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Gonostomatid Fishes of the Western North Pacific

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Abstract Eight genera and 15 species of mesopelagic fishes belonging to the family Gonostomatidae are reported from the western North Pacific, based upon the materials collected by research vessels of the Ocean Research Institute, University of Tokyo, during the years 1964 to 1968. Of these, nine species; *Pollichthys mauli* Grey, *Vinciguerria attenuata* (Cocco), *Gonostoma atlanticum* Norman, *G. elongatum* Günther, *Cyclothone alba* Brauer, *C. pseudopallida* Mukhacheva, *C. pallida* Brauer, *C. acclinidens* Garman and *Valenciennellus tripunctulatus* (Esmark), are new to the Japanese fauna. Keys to each genus and species, and some systematic accounts are presented except the genus *Polymetme*.

Since 1964, ecological studies of planktonic and micronektonic animals have been made in the western North Pacific, mainly off the coasts of Japan by the R/V Tansei Maru and R/V Hakuhō Maru of the Ocean Research Institute, University of Tokyo. The investigated area covered the water masses of the Kuroshio, Kuroshio Extention, Oyashio, and Western North Pacific Central Water. More than 500 samples have been collected from the surface to about 2000 m depths by ORI-plankton net, 160 cm in diameter and 750 cm long, sometimes equipped with opening-closing devices (Omori, 1965; Omori et al., 1965). In some cases, Isaacs-Kidd midwater trawl was also used supplementalily. The samples collected contained many kinds of micronektonic deep sea fishes including new or rare species (Abe et al., 1965a, 1965b). Fishes of the families of Gonostomatidae and Myctophidae dominated the catch in both number and variety.

This paper presents practical keys to identify the adult or adolescent fishes of the family Gonostomatidae from the western North Pacific, since the progress in the ecological studies of these fishes has been much restricted because of the difficulties in their identification. Here, keys and some systematic accounts are presented for the 15 mesopelagic species of eight genera with new Japanese vernacular names of three genera and nine species. A key to the species of the genus *Polymetme* has not been prepared, since there remain many taxonomical problems among these fishes. Differing from the fishes of the other eight genera which are pelagic, the fishes of the genus *Polymetme* are likely to be benthic or nearly benthic species.

In the section of reference specimens for each species, the length after the catalogue number is the standard length.

The reference specimens are deposited in the Ocean Research Institute (ORI), and the Section of Zoology, University Museum, University of Tokyo (ZUMT). Collection data at each sampling station are shown in Table 1.

Studies on geographical distributions and diurnal vertical migrations of these species are being prepared for publication.

Family Gonostomatidae
"Yoko-eso ka" (Japanese name)

In the family Gonostomatidae, Grey (1960, 1964) recognized 21 genera from the world oceans. The key to the nine genera of the western North Pacific presented here is mostly based upon Grey (1960), although partly simplified and modified. Figures, show-

Table 1. Data on the stations where the specimens studied were collected by R/V Tansei Maru and Hakuhō Maru in the western North Pacific, 1964–1968.

Station	Date	Time	Lat., N	Long., E	Haul depth (m)
	1964				
2	1–20	1808–1855	34°58.8′	139°13.1′	0–ca. 400
3–3	1–21	1419–1533	35°12.8′	139°15.5′	0–500
6–7	1–24, 25	2341–0059	35°05.9′	139°18.7′	0–255
9	1–26	1329–1418	34°56.1′	139°24.0′	0–370
53	5–21	1355–1447	34°54.2′	139°23.7′	0–715
66–3	8–13	2027–2057	35°00.1′	139°20.8′	190–210
66–7	8–14	0340–0440	35°01.6′	139°21.9′	390–480
76–2	8–18	1750–2023	34°31.3′	138°33.6′	0–2300
93–2	10–28	1228–1335	34°55.8′	138°38.5′	0–1300
	1965				
111–1	4–24	1440–1556	34°30.7′	138°32.1′	0–1000
115–1	4–25	1225–1342	32°31.2′	138°37.9′	0–920
117–2	4–26	0544–0842	32°34.8′	140°37.0′	0–1560
118–1	4–26	1127–1240	33°02.5′	140°30.8′	0–1250
120–1	4–26	1930–2049	34°02.2′	140°30.6′	0–1000
121–1	4–26, 27	2358–0115	34°32.2′	140°32.5′	0–850
121–2	4–27	0120–0420	34°34.2′	140°41.0′	0–1100
126–1	7–10	1230–1310	34°53.5′	138°38.6′	0–400
	1966				
138	4–19	1343–1455	35°01.7′	139°15.4′	0–ca. 900
140	4–20	1054–1208	35°04.4′	139°23.4′	0–700
143–1	6–10	2125–2039	28°04.1′	131°56.4′	0–750
143–2	6–10	2243–2358	28°00.0′	131°56.6′	0–845
144–1	6–11	2010–2122	28°04.6′	134°08.9′	0–800
144–2	6–11	1831–1947	28°06.1′	134°04.5′	0–845
144–3	6–11, 12	2129–0022	28°02.8′	134°14.7′	0–1368
145–4	6–12	1550–1839	28°06.2′	135°45.4′	0–1878
150	6–15	2214–2253	34°04.7′	137°01.9′	0–650
195–2	9–29, 30	2357–0106	37°03.7′	142°37.7′	0–1050
199	10–17	1425–1526	33°39.2′	136°29.5′	0–700
	1967				
1–F	3–7	2300–2337	35°03.8′	138°38.6′	0–40
4–A	3–13	0059–0129	34°49.0′	139°27.3′	0–130
4–D	3–13	0246–0316	34°48.7′	139°26.5′	0–132
269	8–6	0932–1008	37°55.0′	142°54.5′	0–370
277	8–8	0255–0303	34°50.8′	139°30.6′	0–ca. 900
H4–2*	9–13	1324–1431	22°07.3′	142°20.9′	0–950
H5–1*	9–15	2113–2217	30°02.2′	142°00.0′	0–670
	1968				
NOMI–14	10–5	1150–1332	35°01.4′	139°20.7′	0–ca. 900
NOMI–16	10–5	1804–1838	35°14.1′	139°19.7′	0–ca. 150
H48–2*	5–26	2125–2246	22°59.2′	124°15.1′	0–850
H56–4*	5–31	2220–2327	26°04.7′	131°53.0′	0–ca. 900

* R/V Hakuhō Maru stations.

ing the terminology of photophores and distinctive characters, are included to aid in identification.

Key to the genera of the family Gonostomatidae of the western North Pacific
Mainly after Grey (1960, 1964).
(Figs. 1–7, Plates 1–3, Table 2)

1a. BR 8 or more; serial photophores separated, not grouped in common glands (Fig. 1a).

2a. Photophores present on isthmus (Fig. 2a); IV 20 or more; IC (=IV+VAV+AC) 42 or more.

3a. More than two rows of photophores on body (Fig. 2e); OA 40 or more; IV 40–49; premaxillary teeth uniserial.
. . . . . *Diplophos* Günther, 1873

3b. Only two rows of photophores on body; OA 16–34; IV 19–28; premaxillary teeth uniserial or biserial.

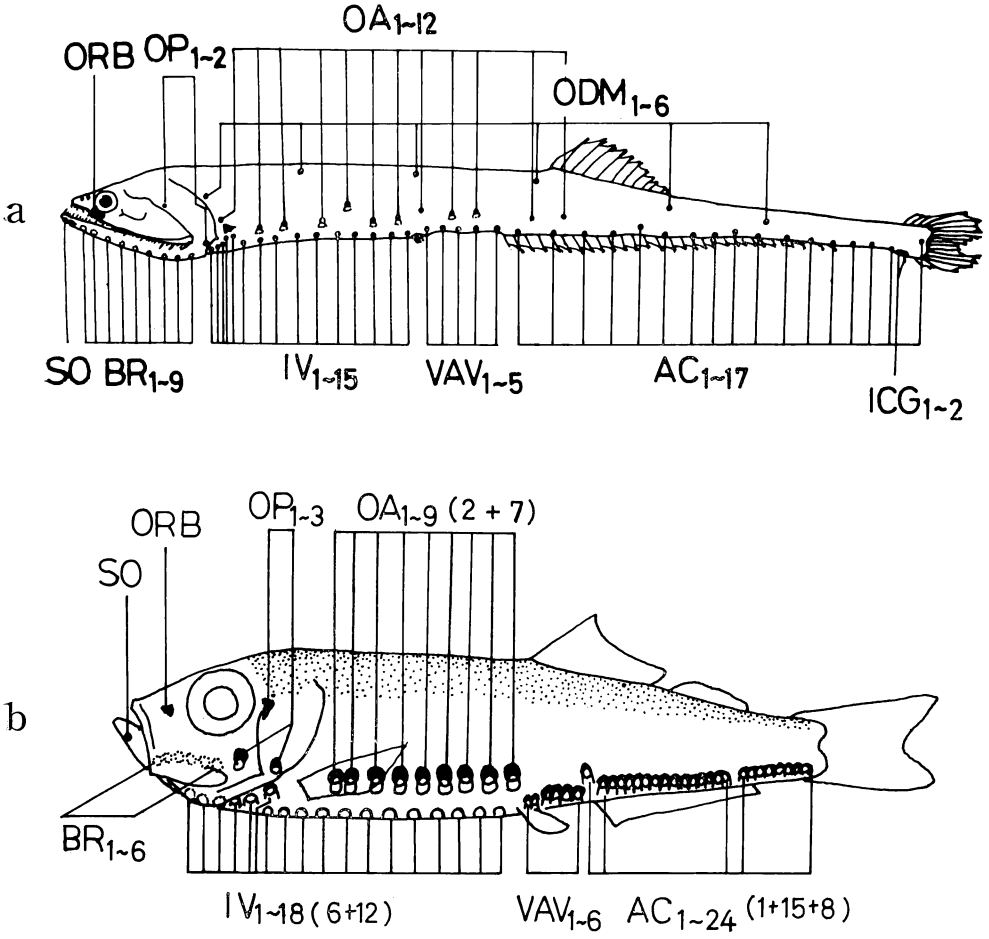

Fig. 1. Diagrams showing the general distribution of photophores and the terminology. a. *Gonostoma gracile*. b. *Maurolicus muelleri*. SO, a pair of organs often found near the symphysis of the lower jaw; BR, branchiostegal organs; ORB, organs situated close to eye; OP, opercular organs; IV, preventral organs of the ventral series; VAV, organs of ventral series between the pelvic insertion and anal origin; AC, photophores of ventral series posterior to the anal origin; OA, organs of the lateral series; ODM, organs along the dorsal margin in *Gonostoma gracile*; ICG, infracaudal gland.

4a. ORB 1, close to front of eye; premaxilllary teeth biserial; AC 22–25..... *Polymetme* McCulloch, 1926

4b. ORB 2, one close to front of eye, another close to its hinder margin or below center (*Ichthyococcus*); premaxillary teeth uniserial; AC 12–21.

5a. Mouth large, bordered by premaxillary anteriorly; jaws equal, or lower jaw slightly protruded; pelvic insertion in advance of dorsal origin (Fig. 2c); gill rakers minutely denticulate on inner edge.

6a. Anal origin beneath middle or anterior portion of dorsal base; anal rays 22–30; anterior ORB larger than posterior one; AC 19–21..... *Pollichthys* Grey, 1959

6b. Anal origin beneath middle or posterior portion of dorsal base; anal rays 12–16; anterior ORB equal in size or posterior one larger; AC 12–16.... *Vinciguerria* Jordan and Evermann, 1896

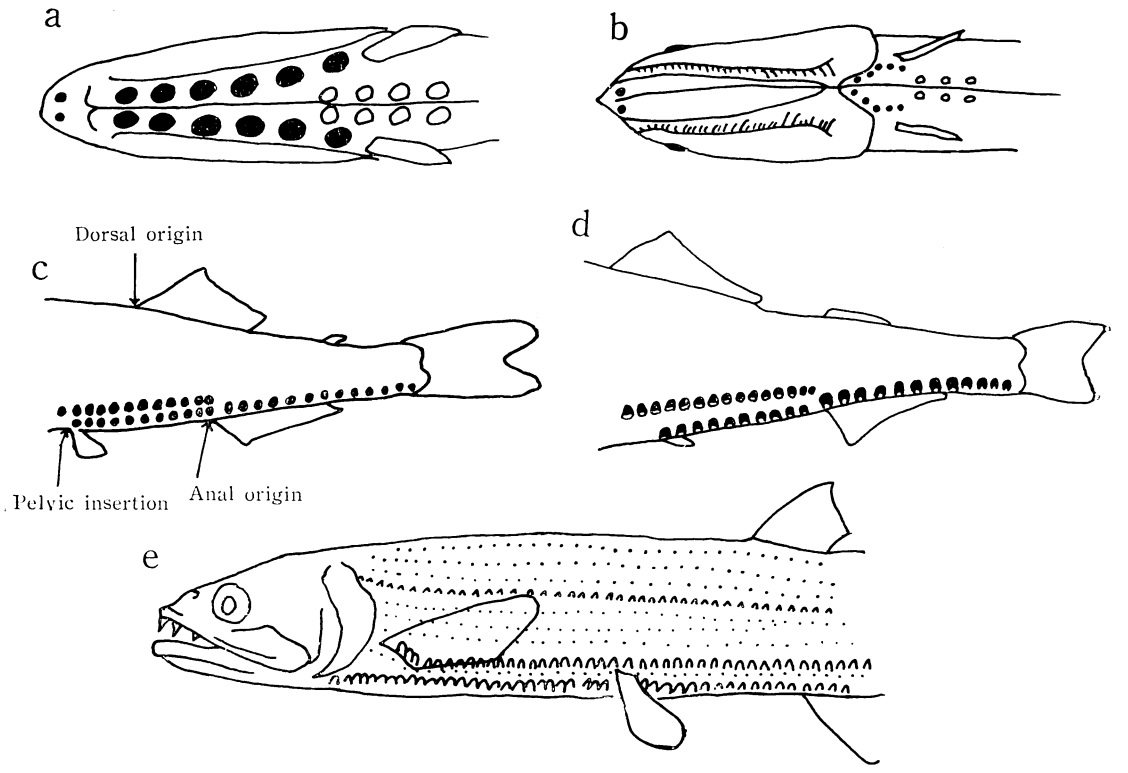

Fig. 2. Key characters of the five genera treated in the present study. a, photophores on isthmus (*Maurolicus muelleri*). b, no photophores on isthmus (*Gonostoma gracile*). c, pelvic insertion in advance of dorsal origin (*Vinciguerria nimbaria*). d, pelvic insertion behind dorsal origin; anal origin behind dorsal fin (*Ichthyococcus elongatus*). e, more than two rows of photophores on body *Diplophos orientalis*).

5b. Mouth small; premaxillary not entering into gape; lower jaw included anteriorly; pelvic insertion behind dorsal origin (Fig. 2d); gill rakers smooth... *Ichthyococcus* Bonaparte, 1841

2b. No photophores on isthmus (Fig. 2b); IV 17 or fewer; IC (=IV+VAV+AC) 26–44.

7a. SO present (usually absent in *G. bathyphilum**); OA 11–21; anal rays 21–31; vertebrae 37–42**; maxillary with a series of well separated, relatively long, slender, subequal teeth and short teeth in the interspaces between them (Fig. 3a)..... ....*Gonostoma* Rafinesque, 1810

7b. SO absent; OA 6–10; anal rays 16–21; vertebrae 29–33; maxillary with a series of close-set, subequal teeth increasing in size unevenly or evenly towards the rear (Figs. 3b, 3c)..... *Cyclothone* Goode and Bean, 1883

1b. BR 6; at least some of the serial photophores grouped together in common glands, appearing as black or silvery bands (fig. 1b. AC).

8a. AC composed largely of separate photophores, more or less evenly spaced usually including one or two graoups of 2–4 small photophores each; always at least 3 separate photophores present.

(Four genera; *Neophos* Myers, 1932, *Thorophos* Bruun, 1931, *Araiophos* Grey, 1961, and *Danaphos* Bruun, 1931 are included here (Grey; 1960, 1964). No specimens belonging to these genera have been collected in the investigated area. But fishes of these genera are very likely to be collected in the western North Pacific in the future, since these fishes have been recorded from the tropical Pacific and Indian Oceans.)

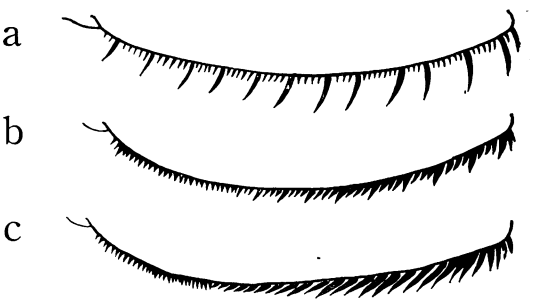

Fig. 3. Maxillary teeth showing the differences in dentition between the genera *Gonostoma* and *Cyclothone*. a, *G. elongatum*; b, *C. pallida*; c, *C. acclinidens*.

8b. AC composed of two to six groups of 2 or more photophores each (one separate photophore present anteriorly only in *Maurolicus*) (Fig. 1b).

9a. AC composed of three to six groups of 2–4 small photophores each, no AC above the anal origin; IV (3)*+(4)* on isthmus, 16–17 on abdomen, total 23–24; VAV 4–5; no SO; OA (2)*+3=5..... *Valenciennellus* Jordan and Evermann, 1896

9b. AC composed of two groups of (14–18) and (7–9) photophores preceded by a single elevated organ, AC present above the anal origin; IV (6)+(12–13)=18–19; VAV 6; SO present; OA 9 (rarely 10)..... .....*Maurolicus* Cocco, 1838

* This species has not been recorded from the North Pacific, but recorded from the South Pacific (Bussing, 1965).

** Grey (1960) reported as 37–40, but more higher count of 41–42 was observed in *G. gracile* (Kawaguchi et al., 1967).

* Photophore counts in parentheses indicate that these photophores are grouped in common gland.

Genus *Diplophos* Günther, 1873
"Yume-hadaka zoku" (Japanese name)

Diplophos orientalis Matsubara
"Yume-hadaka" (Japanese name)
(Plate 1–A, Fig. 2e)

Diplophos taenia orientalis Matsubara, 1940: 317.

Diplophos orientalis, Matsubara, 1955a: 220; Abe, 1958: 1241, fig. 598.

Reference specimens: ORI–1013, 276 mm, st. 4–A; ORI–1014, 223 mm, st. 4–D; ZUMT–52393, 200 mm, st. 1–F.

Three species, *D. pacificus* Günther, *D. proximus* Parr, and *D. orientalis* Matsubara, have been reported in this genus from the Pacific Ocean. But no clear-cut differences have been found among these three species (Grey, 1960: table 2). This confusion has resulted mostly because all the specimens of *D. orientalis* ever recorded are more than 177 mm in standard length, on the other hand all the specimens of the other two species are less than 100.5 mm. This fact makes it uncertain whether or not the differences among these three species are due to morphological changes related to the growth of one species. Grey (1960: 81), further, suggested the possibility that *D. orientalis* merely represents the adults stage of *D. pacificus*, and/or *D. proximus*. Study of the morphology of *D. orientalis* of various sizes, especially of less than 100 mm, is very much needed to solve the above-mentioned problem, but at present it is impossible because of the lack of specimens.

Recently Johnson (1970: 437) preliminarily stated that *D. pacificus*, *D. proximus* and *D. orientalis* are synonymous and that all three species probably synonymous with *D. taenia*. The publication of Johnson's concrete basis on this problem is awaited.

The present specimens agree well with the description of *D. orientalis* made by Matsubara (1940) and Abe (1958), and were tentatively identified with *D. orientalis*.

Genus *Polymetme* McCulloch, 1926
"Gin-hadaka zoku" (Japanese name)

Fishes of this genus were not taken by the midwater samplings made by ORI-plankton net, but these are common in the catches of the bottom trawling of the commercial fisheries on the continental shelf and slope off southern Japan. This suggests that the fishes of this genus are bottom or near bottom dwellers. Grey (1964: 111) also suggested the similar habits as above. Although Tominaga (*in* Sakamoto et al., 1967: 189, table 2) reported two specimens of *P. illustris* from the midwater of Suruga Bay, these are misidentifications of *Vinciguerria* sp. (Y. Tominaga, personal communication).

Hitherto, four species have been recorded from off Japan under the name of *Yarrella illustris* (McCulloch), *Y. elongata* Matsubara, *Y. microcephala* Matsubara, *Y. surugaensis* Matsubara (Matsubara, 1938: 39, figs. 4, 5, 6, tables 1, 2; Matsubara, 1941: 1; Matsubara, 1943: 73, fig. 22; Matsubara, 1955a: 220).

There had been a taxonomic confusion between the fishes of the genera *Polymetme* McCulloch 1926 and *Yarrella* Goode and Bean 1896, but Grey (1960: 70, 86, 93; 1964: 83, 101, 111) pointed out that *Yarrella* has more than two rows of photophores on the body, whereas *Polymetme* has only two rows of photophores, and clarified the confusion between these two genera. According to Grey (1960: 93–95) the fishes reported under the genus name of *Yarrella* by Matsubara should be identified with the genus *Polymetme*, except *Y. microcephala* Matsubara. Then, the Japanese name "Gin-hadaka", given for the genus *Yarrella* by Matsubara (1938: 39), should be applied to the genus *Polymetme*. Grey (1960: 95), further, pointed out the possibility that *Y. microcephala* does not belong to the genus *Polymetme* and *P. surugaensis* is a synonym of *P. illustris*. For the correct identification of *Polymetme* from off Japan, there remains much to be studied based upon the direct comparison of specimens.

Genus *Pollichthys* Grey, 1959
"Yōji-eso zoku" (New Japanese name)

Only one species, *P. mauli* (Poll), has been reported in this genus from the world.

Pollichthys mauli (Poll)
"Yōji-eso" (New Japanese name)
(Plate 1–B)

Yarrella mauli Poll, 1953: 59, fig. 24.
Pollichthys mauli, Grey, 1959: 167; Grey, 1964: 118, fig. 27.
Reference specimens: ORI–354, 33 mm, st. 115–1; ZUMT–52394, 27 mm, st. 144–2.

This species is very similar to fishes of the genera *Cyclothone* and *Gonostoma* in body shape, but is clearly distinguishable by characters shown in Table 2.

Genus *Vinciguerria* Jordan and Evermann, 1896
"Uki-eso zoku" (New Japanese name)

Three species, *V. poweriae* (Cocco), *V. nimbaria* (Jordan and Williams) and *V. lucetia* Garman, have been reported from the North Pacific. In addition, *V. attenuata* is newly recorded from the westernNorth Pacific in this study.

Fishes of the genus *Vinciguerria* are easily distinguished from the closely related genera *Ichthyococcus* and *Pollichthys* by the relative positions of dorsal origin, pelvic fin base and anal origin of each species (see the key to genera and Figs. 2c, 2d).

Key to species

1a. SO present (absent in specimen smaller than 20 mm SL); gill rakers on first arch 14–15 (rarely 13)+5–6=19–21: eye not tubular..... ....*nimbaria* (Jordan and Williams), 1895

1b. SO absent; gill rakers on first arch 13–15+5–6=18–19; eye somewhat tubular, especially in adolescent (pl. 1–D)..... .....*attenuata* (Cocco), 1838

Vinciguerria nimbaria (Jordan and Williams) 1896
"Yabe-uki-eso" (Japanese name)
(Plate 1–D)

Zalarges nimbarius Jordan and Williams, 1896, In Jordan and Starks, 1896: 793, pl. 76.
Vinciguerria nimbaria, Grey, 1964: 130, figs. 29–32; Okiyama, 1969: 120, figs. 1–2, table 1.
Vinciguerria lucetia, Imai, 1961: 149, listed.
Reference specimens: ORI–1020, 36 mm, ORI–1021, 35 mm, ORI–1022, 35 mm, st. H56–4; ZUMT–52395, 33 mm, st. 120–1; ZUMT–52396, 20 mm, st. 9.

This species is different from the closely related species *V. lucetia* Garman, which has 27–33 gill rakers, in having 19–21 gill rakers on first arch. Grey (1964: 129) reported that *V. lucetia* has 20–23 (usually 20–22) IV photophores, whereas *V. nimbaria* has 23–24 IV. But most of specimens of *V. nimbaria* from off Japan have 23 IV, suggesting that IV count is not always a good distinctive character between these two species.

Vinciguerria attenuata (Cocco)
"Uki-eso" (New Japanese name)
(Plate 1–C)

Maurolicus attenuatus Cocco, 1838: 193, pl. 8, fig. 13.
Vinciguerria attenuata, Grey, 1964: 143, fig. 34, table 4.
Reference specimens: ORI–1025, 22 mm, st.

Table 2. Comparison of some distinctive characters of the fishes of the genera *Pollichthys*, *Cyclothone*, and *Gonostoma*.

Genus name	Photophores on isthumus	SO photophores	Number of BR photophores
Pollichthys	present	present	8
Cyclothone	absent	absent	8–11
Gonostoma	absent	present	9

H4–2; ORI–1026, 18 mm, st. 277; ORI–1027, 21 mm, st. 144–3; ZUMT–52397, 16 mm, st. 144–3, ZUMT–52398, 18 mm, st. 145–4.

This species has a somewhat tubular eye and 13–15+5–6=18–19 gill rakers on the first arch. On the other hand *V. poweriae*, which is most similar and reported from the eastern Pacific (Berry, 1966: 648), has a normal eye and 11–12+3–4=15 gill rakers on the first arch (Grey, 1964: 129).

This is the first record of *V. attenuata* from the North Pacific Ocean.

Genus *Ichthyococcus* Bonaparte, 1814
"Shinju-eso zoku" (Japanese name)

Two species, *I. elongatus* Imai and *I. irregularis* Rechnitzer and Böhlke, have been recorded from the North Pacific. In the western North Pacific, only *I. elongatus* occurs, and *I. irregularis* has hitherto been recorded only from the eastern North Pacific.

Ichthyococcus elongatus Imai
"Shinju-eso" (Japanese name)
(Plate 2–A, Fig. 2d)

Ichthyococcus elongatus Imai, 1941: 234, fig. 1, table 1; Rechnitzer and Böhlke, 1958: 12, 15, fig. 2, plate 1; Grey, 1964: 155.

Reference specimens: ORI–356, 45 mm, st. 269; ORI–357, 49 mm, st. NOMI–14; ZUMT–52399, 26 mm, st. 144–1; ZUMT–52400, 25 mm, st. 126–1.

The characters, shown in Table 3, will serve to distinguish this species from *I. irregularis* (Rechnitzer and Böhlke, 1958: 12; Grey, 1964: 155).

Genus *Gonostoma* Rafinesque, 1810
"Yoko-eso zoku" (Japanese name)

Five species have been reported from the Pacific; *G. gracile* Günther, *G. elongatum* Günther, *G. atlanticum* Norman, *G. ebelingi* Grey and *G. bathyphilum* (Vaillant). Of these, the first three species occur in the western North Pacific, while *G. ebelingi* is reported from the tropical Pacific and *G. bathyphilum* from the South Pacific (Grey, 1960: 109, fig. 3; Bussing, 1965: 197).

Key to species

1a. A row of six widely separated photophores present near the dorsal profile of body (Fig. 1a, ODM), a part of which often lost in damaged specimens; OA photophores irregulary arranged; dorsal origin above fourth or fifth anal rays..... .....*gracile* Günther, 1878

1b. No row of photophores near the dorsa profile of body (only two rows of photophores, OA and IV series, present); OA photophores, except for first elevated one, form a nearly straight line; dorsal origin above, or slightly behind anal origin.

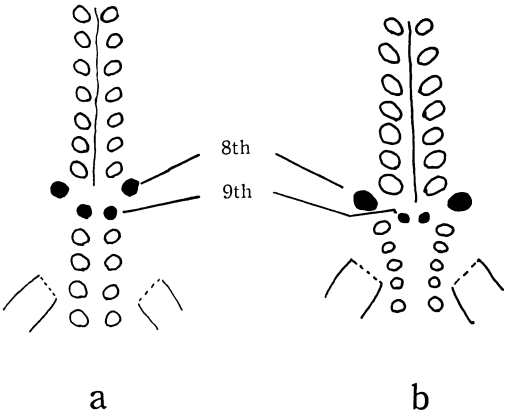

Fig. 4. Pattern of anterior IV photophores in the Pacific *Ichthyococcus*. a, *I. elongatus*. and b, *I. irregulalis* (after Rechnitzer and Böhlke, 1958: 12, fig. 1).

Table 3. Comparison of some distinctive characters of *Ichthyococcus elongatus* and *I. irregularis*.

Species	Dorsal rays	Gill rakers on lower limb of first arch	OA photophores	Body depth (% of SL)	IV photophores arranged
I. elongatus	14–16	24–26	31–32	21–29	in a straight line except 8th (Fig. 4a)
I. irregularis	10–13	15–19	23–26	33–39	irregularly (Fig. 4b)

2a. Anus below, or slightly behind fourth VAV photophore; VAV 4–5.
  3a. Adipose fin present; OA photophores, except for the last two or three, associated with whitish glandular mass; distance between anal origin and caudal base 44–49 percent of standard length. .....*elongatum* Günther, 1878
  3b. Adipose fin absent; OA photophores not associated with glandular mass; distance between anal origin and caudal base 43–44 percent of standard length. .....*atlanticum* Norman, 1930
2b. Anus below sixth VAV photophore; VAV 9–10...*ebelingi* Grey, 1960.... (This species has been recorded only from the tropical Pacific, but it is possible that it occurs from off southern Japan, transported by the Kuroshio Current.)

Gonostoma gracile Günther
"Yoko-eso" (Japanese name)
(Plate 2–B, Fig. 1a)

Gonostoma gracile Günther, 1878 187; Günther, 1887: 174, pl. 45, fig. c; Norman, 1930: 285; Mead and Taylor, 1953: 568, 570; Matsubara, 1955a: 220, pl. 16, fig. 60; Grey, 1960: 105, 124, table 6; Kawaguchi and Marumo, 1967: 53, fig. 1, table 1.

Neostoma gracile, Jordan and Starks, 1904: 579; Matsubara, 1938: 38, fig. 3.

Gonostoma vitiazi Rass, 1950: 1041, fig. 1, table 1.

Reference specimens: ORI–3, 58 mm, ORI–4, 58 mm, st. 3–3; ORI–11, 100 mm, st. 53; ORI–20, 106 mm, st. 66–3; ZUMT–52401, 116 mm, st. 66–7; ORI–1034, 111 mm, st. 111–1.

The distinctive characters are as shown in the key to species. This species lacks an adipose fin, though Matsubara (1955a: 219) stated the presence of adipose fin, in the key to the genus *Gonostoma*.

Gonostoma elongatum Günther
"Ō-yoko-eso" (New Japanese name)
(Plate 2–C)

Gonostoma elongatum Günther, 1878, p. 187; Günther, 1887 173, pl. 45, fig. b; Grey, 1964: 171, fig. 39.

Reference specimens: ZUMT–52402, 209, mm st. 121–1; ORI–1016, 221 mm, st. H48–2.

The distinctive characters are as set forth in the key to species.

Gonostoma atlanticum Norman
"Tsumari-yoko-eso" (New Japanese name)
(Plate 2–D)

Gonostoma denudatum atlanticum Norman, 1930: 283.

Gonostoma atlanticum, Grey, 1960: 106, tables 5, 6; Grey, 1964: 166, fig. 38.

Reference specimen: ORI–1017, 44 mm, st. 143–1.

The species is distinguishable from the closely related Atlantic and Mediterranean species, *G. denudatum*, in having no adipose fin and 16–17 gill rakers on first arch (15 in *denudatum*) (Grey, 1964: 166).

Genus *Cyclothone* Goode and Bean, 1883
"Oni-hadaka zoku" (Japanese name)

Five species occur in the western North Pacific; *C. alba* Brauer, *C. pseudopallida* Mukhacheva, *C. pallida* Brauer, *C. atraria* Gilbert, and *C. acclinidens* Garman. The fishes of this genus are very small and specimens of more than 70 mm in standard length are very rare even in the adult. The genus *Cyclothone* is distinguished from the closely related genus *Gonostoma* in dentition, as set forth in the key to genera.

Key to species

1a. One gill raker present in the angle between the epibranchial and ceratobranchial (Fig. 5c); gill rakers on first arch 14; gill lamellae fused along the hypobranchial (Fig. 5c); BR photophores 8; body colour white.....*alba* Brauer, 1906

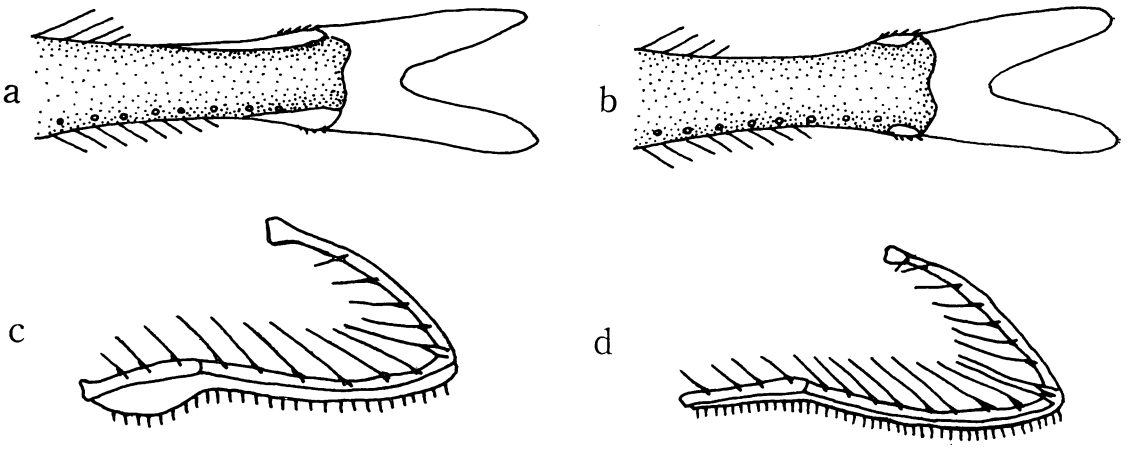

Fig. 5. Key characters of the fishes of the genus *Cyclothone*. Supracaudal gland. a, extremely developed gland of *C. acclinidens*. b, poorly developed gland of *C. pallida*, *C. pseudopallida* and *C. atraria*. Number of gill rakers in the angle between the epibranchial and ceratobranchial, and condition of gill lamellae along the hypobranchial. c, one gill raker and fused lamellae (*C. alba*). d, two gill rakers and free lamellae (*C. atraria*).

1b. Two gill rakers present in the angle between the epibranchial and ceratobranchial (Fig. 5d); gill rakers on first arch 18–24; gill lamellae fused or not fused along the hypobranchial; BR photophores 8–11; body more or less colored.

2a. Supracaudal gland extremely developed between the end of dorsal base and caudal base, forming a white band (Fig. 5a); size of teeth in posterior half of maxillary increases gradually toward the rear except for the last 2 or 3 (Fig. 3c)..... *acclinidens* Garman, 1899

2b. Supracaudal gland poorly developed and restricted to the base of short procurrent rays of caudal fin (Fig. 5b); size of teeth in posterior half of maxillary increases unevenly toward the rear. (For the identification of the following three species, characters shown in Table 4 are also useful.)

3a. Gill rakers on first arch 18–20; gill lamellae fused along the hypobranchial (Fig. 5c)..... *pseudopallida* Mukhacheva, 1964

3b. Gill rakers on first arch 21–24; gill lamellae free (Fig. 5d).

4a. OA photophores 7+1 (rarely 7+2), last one behind pelvic fin (Fig. 6c); area just before anal origin transparent, but sometimes sparsely pigmented externally (Fig. 6c); scale pockets usually not detectable..... *pallida* Brauer, 1902

4b. OA photophores 7+2 (rarely 7+3), last two behind pelvic fin (Fig. 6d); area just before the anal origin densely pigmented externally and not transparent (Plate 3–D), but transparent in the sparsely pigmented specimens less than 15 mm in standard length; scale pockets usually detectable (Fig. 6d).... *atraria* Gilbert, 1905

Cyclothone alba Brauer
"Yuki-oni-hadaka" (New Japanese name)
(Plate 3–A)

Cyclothone signata var. *alba* Brauer, 1906: 80, fig. 30.

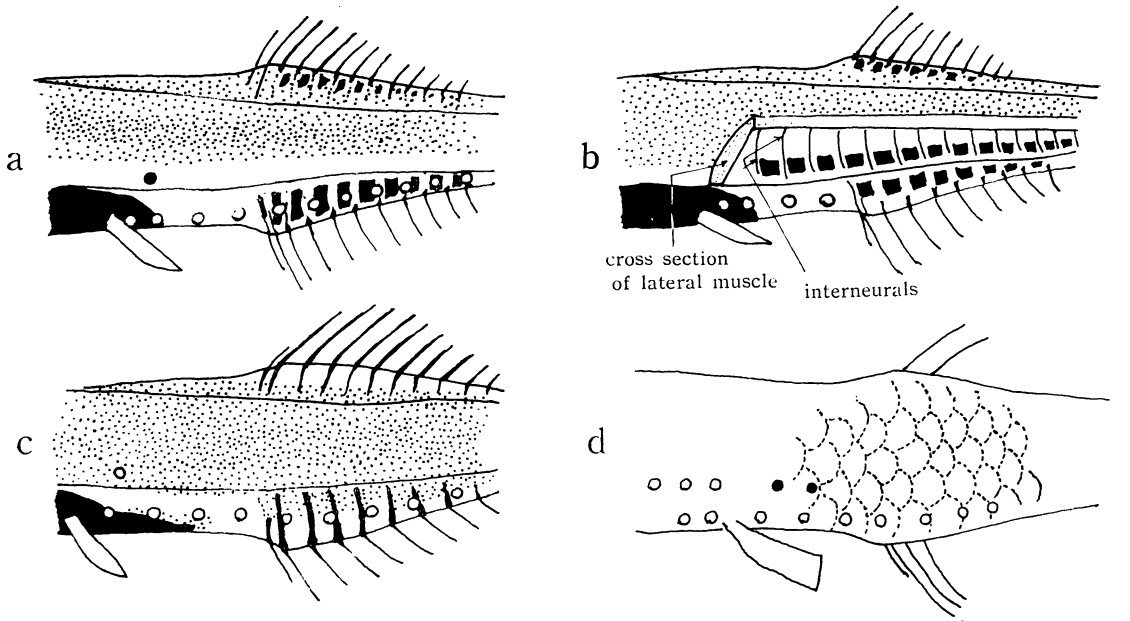

Fig. 6. Pattern of photophore arrangement and pigmentation of the fishes of the genus *Cyclothone*. a, b, *C. pseudopallida*: first two VAV close together; anal base not pigmented; patches of internal pigment between pterygiophores of anal fin and between interneurals. c, *C. pallida*: anal base pigmented; no patch of internal pigments between pterygiophores of anal fin. d, *C. atraria*: scale pocket present; last two OA behind pelvic insertion.

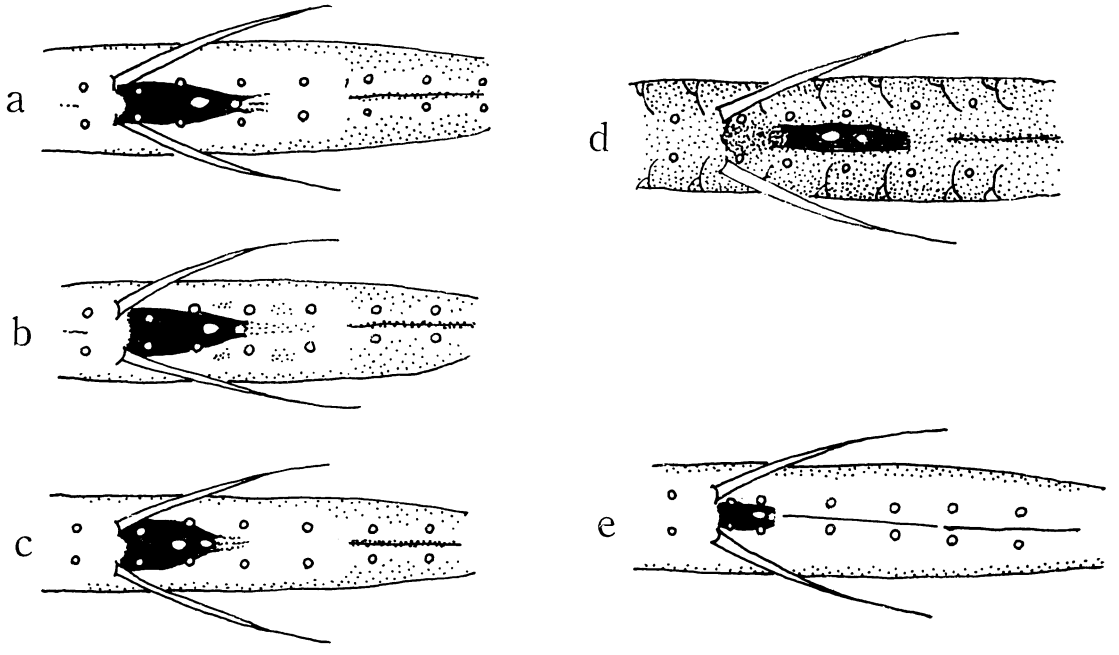

Fig. 7. Pattern of the photophore arrangement and pigmentation, and the position of anus and genital pore in the fishes of the genus *Cyclothone*. a, b, c, variations in *C. pallida*. d, *C. atraria*; e, *C. pseudopallida*.

Cyclothone alba, Koefoed, 1960: 10, plate I–B; Mukhacheva, 1964: 101, fig. 2.

Reference specimens: ORI–332, 27 mm, ORI–333, 26 mm, ORI–334, 24 mm, st. 117–2; ZUMT–52403, 26 mm, ZUMT–52404, 25 mm, st. 117–2.

In addition to the characters set forth in the key, the following characters serve the identification of this species: body colour white; head and flank partly flecked with brown pigment; internal pigment between interneurals and interhaemals conspicuous and forming a series of vertical stripes on the flank.

This species is different from the most closely related species, *C. signata*, which occurs in the tropical Pacific and the eastern Pacific, in having 8 BR photophores (in *signata* BR 9). *C. signata* reported by Imai (1941: 243) from Sagami Bay is probably *C. alba*, since *C. signata* has not been collected from off Japan, whereas *C. alba* is very common.

Cyclothone pseudopallida Mukhacheva
"Haiiro-oni-hadaka" (New Japanese name)
(Plate 3–B, Figs. 6a, b. 7e, Table 4)

Cyclothone pseudopallida Mukhacheva, 1964: 110, fig. 7, table 2.

Reference specimens: ORI–337, 42 mm, ORI–338, 42 mm, ORI–339, 36 mm, st. 199; ZUMT–52405, 38 mm, ZUMT–52406, 41 mm, st. 277.

The distinctive characters of this species are shown in Table 4 in comparison to those of the related species *C. pallida* and *C. atraria*. Furthermore, the following characters serve the identification of this species: body pigmented and grey or greyish brown, but ventral margin of the body not pigmented, border between upper pigmented and lower unpigmented area very clear (Fig. 6a); anal fin rays and skin of anal base also not pigmented; patches of internal pigment observed in the spaces between pterygiophores of anal fin rays (Fig. 6a, b); a series of transverse stripes arranged ventrolaterally in the muscle of body at interval of each vertebra (Fig. 6b).

Cyclothone pallida Brauer
"Usu-oni-hadaka" (New Japanese name)
(Plate 3–C, Figs. 6c, 7a, b, c, Table 4)

Cyclothone pallida Brauer, 1902: 281; Parr, 1934, p. 12, fig. 3; Koefoed, 1960: 6; Mukhacheva, 1964: 113, fig. 9.

Cyclothone microdon var. *pallida*, Zugmayer, 1911: 44, pl. 2, fig. 3.

Reference specimens: ORI–208, 51 mm, st. 138; ORI–209, 51 mm, st. 93–2; ORI–210, 36 mm, st. 140; ZUMT–52407, 37 mm, ZUMT–52408, 41 mm, st. 150.

Although the appearance of typical *C. pallida* is very different from that of *C. atraria* as shown in Plate 3–C and D, it is difficult to describe definitely the clear-cut differences between these two species, especially in damaged specimens. The cause of this difficulty is that there are considerable variations in the characters of these species, and most of specimens are more or less damaged; therefore it is uncertain whether absence of the characters is due to variation or loss. Such a problem is pointed out between *C. pallida* and *C. microdon* of the Atlantic (Koefoed, 1960: 6).

The characters presented in Table 4 and the key, however, are usually observed even in the considerably damaged specimens and useful for the distinction of this species. Body color of fresh specimens is light brown or brown.

Cyclothone atraria Gilbert
"Oni-hadaka" (Japanese name)
(Plate 3–D, Figs. 6d, 7d, Table 4)

Cyclothone atraria Gilbert, 1905: 605, pl. 72, fig. 2; Berry and Perkins, 1966: 647, table 2; Mukhacheva, 1969: 182.

Cyclothone pacifica Mukhacheva, 1964: 121, fig. 13; Kawaguchi and Marumo, 1967: 65.

Cyclothone microdon, Matsubara, 1955b: 74, fig. 1; Matsubara, 1955a: 220; Iwai, 1958: 1, figs. 1–3.

Table 4 Comparison of some distinctive characteristics of *Cyclothone pseudopallida*, *C. pallida* and *C. atraria*

Characters	*C. pseudopallida*	*C. pallida*	*C. atraria*
Anal opening placed	close to base of pelvic fins; under or just before second VAV (Fig. 7e)	closer to base of pelvic base than to anal origin; usually between second and third VAV (Fig. 7a, b), rarely just before second VAV (Fig. 7c).	in the middle between base of pelvic fins and anal origin, or somewhat posterior to the middle; just before or under third VAV (Fig. 7d).
Genital opening placed	under or just behind second VAV; close to anal opening (Fig. 7e)	between second and third VAV; apart from anal opening (Fig. 7a, b).	behind third VAV; separated from anal opening (Fig. 7d).
Black peritoneum ending	just behind or under second VAV, and clearly observed through the transparent skin (Figs. 6a, 7e).	between second and third VAV, and clearly observed through the transparent skin (Figs. 6c, 7a, b, c).	between third and fourth VAV, and usually invisible through the densely pigmented skin (Figs. 6d, 7d).
pigmentation of anal base	skin transparent and not pigmented, and pterygiophores visible through this skin; patches of internal pigment present at space between the pterygiophores of anal fin (Fig. 6a, b).	skin transparent, but sparsely pigmented, and pterygiophores observed through this skin (Fig. 6c); spaces between pterygiophores transparent, not pigmented internally, but in fatty specimens the space filled with fat.	skin densely pigmented dark brown as in other part of body surface, and pterygiophores invisible through the skin (Fig. 6d)
Area just before anal base	transparent (Fig. 6a).	usually transparent, but sometimes sparsely pigmented externally (Figs. 6c, 7b); in fatty specimens filled with fat.	densely pigmented externally and not transparent, but somewhat transparent in sparsely pigmented youngs less than 15 mm in standard length.

Reference specimens: ORI–201, 46 mm, ORI–202, 58 mm, ORI–203, 41 mm, st. 76–2; ZUMT–52409, 46 mm, ZUMT–52410, 54 mm, st. 76–2.

This species has been also reported under the other names of *C. microdon* (Günther) and *C. pacifica* Mukhacheva, from the North Pacific. Although Mukhacheva (1964) described *C. pacifica* as a new species from the North Pacific, later Mukhacheva (1969) regarded *C. pacifica* as a synonym of *C. atraria* Gilbert based upon the study of Berry and Perkins (1966). This species has free gill lamellae (Fig. 5d), and its geographical distirubtion is restricted to the North Pacific, north of the Tropic of Cancer. On the other hand, the closely related *C. microdon* has fused gill lamellae (Fig. 5c) and is found in the South Pacific and Atlantic Oceans (Mukhacheva, 1964). The fishes hitherto reported under the name of *C. microdon* from the North Pacific by Matsubara (1955a, b) and Iwai (1958) are considered to be *C. atraria*, because of the presence of the free gill lamellae. Matsubara (1955b) applied the Japanese name "Oni-hadaka" to *C. microdon*, but his specimen was from the North Pacific and thought to be *C. atraria*. From this view I adopt this Japanese name for *C. atraria*. The specimen reported as *C. microdon* by Abe (1957: 1148, fig. 577) was examined and identified as *C. pallida*.

This species differs from *C. pallida* in having the characters presented in Table 4.

Cyclothone acclinidens Garman
"Sen-oni-hadaka" (New Japanese name)
(Plate 3–E, Fig. 5a)

Cyclothone acclinidens Garman, 1899: 247, pl. J, fig. 4; Brauer, 1906: 85, fig. 34,

pl. 4–1; Mukhacheva, 1964: 124, fig. 14, table 3.

Reference specimens: ORI–213, 28 mm, st. 199; ZUMT–52411, 25 mm, st. 199.

The distinctive characters of this species are the well-developed supracaudal gland and the dentition as shown in the key and Figs. 3c and 5a. Further, the following characters will also help the identification: body spotted with light brown pigment, and head and flank densely pigmented; area just before the anal origin transparent or sparsely pigmented; anal opening at the middle between the pelvic insertion and anal origin, and between second and third VAV.

This is the most northerly record of *C. acclinidens* in the western North Pacific. The main range of the species is the tropical and eastern Pacific (Mukhacheva, 1964: 127, fig. 15).

Genus *Valenciennellus* Jordan and Evermann, 1896
"Hoshi-eso zoku" (New Japanese name)

Only one species has been recorded from the western North Pacific.

Valenciennellus tripunctulatus (Esmark)
"Hoshi-eso" (New Japanese name)
(Plate 1–E)

Maurolicus tripunctulatus Esmark, 1871: 489.

Valenciennellus tripunctulatus, Grey, 1964: 219, fig. 59, table 10.

Reference specimens: ORI–360, 24 mm, st. H5–1; ORI–361, 27 mm, st. 195–2; ORI–362, 25 mm, st. 121–2; ZUMT–52412, 21 mm, st. 143–2; ZUMT–52413, 19 mm, st. 118–1.

All of the present specimens have five groups of AC photophores and differ from the specimens with four groups of AC photophores, which were reported as *V. stellatus* by Garman (1899: 239, pl. 53, fig. 2) and ? *V. tripunctulatus* by Berry (1966: 647) from the eastern North Pacific.

Genus *Maurolicus* Cocco, 1838
"Kyūri-eso zuku" (Japanese name)

This genus contains only one species, *M. muelleri* (Gmelin) (Grey, 1964: 226).

Maurolicus muelleri (Gmelin)
"Kyūri-eso" (Japanese name)
(Plate 2–E, Fig. 1–b)

Salmo Mülleri Gmelin, 1788: 1378.

Maurolicus muelleri, Grey, 1964: 226, fig. 60, table 10; Koefoed, 1958: 1, table 1.

Maurolicus japonicus Ishikawa, 1915: 183, pls. 12, 13; Matsubara, 1938: 46; Matsubara, 1941: 2; Mead and Taylor, 1953: 568, table 2; Matsubara, 1955a: 221; Nishimura, 1957a: 1, fig. 4; Nishimura, 1957b: 13.

Reference specimens: ORI–1030, 34 mm, ORI–1031, 32 mm, st. NOMI–16; ORI–1032, 32 mm, st. 6–7; ZUMT–52414, 28 mm, st. 2.

Grey (1964: 229, table 11) studied the geographical variation of this species based upon the samples from the world oceans and concluded that *M. japonicus* Ishikawa is synonymous with *M. muelleri* Gmelin.

Body color silver, filters of ventral photophores pink in the fresh specimens.

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深海性魚類の生態研究において，種の同定の困難さがその進歩を遅らせてきたと考えられる．そこで本論文では西部北太平洋産の中・深層遊泳性魚類の重要種，ヨコエソ科8属15種の検索表の作製および同定に有用な分類学的記載を行なった．8属15種中3属(ヨウジエソ属，ウキエソ属，ホシエソ属)，9種（ヨウジエソ，ウキエソ，オオヨコエソ，ツマリヨコエソ，ユキオニハダカ，ハイイロオニハダカ，ウスオニハダカ，センオニハダカ，ホシエソ）は日本初記録であり新和名を付した．なお底生性あるいはそれに近い生息生態をもつと考えられるギンハダカ属魚類には分類学上混乱があるので，これらの検索表は作製せず，問題点を指摘するにとどめた．

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