.4	49.6	3
D ₁ origin		36.9	39.8	37.7	38.1	36.9	39.8	3
D ₂ origin		58.9	59.3	58.8	59.0	58.8	59.3	3
D ₃ origin		81.1		78.9	-	78.9	81.1	2
Anus		68.0		63.8	-	63.8	68.0	2
Length of P ₁		21.9	21.8	19.6	21.1	19.6	21.9	3
Length of P ₂		15.0	18.5	15.8	16.4	15.0	18.5	3
Length of D ₁	15.1	13.5	16.6	12.9	14.5	12.9	16.6	4
Length of D ₂	18.5	17.1	18.1	16.5	17.5	16.5	18.5	4
Length of D ₃				17.8	-	17.8	17.8	1
Length of A ₁		16.5	9.7	15.8	14.0	9.7	16.5	3
Length of A ₂				15.7	-	15.7	15.7	1
Length of C ray		1.3		1.6	-	1.3	1.6	2
Length of base of D ₃		17.6	18.1	17.8	17.8	17.6	18.1	3
Length of base of A ₂		16.0	21.3	15.7	17.7	15.7	21.3	3

--:No data.

Table 10. Body proportion of *Latimeria menadoensis* expressed as % of TL. Only specimen with data are listed.

CCC No.	175	215	254	299				
Sex	F	F	M	F				
Total length (cm)	124	129	116	130				
	% of TL	% of TL	% of TL	% of TL	mean	minimum	maximum	n
Standard length	96.0	98.4	93.1	98.5	93.1	93.1	98.5	4
Head length to posterior tip of operculum	21.0	22.6	25.9	19.2	19.2	19.2	25.9	4
Head length to posterior tip of fleshy flap of operculum		26.5		27.1	26.5	26.5	27.1	2
Snout length		7.1		6.0	6.0	6.0	7.1	2
Upper jaw length		10.1		8.8	8.8	8.8	10.1	2
Lower jaw length		15.7		8.3	8.3	8.3	15.7	2
Eye diameter	3.2	3.6	3.9	3.5	3.2	3.2	3.9	4
Interdorsal distance (D ₁ origin to D ₂ origin)		21.7		16.4	16.4	16.4	21.7	2
Maximum body depth at D ₁ origin	20.2		28.9	26.2	20.2	20.2	28.9	3
Depth of head at dorsal tip of head		17.4		15.9	15.9	15.9	17.4	2
Maximum caudal peduncle depth (D ₃ origin to A ₂ origin)		19.5	17.7		17.7	17.7	19.5	2
Length of caudal lobe		6.0		6.7	6.0	6.0	6.7	2
Depth of caudal lobe		2.9		3.3	2.9	2.9	3.3	2
Snout to								
P ₁			25.0	24.8	24.8	24.8	25.0	2
P ₂ insertion		48.8	43.1	44.7	43.1	43.1	48.8	3
D ₁ origin		36.3	37.1	37.1	36.3	36.3	37.1	3
D ₂ origin		58.0	55.2	57.9	55.2	55.2	58.0	3
D ₃ origin		79.8		77.7	77.7	77.7	79.8	2
Anus		66.9		62.8	62.8	62.8	66.9	2
Length of P ₁		21.6	20.3	19.3	19.3	19.3	21.6	3
Length of P ₂		14.7	17.2	15.5	14.7	14.7	17.2	3
Length of D ₁	14.5	13.3	15.4	12.7	12.7	12.7	15.4	4
Length of D ₂	17.7	16.8	16.8	16.2	16.2	16.2	17.7	4
Length of D ₃				17.5	17.5	17.5	17.5	1
Length of A ₁		16.2	9.1	15.6	9.1	9.1	16.2	3
Length of A ₂				15.4	15.4	15.4	15.4	1
Length of C ray		1.3		1.6	1.3	1.3	1.6	2
Length of base of D ₃		17.3	16.8	17.5	16.8	16.8	17.5	3
Length of base of A ₂		15.7	19.8	15.4	15.4	15.4	19.8	3

-:No data.

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Table 11. Body proportion of *Latimeria menadoensis* expressed as % of HL. Only specimen with data are listed.

CCC No.	175		215		254		299		F	M	108	F	128	% of HL*	n	mean	minimum	maximum	% of HL*	n	mean	minimum	maximum
	F	119	% of HL**	% of HL**	F	127	% of HL*	% of HL*															
Standard length(cm)	476.9	375.8	441.8	377.2	386.7	520.5	369.2	456.5	366.7	520.5	4	374.1	369.2	377.2	3	374.1	369.2	377.2	3	374.1	369.2	377.2	3
Total length	457.7	360.6	434.9	371.3	360.0	512.4	363.5	441.3	360.0	457.7	4	365.2	360.6	371.3	3	365.2	360.6	371.3	3	365.2	360.6	371.3	3
Head length to posterior tip of operculum	78.8		85.4			70.9										78.4	70.9	85.4	3				
Head length to posterior tip of fleshy flap of operculum	126.9		117.1			141.0		128.3	117.1	141.0	3												
Snout length		31.2	26.6			31.3	22.2	-	30.0	31.3	2	-	22.2	26.6	2	-	22.2	26.6	2	-	22.2	26.6	2
Upper jaw length		44.5	38.0			45.8	32.5	-	44.5	45.8	2	-	32.5	38.0	2	-	32.5	38.0	2	-	32.5	38.0	2
Lower jaw length		69.5	59.4			43.4	30.8	-	43.4	69.5	2	-	30.8	59.4	2	-	30.8	59.4	2	-	30.8	59.4	2
Eye diameter	15.4	12.1	16.1	13.7	15.0	18.5	13.1	16.2	15.0	18.5	4	13.0	12.1	13.7	3	13.0	12.1	13.7	3	13.0	12.1	13.7	3
Interdorsal distance(D ₁ origin to D ₅ origin)		95.9	81.9			85.1	60.4	-	70.0	95.9	2	-	60.4	81.9	2	-	60.4	81.9	2	-	60.4	81.9	2
Maximum body depth at D ₁ origin	96.2	75.8			111.7	136.1	96.6	114.7	96.2	136.1	3	-	75.8	96.6	2	-	75.8	96.6	2	-	75.8	96.6	2
Depth of head at at dorsal tip of head		77.1	65.8			82.7	58.7	-	77.1	82.7	2	-	58.7	65.8	2	-	58.7	65.8	2	-	58.7	65.8	2
Maximum caudal peduncle depth(D ₃ origin to A ₂ origin)		86.3	73.7			68.3		-	68.3	86.3	2	-	73.7	73.7	2	-	73.7	73.7	2	-	73.7	73.7	2
Length of caudal lobe		21.9	18.7			34.9	24.8	-	18.7	34.9	2	-	18.7	24.8	2	-	18.7	24.8	2	-	18.7	24.8	2
Depth of caudal lobe		13.0	11.1			17.3	12.3	-	13.0	17.3	2	-	11.1	12.3	2	-	11.1	12.3	2	-	11.1	12.3	2
Snout to																							
P ₁					96.7	129.3	91.7	-	96.7	107.6	2	-	91.7	91.7	1	-	91.7	91.7	1	-	91.7	91.7	1
P ₂ insertion			215.8	184.2	166.7	232.5	165.0	205.0	166.7	232.5	3	-	165.0	184.2	2	-	165.0	184.2	2	-	165.0	184.2	2
D ₁ origin			160.3	136.8	143.3	193.2	137.0	165.6	143.3	193.2	3	-	136.8	137.0	2	-	136.8	137.0	2	-	136.8	137.0	2
D ₂ origin			256.2	218.7	213.3	301.2	213.7	256.9	213.3	301.2	3	-	213.7	218.7	2	-	213.7	218.7	2	-	213.7	218.7	2
D ₃ origin			352.7	301.2	404.4	286.9		-	352.7	404.4	2	-	286.9	301.2	2	-	286.9	301.2	2	-	286.9	301.2	2
Anus			295.5	252.3		326.9	231.9	-	236.7	326.9	2	-	231.9	252.3	2	-	231.9	252.3	2	-	231.9	252.3	2
Length of P ₁			95.2	81.3	78.3	100.4	71.2	91.3	78.3	100.4	3	-	71.2	81.3	2	-	71.2	81.3	2	-	71.2	81.3	2
Length of P ₂			65.1	55.6	66.7	80.7	57.3	70.8	65.1	80.7	3	-	55.6	57.3	2	-	55.6	57.3	2	-	55.6	57.3	2
Length of D ₁	69.2	54.5	58.6	50.0	59.7	66.3	47.0	50.7	58.6	69.2	4	50.5	47.0	54.5	3	50.5	47.0	54.5	3	50.5	47.0	54.5	3
Length of D ₂	84.6	66.7	74.3	63.5	65.0	84.3	59.8	61.7	65.0	84.6	4	63.3	59.8	66.7	3	63.3	59.8	66.7	3	63.3	59.8	66.7	3
Length of D ₃						91.2	64.7	-	91.2	91.2	1	-	64.7	64.7	1	-	64.7	64.7	1	-	64.7	64.7	1
Length of A ₁			71.6	61.1	35.0	81.1	57.5	62.6	35.0	81.1	3	-	57.5	61.1	2	-	57.5	61.1	2	-	57.5	61.1	2
Length of A ₂						80.3	57.0	-	80.3	80.3	1	-	57.0	57.0	1	-	57.0	57.0	1	-	57.0	57.0	1
Length of C ray			5.8	5.0		8.4	6.0	-	8.4	8.4	2	-	5.0	6.0	2	-	5.0	6.0	2	-	5.0	6.0	2
Length of base of D ₃			76.4	65.2	65.0	91.2	64.7	77.5	65.0	91.2	3	-	64.7	65.2	2	-	64.7	65.2	2	-	64.7	65.2	2
Length of base of A ₂			69.5	59.4	76.7	80.3	57.0	75.5	69.5	80.3	3	-	59.4	59.4	2	-	59.4	59.4	2	-	59.4	59.4	2

*: Length from snout to posterior tip of operculum. **: Length from snout to posterior tip of fleshy flap of operculum. -:No data.

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