

Review of the Indo-Pacific Pipefish Genus *Trachyrhamphus* (Syngnathidae)

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Abstract -- The tail-pouch (urophorine) pipefish genus *Trachyrhamphus* Kaup 1853 is diagnosed and treated as a senior synonym of *YoZIA* Jordan and Snyder 1901. Synonymies, diagnoses, illustrations, key, and data on intraspecific variation and distribution are provided for three recognized species. Subadults-adults of the type-species, *T. serratus* (Temminck and Schlegel), and *T. longirostris* Kaup have denticulations on the median dorsal snout ridge and 41-53 tail rings, but differ in average snout length in HL ratios (2.5 versus 2.0 in *T. longirostris*). The remaining species, *T. bicoarctatus* (Bleeker), lacks denticulations on the snout, has a low average snout length in HL ratio (1.7) and has 55-63 tail rings. *Trachyrhamphus serratus* is known from SW India to Japan; *T. longirostris* is known from the Red Sea to Japan (including Australia); *T. bicoarctatus* occurs from the Persian (Arabian) Gulf and Red Sea, along the east coast of Africa, and eastward to Australia, New Caledonia, Japan and the Mariana Is. *YoZIA tigris* (Castelnau) is referred to the monotypic Australian genus *Filicampus* Whitley, and *YoZIA punctata* Kamohara is provisionally referred to the genus *Halicampus* Kaup.

Introduction

I here treat the urophorine (tail-pouch) pipefish genus *Trachyrhamphus* Kaup 1853 and the three species recognized therein: *T. serratus* (Temminck and Schlegel), *T. longirostris* Kaup and *T. bicoarctatus* (Bleeker). Representatives of these taxa reach a rather large size (ca. 390-400 mm), but their taxonomy, nomenclature and distribution are presently confused or poorly understood. Species of *Trachyrhamphus* have often been included in the genus *YoZIA* Jordan and Snyder 1901, here referred to the synonymy of *Trachyrhamphus*, and available keys and diagnoses do not permit ready identification of individuals or species. This review, based on the examination of the majority of known specimens, clarifies some of these problems and provides a basis for further studies on these Indo-Pacific pipefishes.

Methods and Materials

Measurements are in millimeters (mm) and some are referred to standard length (SL), total length (TL) or head length (HL). Counts of trunk rings begin with that bearing the pectoral fins and end with that bearing the anus (anal ring); color descriptions are from specimens preserved in alcohol; description of the branchial skeleton is based on the examination of one cleared and stained specimen of each species; other methods are those of Dawson (1977). Synonymies include names as originally published and the initial reference to new combinations thereof. The key is best suited for the identification of subadult-adult specimens, but it should also permit identification of undamaged juveniles. Materials examined are listed by general localities from west to east and roughly north to south; given lengths preceded by "ca." indicate the presence of one or more decaudate or otherwise damaged specimens; depths are in meters (m). The distribution map delineates general localities; each symbol represents one or more collections.

Abbreviations for repositories of material examined are: AMS - Australian Museum, Sydney; ANSP - Academy of Natural Sciences of Philadelphia; BMNH - British Museum (Natural History), London; BPBM - Bernice P. Bishop Museum, Honolulu; CAS - California Academy of Sciences, San Francisco; CAS - SU - former Stanford University material now housed at CAS; CSIRO - CSIRO, Cronulla, NSW; CU - Cornell University, Ithaca, NY; FMNH - Field Museum of Natural History, Chicago; FRBB - Fisheries Resources Bureau, Bahrain; GCRL - Gulf Coast Research Laboratory Museum; HUJ - Hebrew University of Jerusalem; KFRS - Kanudi Fisheries Research Station, Papua New Guinea; MCZ - Museum of Comparative Zoology, Harvard University, Cambridge, Mass; MNHN - Muséum National d'Histoire Naturelle, Paris; MTUF - Museum, Tokyo University of Fisheries; NMS - Fisheries Experimental Station, Nagasaki University; NTFD - Northern Territory Fisheries Department, Darwin; NTM - Northern Territory Museum, Darwin; QM - Queensland Museum, Brisbane; RMNH - Rijksmuseum van Natuurlijke Historie, Leiden; RUSI - J.L.B. Smith Institute of Ichthyology, Grahamstown; SAM - South African Museum, Cape Town; TAU - Tel-Aviv University; UMMZ - Museum of Zoology, University of Michigan, Ann Arbor; USNM - National Museum of Natural History, Smithsonian Institution, Washington, D. C.; UW - University of Washington, College of Fisheries, Seattle; ZMUC - Zoologisk Museum, University of Copenhagen; ZSI - Zoological Survey of India, Calcutta.

Genus *Trachyrhamphus* Kaup

Trachyrhamphus Kaup, 1853:231 (type-species: *Syngnathus serratus*)

Temminck and Schlegel 1850, by monotypy).

Trachyrhynchus Kaup, 1856:25 (nomen nudum).

Yozi Jordan and Snyder, 1901:8 (type-species: *Yozi wakanourae* Jordan and Snyder 1901 (= *Syngnathus bicoarctatus* Bleeker 1857), by original designation).

DIAGNOSIS: Superior trunk and tail ridges discontinuous near rear of dorsal-fin base, the trunk ridge arched dorsad on subdorsal rings; inferior trunk ridge ends on anal ring; lateral trunk ridge confluent with inferior tail ridge; median ventral trunk ridge low. Snout straight to somewhat arcuate in lateral profile; median dorsal snout ridge low in front, often a little elevated in region above nares, entire to irregularly denticulate, not confluent with supraorbital ridges, terminates on anterior part of interorbital; sides of head sloped dorsomesiad behind eyes toward low to somewhat elevated median dorsal ridges; opercle sometimes finely striate throughout, usually with an indistinct, complete or incomplete, ridge angled posterodorsad toward gill opening; pectoral-fin base more or less rounded, not protruding strongly laterad, without distinct ridges; 1st trunk ring (pectoral ring) long, distance from base of ventralmost pectoral-fin ray to rear margin of 1st ring greater than length of 2nd trunk ring; some trunk rings (usually between 4th-12th) swollen or enlarged in dorsal and lateral aspects; distance between inferior ridges on distal third of tail of adults usually about a third greater than distance between corresponding superior ridges; principal body ridges distinct, not elevated strongly, indented between rings, the margins entire to granular in subadults-adults; nares typically 2-pored bilaterally, scutella without longitudinal keels; dermal flaps present or absent in adults, those on dorsum of trunk and tail exceptionally elongate in planktonic young; dorsal-fin origin on trunk, the fin-base somewhat elevated; pectoral fin rounded. Trunk rings 21-24, total rings 64-86, total subdorsal rings 4.75-6.5, dorsal-fin rays 24-32, pectoral-fin rays 14-19, anal-fin rays typically 4, caudal-fin rays typically 9. Head length 9.7-16.0 in SL, snout length 1.5-2.8 in HL, length of dorsal-fin base 0.8-1.8 in HL (data from late juveniles - adults). Males with brood pouch located under tail, pouch plates little enlarged, membranous lateral folds present, pouch-closure the everted type of Herald (1959). All branchial elements, except 3rd basibranchial, present. Without odontoid processes in jaws (Dawson and Fritzsche, 1975) or bony platelets in gill membranes (Dawson, 1978).

COMPARISONS: The combination of 64-86 total rings, long 1st trunk ring elevated dorsal-fin base, and typically 9 caudal-fin rays is unique among pipefishes sharing the principal body ridge configuration of *Trachyrham-*

phus. Among urophorine (tail-pouch) pipefishes with this ridge configuration, *Trachyrhamphus* is perhaps most similar to the monotypic endemic Australian genus *Filicampus* Whitley 1948a [type-species: *Syngnathus superciliaris* Günther 1880 (= *S. tigris* Castelnau 1879)]. *Trachyrhamphus* differs from this genus in having more trunk rings (21-24 versus 17-19), a long 1st trunk ring (relatively short in *Filicampus*), and in having a 2nd basibranchial (absent in *Filicampus*). Species of *Trachyrhamphus* also lack well-developed gill rakers (present in *Filicampus*) and have one more caudal-fin ray (typically 9 versus 8 in *Filicampus*).

REMARKS: Kaup (1856) diagnosed *Trachyrhamphus* as having the snout denticulated on its dorsal aspect only," and distinguished the three nominal species include therein largely by differences in the length of the snout; short in *T. serratus*, long in *T. longirostris*, and of intermediate length in *T. intermedius*. Kaup also noted that the "snout crest" (median dorsal ridge) was spiny in *T. serratus* and acutely ridged in *T. intermedius*, but failed to specifically comment on this ridge in his description of *T. longirostris*. Present studies show that snout length and ornamentation of the median dorsal snout ridge increase ontogenetically in these species and that the immature holotype of *T. intermedius* is conspecific with *T. longirostris*. Jordan and Snyder (1901) distinguished the genus *Yozia* from *Trachyrhamphus* solely on the presence of a long snout without "serrations" in the type-species *Yozia wakanourae* (= *T. bicoarctatus*). Snout length also increases ontogenetically in *T. bicoarctatus* and, among subadults-adults, the median dorsal snout ridge is rather strongly denticulate in *T. serratus*, essentially entire in *T. bicoarctatus*, and variously entire to denticulate in *T. longirostris*. In the absence of substantial distinguishing characters, I refer *Yozia* Jordan and Snyder to the synonymy of the genus *Trachyrhamphus* Kaup.

There are typically 9 caudal-fin rays in species of *Trachyrhamphus* but 8 rays occur in about 9% of the examined specimens of *T. bicoarctatus* and *T. serratus*. Dawson et al. (1979) showed the caudal fin to be rather long and somewhat rounded in brood-pouch young and/or planktonic juveniles of *T. bicoarctatus* and *T. longirostris* (respectively, as *Yozia bicoarctata* and *Y. intermedia*). However, in subadult-adult specimens of *Trachyrhamphus*, the caudal fin is often lost, regenerated, vestigial, or represented by stubby rudimentary fin-rays. The typical adult fin (Fig. 1) is truncate or obliquely angular in *T. bicoarctatus* and *T. serratus*, the ventralmost ray is usually thicker and sometimes longer than the other caudal-fin rays, and the lower interradiial membrane is usually deeply incised or absent. In *T. longirostris*, the caudal fin is often rounded in subadults-adults, but configuration of the

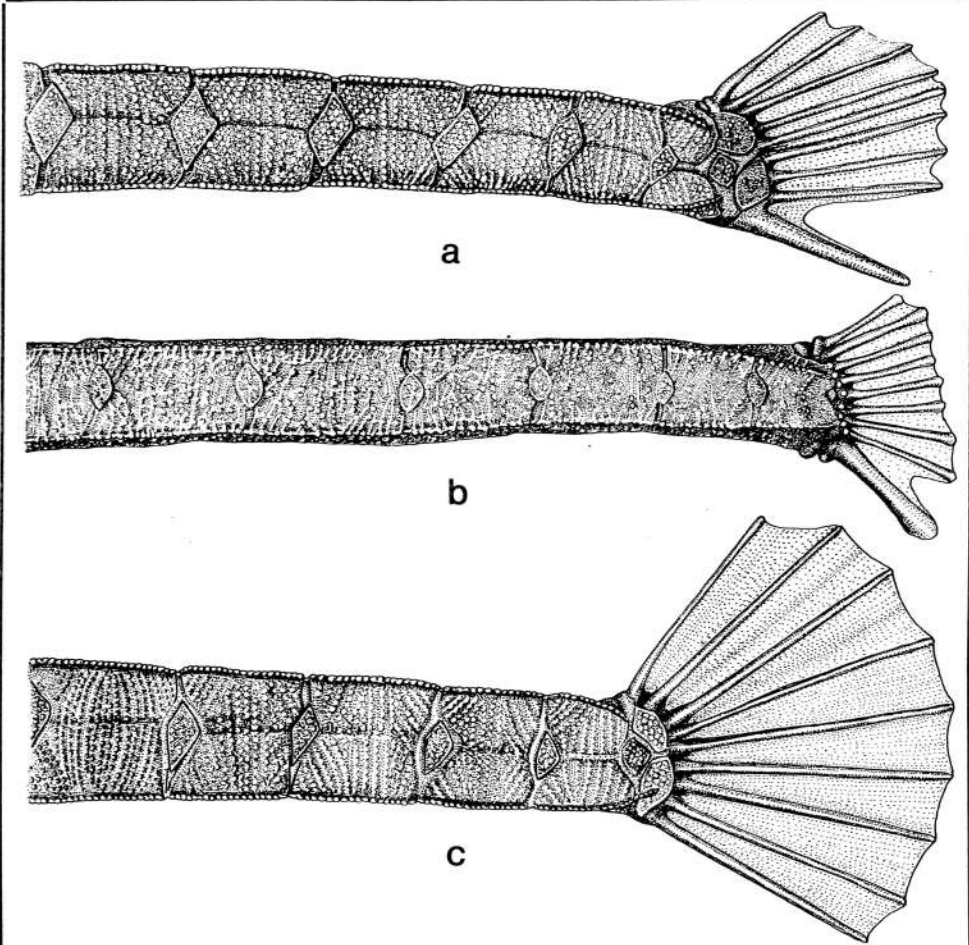


Fig. 1. Typical configuration of posterior tail rings and caudal fin in nonregenerated subadult-adult specimens of (a) *Trachyrhamphus serratus*, (b) *T. bicoarctatus*, and (c) *T. longirostris*.

fin is similar to that of *T. serratus* in many of the largest specimens examined. Causes of these modifications are uncertain but configuration of the caudal fin may well be influenced by the behavior of subadult-adult fish. Discussion with divers and examination of underwater photographs by R. Kuitert and J. E. Randall indicates that specimens of *T. bicoarctatus* are sometimes observed in an upright S configuration on, or just above, the bottom. The head is directed into the current, the midportion of the tail (lower part of S) is more or less parallel to the bottom, and the distal extremity of the tail (including caudal fin) is apparently deflected ventrad into

the substrate. This behavior pattern requires further study, but use of the tail as an anchoring device could well result in modification, abrasion or loss of the caudal fin in species of *Trachyrhamphus*. Interspecific differences in the typical fin configuration of subadults-adults may reflect differences in behavior or in preferred substrate.

Dawson et al. (1979) showed that brood-pouch young and/or planktonic juveniles of species treated here have elongate dermal appendages on the dorsum of the body, and suggested that these function as buoyant processes in planktonic specimens. Demersal subadult-adult specimens of *Trachyrhamphus* lack these elongate appendages and some may be devoid of dermal flaps. However, simple flaps may be present on or above the eye, on the opercle, on the lateral trunk ridge, on the dorsum of the body, and on the side of the tail near the inferior ridge

Yozia punctata, described by Kamohara (1952) and referred to the genus *Trachyrhamphus* by Matsubara (1955), is a poorly known species which is apparently endemic to Japan. This pipefish differs from species of *Trachyrhamphus* in having 14-15 trunk rings, ca. 48-49 total rings, comparatively well-developed brood-pouch plates, a strongly protruding pectoral-fin base, and in the presence of some branched dermal flaps. Pending further study, this species is provisionally referred to the genus *Halicampus* Kaup 1856.

Based on the literature and material examined, the genus *Trachyrhamphus* is presently known from the Red Sea and Persian Gulf (Arabian Gulf), southward along the eastern coast of Africa, and eastward to Japan, the Mariana Is. and New Caledonia. Maximum recorded depth is 91.4 m and available data suggest that all specimens are from marine habitats.

KEY TO THE SPECIES OF *TRACHYRHAMPHUS*

1. Tail rings 41-53, snout length 1.9 - 2.8 in HL, snout depth averages 6 or less in snout length 2
- 1'. Tail rings 55-63, snout length 1.5 - 2.0 in HL, snout depth averages 7.5 in snout length *T. bicoarctatus*
2. Snout length 2.2-2.8 in HL, snout depth averages 3.9 in snout length *T. serratus*
2. Snout length 1.9-2.1 in HL, snout depth averages 5.9 in snout length *T. longirostris*

Trachyrhamphus serratus (Temminck and Schlegel)

Figs. 2 - 3

Syngnathus typhle (not of Linnaeus) Russell, 1803:21, pl. 30, fig. 2 [Vizagapatam (India)].

Syngnathus serratus Temminck and Schlegel, 1850:272, pl. 120, fig. 4 (orig. descr.; Japan).

Syngnathus subbooko Bleeker, 1853:5 (replacement name for *S. typhle* of Russell, 1803).

Trachyrhamphus serratus Kaup, 1853:231 (n. comb.).

Syngnathus trachyrhynchus Günther, 1870:167 (nomen nudum).

Syngnathus chinensis Günther, 1870:167 (nomen nudum).

Trachyrhamphus cultrirostris Peters, 1870:710 (orig. descr.; probably Siam).

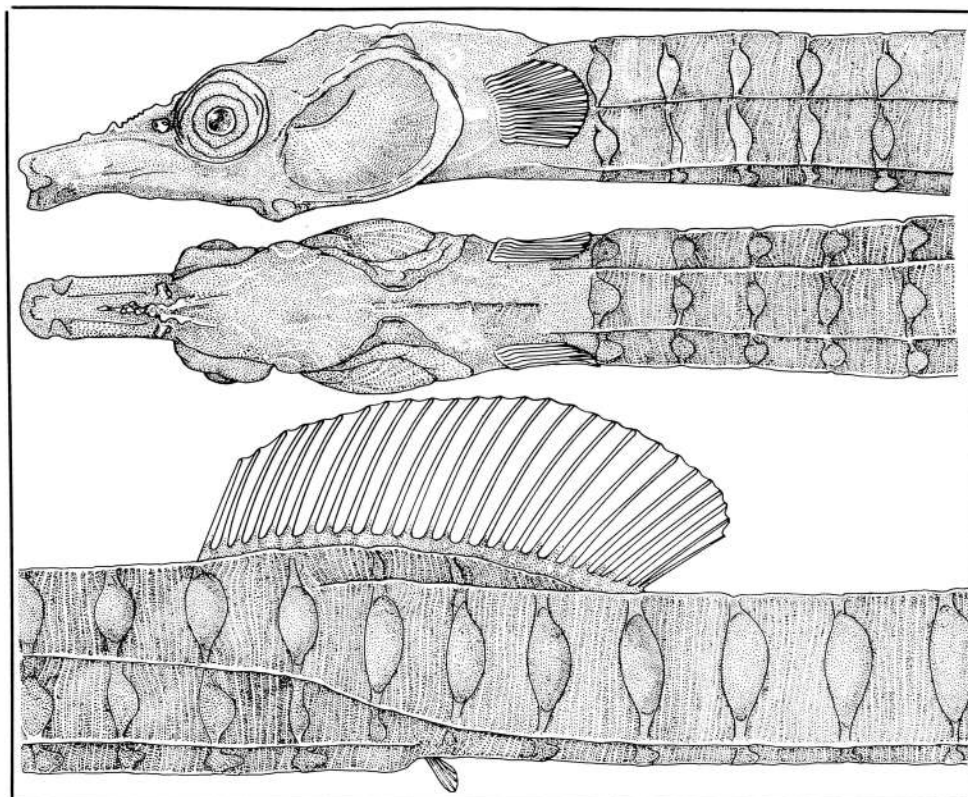


Fig. 2.

Trachyrhamphus serratus. Lateral and dorsal aspects of head and anterior trunk rings, together with section of body illustrating configuration of principal ridges and dorsal and anal fins. From 216 mm SL female or immature male (GCRL 15269).

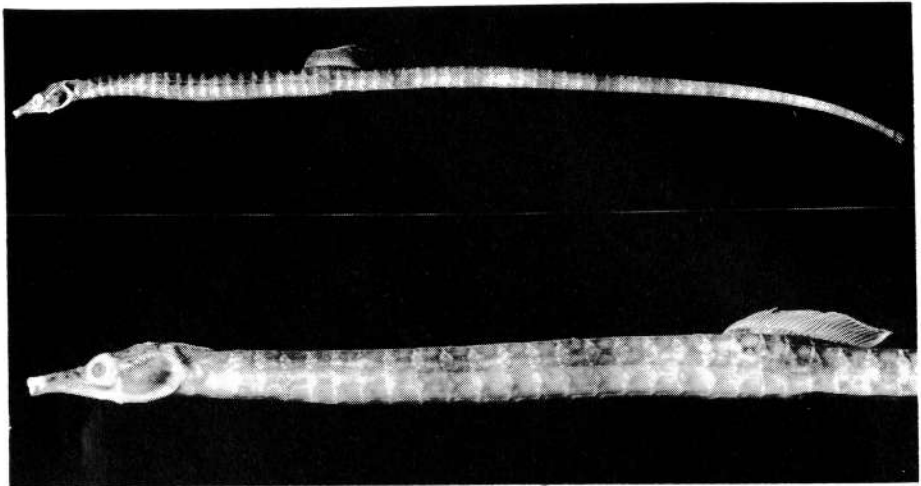


Fig. 3. *Trachyrhamphus serratus*. GCRL 15269 (216 mm SL, female or immature male).

DIAGNOSIS: Tail rings 41-48, HL averages 13.9 in SL, snout length averages 2.5 in HL, snout depth averages 3.9 in snout length, median dorsal snout ridge with prominent denticulations in subadults-adults.

DESCRIPTION: Rings 21-23 + 41-48, subdorsal rings 3.5-2.0 + 1.75-3.5 = 4.75-6.0, dorsal-fin rays 24-29, pectoral-fin rays 14-18 (see Tables 1-4 for additional counts). Proportional data, based on 43 specimens 137.5-313.0 (\bar{x} = 195.5) mm SL, follow: HL in SL 11.6-16.0 (13.9), snout length in HL 2.2-2.8 (2.5), snout depth in snout length 2.9-4.7 (3.9), length of dorsal-fin base in HL 0.8-1.4 (1.1), anal ring depth in HL 2.0-3.6 (2.8), trunk depth in HL 2.2-3.4 (2.8), pectoral-fin length in HL 3.9-7.4 (5.3).

Snout somewhat arcuate or deflected a little ventrad in lateral profile; median dorsal snout ridge a little elevated on posterior half of snout length, the margin typically with prominent irregular denticulations.

Ground color mainly brownish; the snout sometimes pale near tip; the body plain or mottled, usually with 12-13 dark bars (2-3 rings wide), separated by 3-4 ring pale or tan interspaces, crossing sides and dorsum; dorsal fin hyaline or with indications of 1-2 short brownish bars on fin-rays; pectoral fin usually hyaline; caudal fin brownish, shading to pale distally.

COMPARISONS: Characters in key and diagnosis distinguish subadults-adults of *T. serratus* from those of congeners. For discussion of caudal fin, see Remarks under discussion of genus.

REMARKS: Boeseman (1947) discussed the syntypes of *Syngnathus serratus*, compared the figure accompanying the original description with a 200 mm male in RMNH 3847, and selected this specimen (now 190 mm SL) as the lectotype (see Tables 1-4 for additional data).

Dawson et al. (1979) noted that pouch-larvae of *Trachyrhamphus serratus* have indications of a single incipient dermal process on the dorsum of the tail. Reexamination of these specimens shows that, in at least one instance, there are two pairs of knob-like protrusions on the tail; one pair near the caudal-fin base, the other located several tail rings anteriorly. Although I have not seen planktonic juveniles of *T. serratus*, they may be expected to have two or more pairs of elongate dermal appendages on the dorsum of the tail.

Among present material, the brood pouch extends below the anterior 16-25 tail rings in 11 examined males (180-313 mm SL). Several specimens have early (coiled) larvae in the pouch but none retain brood-pouch eggs.

Duncker (1915) showed that trunk rings were modally 22 in 6 specimens from India and 23 in 17 specimens examined from eastern Asia (including Siam). Present data, comparing Indian Ocean fish with those from Taiwan and Japan (Table 4), agree with Duncker's observations, and also show that numbers of tail rings and total rings are lower in Indian Ocean material. Some tendency toward higher frequencies of dorsal-fin rays and lower frequencies of pectoral-fin rays is indicated for Pacific Ocean material but the data are inconclusive. I find no substantial differences between these populations in coloration or other features, and consider these meristic differences to be evidence of clinal variation similar to that observed for other Indo-Pacific pipefishes (Dawson 1976, 1977).

DISTRIBUTION: There are a number of literature records from India, China and Japan, and *T. serratus* has also been recorded from Sri Lanka (Duncker, 1910), Bangladesh (Quereshi, 1970), Singapore (Duncker, 1904) and Quelpart I. (Korea) by Mori (1952). Aside from a highly questionable reference to Mauritius (Kähsbauer, 1950), there are no records from the western Indian Ocean. Materials examined here range from SW India (Kottayam) to Honshu I., Japan (Fig. 4). One sample is reported from "sea-weed," another from a seine collection, and there are a number of trawl samples from depths of 14.6-91.4 m.

MATERIAL EXAMINED: Seventy-three specimens (excluding larvae), 137.5-313 mm SL, including lectotype and three paralectotypes.

Table 1. Frequency distributions of trunk rings, tail rings and total rings in species of *Trachyrhamphus*.

Species	Trunk Rings										Tail Rings																
	21	22	23	24	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63
<i>serratus</i>	2	30	14*		1		6	15	10	5	8*	1															
<i>longirostris</i>	2	18	19	5*		2	9	5	8	11	6	1		1													
<i>bicoarctatus</i>	11	33*	8	3															3	7	9	10	4*	14	5	1	2
			64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86		
<i>serratus</i>			1	6	17	7	2	7	5*	1																	
<i>longirostris</i>			4	7	3	1	10	9	6	2	1					1*											
<i>bicoarctatus</i>														1	3	6	10	9	6*	9	5	3	2	1			

* Primary type.

Table 2. Frequency distributions of dorsal- and pectoral-fin rays in species of *Trachyrhamphus*.

Species	Dorsal - Fin Rays										Pectoral - Fin Rays						
	24	25	26	27	28	29	30	31	32		14	15	16	17	18	19	
<i>serratus</i>		1	4	8	22	11*	4					1	12	48	27	1	
<i>longirostris</i>				2	20*	11	8	3						9	33*	24	7
<i>bicoarctatus</i>	1	3	8	14	15	16	9*	2	2			2	34	73	18	2	

*Primary type.

Table 3. Frequency distributions of subdorsal trunk rings, subdorsal tail rings and total subdorsal rings in species of *Trachyrhamphus*.

Species	Subdorsal trunk rings								
	4.00	3.75	3.50	3.25	3.00	2.75	2.50	2.25	2.00
<i>serratus</i>			5	5	19*	9	13	2	2
<i>longirostris</i>			5	6*	12	13	11	1	
<i>bicoarctatus</i>	2	1	11	9	18	7*	18	6	1
	Subdorsal tail rings								
	1.75	2.00	2.25	2.50	2.75	3.00	3.25	3.50	
<i>serratus</i>	4	10	17*	8	8	3	3	2	
<i>longirostris</i>	2	5	13	18*	4	5	1		
<i>bicoarctatus</i>	1	8	6	18	19	11*	5	5	
	Total subdorsal rings								
	4.75	5.00	5.25	5.50	5.75	6.00	6.25	6.50	
<i>serratus</i>	4	17	15*	10	7	2			
<i>longirostris</i>	2	10	18	8	8*	2			
<i>bicoarctatus</i>	4	7	11	11	18*	17	4	1	

* Primary type.

Table 4. Geographic variation in frequencies of rings, dorsal-fin rays and pectoral-fin rays in *Trachyrhamphus serratus*.

Locale	Trunk rings			Tail rings						Total rings					Micronesia	
	21	22	23	43	44	45	46	47	48	65	66	67	68	69		70
India-W. Burma	2	27		6	15	8				6	17	6				
Taiwan-Japan		3	13*			2	5	8*	1			1	2	7	5*	1
				Dorsal-fin rays				Pectoral-fin rays								
				24	25	26	27	28	29	14	15	16	17	18		
India-W. Burma					4	7	16	6			2	34	23	1		
Taiwan-Japan				1		1	5	5*	4	1	10	13	3			

* Primary type.

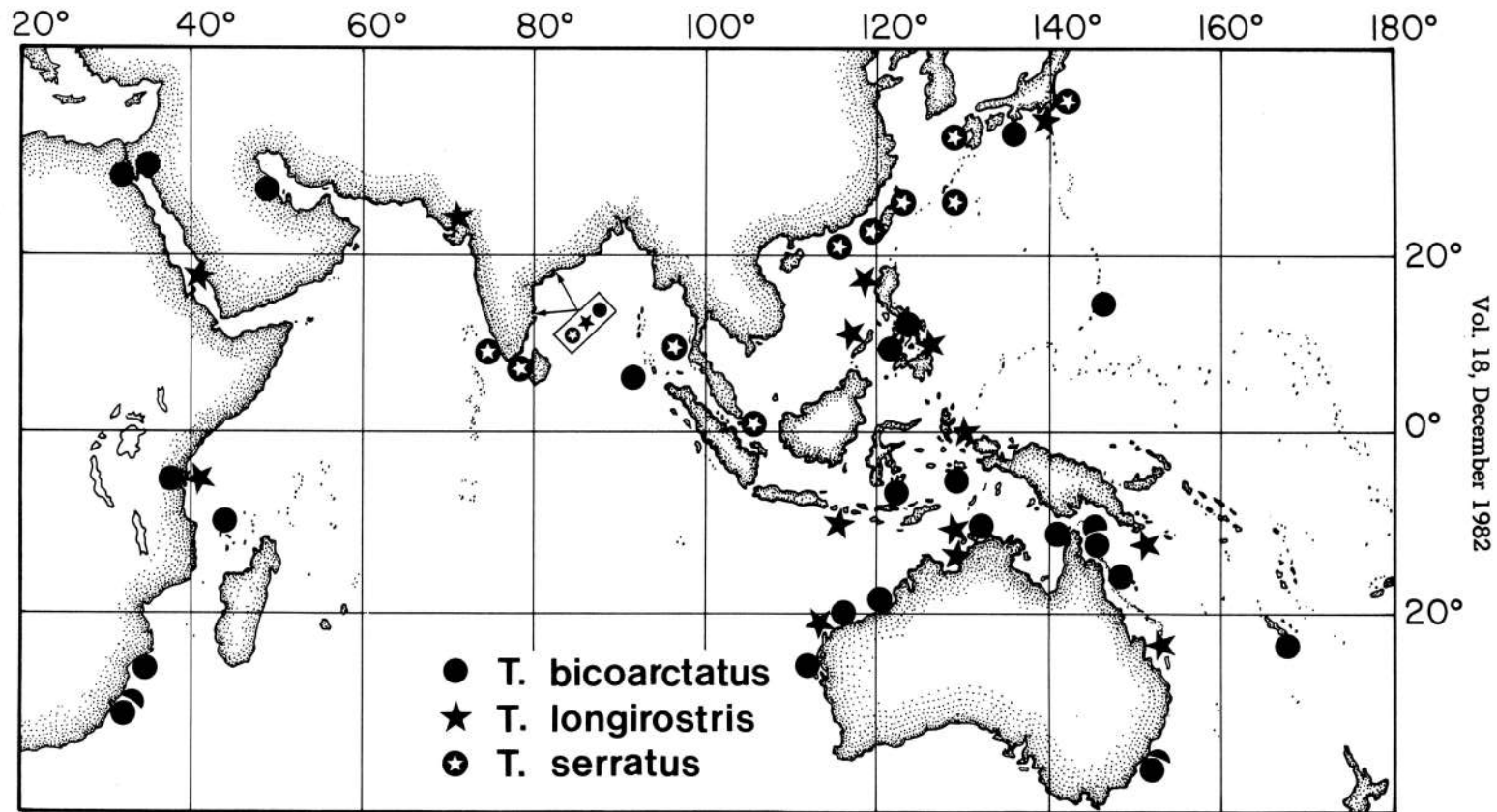


Fig. 4. Distribution of species of *Trachyrhamphus* based on material examined.

LECTOTYPE: RMNH 3847a (190 mm SL, male), Japan, von Siebold, no other data.

PARALECTOTYPES: RMNH 3847b-d (3, ca. 130.5-152), data as for lectotype.

OTHER MATERIAL: INDIA, Kottayam: GCRL 14103 (1,145.5), GCRL 14104 (4,154-163.5), GCRL 14779 (8,172-192). Quilon: GCRL 14106 (5,170-208). Gulf of Mannar: GCRL 15260 (2,163-191.5). Madras: CAS 33947 (1,203), CAS 37215 (1,190.5), CAS-SU 41789 (1, damaged), GCRL 14105 (5,197-207), GCRL 15269 (3,211-225), GCRL 15762 (1,216.5), RMNH 8818 (1, ca. 233), ZSI uncat. (3,181-222). Waltair: GCRL 15222 (5,180-202), GCRL 16360 (7,177-208). BURMA, Moscos Is.: CAS-SU 39504 (1,193.5). SINGAPORE: CAS-SU 35678 (1,137.5). MACAO: MNHN 6040 (1,247). CHINA, Loc. unknown: MNHN 6038 (1,231.5). TAIWAN: CAS 27412 (1,268.5), CAS 28175 (2,228-246), CAS-SU 49368 (2,226.5-240), GCRL 13872 (3,231-313), YCM P.6168 (1,251.5). JAPAN, Okinawa: FMNH 89932 (2,150.5-213). Kyushu I.: NMS P.7110002 (1,226.5), NMS P.7110003 (1,236), UMMZ 202751 (2,146-153). Honshu I.: FMNH 89785 (1, ca. 311). Loc. uncertain: RMNH 7225 (1, ca. 225).

Trachyrhamphus longirostris Kaup

Figs. 5-6.

Trachyrhamphus longirostris Kaup, 1856:24, 74 (orig. descr.; Asia).

Trachyrhamphus intermedius Kaup, 1856:24, 74 (orig. descr.; "China? or Japan").

Syngnathus longirostris. Günther, 1870:167 (n. comb.).

Syngnathus intermedius. Günther, 1870:168 (n. comb.).

Syngnathus ceylonensis Günther, 1870:168 (orig. descr.; Ceylon and Zanzibar).

Yozia intermedia. Duncker, 1915: 106 (n. comb.).

Yozia longirostris. Duncker, 1915:107 (n. comb.).

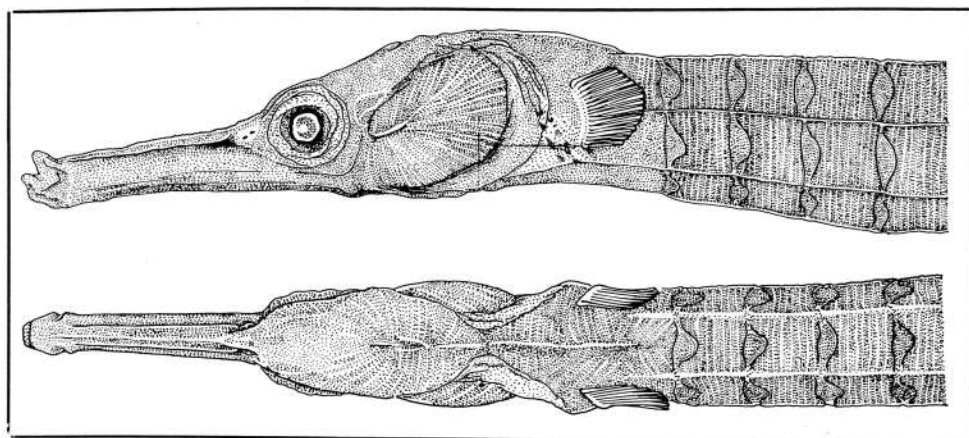


Fig. 5. *Trachyrhamphus longirostris*. Lateral and dorsal aspects of head and anterior trunk rings. From 236 mm SL female or immature male (GCRL 16443).

DIAGNOSIS: Tail rings 42-53, HL averages 11.3 in SL, snout length averages 2.0 in HL, snout depth averages 5.9 in snout length, median dorsal snout ridge usually with some small denticulations in subadults-adults.

DESCRIPTION: Rings 21-24 + 42-53, subdorsal rings 3.75-2.25 + 1.75-3.25 = 4.75-6.0, dorsal-fin rays 26-30, pectoral-fin rays 16-19 (see Tables 1-3 for additional counts). Proportional data, based on 28 specimens, 78.0-280.0 (\bar{x} = 226.0) mm SL, follow: HL in SL 9.7-13.1 (11.3), snout length in HL 1.9-2.1 (2.0), snout depth in snout length 4.8-7.0 (5.9), length of dorsal-fin base in HL 1.1-1.6 (1.3), anal ring depth in HL 2.8-4.5 (3.2), trunk depth in HL 2.8-3.9 (3.3), pectoral-fin length in HL 5.6-8.0 (6.7).

Median dorsal snout ridge entire and the snout more or less straight in small fish, the ridge denticulate and lateral profile of snout somewhat arcuate in most adults; denticulations on median dorsal snout ridge small, usually best developed in area above nares.

Ground color tan to brown; body plain or mottled, usually without distinctive markings; sometimes with 12-13 diffuse dark bars (ca. 1-2 rings wide) crossing dorsum and sides of body; dorsal fin hyaline or with 1-3 short brownish bars on fin-rays; pectoral fins hyaline; caudal fin brown, shading to pale distally.

COMPARISONS: Characters in key and diagnosis distinguish subadults-adults of *T. longirostris* from those of congeners. For additional comparisons, see this section under *T. bicoarctatus*, and Remarks under discussion of genus.

REMARKS: Kaup (1856:24) described *T. longirostris* as having 27 + 53 rings, 27 dorsal-fin rays, 18 pectoral-fin rays, 3 anal-fin rays, and 9 caudal-fin rays, and stated that the British Museum had two specimens collected by Sir Edward Belcher, including a 12.5 inch (317.5 mm) male. Later, in his list of specimens examined (p. 74), Kaup stated that there was only a "single specimen" in the London collection and that it was procured in "Asia". Günther (1870) noted that there was only one specimen in the British Museum, and Day (1878) noted that there was only one specimen in the British Museum, and Day (1878) suggested that a Belcher fish (specimen C), listed under *Syngnathus zanzibarensis* (= *Trachyrhamphus bicoarctatus*) by Günther (1870), might be the missing second specimen of *T. longirostris*. This may well be the case, but it also appears likely that Kaup, after completing this description, decided that this specimen (BMNH 1848.3.16.4) was not conspecific with his male specimen of *T. longirostris* and deleted it from his list of material (p. 74). In view of Kaup's conflicting remarks, the original presence or absence of the second specimen remains uncertain, and the male fish described by Kaup must be considered the only extant syntype. This specimen (BMNH 1981. 5.22.1), labeled "China," has 24 + 53 rings, 27 dorsal-fin rays, 17 rays in the undamaged left pectoral fin, 4 anal-fin rays, 9 rays in the obliquely angular caudal fin and a total length of about 315 mm. Numbers of tail rings and total rings are greater than those of other specimens examined here (Table 1), but, in view of the uncertain type locality, this is assumed to indicate geographic variation not reflected in other material examined.

Kaup (1856) described *T. intermedius* from a single damaged specimen of uncertain origin. The holotype (MNHN 6039), conspecific with *T. longirostris*, now lacks the pectoral, anal and caudal fins, there are about 26 rays in the damaged dorsal fin, and 28 tail rings remain. This young fish has some fine denticulations on the snout ridge, snout depth is ca. 5.5 in snout length, there are 23 trunk rings and 2.75 + 2.5 subdorsal rings, a small dermal flap is located above the left eye, and present overall length is about 134 mm.

Dawson et al. (1979) illustrated and discussed a planktonic juvenile (78 mm SL) of *T. longirostris* (as *Yozia intermedia*) with two pairs of elongate appendages on the tail but without dermal flaps on the trunk. I have subsequently received a larger specimen (85 mm SL) from a trawl collection which retains the basal portions of two pairs of similar appendages on the tail. This fish (Fig. 6) has 9 narrow brown bars crossing the sides and dorsum of the tail, the ventralmost fin-ray is essentially free from the remainder of the rather long caudal fin, and there is a prominent dermal flap, flattened and broadly expanded distally, above each eye.

Among present material, the brood pouch extends below the anterior 15-24 (usually 19-22) tail rings in 24 males (142-312 mm SL). One fish

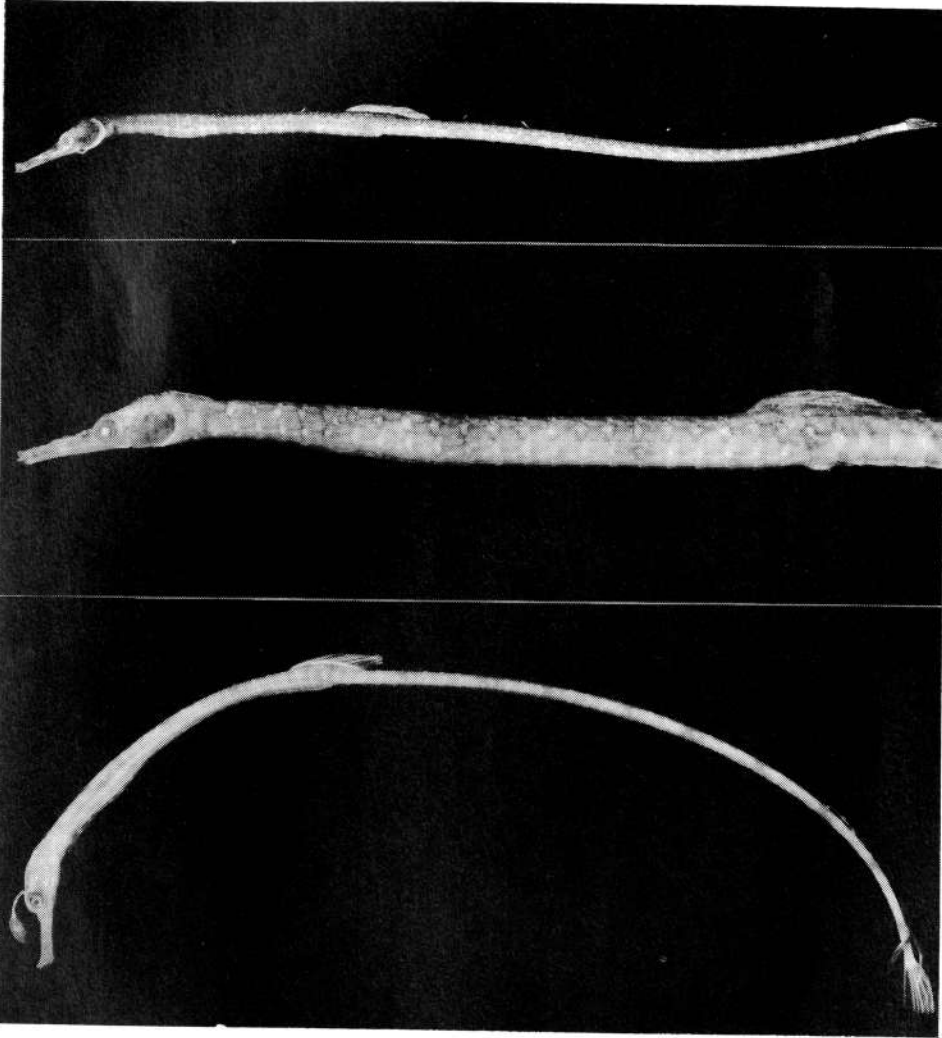


Fig. 6. *Trachyrhamphus longirostris*. Top. - GCRL 16955 (173 mm SL, subadult). Middle. - NTM S.10031-52 (267 mm SL, adult male). Bottom. - GCRL 16456 (85 mm SL, juvenile).

(238 mm SL) retains a single layer of brood-pouch eggs, arranged in 5-6 transverse rows, in the 21-ring pouch.

Present materials are insufficient for adequate determination of geo-

graphic variation in *T. longirostris* but there is some indication of variation in frequencies of tail rings and total rings. Specimens from Indonesia and the Philippine Is. usually (88%) have 42-44 tail rings and 15 of 17 fish have 64-67 total rings. In contrast, 27 specimens from other areas have 44-53 tail rings and 68-77 total rings.

This species has seldom been treated in the literature but it has been recorded from Madagascar (Saùvage, 1891), India (Day, 1878), Sri Lanka and Zanzibar (Günther, 1870), and Japan (Dawson et al., 1979). The specimen from New Caledonia or the New Hebrides illustrated by Fourmanoir and Laboute (1976) is a misidentified specimen of *T. bicoarctatus*. Materials examined show that *T. longirostris* also occurs in the Red Sea, in Indonesia, the Philippine Is., at New Guinea, and along the northern and eastern coasts of Australia (Fig. 4). Collection data include one dredge sample in 49-53 m and nine trawl samples in 16.5-91.4 m.

MATERIAL EXAMINED: Fifty specimens (excluding larvae), 16.5-312 mm SL, including one syntype.

SYNTYPE: BMNH 1981.5.22.1 (312 mm SL, adult male), "China," Sir Edward Belcher.

OTHER MATERIAL: RED SEA, Dahlak Arch.: HUI F.9254 (2,189-215). Loc. uncertain: HUI F.9255 (3,237-256). ZANZIBAR: BMNH 1868.5.3.63 (1,165.5), syntype of *Syngnathus ceylonensis*. INDIA, Jamnagar: GCRL 14108 (1,249.5). Madras: AMS B. 7811 (1,225), GCRL 15554 (5,213-264). Waltair: GCRL 15221 (1,209). SRI LANKA: BMNH 1849.7.27.92 (1, ca. 230), syntype of *S. ceylonensis*. INDONESIA: GCRL 16955 (1,173), USNM 222943 (1,185), ZMUC P. 39557 (1,196). PHILIPPINE IS.: CAS 33534 (1,213), CU 65394 (2,236-251), GCRL 16443 (2,236-278), GCRL 16444 (1,238), USNM 220591 (1,264), USNM 220592 (2, ca. 142-254.5), USNM 220593 (2,262-267), USNM 220594 (1,249.5), USNM 220596 (1,216), UW 7362 (1.183.5). JAPAN, Honshu I.: GCRL 16127 (1.29.5), MTUF 23835 (1,16.5), MTUF 23836 (1,78). PAPUA NEW GUINEA: KFRS F.0759 (1, ca. 170). AUSTRALIA, Western Australia: QM 14281 (1,266.5), WAM P.234 (1,278). Northern Territory: AMS I.19289-002 (.280.5), GCRL 16456 (1,85), GCRL 17397 (1,301), NTFD uncat. (1,145.5), NTM S.107 (1,296), NTM S.0255 (1,271), NTM S.10031-52 (2,267-276). Queensland: AMS IB.8348 (1,277), QM 16707 (1,251). LOC. UNCERTAIN: MNHN 6039 (1, damaged), holotype of *Trachyrhynchus intermedius*, "China? or Japan", no other data.

Trachyrbamphus bicoarctatus (Bleeker)

Figs. 7-9

- Syngnathus bicoarctatus* Bleeker, 1857:99 (orig. descr.; Amboina).
- Syngnathus zanzibarensis* Playfair and Günther, 1866:140, pl. 20, fig. 5 (orig. descr.; Zanzibar).
- Syngnathus brevicaudus* Castelnau, 1875:48 [orig. descr.; Swan R. (W. Austr.)].
- Ichthyocampus maculatus* Alleyne and Macleay, 1877:353, pl. 17, fig. 2 [orig. descr.; Darnley I. (Qld., Austr.)].
- Ichthyocampus annulatus* Macleay, 1878:364, pl. 10, fig. 6 [orig. descr.; Port Darwin (Austr.)].
- Yozia wakanourae* Jordan and Snyder, 1901:8, pl. 6 (orig. descr.; Wakanoura, Japan).
- ? *Trachyrbamphus* (sic) *brevicaudis* (sic). Duncker, 1909:238 (n. comb.).
- Yozia bicoarctata*. Duncker, 1912:233 (n. comb.).
- Yozia brevicaudis*. Duncker, 1915:109 (n. comb.).
- Yozia maculata*. Duncker, 1915:109 (n. comb.).
- Yozia annulata*. Duncker, 1915:110 (n. comb.).
- Yozia bicoarctata erythraeensis* Dollfus and Petit, 1938:500 (orig. descr.; Gulf of Suez).
- Yozia bicoarctata melanesiae* Fowler, 1945:61, figs. 3-4 (orig. descr.; Saipan).
- Yozia bicoarctata bicoarctata*. Fowler, 1945:62 (n. comb.).
- Yozia bicoarctata wakanourae*. Fowler, 1945:62 (n. comb.).
- Yozia bicoarctata zanzibarensis*. Fowler, 1945:62 (n. comb.).
- Yozia bicoarctata brevicauda*. Whitley, 1948a:269, fig. 6 (n. comb.).
- Yozia compitalis* Whitley, 1950:238 [orig. descr.; Pymont, Sydney, NSW (Austr.)].
- Yozia compitalis samaraiensis* Kähsbauer, 1970:157 (orig. descr.; Samarai I., Papua New Guinea).

DIAGNOSIS: Tail rings 55-63, HL averages 11.6 in SL, snout length averages 1.7 in HL, snout depth averages 7.5 in snout length, median dorsal snout ridge without denticulations.

DESCRIPTION: Rings 21-24 + 55-63, subdorsal rings 4.0-2.0 + 1.75-3.5 = 4.75-6.5, dorsal-fin rays 24-32, pectoral-fin rays 15-19 (see Tables 1-3

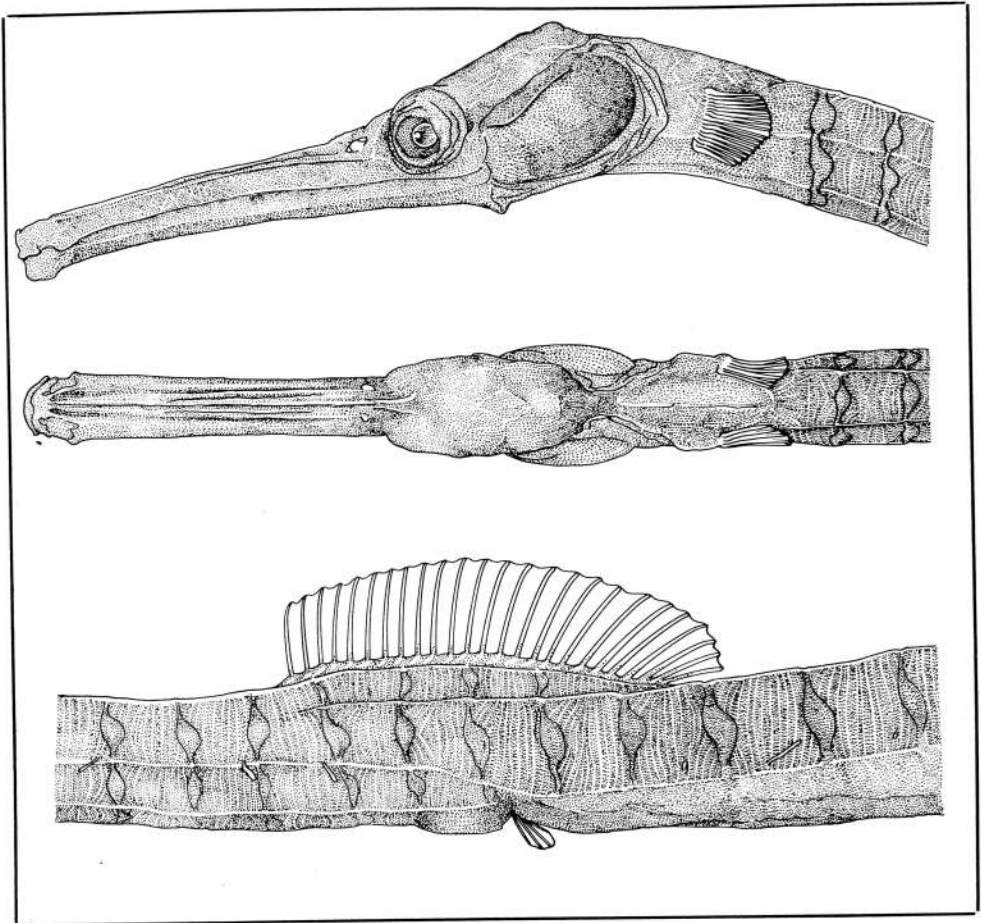


Fig. 7. *Trachyrhamphus bicoarctatus*. Lateral and dorsal aspects of head and anterior trunk rings, together with section of body illustrating principal ridges, dorsal and anal fins, and anterior part of brood pouch. From 299 mm SL male (GCRL 16867).

and 5 for additional counts). Proportional data, based on 30 specimens 189-385 (\bar{x} = 300.5) mm SL, follow: HL in SL 9.9-13.0 (11.6), snout length in HL 1.5-2.0 (1.7), snout depth in snout length 5.2-11.1 (7.5), length of dorsal-fin base in HL 1.3-1.8 (1.5), anal ring depth in HL 3.5-6.4 (4.4), trunk depth in HL 3.3-4.6 (4.0), pectoral-fin length in HL 7.4-11.4 (9.4).

Snout essentially straight in small fish (<150mm SL), arcuate or deflected ventrad in subadults and adults; median dorsal snout ridge without denticulations, sometimes entire, usually with irregular low emarginations on posterior half of snout length; small fish (ca. 180-250 mm SL) sometimes with a ring of minute dermal flaps on eye.

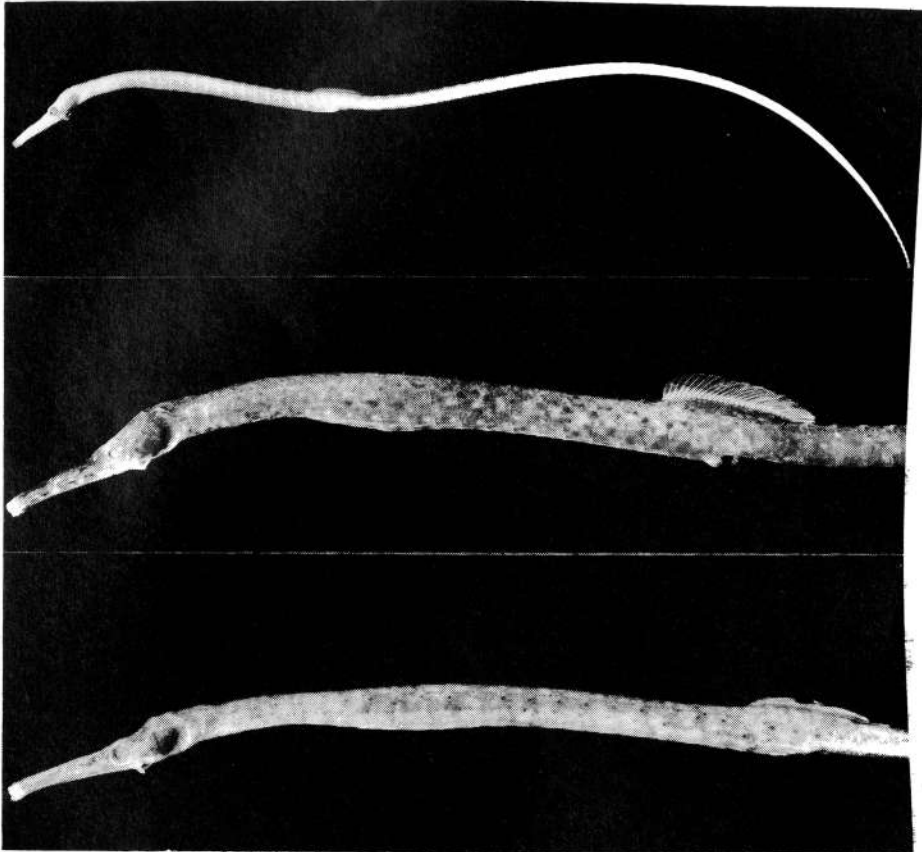


Fig. 8. *Trachyrhynchus bicoarctatus*. Top. - GCRL 16976 (190.5mm SL, juvenile). Middle. - GCRL 16976 (270 mm SL, female). Bottom. - GCRL 16231 (385 mm SL, female).

Ground color near white to black; snout tip often pale; body plain, spotted, or mottled; some specimens with 12-13 pale bars (ca. 1 ring wide) crossing sides and dorsum of tail; dorsal-fin rays often narrowly edged with brown, the membranes hyaline; pectoral fin hyaline; caudal fin pale to brown.

COMPARISONS: Characters in key and diagnosis distinguish subadults-adults of *T. bicoarctatus* from those of congeners. Planktonic juveniles (<ca. 100 mm SL) have one pair of elongate dermal appendages on the dorsum of the 3rd or 4th trunk ring (Fig. 9) and 5 pairs of similar appendages on the dorsum of the tail (ca. rings 41-63). Comparable juveniles are as yet unknown for *T. serratus*, but those of *T. longirostris* lack appendages on the trunk and have only two pairs on the tail. This species attains a length of at least 385 mm SL, whereas maximum observed length is



Fig. 9. *Trachyrhamphus bicoarctatus*. Head and anterior part of body of 102 mm SL planktonic juvenile (ZMUC P.39705), together with basal portion of anterior pair of elongate dermal appendages.

T. longirostris and *T. serratus* (respectively, 312 and 313 mm SL). For comment on caudal fin, see Remarks under discussion of genus.

REMARKS: The holotype of *Syngnathus bicoarctatus* (RMNH 7237) is a young female or immature male (ca. 242 mm SL) with damaged head and pectoral fins. The caudal fin is damaged, but there appear to be 8 fin-rays remaining and the ventralmost is somewhat enlarged. The specimen is pencil-marked and is presumably the model for the illustration (Pl. 450, fig. 5) in Bleeker's unpublished Atlas. However, the figured shape of the head and caudal fin are not typical of this species, and these portions were apparently subject to some artistic license.

I have been unable to locate the holotype of *Syngnathus brevicaudus* Castelnau, but the description was doubtless based on a specimen of *Trachyrhamphus bicoarctatus* with a regenerated tail. Herald and Randall (1972) identified "the two type specimens" of *Ichthyocampus annulatus* Macleay as *Micrognathus brevirostris* (Rüppell), and suggested that the figure (Macleay, 1878, pl. 10, fig. 6) accompanying the original description (= *Trachyrhamphus bicoarctatus*) was published in error. The fish mentioned by Herald and Randall (AMS I.16288-001) and a third "syntype" (AMS IA. 1556) are conspecific with *Micrognathus micronotopterus* (Fowler), and I find no evidence that Macleay identified these specimens as *Ichthyocampus annulatus*. In cases where a figured description differs strikingly from presumed type material, I believe that the name must be applied to the illustrated taxon. Thus, I consider Macleay's name to be a junior synonym of *Trachyrhamphus bicoarctatus*. I find nothing in Kähnsbauer's (1970) description to warrant subspecific status for *Yozia compitalis samaraiensis* and

the type specimens of other nominal taxa in the foregoing synonymy are conspecific with *Trachyrhynchus bicoarctatus*.

Dawson et al. (1979) described and figured the six pairs of elongate appendages occurring on the dorsum of brood-pouch young (10-11 mm SL) of *T. bicoarctatus*. Subsequent examination of planktonic juveniles has shown that these appendages may be retained in specimens as large as 102 mm SL (Fig. 9).

Among present material, the brood pouch extends below the anterior 15-22 tail rings in 16 undamaged males 254-366 mm SL. One male (342 mm SL) has a single layer of brood-pouch eggs, arranged in ca. 12 transverse rows, in the 17-ring pouch.

In Australia, some clinal variation is indicated in numbers of trunk rings and tail rings, wherein the total number of rings is generally lower (76-81) in material from the Northern Territory, Queensland and New South Wales and higher (79-84) in the few specimens examined from Western Australia. Elsewhere, present data fail to indicate significant geographic variation in numbers of rings, but frequencies of dorsal-fin rays (Table 5) tend to be highest in the western Indo-Pacific region and lowest in Australia and New Caledonia. Although similar variation has been previously noted for several Indo-Pacific pipefishes (Dawson, 1977, 1981), numbers of dorsal-fin rays usually increase from west to east, rather than in the east-west direction indicated here.

Coloration is highly variable in specimens of *T. bicoarctatus* and, in at least one instance, dark brown-black and near-white fish have been taken in a single collection. Descriptions of three nominal taxa (*YoZIA b. melanesiae*, *Y. compitalis*, *Y. c. samaraiensis*), now referred to the synonymy of *T. bicoarctatus*, were largely based on differences in preserved coloration.

DISTRIBUTION: Materials examined show *T. bicoarctatus* to range from the Persian (Arabian) Gulf and northern Red Sea, southward to the vicinity of Durban on the SE coast of Africa, and eastward to Japan (Honshu I.), the Mariana Is. (Saipan) and New Caledonia (Fig. 4). Australian distribution extends from Shark Bay (ca. 25°25'S), Western Australia, along northern and eastern coasts to Sydney Harbor (ca. 33°53'S), New South Wales. One record of interest (omitted from Fig. 4) is that of a young fish (SAM 23544) taken from the stomach of a "yellowfin tuna" (*Thunnus albacares?*) caught in the Atlantic Ocean some 83 km W of Slangkop (34°09'S, 18°21'E) on the western side of the Cape of Good Hope. In addition to the foregoing

Table 5. Geographic variation in frequencies of dorsal-fin rays in *Trachyrhamphus bicoarctatus*.

Locale	Dorsal-fin rays								
	24	25	26	27	28	29	30	31	32
Persian Gulf				1			1		
Red Sea		1			2	4	4		2
E. Africa					4	8		1	
Comoro Is.							1		
India						1	2		
Indonesia					2		1		
Philippine Is.			2	1	4	1			
Japan					1				
Mariana Is.					1				
Australia	1	1	6	12	1	1			
New Caledonia		1							

and to localities cited in the synonymy, there are pertinent literature records from Madagascar (Mauge, 1967), Cargados Carajos (Regan, 1908), Mauritius (Duncker, 1915), Sri Lanka (Johnstone, 1904), Bangladesh (Qureshi, 1970), off Johore (Wongratana, 1968) and Hai-nan I., China (Chen, 1935).

Present data indicate collections over sand, rubble, reef, and "grass" bottoms in depths of 1.6-42 m. One planktonic juvenile (ZMUC P.39705) was taken in a 2 m stramin net in 0-100 m over a depth of 1470 m, SW of the Nicobar Is. (05°50'N, 93°28'E).

MATERIAL EXAMINED: Seventy-five specimens (excluding larvae), 36-385 mm SL, including holotype.

HOLOTYPE: RMNH 7237 (ca. 242 mm SL, female or immature male), Moluccas Is., Amboina, P. Bleeker.

OTHER MATERIAL: PERSIAN (ARABIAN) GULF, Manifa: FRBB uncat. (2,267-319). RED SEA, Gulf of Suez: MNHN 60-576 (337.5, holotype of *YoZIA bicoarctata erythraeensis*). Gulf of Aqaba: GCRL 17066 (1, ca. 315), HUJ F.6037 (1,366), HUJ F.10321 (1,342) HUJ F.10393 (1,304), MNHN 1977-1051 (1,346.5), TAU P.5650 (2,278-340), USNM 210992 (1,337), USNM 220989 (3, ca. 316-367). Loc. uncertain: HUJ D.277 (1,277). ZANZIBAR: BMNH 1867.3.9.391 (1, ca. 317, dried), BMNH 1867.4.18.2-4 (3, ca. 224.5-298, dried), and BMNH 1868.5.30.29 (2, ca. 254-310), syntypes of *Syngnathus zanzibarensis* and MCZ 52491 (1, ca. 300). MOZAMBIQUE: RUSI 12284 (5, ca. 200-347), SAM 12370 (1, ca. 263), SAM 26367 (1, ca. 350), SAM 28902 (1,335). SOUTH AFRICA: RUSI 11487 (1,363), SAM 12808 (1,265), SAM 23544 (1,199.5). COMORO IS.: CAS 32540 (1,315). INDIA, Madras: GCRL 15555 (1,279), GCRL 15672 (1,223). Waltair: GCRL 15220 (1, ca. 277). NICOBAR IS. (vicinity): ZMUC P.39705 (1,102) INDONESIA, Celebes Is.: USNM 215322 (1,264). Moluccas Is. Amboina: BPBM 18327 (1, ca. 345). PHILIPPINE IS., Luzon Is.: AMS 1.21911-001 (1,231), AMS 1.21923-001 (2, ca. 295-357), ANSP 149085 (1,215), GCRL 16939 (1,239). Jolo Is.: USNM 137268 (1, ca. 154). Negros Is.: UW 7388 (2, ca. 337-364). JAPAN, Kyūshū Is.: UMMZ 202749 (1, dam.). Honshu Is.: CAS-SU 6517 (262, holotype of *YoZIA wakanourae*). MARIANA IS., Saipan: ANSP 71587 (247.5, holotype of *YoZIA bicoarctata melanesiae*). AUSTRALIA, Western Australia: AMS 1.19349-001 (1,316), GCRL 16321 (1,385), WAM P.5264 (1,282.5), WAM P.26469-001 (1, ca. 377), WAM P.26478-002 (1,298.5), WAM P.26492-002 (1,259.5). Northern Territory: CSIRO A.2639 (1,315), NTM S.10004-045 (1, ca. 340). Queens-

land: AMS I.16287-001, formerly Macleay Mus. F.261 (295, holotype of *Ichthyocampus maculatus*), AMS I.20751-027 (1, 331.5), AMS I.20771-073 (1, 299.5), AMS uncat. (1, 36). New South Wales: AMS I.18783-002 (1, 211), AMS I.19259-001 (2, ca. 265-312), AMS IB.1665 (189, holotype of *Yozia compitalis*), GCRL 16230 (1,287.5), GCRL 16453 (1,255), GCRL 16976 (3, 190.5-270). NEW CALEDONIA: GCRL 16867 (1, 299). LOC. UNCERTAIN: BMNH 1848.3.16.4 (1, 299.5), "China seas," Belcher, no other data.

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