AUSTRALIAN MUSEUM SCIENTIFIC PUBLICATIONS

Leis, Jeff M., and J. E. Randall, 1982. *Chilomycterus spilostylus*, a new species of Indo-Pacific burrfish (Pisces, Tetraodontiformes, Diodontidae). *Records of the Australian Museum* 34(3): 363–371. [15 March 1982].

doi:10.3853/j.0067-1975.34.1982.294

ISSN 0067-1975

Published by the Australian Museum, Sydney

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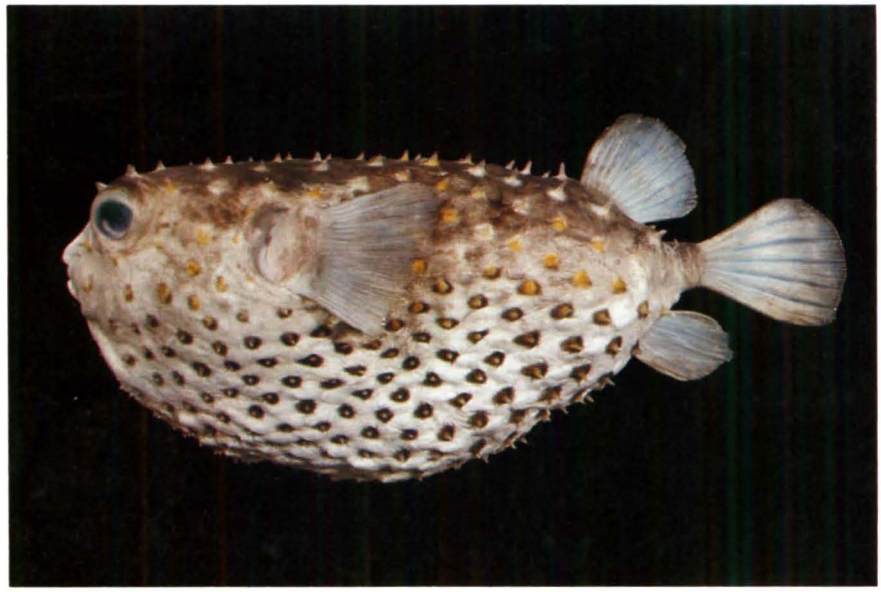

Figure 1. *Chilomycterus spilostylus*, holotype, 234mm SL, BPBM 13896, Gulf of Aqaba (J. Randall).

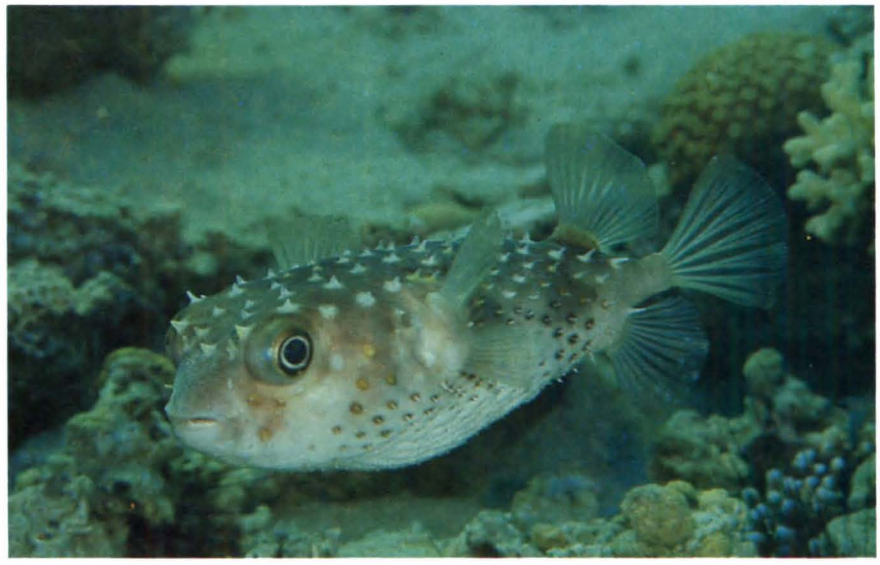

Figure 2. Underwater photo of *Chilomycterus spilostylus*, Gulf of Aqaba, Red Sea (J. Randall).

CHILOMYCTERUS SPILOSTYLUS, A NEW SPECIES OF INDO-PACIFIC BURRFISH (PISCES, TETRAODONTIFORMES, DIODONTIDAE)

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SUMMARY

A new spiny puffer (Diodontidae) *Chilomycterus spilostylus,* is described from ten specimens, from the northern Red Sea, the South China Sea and the Philippine Islands. *C. spilostylus* is distinguished from all other Indo-Pacific *Chilomycterus* by colour, spine morphology, and spine arrangement. All spines are fixed and short, and many on the head have four rather than three subdermal bases. A single medial frontal spine is located between the nostrils and three spines are over the eye. We tentatively conclude that the form incorrectly called *Cyclichthys echinatus* (Gronow) is the pelagic juvenile stage of *C. spilostylus.*

INTRODUCTION

The fishes of the tetraodontiform family Diodontidae have long attracted the attention of ichthyologists because of their unusual appearance and ability to inflate. This attention has resulted in a large number of synonyms in this relatively small family. For example, only five of the 28 nominal species of *Diodon* are valid (Leis 1978). A similar situation exists among the other diodontid genera which include approximately 50 nominal species. Thus, it is surprising to discover a widely distributed species of *Chilomycterus* (sensu lato) which is undescribed. This species, described below as *Chilomycterus spilostylus,* has been ignored or confused with *C. orbicularis* (Bloch) or *Cyclichthys echinatus* (Linnaeus). It first came to our attention when it was collected by Randall in the Gulf of Aqaba, Red Sea. We describe this species here in order to make the name available in advance of revisionary studies of the family by Leis.

MATERIALS AND METHODS

Counts, measurements and definitions generally follow Leis (1978), but some require amplification. The interpectoral spines (P-D-P spines) make up the transverse row over the dorsum between the upper bases of the pectoral fins. The spine arrangement on the top of the head gives the number of spines in the successive transverse spine rows from the frontal spine through the row at the level of the gill opening. This count excludes the supraorbital spines and other spines in an approximate longitudinal row with these (i.e. spines along the dorsolateral edge of the head). The second and third transverse rows are often irregular, and each could be interpreted as constituting more than one row. However, rows with an odd number of spines have the middle spine approximately on the dorsal midline, and those with an even number should have equal numbers on each side of the midline. The frontal spines constitute the anterior-most spine row on the top of the head (again excluding the supraorbital spines). Preserved specimens of diodontids are often distended due

Records of the Australian Museum, 1981, **Volume 34 Number 3,** 363-371, Figures 1-4.

to inflation or from being forced into small containers, resulting in a wide range in body proportions. This distortion is particularly evident in the snout to anus length. Therefore, morphometrics are of limited usefulness and must be interpreted with caution.

The caudal peduncle is measured from the posterior base of the dorsal fin. Head width is measured immediately behind the eyes, body width is measured at the pectoral fin base. Interorbital width is the least bony width along the anterior edge of the orbit. The distance from nostril to mouth is measured from the base of the nasal tentacle to the end of the gape. The last two dorsal and anal fin rays are counted separately because they have separate bases. Pectoral fin ray counts exclude the rudimentary uppermost nubbin-like ray. Measurements were made to the nearest 0.5 mm, and are given in millimetres unless stated. Abbreviations of institutions containing material examined are: AMS, Australian Museum, Sydney; BM (NH), British Museum (Natural History), London; BPBM, Bernice P. Bishop Museum, Honolulu; HUJF, Zoological Museum, Hebrew University of Jerusalem; USNM, United States National Museum of Natural History, Washington, D.C.; SU, Stanford University, which collections are housed at the California Academy of Sciences (CAS), San Francisco; MNHN, Muséum National D'Histoire Naturelle, Paris.

Chilomyterus spilostylus, new species
Figures 1-4

Chilomycterus echinatus? (non Linnaeus or Gronow):— Clark and Gohar, 1953:65 (Suez area, Red Sea).

Chilomycterus (Cyclichthys) echinatus (non Linnaeus or Gronow): — Chu, 1962:1105 (South China Sea).

Chilomycterus orbicularis (non Bloch): — Halstead, 1967: 857, plate 6 (Gulf of Aqaba, Red Sea).

Cyclichthys echinatus (non Linnaeus or Gronow): — Cohen, 1975:132, upper figure (Gulf of Aqaba).

Chilomycterus sp. — Darom, 1976: 86, Figure on p.87 (Gulf of Aqaba); Fridman and Levy, 1977: Figure 71 (Gulf of Aqaba).

HOLOTYPE: BPBM 13896, 234 SL, off Elat marine lab, Gulf of Aqaba, Red Sea, 12 m, J. E. Randall, 8 June 1972.

PARATYPES: AMS I. 20145-001, 187 SL, off Taba, Gulf of Aqaba, 3 m, reef, O. Gon and J. E. Randall, 9 August 1976. BM(NH) 1979.9.24.1, 261 SL, El Himeira, Gulf of Aqaba, 10 m, O. Gon, A. Barnes and A. Diamont, 2 Nov. 1975. BPBM 20456, 281 SL, Elat, Gulf of Aqaba, 10 m, patch reef and sea grass, J. E. Randall, 30 August 1977. BPBM 22724, 210 SL Magellan Bay, north side of Mactan Island, Cebu, Philippines, 30 m, silty sand bottom, J. E. Randall, 2 August 1978. HUJF 8343, 147 SL, Elat, Gulf of Aqaba, R. Lotam, 14 July 1965. SU68649, 145 SL, off Taya Islands, South China Sea (19°38'N, 111°30'E), 92 m (50fm), R. L. Bolin, 21 July 1958. USNM 216146, 270 SL, El Himeira, Gulf of Aqaba, 9-12 m, V.G. Springer, *et al.,* 8 September 1969. USNM 191665, 219 SL, Red Sea, E. Clark (1960).

DIAGNOSIS: A species of *Chilomycterus (sensu lato)* with all body spines fixed and relatively short. Spines all of approximately the same length. Spines triangular in cross section near the base, becoming rounded near the tip. Spines on the top of the head with three or four subdermal bases; other spines with three bases. Three spines

over the eye. The single, medial frontal spine located between the nostrils and in advance of all spines except the anterior suborbital spine. No spines wholly on the caudal peduncle. Nasal organ in the form of a hollow tentacle with two openings. No tentacles in adult other than the nasal ones. The teeth thickened and heavy. Fins without spots. Ground colour brown to grey dorsally fading to white ventrally. Spine bases with white spots dorsally, yellow spots laterally and black spots with yellow centres ventrally. No large blotches or bars.

DESCRIPTION: Measurements and counts in Table 1. Fin rays, Dorsal 12-13, Anal 10-12, Pectoral 20-22 (often asymmetrical), Caudal i, 7-8, i. Spines short and straight, none noticeably elongate; all spine shafts much shorter than their shortest subdermal base; spines triangular in cross section near the base, becoming round to somewhat laterally compressed near the tips (Fig. 3). All spines fixed in an upright position; those on the top of the head with three or (usually) four subdermal bases (the frontal spine with three bases), those elsewhere with three bases. Spine rows often irregular and difficult to count, but approximately 12 (in the longitudinal row including the frontal spine) anterior to the dorsal fin; approximately 19 from the lower jaw to the anus; approximately six interpectoral spines. Arrangement of spines on top of the head (5 transverse rows, Fig. 4) 1, 2, 3-5, 4-5, 4-5. The single medial frontal spine located between the nostrils and in advance of all spines but the anterior suborbital spines (which may be even with the frontal spine). Three supraorbital and two to four suborbital spines. No spines wholly on the caudal peduncle, although the inner subdermal base of the posterior spines surrounding the dorsal fin extends onto the peduncle. The subdermal bases of four (occasionally three) spines form the anterior edge of the depression surrounding gill opening. The body is capable of great inflation.

Dorsal, anal and caudal fins rounded, middle rays longest; pectoral fin slightly emarginate with upper and lower rays longer than middle rays. Dorsal and anal fins of approximately the same size and shape.

Nasal organ a hollow tentacle with two opposed openings near the tip. Nasal tentacles located in the interorbit at the level of the frontal spine.

Dental plates thick and strong.

No tentacles or barbels in adult other than the nasal organs.

Dorsal ground colour medium grey to dark brown fading gradually to a dirty white ventrum (Figs. 1, 2). Dorsally, to the level of the middle of the pectoral base, the base of each spine is covered by a small (less than pupil) light-coloured spot (often faded in preserved material). The ventral spine bases each have a similar black spot. In life the lateral, ventral and some of the dorsal spines (including the central portion of the spine base) are yellow. The fins are light to medium grey, but are never spotted. There is often a narrow white margin on the fins. The iris has a yellow ring in life. No bars or blotches in preserved material. The lower jaw is sometimes dusky (see colour plate VI in Halstead 1967).

DISTRIBUTION: *Chilomycterus spilostylus* is known from the northern Red Sea, the southern Arabian Peninsula, off Hong Kong and the Philippines. A wider distribution along the southern edge of Asia and perhaps the east African coast and Indo-Australian archipelago should be expected.

NAME: This name is a latinized noun in apposition formed by the Greek words 'spilos' (spot) and 'stylos' (pillar or post) referring to the contrasting spot at the base of

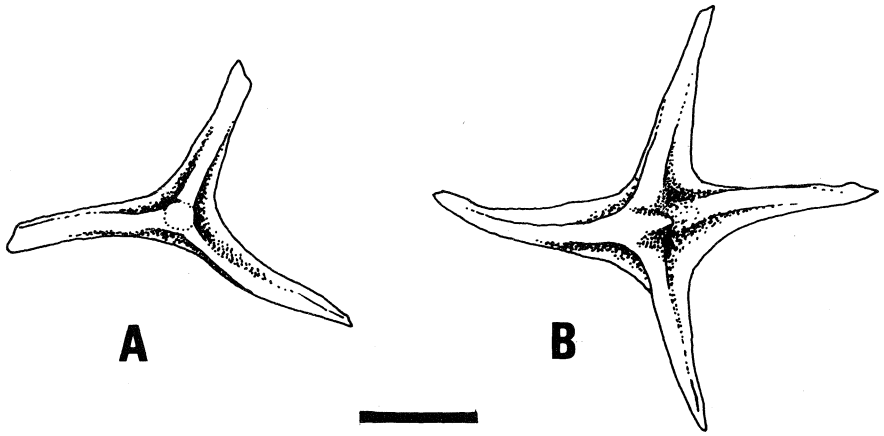

Fig. 3 Spine types of *Chilomycterus spilostylus*. A. Top view of a three-base spine of the right flank. B. Top view of a four-base spine of the top of the head. Both spines dissected from AMS I.20145-001. Scale bar equals 1 cm.

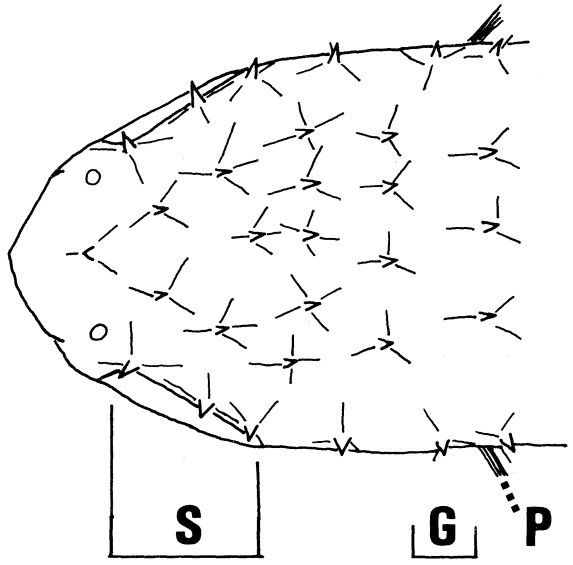

Fig. 4. Semi-diagrammatic dorsal view of the head of *Chilomycterus spilostylus* (AMS I.20145-001) to show arrangement of spines and their subdermal bases. Small circles represent the nasal organs. (S) supraorbital spines, (G) gill opening, and (P) pectoral fin. Scale bar equals 1 cm.

each spine. We propose the English common name of spot-base burrfish for *C. spilostylus* in reference to these spots.

ECOLOGY: *Chilomycterus spilostylus* is found in a variety of habitats. The specimen available to us have come from coral reefs, a sea grass bed, silty sand habitat and a wreck; one was trawled (the only specimen not captured by hand or speared). Capture depths ranged from 3 to over 90 m. The species appears to be solitary, although the trawled specimen was taken with seven *Chilomycterus orbicularis*. This species is probably nocturnal. When observed during daylight hours on the reefs in the Gulf of Aqaba it is inactive, usually beneath ledges or in small caves.

REMARKS: Present concepts of generic relationships within the Diodontidae require revision. The classification (three genera and eight subgenera) proposed by Fraser-Brunner (1943) is untenable, being based in part on ontogenetically varying characters and apparent confusion of type species. The common practice of recognizing only two genera, *Diodon* and *Chilomycterus,* is also invalid. Pending completion of revisionary studies by Leis, we choose the conservative option of allocating *spilostylus* to *Chilomycterus*.

The form incorrectly called *Cyclichthys echinatus* (Gronow) by Smith (1949) and others is almost certainly the pelagic juvenile stage of *C. spilostylus*. The available specimens of *C. echinatus* are generally smaller (129-155 mm) than those of *C. spilostylus* (145-281 mm), but the habitat of *C. echinatus* is unknown because all available specimens were found on South African beaches. However, pelagic warm water fishes are often found on South African beaches, presumably because they become moribund in the cold Southern Ocean after moving south in the warm Mozambique and Agulhas currents (Smith, 1949). Aside from size, *C. echinatus* and *C. spilostylus* differ only in colour, length of fins and in the presence of fleshy tentacles in *C. echinatus* (actually, some specimens lack the tentacles, but they may have been eroded on the beach). The differences in colour and fin length are expected for the pelagic dispersive stage common in the family (Leis, 1978), but the tentacles are not. The tentacles and lack of overlap in the known distributional range of the two forms introduce some doubt as to their conspecificity. Because of this doubt, we do not formally synonymize the two forms and do not include any material of the *"echinatus"* form in the type series of *C. spilostylus*. The nominal species *Diodon echinatus* Linnaeus is a synonym of either *Diodon hystrix* Linnaeus or *Chilomycterus reticulatus* (Linnaeus). Günther (1870) incorrectly called the South African form *Chilomycterus echinatus* (Gronow), and Smith (1949) called the tentacled form *Cyclichthys echinatus* (Gronow). This will be fully discussed by Leis (in prep.). Because the name *echinatus* is not available for the tentacled form, and no other name has been applied to it, a new name will be required if it proves distinct from *C. spilostylus*. We avoid naming it because we feel it will prove to be conspecific with *C. spilostylus,* and take the course of nomenclatorial conservativism by referring to the tentacled form as *C. spilostylus* (?). Assuming the two forms are conspecific, no other species is obviously closely related to *C. spilostylus*.

Chilomycterus spilostylus has occasionally been misidentified as *Chilomycterus orbicularis* of authors. *C. orbicularis* is readily distinguished by the relatively thin, weak dental plates, a possibly erectile and somewhat elongate spine in the pectoral axil, the longer, slightly recurved spines, and the colour pattern which lacks small spots associated with the spine bases.

The other species of *Chilomycterus (sensu lato)* occurring within the known range of *C. spilostylus* can be distinguished from it by one or more of the following

characteristics (all lacking in *C. spilostylus*): erectile spines, on head, ventrum or pectoral axil; colour pattern which lacks small spots associated with spine bases; a spine wholly on caudal peduncle; or nostrils not a hollow tentacle with two openings.

After this paper was submitted, two specimens of *C. spilostylus* were received, one from Suez (MNHN 1966-223) and one from Muscat,Oman (BM(NH) 1889-4-15:76). These specimens are not included in the type series, and do not significantly differ from it in any character except the Muscat specimen has 11 dorsal fin rays.

ACKNOWLEDGEMENTS

Field work by Randall was supported by grant no. 439 from the U.S.-Israel Binational Science Foundation, and was assisted by many associates (see collection data). Leis was supported by an Australian Queen's Fellowship in Marine Science. The following people aided our investigation by providing information or loaning specimens: P. Sonoda (CAS), W. N. Eschmeyer (CAS), A. Ben-Tuvia (HUJF), V. G. Springer (USNM), S. Karnella (USMN), B. B. Collette (U.S. National Marine Fisheries Services Systematics Laboratory, Washington, D.C.), M. L. Bauchot (MNHN) and A. C. Wheeler (BM(NH)). A grant to Randall from the Engelhard Foundation provided funds for the colour plate. D. F. Hoese (AMS) read and criticised the manuscript. H. K. Larson (AMS) drew Fig. 3. Our sincere thanks to all.

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NOTE ADDED IN PROOF

While this paper was in proof, information extending the known range of *C. spilostylus* became available. A 167 mm specimen from off Bombay was examined through the courtesy of E. Silas of the Central Marine Fisheries Research Institute, Cochin, India (Cat. No. CMFRI-F. 116/489), and a photo of a specimen from Bali, Indonesia was provided by P. J. P. Whitehead (BMNH). This fulfills the expectation (above) of a wider distribution in Southern Asia and the Indo-Australian Archipelago. To date, no material unquestionably conspecific with *C. spilostylus* has been seen from the Indian Ocean coast of Africa, although the species may be expected to occur there.

Manuscript accepted for publication 3 June, 1980.

TABLE 1. Counts and measurements (in millimetres) for type specimens of *Chilomycterus spilostylus* (percent standard length given in parentheses).

	Holotype	Paratypes			
	BPBM 13896	SU 68649	HUJF 8343	AMSI. 20145-001	BPBM 22724
Standard Length	234	145	147	187	210
Dorsal Rays	13	12	13	13	12
Anal Rays	11	11	11	12	11
Pectoral Rays	21,22	21,21	22,22	22,22	21,22
Caudal Rays	i,7,i	i,7,i	i,7,i	i,7,i	i,7,i
Head Length	86(36.8)	51(35.2)	55(37.4)	71(38.0)	85.5(40.7)
Snout to Anus Length	203(86.8)	131(90.3)	115(78.2)	150(80.2)	179(85.5)
Pre-dorsal Length	185(79.1)	115(79.3)	118(80.3)	148(79.1)	164.5(78.5)
Peduncle Length	29.5(12.6)	23(15.9)	18(12.2)	22(11.8)	26.5(12.6)
Least Peduncle Depth	16.5(7.1)	10.5(7.2)	10.5(7.1)	10(5.3)	14.5(6.9)
Eye Width	21(9.0)	15(10.3)	18(12.2)	16(8.6)	18(8.6)
Head Width	72(30.8)	51(35.2)	58(39.5)	60(32.1)	73(34.8)
Body Width	75(32.1)	51(35.2)	65(37.4)	73(39.0)	70(33.4)
Interorbital Width	47(20.1)	29(19.9)	31(21.1)	36(19.3)	42(20.0)
Nostril to Mouth Length	21(9.0)	15(10.3)	17(11.6)	18(9.6)	22(10.5)
Height of Gill Opening	23(9.8)	13(9.0)	16.5(11.2)	18.5(9.9)	19.5(9.3)
Mouth Width	33(14.1)	20.5(14.1)	23(15.6)	24(12.8)	26.5(12.6)
Longest Dorsal Ray	45(19.2)	27(18.6)	33(22.4)	32.5(17.4)	40(19.0)
Longest Pectoral Ray	45(19.2)	27(18.6)	29.5(20.1)	32.5(17.4)	38.5(18.3)
Longest Caudal Ray	62(26.5)	36.5(25.2)	42.5(28.9)	40.5(21.7)	56(26.6)
Head Spination	1,2,5,5,5	1,2,3,4,4	1,3,4,5,4	1,2,3,5,4	1,2,4,4,4
Pre-dorsal Spines	14	11	12	12	12
Preanal Spines	20	16	18	18	17
Interpectoral Spines	6-7	6	6	5-7	6
Length of Longest Dorsal Spine	8	7.5	5	7.5	7
Length of the Frontal Spine	5.5	5	5	7	6
Length of Longest Ventral Spine	9	6	6	6.5	7

Table 1 Continued

	Paratypes					
	USNM 191665	BPBM 21174	BM(NH) 1979.9.24.1	USNM 216146	BPBM 20456	Mean
Standard Length	219	225	261	270	281	—
Dorsal Rays	12	12	12	12	12	12.3
Anal Rays	12	10	11	12	12	11.3
Pectoral Rays	21,21	21,21	20,20	21,21	21,22	21.3
Caudal Rays	i,7,i	i,8,i	i,7,i	i,7,i	i,7,i	i,7.1,i
Head Length	85(38.9)	73(32.4)	91(35.0)	100(37.0)	93(33.1)	(36.5)
Snout to Anus Length	178(81.3)	185(82.2)	205(78.8)	210(77.8)	227(80.8)	(82.2)
Pre-dorsal Length	172(78.5)	177(78.7)	210(80.8)	211(78.1)	230.5(82.0)	(79.4)
Peduncle Length	28(12.8)	28(12.4)	30(11.5)	30(11.1)	33(11.7)	(12.5)
Least Peduncle Depth	15(6.8)	17(7.5)	18(6.9)	18(6.7)	17(6.1)	(6.8)
Eye Width	21(9.6)	22.5(10.0)	23(8.8)	24(8.9)	23.5(8.4)	(9.4)
Head Width	75(34.2)	73.5(32.7)	85(32.7)	87(32.2)	86.5(30.8)	(33.5)
Body Width	83(37.9)	75(33.3)	101(38.5)	104(38.5)	94.5(33.6)	(35.9)
Interorbital Width	42.5(19.4)	45(20.0)	50(19.2)	56(20.7)	60(21.4)	(20.1)
Nostril to Mouth Length	21(9.6)	26(11.6)	26(10.0)	27(10.0)	27(9.6)	(10.2)
Height of Gill Opening	17(7.8)	22.5(10.0)	26(10.0)	27.5(10.2)	24(8.5)	(9.6)
Mouth Width	31(14.2)	35.5(15.8)	37(14.2)	28(10.4)	28.5(13.7)	(13.7)
Longest Dorsal Ray	41(18.7)	43(19.1)	49(18.8)	51(18.9)	53(18.9)	(19.1)
Longest Pectoral Ray	42(19.2)	42(18.7)	49.5(19.0)	51(18.9)	54(19.2)	(18.9)
Longest Caudal Ray	47(21.5)	57.5(25.6)	67.5(25.9)	68(25.2)	67.5(24.0)	(25.1)
Head Spination	1,2,4,4,4	1,2,3,5,4	1,2,3,5,4	1,2,3,5,4	1,2,4,4,4	
Pre-dorsal Spines	13	13	13	12	12	
Preanal Spines	21	20	20	20	18	
Interpectoral Spines	6	6	5-6	6	6	
Length of Longest Dorsal Spine	9	8	9	7.5	9	
Length of Frontal Spine	6.5	5.5	6	7	6.5	
Length of Longest Ventral Spine	7	7	8	7	9	