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Fishes of the Boso Peninsula, Central Japan—IV

Deep-sea Midwater Fishes Taken off the Pacific Coast of the Peninsula

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Abstract Examination of 9,350 fish specimens from 56 deep-sea, midwater net collections from 10 cruises off the Pacific coast of Boso Peninsula, central Japan, yielded 120 species (including four unidentified species and one species complex) representing 36 families. Species previously recorded from the area numbered 66. The 54 additional records primarily consisted of rare species, represented by only a few specimens in the collections. Except for the four unidentified species, the cetomimid, *Gyrinomimus bruuni*, was recognized for the first time from Japanese waters. Of the 36 families, myctophids were the most speciose (47 spp.), followed by gonostomatids (10 spp.) and sternoptychids (5 spp.), with gonostomatids the most numerically dominant (83.4%), followed by myctophids (12.3%), and photichthyids (1.1%). Of the 120 species, the gonostomatid genus *Cyclothone* provided the three most numerically dominant species (*C. atraria* [48.2%], *C. alba* [13.9%] and *C. pseudopallida* [10.8%]), followed by another gonostomatid, *Gonostoma gracile* (8.6%), and two myctophids, *Diaphus garmani* (2.6%) and *Ceratoscopelus warmingii* (2.4%). Of the 115 identified species, 17 (14.8%) and 81 (70.4%) have their distribution centers located in northern and southern Japan (north and south of the peninsula), respectively, whereas the remaining 17 species (14.8%) are relatively wide-ranging, extending the length of Japan. The predominance of the southern species, along with occurrences of northern species (mostly represented by subarctic species), are the zoogeographic characteristics of the region, reflecting the presence of the cold, less saline Oyashio waters below the warm Kuroshio current flowing northward along the peninsula. Such zoogeographic characteristics were more or less consistent with those observed for benthic fishes taken off Choshi, on the northernmost part of the Pacific coast of the peninsula.

Key words: ichthyofauna, deep-sea midwater fish, Kuroshio, Oyashio, Boso Peninsula.

The deep-sea midwater fish fauna is characterized by the predominance of specific taxa, such as bathylagids, stomiiforms, some aulopiforms, myctophids, ceratioids and melamphaids, most of which are never encountered in shallow coastal waters. Such faunal uniqueness is even more enhanced by the intriguing morphological and ecological characteristics of the component species, including fragile, tiny black bodies, relatively large mouths, extremely small or large eyes, and numerous body photophores in various forms. Some species undertake extensive, diurnal vertical migrations to the surface at night, while others are non-migratory, remaining at considerable depths both day and night. Although they have been variously called "micronektonic fishes," "meso- and bathypelagic fishes," or "midwater fishes" depending on the emphasis on their morphological or ecological characteristics, they are herein called "deep-sea, midwater fishes," which includes all pelagic fishes encountered in arbitrarily-defined deep-sea midwaters (>200 m depth).

Amongst over 3,500 fish species known from Japanese waters to date (Nakabo ed., 1993), deep-sea midwater fishes constitute approximately 10% (>320 spp.), although the only comprehensive faunal list for a specific region is that published in Miya *et al.* (1995b) for waters off the Pacific coast of Boso Peninsula, central Japan. They reported the occurrences of 66 species (excluding

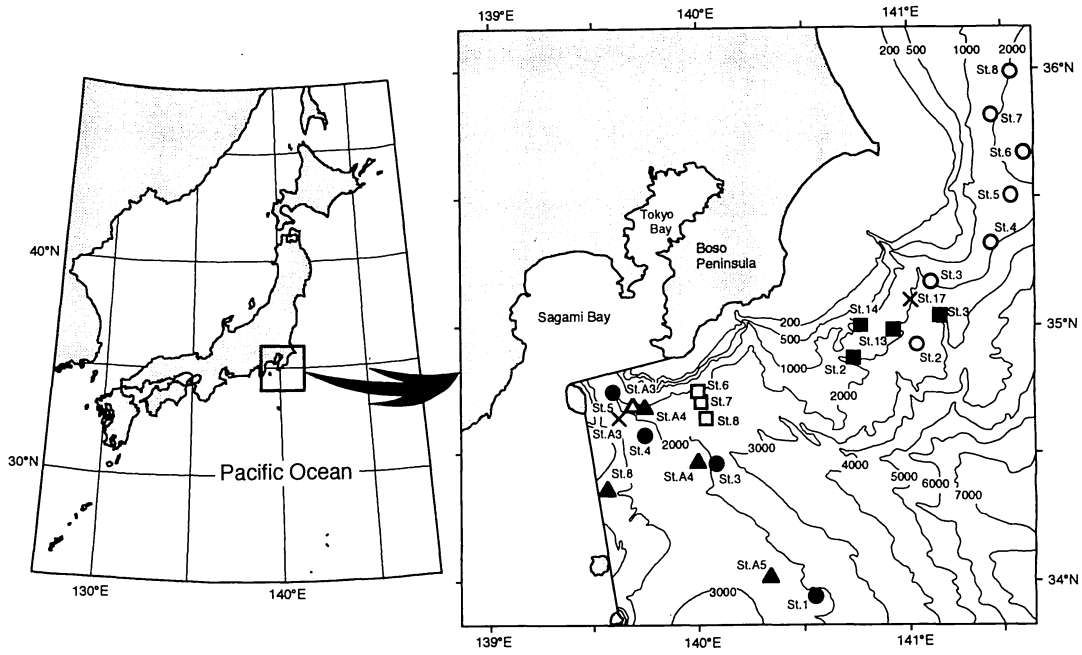

Fig. 1. Locations of the sampling stations, designated by the following symbols, for different cruises of the R/V *Tansei Maru* (KT): KT-75-13, St. 8 (▲); KT-77-13, St. A3–5 (▲): KT-78-15, 16 (△); KT-83-13 (□); KT-85-8, St. A3 (×); KT-91-13 (○); KT-92-11 (●); KT-93-10 (■); KT-95-5, St. 17 (×).

larvae) together with abundance and biomass, and discussed their zoogeographic characteristics, on the basis of seven oblique hauls from the surface to depths of >1,000 m using a 10-ft Isaacs-Kidd midwater trawl.

This paper, the fourth in the series, "Fishes of the Boso Peninsula, central Japan," provides a list of deep-sea, midwater fishes that have been collected from off the Pacific coast of the peninsula, which supplements the 66 species listed in Miya *et al.* (1995b). A total of 56 deep-sea, midwater samples from 10 cruises were examined, resulting in the recognition of 54 additional species, giving a total of 120 species (including four unidentified) representing 36 families. The zoogeographic characteristics are briefly discussed, comparing the fauna with those observed in shallow coastal waters of Ainohama and Chitose, on the southernmost part of the peninsula (Miya *et al.*, 1994a, b), and in coastal and deep-sea waters off Choshi, on the northernmost part of the peninsula (Miya *et al.*, 1995a).

Study Area

The waters off the Pacific coast of Boso Peninsula are here arbitrarily defined as the area bounded by the coordinates 36°10′N, 33°50′N, 138°50′E and 141°40′E, with the exception of Tokyo Bay, Sagami Bay and west of the Izu Islands (Fig. 1). The area encompasses shallow waters >200 m along the land mass to extremely deep waters, exceeding 7,000 m, which eventually lead to the Japan and Izu-Ogasawara trenches via the Sagami Trough.

The study area is greatly affected by the course of the warm Kuroshio current, which generally flows northeastward, a little over 100 km off the peninsula. During September 1991, when vertical profiles of temperature and salinity data from the surface to 1,000 m were available at Sts. 2–8 (open circles in Fig. 1), the Kuroshio current was flowing northeastward along the southeastern side of the transect on which the stations were located (for details, see fig. 1 in Miya *et al.*, 1995b); its effects were recognized between 50 and 150 m, as higher temperature and salinity, while those of subarctic waters were recognized as a salinity-minimum layer between 300 and 500 m (Miya *et al.*, 1995b). All other stations, including the two southernmost (Sts. 1 and A 5), were similarly located to the northwest of

the current, irrespective of year, according to oceanographic reports (Kaiyô Sokuhô) published weekly by the Hydrographic Department, Maritime Safety Agency of Japan.

Materials and Methods

Fishes were collected by oblique or multiple horizontal hauls using the following sampling gears (mesh sizes in parentheses) (for detailed sampling data, see Table 1): MTD nets with mouth diameters of 50 and 80 cm (0.33 and 0.68 mm, respectively; Motoda, 1971); ORI-69/100 nets (0.69/1.0 mm; Omori, 1965); and 10-ft Isaacs-Kidd midwater trawl (10-ft IKMT; 1.0/5.0 mm). For details of the sampling methods involving simultaneous horizontal hauls using MTD nets and oblique hauls using ORI nets, see Miya and Nemoto (1986); for oblique hauls using 10-ft IKMT, see Miya *et al.* (1995b).

The samples were fixed in 5–10% buffered seawater formalin or 99% ethanol (for DNA studies) immediately after collection. All deep-sea, midwater fishes were sorted in the laboratory, counted and identified to species where possible. Species identifications were based primarily on keys given in Nakabo ed. (1993) and supplemented by reviews of specific taxa. Photophore terminology in myctophids followed Nakabo ed. (1993). Epipelagic fishes and all larvae were excluded from the present list. Standard lengths (SL) and total lengths (TL) were measured to the nearest millimeter.

All fishes collected were deposited in the Fish Collection of the Natural History Museum and Institute, Chiba (CBM-ZF). In the list of fishes below, species' names, which follow Nakabo ed. (1993), except for those of bathylagids (herein adopting the generic nomenclature of Dunn [1983]), are followed by their Japanese names (asterisks indicate new names) and distribution patterns, designated N, S, and W in parentheses. N and S denote those species with distribution centers located in northern and southern Japan (north and south of the peninsula), respectively, while W denotes species occurring the length of Japan. For deep-sea, midwater fishes, N, S or W correspond to subarctic (SA), tropical/subtropical (TS), and wide-ranging (W) species, respectively, as defined zoogeographically by Miya *et al.* (1995b) on the basis of their centers of distribution/abundance in relation to water mass distribution. Pseudoceanic (P) and transitional (TS/SA) species in Miya *et al.* (1995b) were allocated to one of the three zoogeographic categories defined here. Information on distribution patterns of fishes was taken from Nakabo ed. (1993).

The fishes are listed by family in phylogenetic sequence (Nakabo ed., 1993) and alphabetically within families by genus and species. Asterisks beside the species' number denote those not recorded in Miya *et al.* (1995 b). A cruise number (KT), station number (St.), and museum number (CBM-ZF) are given for each lot, followed by the number of specimens and size range in parentheses. Where two or more lots existed for the same station number, depth sampled (m) and tow period (Day/Night) are given in parentheses after the station number [e.g., (800D)].

List of Fishes

Order Anguilliformes
Family Nemichthyidae

1. **Avocettina infans* (Günther): kuro-shigi-unagi (S). $N=4$ (250–566 mm TL)
   KT-83-13: St. 6-1, CBM-ZF 6313 (1, 250 mm TL); 7-2, 6327 (1, 352); St. 8-6, 6348 (1, 566). KT-93-10: St. 2, 6156 (1, 276).
2. *Nemichthys scolopaceus* Richardson: shigi-unagi (S). $N=6$ (252–672+ mm TL)
   KT-83-13: St. 8-1, CBM-ZF 6338 (1, 282 mm TL); St. 8-6, 6347 (1, 282+). KT-91-13: St. 3, 5619 (1, 672+); St. 4, 5620 (1, 330+). KT-92-11: St. 4, 5787 (1, 270+). KT-93-10: St. 14, 6186 (1, 252)

Family Serrivomeridae

3. **Stemonidium hypomelas* Gilbert: hime-nokoba-unagi (S). $N=1$ (156 mm TL)
   KT-83-13: St. 6-1, CBM-ZF 6312 (1, 156 mm TL).

Order Salmoniformes
Family Bathylagidae

4. **Bathylagus milleri* (Jordan & Gilbert): kuro-sokoiwashi (N). $N=2$ (167, 195 mm SL)
   KT-83-13: St. 6-2, CBM-ZF 3625 (1, 195 mm SL); St. 7-2, 3579 (1, 167).
5. *Bathylagus ochotensis* (Schmidt): sokoiwashi (N). $N=36$ (18–92 mm SL)
   KT-83-13: St. 6-1, CBM-ZF 3462 (4, 23–56

mm SL); St. 6-2, 3471 (4, 28–56); St. 8-1, 3470 (3, 33–59); St. 8-4, 3463 (1, 30). KT-85-8: St. A 3, 3422 (1, 18). KT-91-13: St. 4, 5600 (1, 58); St. 5, 5601 (1, 59); St. 6, 5602 (1, 34); St. 8, 5603 (1, 27). KT-92-11: St. 1, 5747 (10, 20–29); St. 3, 5769 (3, 19–92); St. 5, 5800 (4, 18–23). KT-95-5: St. 17, 6388 (2, 35, 48).

6. *Bathylagus pacificus* Gilbert: yase-soko-iwashi (N). $N=9$ (29–169 mm SL)
KT-83-13: St. 6-2, CBM-ZF 3567, 3568 (2, 48, 150 mm SL); St. 8-1, 3565 (1, 136). KT-85-8: St. A3, 3574 (1, 169). KT-91-13: St. 4, 5598 (1, 146); St. 7, 5607 (1, 30); St. 8, 5608 (3, 29–49).
7. *Leuroglossus schmidti* Rass: togari-ichimonji-iwashi (N). $N=7$ (29–67 mm SL)
KT-83-13: St. 6-1, CBM-ZF 3547 (2, 42, 43 mm SL); St. 6-2, 3566 (3, 36–39); St. 7-2, 3551 (1, 29); St. 8-1, 3564 (1, 67).

Family Opisthoproctidae

8. **Winteria telescopa* Brauer: kuro-demenigisu (S). $N=1$ (109 mm SL)
KT-83-13: St. 6-1, CBM-ZF 6311 (1, 109 mm SL).

Family Alepocephalidae

9. *Bajacalifornia megalops* Lütken: ukeguchi-iwashi (W). $N=3$ (15–57 mm SL)
KT-91-13: St. 2, CBM-ZF 5668 (1, 24 mm SL); St. 4, 5664 (1, 57). KT-92-11: St. 5, 5827 (1, 15).
Remarks.—*Bajacalifornia erimoensis* Amaoka & Abe has been used for this species in major Japanese regional synopses, such as Masuda *et al.* (1984) and Nakabo ed. (1993), although Sazonov and Ivanov (1980) considered the name to be a junior synonym of *B. megalops*, subsequently followed by Markle and Krefft (1985) and Miya and Markle (1993).

Family Platytroctidae

10. *Hortbyrnia innesi* Fowler: kitano-hanameiwashi (N). $N=1$ (44 mm SL)
KT-91-13: St. 3, CBM-ZF 6142 (1, 44 mm SL).
Remarks.— Sazonov *et al.* (1993) recorded a single adult specimen (215 mm SL) of this species off Tohoku (37°01′N, 141°44′E) from a depth of 740 m.

Order Stomiiformes
Family Gonostomatidae

11. **Cyclothone acclinidens* Garman: sen-onihadaka (S). $N=1$ (23 mm SL)
KT-92-11: St. 5, CBM-ZF 5796 (1, 23 mm SL).
12. *Cyclothone alba* Brauer: yuki-onihadaka (S). $N=1{,}300$ (10–27 mm SL)
KT-75-13: St. 8, CBM-ZF 6295 (22, 11–24 mm SL). KT-77-13: St. A4, 6238 (19, 11–23); St. A 5, 6252 (57, 11–27). KT-78-15: St. A3, 6261 (58, 10–25). KT-78-16: St. A3, 6292 (164, 11–26). KT-83-13: St. 6-1, 264 (12, 17–26); St. 6-2, 346 (19, 12–26); St. 6-3, 248 (42, 11–26); St. 7-2, 348 (28, 16–25); St. 8-1, 352 (53, 16–26); St. 8-2 (350D), 3798 (1, 12); (400D), 3799 (7, 10–23); (450D), 3800 (56, 11–25); (500D), 3801 (34, 10–24); St. 8-3 (600D), 3802 (1, 20); St. 8-4, 251 (19, 10–20); St. 8-5 (250D), 3803 (2, 11, 22); (300D), 3804 (3, 11–15); (350D), 3805, 3806 (151, 10–14); (400D), 3807 (73, 11–15); (500D), 3808 (1, 12). KT-85-8: St. A3, 81 (92, 11–27). KT-91-13: St. 2, 5590 (1, 22); St. 3, 5591 (4, 22–27); St. 4, 5592 (2, 19, 23); St. 5, 5593 (10, 17–25); St. 6, 5594 (5, 16–25); St. 7, 5595 (4, 16–27); St. 8, 5596 (19, 17–26). KT-92-11: St. 1, 5743 (132, 11–25); St. 3, 5764 (12, 15–23); St. 4, 5782 (47, 10–23); St. 5, 5793 (23, 15–25). KT-93-10: St. 2, 6162 (19, 15–24); St. 3, 6168 (20, 17–25); St. 13, 6181 (3, 21–23); St. 14, 6189 (84, 15–26). KT-95-5: St. 17, 6373 (1, 23).
13. *Cyclothone atraria* Gilbert: onihadaka (W). $N=4{,}507$ (9–57 mm SL)
KT-75-13: St. 8, CBM-ZF 6294 (59, 11–51 mm SL); KT-77-13: St. A4, 6236 (46, 10–54); St. A 5, 6250 (74, 11–51). KT-78-15: St. A3, 6260 (74, 12–53). KT-78-16: St. A3, 6290 (88, 11–45). KT-83-13: St. 6-1, 260, 263 (217, 11–56); St. 6-2, 342, 343 (282, 14–54); St. 6-3, 250 (69, 10–57); St. 7-2, 347 (182, 15–50); St. 8-1, 354, 355 (361, 14–54); St. 8-2 (500D), 3847 (7, 10–12); St. 8-3 (600D), 3848 (53, 10–35); (700D), 3849, (27, 13–36); St. 8-4, 253 (78, 11–42); (600N), 3850 (12, 11–27); (700N), 3851 (46, 9–22); St. 8-5 (400D), 3852 (10, 10–13); (450D), 3854 (8, 9–36); (500D), 3853 (17, 9–37). KT-85-8: St. A3, 319 (206, 10–53). KT-91-13: St. 2, 5563 (111, 19–52); St. 3, 5564 (142, 18–52); St. 4, 5565 (138, 23–49); St. 5, 5566 (105, 17–50); St. 6, 5567 (168, 20–53); St. 7, 5568 (153, 17–55); St. 8, 5569 (140, 14–56). KT-92-11: St. 1, 5746 (250, 14–50); St. 3, 5763 (147, 15–50); St. 4, 5781 (251, 10–47); St. 5, 5792 (186, 10–52). KT-93-10: St. 2, 6160 (97, 20–50); St. 3, 6166 (398, 17–54); St. 13, 6180 (3, 49–56); St. 14, 6187 (137, 18–52). KT-95-5: St. 17, 6372 (165, 22–56).
14. **Cyclothone obscura* Brauer: kuro-onihadaka (S). $N=1$ (34 mm SL)
KT-85-8: St. A3, CBM-ZF 453 (1, 34 mm SL).
15. *Cyclothone pallida* Brauer: usu-onihadaka (S). $N=156$ (14–61 mm SL)

KT-75-13: St. 8, CBM-ZF 6296 (7, 22–28 mm SL). KT-77-13: St. A4, 6239 (2, 21, 40); St. A 5, 6254 (3, 19–26). KT-78-15: St. A3, 6263 (1, 22). KT-78-16: St. A3, 6293 (3, 22–40). KT-83-13: St. 6-1, 266 (7, 24–37); St. 6-2, 345 (8, 30–47); St. 7-2, 350 (3, 16–50); St. 8-1, 351 (11, 17–51); St. 8-3 (700D), 3838 (1, 25); St. 8-4 (600N), 3839 (1, 22); (1000N), 3840 (1, 25). KT-85-8: St. A3, 417 (9, 18–45). KT-91-13: St. 2, 5581 (1, 24); St. 3, 5582 (7, 20–42); St. 4, 5583 (12, 20–52); St. 5, 5584 (6, 27–57); St. 6, 5585 (14, 20–44); St. 7, 5586 (4, 35–61); St. 8, 5587 (6, 26–57). KT-92-11: St. 1, 5744 (16, 14–47); St. 3, 5765 (7, 14–50); St. 4, 5783 (7, 16–35); St. 5, 5794 (14, 16–36). KT-93-10: St. 14, 6190 (4, 25–56). KT-95-5: St. 17, 6375 (1, 48).

16. *Cyclothone pseudopallida* Mukhacheva: hai-iro-onihadaka (S). $N=1014$ (10–50 mm SL)
KT-75-13: St. 8, CBM-ZF 6297 (35, 15–39 mm SL). KT-77-13: St. A4, 6237 (17, 11–32); St. A 5, 6251 (15, 12–38). KT-78-15: St. A3, 6262 (18, 16–38). KT-78-16: St. A3, 6291 (75, 12–32). KT-83-13: St. 6-1, 265 (24, 16–40); St. 6-2, 344 (55, 21–43); St. 6-3, 249 (41, 11–35); St. 7-2, 349 (85, 18–36); St. 8-1, 353 (38, 17–37); St. 8-2 (400D), 3820 (1, 14); (450D), 3821 (5, 10–19); St. 8-3 (600D), 3822, 3823 (46, 11–38); St. 8-4, 252 (37, 15–38); (600N), 3824 (13, 18–32); (700N), 3825 (5, 19-35); (800N), 3826 (1, 33); St. 8-5 (350D), 3827 (4, 16–22); (400D), 3828, 3829 (142, 10–23); (450D), 3830 (14, 18–38); (500D), 3831 (7, 18–35). KT-85-8: St. A3, 199 (38, 15–35). KT-91-13: St. 2, 5572 (3, 32–35); St. 3, 5573 (25, 20–50); St. 4, 5574 (13, 22–36); St. 5, 5575 (5, 27–28); St. 6, 5576 (10, 12–33); St. 7, 5577 (10, 23–35); St. 8, 5578 (35, 21–43). KT-92-11: St. 1, 5745 (49, 14–37); St. 3, 5766 (11, 20–36); St. 4, 5784 (29, 15–37); St. 5, 5795 (32, 15–36). KT-93-10: St. 2, 6161 (16, 19–33); St. 3, 6167 (12, 18–37); St. 13, 6182 (3, 26–31); St. 14, 6188 (39, 16–36). KT-95-5: St. 17, 6374 (6, 25–39).

17. **Diplophos orientalis* Matsubara: yume-hadaka (S). $N=1$ (140 mm SL)
KT-83-13: St. 6-2, CBM-ZF 6319 (1, 140 mm SL).

18. **Gonostoma atlanticum* Norman: tsumari-yoko-eso (S). $N=2$ (53, 60 mm SL)
KT-75-13: St. 8, CBM-ZF 6363 (1, 53 mm SL). KT-83-13: St. 8-1, 6336 (1, 60).

19. *Gonostoma elongatum* Günther: ôyoko-eso (S). $N=7$ (15–167 mm SL)
KT-77-13: St. A5, CBM-ZF 6248 (3, 15–167 mm SL). KT-83-13: St. 6-1, 6308 (1, 49). KT-91-13: St. 8, 5561 (2, 23, 63). KT-92-11: St. 4, 5778 (1, 144).

20. *Gonostoma gracile* Günther: yoko-eso (W). $N=805$ (15–129 mm SL)
KT-75-13: St. 8, CBM-ZF 6356 (16, 37–97 mm SL). KT-77-13: St. A3 (300D), 6225 (1, 15); (500D), 6226 (2, 47, 49); (600D), 6229 (1, 93); (800D), 6230 (1, 91); St. A4, 6234 (4, 17–93); St. A5, 6246 (10, 43–112). KT-78-15: St. A3, 6257 (17, 19–101). KT-78-16: St. A3, 6286 (26, 15–101). KT-83-13: St. 6-1, 6306 (52, 35–118); St. 6-2, 6315 (31, 31–118); St. 6-3, 6354 (4, 32–65); St. 7-2, 6322 (64, 22–107); St. 8-1, 6333 (40, 35–120); St. 8-4, 6342 (13, 9–99); St. 8-3 (600D), 6350 (2, 50, 74); (800D), 6352 (1, 112); St. 8-4 (800N), 6353 (2, 51, 87); St. 8-6, 6346 (34, 30–119). KT-85-8: St. A3, 6523 (23, 12–109). KT-91-13: St. 2, 5553 (27, 26–118); St. 3, 5554 (32, 30–112); St. 4, 5555 (58, 26–110); St. 5, 5556 (37, 34–129); St. 6, 5557 (30, 20–116); St. 7, 5558 (37, 23–118); St. 8, 5559 (25, 19–110). KT-92-11: St. 1, 5742 (50, 20–119); St. 3, 5767 (34, 19–112); St. 4, 5780 (44, 19–104); St. 5, 5791 (28, 20–97). KT-93-10: St. 2, 6159 (29, 24–98); St. 3, 6165 (6, 28–94); St. 13, 6179 (7, 38–106). KT-95-5: St. 17, 6371 (17, 22–110).

Family Sternoptychidae

21. *Argyropelecus aculeatus* Valenciennes: togari-mune-eso (S). $N=13$ (12–52 mm SL)
KT-91-13: St. 5, 5645 (1, 12 mm SL); St. 6, 5646 (1, 26). KT-92-11: St. 1, 5749 (3, 34–52); St. 5, 5799 (1, 17). KT-95-5: St. 17, 6387 (7, 12–23).

22. *Argyropelecus hemigymnus* Cocco: tengan-mune-eso (S). $N=2$ (13, 18 mm SL)
KT-91-13: St. 7, CBM-ZF 5647 (1, 18 mm SL). KT-92-11: St. 1, 5750 (1, 13).

23. *Maurolicus japonicus* Ishikawa: kyûri-eso (W). $N=12$ (11–23 mm SL)
KT-91-13: St. 2, CBM-ZF 5634 (1, 23 mm SL). KT-92-11: St. 3, 5771 (1, 15); St. 5, 5804 (8, 11–16). KT-95-5: St. 17, 6390 (2, 17, 19).
Remarks.—Parin and Kobyliansky (1993) reviewed the taxonomy of *Maurolicus,* resurrecting *M. japonicus* for populations in Japanese and Hawaiian waters.

24. **Polyipnus matsubarai* Schultz: hoshi-hônen-eso (S). $N=2$ (19, 36 mm SL)
KT-75-13: St. 8, CBM-ZF 6358 (1, 36 mm SL). KT-95-5: St. 17, 6385 (1, 19).

25. *Sternoptyx diaphana* Hermann: mune-eso (S). $N=40$ (8–39 mm SL)
KT-75-13: St. 8, CBM-ZF 6359 (2, 12, 15 mm SL). KT-77-13: St. A5, 6240 (2, 16, 37). KT-78-16: St. A3, 6281 (3, 11–30). KT-91-13: St.

2, 5637 (3, 9–10); St. 3, 5638 (2, 12, 18); St. 4, 5639 (4, 10–21); St. 5, 5640; (1, 10); St. 6, 5641 (6, 8–30); St. 7, 5642 (1, 23); St. 8, 5643 (2, 9, 15). KT-92-11: St. 1, 5748 (8, 9–26); St. 3, 5770 (1, 39); St. 4, 5789 (1, 15); St. 5, 5809 (2, 13, 14). KT-95-5: St. 17, 6384 (2, 16, 32).

Family Photichthyidae

26. *Ichthyococcus elongatus* Imai: shinju-eso (S). $N=7$ (15–40 mm SL)
KT-83-13: St. 7-2, CBM-ZF 6324 (1, 40 mm SL). KT-85-8: St. A3, 6525 (1, 15). KT-91-13: St. 7, 5609 (2, 21, 26). KT-93-10: St. 13, 6176 (1, 19); St. 14, 6183 (2, 18, 23+).
27. **Pollichthys mauli* (Paul): yôji-eso (S). $N=1$ (43 mm SL)
KT-83-13: St. 6-2, CBM-ZF 6318 (1, 43 mm SL).
28. **Vinciguerria attenuata* (Cocco): uki-eso (S). $N=47$ (10–22 mm SL)
KT-75-13: St. 8, CBM-ZF 6357 (1, 16 mm SL). KT-78-15: St. A3, 6256 (1, 13). KT-85-8: St. A 3, 6526 (4, 13–14). KT-92-11: St. 1, 5756 (26, 10–22); St. 3, 5772 (2, 15, 16); St. 4, 5790 (2, 13, 16); St. 5, 5810 (3, 13–16). KT-93-10: St. 2, 6164 (3, 13–20); St. 3, 6173 (4, 13–19); St. 13, 6178 (1, 22)
29. *Vinciguerria nimbaria* Jordan & Williams: yabe-uki-eso (S). $N=48$ (12–29 mm SL)
KT-77-13: St. A5, CBM-ZF 6244, 6253 (2, 15, 17 mm SL). KT-78-16: St. A3, 6284 (1, 28). KT-83-13: St. 6-1, 6307 (2, 21, 22); St. 6-2, 6316 (1, 26); St. 7-2, 6323 (1, 26); St. 8-1, 6332 (1, 18); St. 8-4, 6341 (1, 28). KT-85-8: St. A3, 6527 (2, 14, 16). KT-91-13: St. 2, 5610 (1, 29); St. 3, 5611 (1, 19); St. 5, 5612 (1, 18). KT-92-11: St. 1, 5757 (14, 12–18); St. 5, 5811 (5, 18–25). KT-93-10: St. 2, 6163 (3, 13–18); St. 3, 6172 (6, 14–22); St. 13, 6177 (6, 17–20).

Family Chauliodontidae

30. **Chauliodus macouni* Bean: higashi-hôrai-eso (N). $N=2$ (170, 215 mm SL)
KT-83-13: St. 6-1, CBM-ZF 6310 (1, 215 mm SL); St. 8-1, 6334 (1, 170).
31. *Chauliodus sloani* Schneider: hôrai-eso (W). $N=25$ (26–150 mm SL)
KT-75-13: St. 8, CBM-ZF 6361 (1, 35 mm SL). KT-78-16: St. A3, 6287 (2, 27, 80). KT-83-13: St. 6-1, 6309 (1, 28); St. 6-2, 6317 (1, 48); St. 7-2, 6326 (2, 32, 49); St. 8-1, 6335 (1, 63); St. 8-4, 6344 (1, 30). KT-85-8: St. A3, 6524 (1, 26). KT-91-13: St. 2, 5653 (1, 135); St. 3, 5657 (1, 28); St. 4, 5658 (1, 50); St. 5, 5655 (1, 50); St. 7, 5654 (2, 54, 150); St. 8, 5656 (2, 65, 67). KT-92-11: St. 1, 5751 (3, 41–72); St. 4, 5785 (3, 26–31); St. 5, 5797 (1, 125).

Family Stomiidae

32. *Macrostomias pacificus* Fedorov & Melchikova: hoso-wanitokagegisu (W). $N=3$ (94–245 mm SL)
KT-91-13: St. 3, CBM-ZF 5660 (1, 245 mm SL). KT-92-11: St. 1, 5753 (1, 94); St. 3, 5775 (1, 97).
33. **Stomias affinis* Günther: wanitokagegisu (S). $N=3$ (22–26 mm SL)
KT-75-13: St. 8, CBM-ZF 6362 (1, 26 mm SL). KT-78-16: St. A3, 6288 (1, 22). KT-83-13: St. 8-2 (500D), 6349 (1, 23).
34. *Stomias nebulosus* Alcock: yoroi-hoshi-eso (S). $N=1$ (57 mm SL)
KT-91-13: St. 6, CBM-ZF 5659 (1, 57 mm SL).

Family Astronesthidae

35. *Astronesthes indica* Brauer: hohojiro-tokagegisu (S). $N=2$ (33, 34 mm SL)
KT-91-13: St. 5, CBM-ZF 5663 (2, 33, 34 mm SL).

Family Melanostomiidae

36. **Bathophilus nigerrimus* Giglioli: ginga-eso (S). $N=1$ (16 mm SL)
KT-83-13: St. 6-3, CBM-ZF 6355 (1, 16 mm SL).
37. **Eustomias* sp.: $N=1$ (165 mm SL)
KT-92-11: St. 1, CBM-ZF 6547 (1, 165 mm SL).
Remarks.—The species apparently belongs to a subgenus of *Eustomias, Dinematochirus* Regan & Trewavas, in that it has an extremely short barbel (9.5% SL) with a single terminal bulb, a short ventral body groove extending to PV5, seven pelvic fin rays and two pectoral fin rays closely bound together (Gibbs *et al.*, 1983). It is most similar in barbel morphology to *Eustomias* cf. *bigelowi* (in Parin and Sokolovsky, 1976) and *Eustomias bigelowi*? (in Parin *et al.*, 1977), although none of those specimens have been formally named.
38. *Opostomias mitsuii* Imai: mitsui-hoshi-eso (W). $N=2$ (54, 57 mm SL)
KT-83-13: St. 7-2, CBM-ZF 6325 (1, 54 mm SL). KT-91-13: St. 4, 5661 (1, 57).
39. **Photonectes albipennis* (Döderlein): hotei-eso (W). $N=1$ (20 mm SL)
KT-92-11: St. 1, CBM-ZF 5754 (1, 20 mm SL).

Family Idiacanthidae

40. **Idiacanthus antrostomus* Gilbert: mitsumata-yariuo (W). $N=7$ (54–111 mm SL)

KT-77-13: St. A3 (500D), CBM-ZF 6227 (1, 71 mm SL). KT-78-15: St. A3, 6259 (2, 54, 57). KT-83-13: St. 8-1, 6337 (1, 59); St. 8-4, 6343 (1, 70). KT-92-11: St. 1, 5752 (2, 65, 111).

Order Aulopiformes
Family Scopelarchidae

41. **Scopelarchus analis* (Brauer): deme-eso-damashi (S). *N*=2 (25, 32 mm SL)
KT-77-13: St. A3 (100N), CBM-ZF 6220 (1, 32 mm SL). KT-78-15: St. A3, 6258 (1, 25).

Family Notosudidae

42. **Scopelosaurus harryi* (Mead): harii-fude-eso (S). *N*=3 (34–37 mm SL)
KT-83-13: St. 7-2, CBM-ZF 6330 (1, 37 mm SL). KT-93-10: St. 2, 6155 (1, 34). KT-95-5: St. 17, 6389 (1, 35).

43. *Scopelosaurus hoedti* Bleeker: hikari-fude-eso (S). *N*=2 (42, 48 mm SL)
KT-91-13: St. 4, CBM-ZF 5675 (1, 48 mm SL). KT-92-11: St. 1, 5761 (1, 42).

Family Paralepididae

44. **Lestidiops sphyraenopsis* Hubbs: yase-hadaka-eso (N). *N*=1 (66 mm SL)
KT-95-5: St. 17, CBM-ZF 6391 (1, 66 mm SL).

45. *Lestrolepis intermedia* (Poey): futasuji-namehadaka (S). *N*=5 (58–93 mm SL)
KT-85-8: St. A3, CBM-ZF 6529 (1, 60 mm SL). KT-91-13: St. 4, 5672 (1, 93); St. 5, 5671 (1, 68). KT-92-11: St. 3, 5776 (1, 62); St. 5, 5805 (1, 58).

46. *Paralepis atlantica* Krøyer: kusabi-uroko-eso (W). *N*=5 (18–76 mm SL)
KT-91-13: St. 4, CBM-ZF 5669 (2, 48, 64 mm SL); St. 6, 5670 (1, 76). KT-92-11: St. 4, 5788 (1, 18); St. 5, 5807 (1, 34).

Family Omosudidae

47. **Omosudis lowei* Günther: kiba-hadaka (S). *N*=1 (17 mm SL)
KT-93-10: St. 2, CBM-ZF 6158 (1, 17 mm SL).

Family Anotopteridae

48. **Anotopterus pharao* Zugmayer: mizu-uo-damashi (W). *N*=2 (42, 48 mm SL)
KT-85-8: St. A3, CBM-ZF 6530 (1, 48 mm SL). KT-93-10: St. 14, 6185 (1, 42).

Order Myctophiformes
Family Neoscopelidae

49. **Neoscopelus macrolepidotus* Johnson: soto-ori-iwashi (W). *N*=1 (48 mm SL)
KT-83-13: St. 8-1, CBM-ZF 6339 (1, 48 mm SL).

Family Myctophidae

50. *Benthosema suborbitale* (Gilbert): soko-hadaka (S). *N*=25 (10–30 mm SL)
KT-83-13: St. 6-1, CBM-ZF 4870 (2, 25, 26 mm SL); St. 8-4, 4934 (2, 11, 15); St. 8-1, 4921 (1, 29). KT-91-13: St. 2, 4049 (1, 20); St. 5, 4105 (1, 30); St. 6, 4124 (1, 18); St. 7, 4138 (1, 19); St. 8, 4173 (1, 21). KT-92-11: St. 1, 6394 (9, 10–26); St. 3, 6417 (1, 13); St. 4, 6427 (2, 12, 17); St. 5, 6441 (3, 12–14).

51. **Bolinichthys longipes* (Brauer): hoso-mikazuki-hadaka (S). *N*=5 (12–16 mm SL)
KT-83-13: St. 6-3, CBM-ZF 4156 (1, 13 mm SL); St. 8-4, 4157 (1, 15). KT-92-11: St. 1, 6395 (1, 12); St. 4, 6428 (1, 16); St. 5, 6442 (1, 13).

52. *Ceratoscopelus warmingii* (Lütken): gokô-hadaka (S). *N*=223 (16–58 mm SL)
KT-83-13: St. 6-1, CBM-ZF 4871 (7, 16–42 mm SL); St. 6-2, 4896 (5, 18–30); St. 6-3, 4883 (1, 28); St. 7-2, 4905 (27, 16–52); St. 8-2 (500 D), 4924 (1, 17); St. 8-4, 4935 (7, 17–25); St. 8-6, 4948 (27, 16–52). KT-91-13: St. 2, 4050 (19, 25–48); St. 3, 4063 (1, 34); St. 4, 4086 (8, 27–58); St. 5, 4106 (42, 23–53); St. 6, 4125 (18, 26–37); St. 7, 4140 (4, 29–35); St. 8, 4174 (6, 27–47). KT-92-11: St. 1, 6396 (6, 17–20); St. 3, 6418 (2, 18); St. 4, 6429 (1, 17); St. 5, 6443 (3, 17–52). KT-93-10: St. 2, 6480 (2, 17, 24); St. 3, 6490 (27, 21–44); St. 14, 6510 (7, 41–56). KT-95-5: St. 17, 6376 (2, 43, 49).

53. **Diaphus aliciae* Fowler: nirami-hadaka (S). *N*=4 (19–23 mm SL)
KT-93-10: St. 3, CBM-ZF 6512 (1, 21 mm SL); St. 14, 6511 (3, 19–23).

54. *Diaphus garmani* Gilbert: hiro-hadaka (S). *N*=242 (9–38 mm SL)
KT-83-13: St. 6-1, CBM-ZF 4878 (8, 11–23 mm SL); St. 6-2, 4902 (4, 12–22); St. 6-3, 4879 (9, 10–17); St. 7-2, 4903 (3, 23–35); St. 8-2 (500 D), 4928 (32, 9–34); St. 8-4, 4945 (6, 10–16); St. 8-6, 4946 (3, 22–27). KT-85-8: St. A3, 4751 (3, 15–32). KT-91-13: St. 2, 4057 (8, 18–32); St. 3, 4058 (31, 13–34); St. 4, 4094 (1, 38); St. 6, 4134 (5, 19–24); St. 7, 4135 (2, 22, 38); St. 8, 4177 (1, 24). KT-92-11: St. 1, 6397 (11, 11–22); St. 3, 6419 (9, 13–36); St. 4, 6430 (30, 10–21); St. 5, 6444 (75, 10–35). KT-93-10: St. 3, 6546 (1, 38).

55. *Diaphus kuroshio* Kawaguchi & Nafpaktitis: kuroshio-hadaka (S). *N*=41 (15–63 mm SL)
KT-83-13: St. 6-1, CBM-ZF 4875 (5, 23–63 mm SL); St. 7-2, 4904 (3, 58–63). KT-85-8: St. A3, 4747 (1, 61). KT-91-13: St. 3, 4059 (1, 57);

St. 4, 4096 (18, 15–62); St. 7, 4136 (1, 32). KT-92-11: St. 1, 6398 (2, 58, 63); St. 3, 6420 (2, 59, 61). KT-93-10: St. 3, 6491 (4, 24–62); St. 14, 6513 (3, 21–59). KT-95-5: St. 17, 6377 (1, 22).

56. **Diaphus luetkeni* (Brauer): ganten-hadaka (S). *N*=4 (11–24 mm SL)
KT-83-13: St. 8-4, CBM-ZF 4944 (2, 11, 13 mm SL); St. 8-6, 4947 (1, 24). KT-92-11: St. 5, 6445 (1, 13).
57. *Diaphus metopoclampus* (Cocco): daikoku-hadaka (S). *N*=1 (67 mm SL)
KT-92-11: St. 1, CBM-ZF 6399 (1, 67 mm SL).
58. *Diaphus mollis* Tåning: otome-hadaka (S). *N*=56 (9–36 mm SL)
KT-83-13: St. 6-1, CBM-ZF 4877, (3, 14–27 mm SL); St. 6-3, 4880 (1, 29); St. 8-2 (500D), 4927 (1, 19). KT-91-13: St. 3, 4060 (1, 29); St. 4, 4099 (7, 15–24); St. 5, 4100 (2, 28, 36). KT-92-11: St. 1, 6400 (21, 10–26); St. 3, 6421 (4, 16–26); St. 4, 6431 (4, 14–21); St. 5, 6446 (12, 9–25).
59. *Diaphus parri* Tåning: chikame-hadaka (S). *N*=1 (24 mm SL)
KT-91-13: St. 7, CBM-ZF 4137 (1, 24 mm SL).
60. *Diaphus perspicillatus* (Ogilby): shiro-hana-hadaka (S). *N*=12 (19–36 mm SL)
KT-91-13: St. 2, CBM-ZF 4056 (1, 27 mm SL); St. 4, 4097 (7, 19–36); St. 5, 4102 (4, 20–22).
61. *Diaphus regani* Tåning: agari-hadaka (S). *N*=1 (22 mm SL)
KT-91-13: St. 6, CBM-ZF 4132 (1, 22 mm SL).
62. **Diaphus schmidti* Tåning: taka-hadaka (S). *N*=7 (30–36 mm SL)
KT-93-10: St. 3, CBM-ZF 6545 (1, 35 mm SL); St. 14, 6514 (2, 30, 35). KT-95-5: St. 17, 6378 (4, 32–36).
63. *Diaphus signatus* Gilbert: bô-hadaka (S). *N*=1 (30 mm SL)
KT-91-13: St. 4, CBM-ZF 4095 (1, 30 mm SL).
64. *Diaphus suborbitalis* Weber: sen-hadaka (S). *N*=14 (9–19 mm SL)
KT-91-13: St. 5, CBM-ZF 4103 (2, 15, 19 mm SL). KT-92-11: St. 1, 6401 (11, 9–13); St. 4, 6432 (1, 14).
65. **Diaphus theta* Eigenmann & Eigenmann: todo-hadaka (N). *N*=1 (37 mm SL)
KT-83-13: St. 6-1, CBM-ZF 4876 (1, 37 mm SL).
66. *Diogenichthys atlanticus* (Tåning): ita-hadaka (S). *N*=121 (10–20 mm SL)
KT-83-13: St. 6-1, CBM-ZF 4874 (1, 18 mm SL); St. 6-2, 4900 (2, 16, 19); St. 6-3, 4882 (10, 11–18); St. 8-2 (500D), 4923 (7, 11–13); St. 8-3 (600D), 4932 (1, 11); St. 8-4, 4933 (10, 10–17); St. 8-1, 4922 (1, 20). KT-85-8: St. A3, 4752 (8, 10–15). KT-91-13: St. 3, 4062 (1, 18); St. 4, 4093 (3, 17–19). KT-92-11: St. 1, 6402 (43, 11–18); St. 3, 6422 (2, 19); St. 4, 6434 (18, 11–14); St. 5, 6447 (13, 12–19). KT-93-10: St. 13, 6502 (1, 18).
67. *Hygophum proximum* Becker: tsumari-donguri-hadaka (S). *N*=5 (11–19 mm SL)
KT-83-13: St. 8-3 (600D), CBM-ZF 4929 (1, 14 mm SL). KT-91-13: St. 2, 4051 (1, 19); St. 4, 4087 (1, 19). KT-92-11: St. 4, 6435 (1, 11); St. 5, 6448 (1, 13).
68. *Hygophum reinhardtii* (Lütken): donguri-hadaka (S). *N*=11 (13–41 mm SL)
KT-83-13: St. 6-1, CBM-ZF 4884 (2, 13, 14 mm SL). KT-91-13: St. 6, 4126 (1, 22). KT-92-11: St. 1, 6403 (4, 16–41); St. 3, 6423 (1, 17). KT-93-10: St. 2, 6482 (1, 21); St. 3, 6493 (1, 19); St. 13, 6503 (1, 21).
69. *Lampadena luminosa* (Garman): kagami-iwashi (S). *N*=6 (16–25 mm SL)
KT-91-13: St. 5, CBM-ZF 4114 (3, 20–25 mm SL); St. 6, 4120 (1, 23). KT-92-11: St. 1, 6404 (2, 16, 18).
70. **Lampadena yaquinae* (Coleman & Nafpaktitis): sankô-hadaka (N). *N*=1 (38 mm SL)
KT-95-5: St. 17, CBM-ZF 6379 (1, 38 mm SL).
71. *Lampanyctus alatus* Goode & Bean: tomi-hadaka (S). *N*=78 (13–53 mm SL)
KT-83-13: St. 6-3, CBM-ZF 4867 (1, 23 mm SL); St. 6-2, 4892 (1, 15); St. 6-3, 4891 (4, 14–52); St. 7-2, 4912 (4, 21–33); St. 8-2 (500D), 4925 (1, 16); St. 8-1, 4913 (1, 18). KT-91-13: St. 5, 4112 (3, 24–26). KT-92-11: St. 1, 6405 (23, 14–53); St. 3, 6424 (1, 23); St. 4, 6436 (21, 13–21); St. 5, 6449 (7, 14–20). KT-93-10: St. 2, 6483 (8, 16–47); St. 3, 6494 (1, 33). KT-95-5: St. 17, 6380 (2, 49, 50).
72. **Lampanyctus festivus* Tåning: niji-hadaka (W). *N*=4 (24–37 mm SL)
KT-93-10: St. 2, CBM-ZF 6484 (1, 24 mm SL); St. 13, 6504 (1, 37); St. 14, 6516 (2, 34, 36).
73. *Lampanyctus jordani* Gilbert: mame-hadaka (N). *N*=27 (22–125 mm SL)
KT-83-13: St. 6-1, CBM-ZF 4868 (5, 107–122 mm SL); St. 6-2, 4893 (3, 106–121); St. 7-2, 4908 (2, 25, 118); St. 8-1, 4916 (3, 22–113). KT-91-13: St. 3, 4082 (4, 115–125); St. 4, 4083 (1, 24); St. 5, 4118 (2, 120, 125); St. 6, 4119 (2, 25, 93); St. 7, 4144 (2, 115, 121); St. 8, 4171 (1, 117). KT-92-11: St. 5, 6450 (1, 24). KT-95-5: St. 17, 6381 (1, 60).
74. *Lampanyctus niger* (Günther): tongari-hadaka (S). *N*=12 (19–55 mm SL)
KT-91-13: St. 4, CBM-ZF 4084 (2, 37, 38 mm SL); St. 7, 4142 (1, 25). KT-92-11: St. 1, 6406 (1, 53); St. 4, 6437 (1, 24); St. 5, 6451 (1, 22). KT-93-10: St. 2, 6485 (3, 20–55); St. 3, 6495 (2,

19, 21); St. 13, 6505 (1, 53).

75. *Lampanyctus nobilis* Tåning: hoso-tongari-hadaka (S). $N=20$ (17–44 mm SL)
KT-83-13: St. 8-1, CBM-ZF 4915 (1, 26 mm SL). KT-91-13: St. 2, 4048 (1, 31); St. 3, 4081 (3, 27–40); St. 4, 4085 (1, 31); St. 5, 4115 (2, 24, 43); St. 6, 4122 (6, 23–32); St. 7, 4143 (2, 27, 44); St. 8, 4172 (1, 42). KT-92-11: St. 5, 6452 (3, 17–27).

76. **Lampanyctus regalis* (Gilbert): mikado-hadaka (N). $N=4$ (24–83 mm SL)
KT-85-8: St. A3, CBM-ZF 4756 (1, 83 mm SL). KT-93-10: St. 3, 6496 (1, 28); St. 14, 6517 (2, 24, 27).

77. *Lampanyctus tenuiformis* Brauer: nettai-niji-hadaka (S). $N=6$ (21–53 mm SL)
KT-83-13: St. 6-2, CBM-ZF 4894 (1, 33 mm SL); St. 7-2, 4911 (1, 51). KT-85-8: St. A3, 4757 (2, 21, 28). KT-91-13: St. 6, 4123 (1, 53). KT-92-11: St. 4, 6438 (1, 36).

78. **Lampanyctus turneri* (Fowler): kata-hadaka (S). $N=1$ (16 mm SL)
KT-83-13: St. 8-1, CBM-ZF 4914 (1, 16 mm SL).

79. **Lampanyctus* sp. 1: tenashi-hadaka (S). $N=1$ (49 mm SL)
KT-95-5: St. 17, CBM-ZF 6382 (1, 49 mm SL).
Remarks.— This species, which has not been formally named, was designated *Lampanyctus* sp. 1 in Nakabo ed. (1993).

80. **Lampanyctus* sp.: $N=2$ (31, 32 mm SL)
KT-92-11: St. 1, CBM-ZF 6407 (2, 31, 32 mm SL).
Remarks.— These specimens were most similar to *Lampanyctus tenuiformis*, having long pectoral fin rays, no cheek or secondary photophores, Prc_{1-3} located on the same level, and a line through VLO and SAO_{1-2} being nearly horizontal. They differed, however, in having luminous scales filling all the infracaudal space (vs. four-fifths), lower dorsal fin ray counts (13 vs. 15) and higher gill-raker counts (5+1+11=17 vs. 4+1+9=14).

81. **Lobianchia gemellarii* (Cocco): hakutô-hadaka (S). $N=3$ (12–38 mm SL)
KT-83-13: St. 6-2, CBM-ZF 4895 (1, 38 mm SL); St. 8-1, 4917 (1, 22). KT-92-11: St. 1, 6408 (1, 12).

82. **Loweina terminata* Becker: kirara-hadaka (S). $N=1$ (23 mm SL)
KT-83-13: St. 7-2, CBM-ZF 4910 (1, 23 mm SL).

83. *Myctophum asperum* Richardson: ara-hadaka (S). $N=18$ (15–80 mm SL)
KT-91-13: St. 2, CBM-ZF 4052 (3, 24–40 mm SL); St. 3, 4064 (1, 29); St. 4, 4088 (1, 27); St. 5, 4107 (1, 35); St. 6, 4127 (1, 22). KT-92-11: St. 1, 6409 (5, 15–17); St. 5, 6453 (1, 21). KT-93-10: St. 3, 6497 (1, 35); St. 14, 6518 (4, 29–80).

84. *Myctophum nitidulum* Garman: susuki-hadaka (S). $N=18$ (16–31 mm SL)
KT-83-13: St. 6-2, CBM-ZF 4897 (3, 16–31 mm SL); St. 6-3, 4886 (1, 19). KT-91-13: St. 5, 4108 (2, 26, 28). KT-92-11: St. 1, 6410 (4, 16–20); St. 5, 6454 (3, 18). KT-93-10: St. 2, 6486 (2, 17, 21); St. 13, 6506 (2, 23, 24); St. 14, 6519 (1, 28).

85. *Myctophum orientale* (Gilbert): usu-hadaka (S). $N=2$ (22, 23 mm SL)
KT-91-13: St. 6, CBM-ZF 4128 (2, 22, 23 mm SL).

86. **Myctophum* sp.: $N=1$ (17 mm SL)
KT-92-11: St. 1, CBM-ZF 6411 (1, 17 mm SL).
Remarks.—This species is most similar to *M. nitidulum*, although readily distinguishable from the latter in having the VO_{1-2} interspace notably greater than those of VO2–4 (the latter equally spaced).

87. **Notolychnus valdiviae* (Brauer): ura-hadaka (S). $N=4$ (12–20 mm SL)
KT-83-13: St. 6-3, CBM-ZF 4888 (1, 12 mm SL). KT-92-11: St. 1, 6412 (1, 20); St. 4, 6440 (2, 13, 19).

88. *Notoscopelus resplendens* (Richardson): isari-bi-hadaka (S). $N=5$ (46–60 mm SL)
KT-91-13: St. 2, CBM-ZF 4053 (2, 47 mm SL); St. 3, 4065 (2, 60); St. 4, 4089 (1, 46).

89. *Stenobrachius leucopsarus* (Eigenmann & Eigenmann): kohire-hadaka (N). $N=1$ (95 mm SL)
KT-91-13: St. 3, CBM-ZF 4066 (1, 95 mm SL).

90. *Stenobrachius nannochir* (Gilbert): sekki-hadaka (N). $N=122$ (16–112 mm SL)
KT-83-13: St. 6-1, CBM-ZF 4873, (13, 52–100 mm SL); St. 6-2, 4898 (4, 49–103); St. 6-3, 4889 (1, 84); St. 7-2, 4907 (6, 53–95); St. 8-6, 4950 (7, 58–112); St. 8-1, 4919 (6, 68–95). KT-85-8: St. A3, 4755 (4, 60–82). KT-91-13: St. 2, 4054 (7, 55–90); St. 3, 4067 (10, 58–103); St. 4, 4090 (8, 50–89); St. 5, 4113 (9, 60–105); St. 6, 4130 (6, 67–95); St. 7, 4141 (7, 55–95); St. 8, 4175 (4, 66–86). KT-92-11: St. 1, 6413 (3, 63–73); St. 3, 6425 (2, 64, 65). KT-93-10: St. 2, 6487 (3, 50–70); St. 3, 6499 (2, 61, 70); St. 13, 6507 (3, 58–90); St. 14, 6520 (2, 57, 69). KT-95-5: St. 17, 6383 (15, 58–83).

91. *Symbolophorus californiensis* (Eigenmann & Eigenmann): naga-hadaka (N). $N=9$ (22–28 mm SL)
KT-91-13: St. 5, CBM-ZF 4110 (1, 25 mm SL). KT-92-11: St. 1, 6414 (3, 23–25). KT-93-10:

St. 3, 6500 (1, 23); St. 14, 6521 (4, 22–28).

92. *Symbolophorus evermanni* Gilbert: magarihadaka (S). $N=20$ (17–90 mm SL)
KT-83-13: St. 6-1, CBM-ZF 4872 (1, 21 mm SL); St. 6-2, 4899 (1, 29); St. 7-2, 4906 (5, 17–30); St. 8-4, 4941 (2, 19); St. 8-1, 4920 (1, 20). KT-91-13: St. 2, 4055 (1, 31); St. 3, 4068 (1, 20); St. 4, 4091 (3, 29–68); St. 6, 4131 (2, 28, 31); St. 8, 4176 (1, 20). KT-92-11: St. 1, 6415 (1, 22). KT-93-10: St. 2, 6488 (1, 38).
93. *Taaningichthys bathyphilus* (Tåning): hagekuro-hadaka (S). $N=1$ (28 mm SL)
KT-91-13: St. 5, CBM-ZF 4111 (1, 28 mm SL).
94. *Taaningichthys minimus* (Tåning): kurohadaka (S). $N=1$ (58 mm SL)
KT-91-13: St. 4, CBM-ZF 4092 (1, 58 mm SL).
95. *Taaningichthys paurolychnus* Davy: chihirokuro-hadaka (S). $N=2$ (48, 82 mm SL)
KT-91-13: St. 3, CBM-ZF 4069 (1, 48 mm SL). KT-93-10: St. 13, 6508 (1, 82).
96. **Triphoturus microchir* (Gilbert): tsumarihadaka (S). $N=3$ (15–23 mm SL)
KT-92-11: St. 5, CBM-ZF 6455 (2, 15, 18 mm SL). KT-93-10: St. 3, 6501 (1, 23).

Order Gadiformes
Family Melanonidae

97. **Melanonus zugmayeri* Norman: kawarihiredara (W). $N=1$ (119 mm SL)
KT-85-8: St. A3, CBM-ZF 5872 (1, 119 mm SL).

Family Bregmacerotidae

98. **Bregmaceros arabicus* d'Ancona & Cavinato: indo-saiuo (S). $N=1$ (15 mm SL)
KT-77-13: St. A4, CBM-ZF 6235 (1, 15 mm SL).
99. *Bregmaceros japonicus* Tanaka: saiuo (S). $N=7$ (15–55 mm SL)
KT-91-13: St. 2, CBM-ZF 5613 (1, 44 mm SL); St. 4, 5614 (1, 55). KT-92-11: St. 1, 5755 (4, 18–19); St. 5, 5801 (1, 15).

Family Macrouridae

100. *Caelorinchus tokiensis* (Steindachner & Döderlein): miyako-hige (S). $N=1$ (30+ mm TL)
KT-91-13: St. 8, CBM-ZF 5667 (1, 30+ mm TL).
101. *Coryphaenoides cinereus* Gilbert: karafutosokodara (N). $N=1$ (75+ mm TL)
KT-91-13: St. 2, CBM-ZF 5665 (1, 75+ mm TL).
102. **Coryphaenoides pectoralis* (Gilbert): munedara (N). $N=1$ (141+ mm TL)
KT-83-13: St. 6-2, CBM-ZF 5867 (1, 141+ mm TL).
103. **Hymenocephalus lethonemus* Jordan & Gilbert: itodara (S). $N=1$ (53 mm TL)
KT-83-13: St. 6-3, CBM-ZF 5859 (1, 53 mm TL).

Order Ophidiiformes
Family Ophidiidae

104. **Bassozetus zenkevitchi* Rass: fukumenitachi-uo (S). $N=2$ (153, 215 mm SL)
KT-92-11: St. 3, CBM-ZF 5768 (1, 153 mm SL); St. 4, 5777 (1, 215).

Order Lophiiformes
Family Oneirodidae

105. *Bertella idiomorpha* Pietsch: bâterusen-ankô (N). $N=3$ (23–55 mm SL)
KT-83-13: St. 8-1, CBM-ZF 6340 (1, 55 mm SL). KT-91-13: St. 6, 6150 (1, 55). KT-92-11: St. 5, 5812 (1, 23).
106. *Chirophryne xenolophus* Regan & Trewavas: tsuno-rakuda-ankô* (S). $N=1$ (64 mm SL)
KT-91-13: St. 8, CBM-ZF 6151 (1, 64 mm SL).
Remarks.—Although Pietsch (1978) recorded this rare oneirodid species from Japanese waters (32°10′N, 136°05′E), Nakabo ed. (1993) omitted its inclusion in his regional synopsis.
107. *Oneirodes eschrichtii* Lütken: hime-rakudaankô (W). $N=2$ (12, 13 mm SL)
KT-91-13: St. 5, CBM-ZF 6152 (1, 12 mm SL); St. 7, 6153 (1, 13).
108. *Puck pinnata* Pietsch: akuma-ankô* (S). $N=1$ (11 mm SL)
KT-91-13: St. 4, CBM-ZF 6154 (1, 11 mm SL).
Remarks.—This rare oneirodid species (specimen identified by T. W. Pietsch) was recorded for the first time from Japanese waters by Miya *et al.* (1995b), although they did not propose a Japanese name.

Order Beryciformes
Family Melamphaidae

109. *Poromitra crasciceps* (Günther): kabuto-uo (W). $N=1$ (105 mm SL)
KT-91-13: St. 6, CBM-ZF 5633 (1, 105 mm SL).
110. *Scopeloberyx opisthopterus* species complex. $N=57$ (12–35 mm SL)
KT-83-13: St. 6-3, CBM-ZF 5940 (1, 20 mm SL); St. 6-2, 5941 (2, 25, 27); St. 7-2, 5942 (4, 14–29); St. 8-1, 5943 (8, 12–33). KT-91-13: St. 3, 5626 (3, 22–33); St. 4, 5627 (3, 20–34); St. 5, 5628 (6, 13–35); St. 6, 5629 (5, 22–35); St. 7, 5630 (5, 14–22); St. 8, 5631 (3, 21–34). KT-92-11: St. 1, 5759 (7, 12–21); St. 3, 5774 (3, 28–

33); St. 5, 5808 (3, 12–15). KT-95-5: St. 17, 6393 (4, 19–34).
Remarks.—This dwarf form of the melamphaid includes *Scopeloberyx opisthopterus* and *S.* sp., the latter being an undescribed species (Y. Sato, pers. comm.).

Order Cetomimiformes
Family Rondeletiidae

111. **Rondeletia loricata* Abe & Hotta: akachokkikujira-uo (S). $N=3$ (36–47 mm SL)
KT-83-13: St. 7-2, CBM-ZF 101 (1, 46 mm SL). KT-85-8: St. A3, 458 (2, 36, 47).

Family Cetomimidae

112. **Cetomimus* sp.: sagami-kujira-uo.* $N=1$ (58 mm SL)
KT-85-8: St. A3, CBM-ZF 459 (1, 58 mm SL).
Remarks.—J. R. Paxton (pers. comm.) has indicated that this undescribed species represents a new subgenus of *Cetomimus*.

113. **Gyrinomimus bruuni* Rofen: yase-kujira-uo* (S). $N=1$ (90 mm SL)
KT-85-8: St. A3, CBM-ZF 460 (1, 90 mm SL).
Remarks.—This species was previously known only from the western equatorial Indian Ocean off Kenya (5°25′S, 47°09′E). The present specimen, identified by J. R. Paxton, represents the first record from Japanese waters.

Order Perciformes
Family Percichthyidae

114. **Bathysphyraenops simplex* Parr: togesumikui-uo (S). $N=1$ (14 mm SL)
KT-92-11: St. 4, CBM-ZF 5786 (1, 14 mm SL).

115. **Howella zina* Fedoryako: togekushisumikui-uo (S). $N=1$ (44 mm SL)
KT-93-10: St. 14, CBM-ZF 6184 (1, 44 mm SL).

Family Epigonidae

116. **Epigonus denticulatus* Dieuzeide: hageyasemutsu (S). $N=1$ (32 mm SL)
KT-92-11: St. 5, CBM-ZF 5802 (1, 32 mm SL).

Family Parabrotulidae

117. *Parabrotula plagiophthalma* Zugmayer: niseitachi-uo (W). $N=4$ (32–43 mm SL)
KT-83-13: St. 8-1, CBM-ZF 107, 1028 (2, 32, 33 mm SL). KT-91-13: St. 3, 5616 (2, 34, 43).

Family Chiasmodontidae

118. **Dysalotus alcocki* MacGilchrist: togebôzugisu (S). $N=2$ (61, 63 mm SL)
KT-93-10: St. 3, CBM-ZF 6170 (1, 63 mm SL); St. 13, 6175 (1, 61).

Family Gempylidae

119. **Nealotus tripes* Johnson: fûrai-kamasu (S). $N=1$ (43 mm SL)
KT-83-13: St. 7-2, CBM-ZF 6329 (1, 43 mm SL).

Family Trichiuridae

120. **Benthodesmus tenuis* (Günther): tachimodoki (S). $N=1$ (225 mm TL)
KT-83-13: St. 7-2, CBM-ZF 6328 (1, 225 mm TL).

Discussion

Examination of 9,350 adult fish specimens from 56 lots collected during 10 sampling cruises, resulted in a total of 120 species, representing 36 families being included in the deep-sea, midwater fish fauna off the Pacific coast of Boso Peninsula. Newly-recorded for the region numbered 54, including four, probably undescribed species of the following genera: *Eustomias* (Melanostomiidae), *Lampanyctus*, *Myctophum* (Myctophidae) and *Cetomimus* (Cetomimidae). The rare cetomimid fish, *Gyrinomimus bruuni*, previously recorded only from the western equatorial Indian Ocean off Kenya (Rofen, 1959), was recognized for the first time from Japanese waters.

Although it is highly unlikely that the species recorded in the present study represent the total fish fauna, the results obtained may be a moderate estimation of the fauna, considering the sampling efforts and the location of the study area, where species with various zoogeographic affinities, including tropical/subtropical, subarctic, wide-ranging, pseudoceanic and transitional, occur heterogeneously (Miya *et al.*, 1995b). In fact, the number of myctophid species (47), representing the most speciose family in the area, is comparable to that recorded in Suruga Bay (50 spp.; Kubota *et al.*, 1989), a more southern, adjacent part of the Pacific coast of central Japan, where extensive surveys have been made by Kawaguchi (1977) and Kubota *et al.* (1989). Furthermore, most of the more common species should have been listed, since the total of those newly-recorded contributed just $\leq 0.1\%$ (total,

Table 1. Summary of deep-sea midwater fish sampling data

Cruise	Station	Latitude	Longitude	Date	Time	Net	Mesh (mm)	Method	Depth (m)
KT-75-13	8	34°22.1′N	138°33.9′E	15 Sept. 1975	0437–0554	ORI-100	1.0	oblique	0–?
KT-77-13	A4	34°27.8′N	140°00.2′E	14 Sept. 1977	0645–0800	ORI-100	1.0	oblique	0–1500
	A5	34°00.9′N	140°20.1′E	13 Sept. 1977	1845–2000				0–1150
	A3 (300D)	34°41.1′N	139°45.4′E	14 Sept. 1977	1437–1710	50 cm MTD	0.33	horizontal	300
	A3 (500D)								500
	A3 (600D)								600
	A3 (800D)								800
	A3 (100N)	34°42.2′N	139°47.7′E		2125–2222				100
KT-78-15	A3	34°40.7′N	139°42.0′E	9 Sept. 1978	1640–1755	ORI-100	1.0	oblique	0–840
KT-78-16	A3	34°40.3′N	139°42.5′E	2 Nov. 1978	0148–0310	ORI-100	1.0	oblique	0–670
KT-83-13	6-1	34°44.7′N	139°59.8′E	6 Aug. 1983	0256–0530	10-ft IKMT	5.0	oblique	0–850
	6-2	34°43.9′N	140°00.8′E		0548–0810				0–1030
	6-3	35°44.9′N	140°01.6′E		0824–1045				0–880
	6-4	34°35.9′N	140°01.7′E		1306–1424	ORI-69	0.69	oblique	0–1200
	6-5	34°45.5′N	140°00.5′E		1430–1543				0–1250
	7-1	34°41.8′N	140°03.1′E	6–7 Aug. 1983	2247–0041	10-ft IKMT	5.0	oblique	0–860
	7-2	34°39.0′N	140°00.1′E	7 Aug. 1983	0050–0310				0–850
	8-1	34°38.1′N	140°00.1′E	8 Aug. 1983	0648–0938				0–1130
	8-2 (350D)	34°35.1′N	139°59.5′E	7 Aug. 1983	0852–1055	80 cm MTD	0.68	horizontal	280–320
	8-2 (400D)								330–370
	8-2 (450D)								370–420
	8-2 (500D)								420–470
	8-3 (600D)	34°39.5′N	140°07.6′E		1550–1800				590–630
	8-3 (700D)								710–750
	8-3 (800D)								820–870

Table 1. continued

Cruise	Station	Latitude	Longitude	Date	Time	Net	Mesh (mm)	Method	Depth (m)
	8-4	34°38.6′N	140°06.6′E	7 Aug. 1983	1905–2011	ORI-69	0.69	oblique	0–910
	8-4 (600N)	34°37.7′N	140°03.2′E	7–8 Aug. 1983	2230–0030	80 cm MTD	0.68	horizontal	540–640
	8-4 (700N)								610–750
	8-4 (800N)								690–870
	8-4 (1000N)								860–1090
	8-5 (250D)	34°37.5′N	140°02.6′E	8 Aug. 1983	0148–0400				260–270
	8-5 (300D)								320–340
	8-5 (350D)								390–400
	8-5 (400D)								450–470
	8-5 (450D)								520–540
	8-5 (500D)								580–600
	8-6	34°37.8′N	140°05.1′E	7 Agu. 1983	2019–2128	ORI-69	0.69	oblique	0–950
KT-85-8	A3	34°38.4′N	139°38.3′E	7 July 1985	0242–0448	10-ft IKMT	0.5	oblique	0–1110
KT-91-13	2	34°56.7′N	141°02.0′E	4 Sept. 1991	2328–0127	10-ft IKMT	5.0	oblique	0–1310
	3	35°10.8′N	141°07.9′E	5 Sept. 1991	0440–0650				0–1200
	4	35°19.1′N	141°26.5′E		0900–1105				0–1150
	5	35°30.2′N	141°32.6′E		1253–1434				0–1230
	6	35°41.3′N	141°37.1′E		1610–1820				0–1240
	7	35°49.6′N	141°27.9′E		2028–2237				0–1460
	8	35°59.2′N	141°32.4′E		0316–0519				0–1470
KT-92-11	1	33°57.9′N	140°33.8′E	30 July 1992	0340–0539	10-ft IKMT	1.0	oblique	0–776
	3	34°27.0′N	140°05.0′E	29 July 1992	0015–0237				0–1771
	4	34°34.3′N	139°48.8′E		1850–2114				0–1747
	5	34°45.1′N	139°35.1′E		2305–0111				0–1098
KT-93-10	2	34°52.6′N	140°43.8′E	7 July 1993	0515–0725	10-ft IKMT	5.0	oblique	0–1110
	3	35°02.3′N	141°10.0′E		0926–1156				0–1160
	13	34°59.3′N	140°55.7′E	9 July 1993	0555–1012				0–1994
	14	35°00.4′N	141°46.4′E		1034–1446				0–>2000
KT-95-5	17	35°06.3′N	141°00.3′E	24–25 Apr. 1995	2300–0110	10-ft IKMT	5.0	oblique	0–>2000

1.6%) of the overall, total numerical catch, each species being represented by seven or fewer specimens (with the exception of the photichthyid, *Vinciguerria attenuata* [$n=47$, ranked 14th in numerical dominance]). Since the zoogeographic affinity of *V. attenuata* is rather more tropical compared with that of its relatively abundant congener, *V. nimbaria* ($n=48$, ranked 13th) (Gorbunova, 1972), it was likely that effects of the Kuroshio current had been more pronounced at the times of the two cruises (KT-92-11 and KT-93-10), during which most of the *V. attenuata* specimens were collected.

Of the 36 families, the three most speciose families were myctophids (47 spp.), gonostomatids (10 spp.) and sternoptychids (5 spp.), with gonostomatids the most numerically dominant (83.4%), followed by myctophids (12.3%), and photichthyids (1.1%). These tendencies were generally consistent with those observed by Miya *et al.* (1995b), although the numerical dominance of melamphaids and sternoptychids were slightly greater than that of photichthyids in the latter.

Of the 120 species, the gonostomatid genus *Cyclothone* provided the three most numerically dominant species (*C. atraria* [48.2%], *C. alba* [13.9%] and *C. pseudopallida* [10.8%]), followed by another gonostomatid, *Gonostoma gracile* (8.6%), two myctophids, *Diaphus garmani* (2.6%) and *Ceratoscopelus warmingii* (2.4%), the gonostomatid, *Cyclothone pallida* (1.7%), and the three myctophids, *Stenobrachius nannochir* (1.3%), *Diogenichthys atlanticus* (1.3%) and *Lampanyctus alatus* (0.8%). Despite the great potential for variability owing to the course of the Kuroshio current, the composition of the top ten numerically dominant species in the present list was almost identical with that given by Miya *et al.* (1995b). In fact, both lists share eight species, with the exception of the two least dominant species. It should be mentioned that the position of the small-sized *C. alba* (15–27 mm SL) and relatively larger *G. gracile* (20–119 mm SL) that ranked 7th and 2nd, respectively, in Miya *et al.* (1995b) were reversed, being 2nd and 4th in the present list. This was apparently due to the loss of smaller fish during sampling in the earlier study, since Miya *et al.* (1995b) employed a 10-ft IKMT with a large mesh size (5.0 mm), while most of the present collections were taken by nets with small mesh sizes ≤ 1.0 mm (see Table 1).

Of the 115 identified species, 17 species (14.8%) and 81 species (70.4%) have their distribution centers located in northern and southern Japan (north and south of the peninsula) respectively, whereas the remaining 17 species (14.8%) are relatively wide-ranging, extending the length of Japan. This finding was identical with that observed by Miya *et al.* (1995b), in which they concluded that the northern half of the present study area was located at an interface between peripheral breeding populations of the tropical/subtropical, subarctic and pseudoceanic species. The effects of the Kuroshio current seemed to have been more pronounced in the southern parts of the study area, since tropical/subtropical species that were minor or completely absent in Miya *et al.* (1995b) (including *Diogenichthys atlanticus* and *Vinciguerria attenuata*), were found to be relatively abundant during the present study. In contrast, of the 50 newly-recorded species (excluding unidentified forms), seven had northern zoogeographic affinities, although all were minor elements of the fauna, being represented by four or fewer specimens ($<$ 0.1%).

The predominance of southern species, along with occurrences of northern species (mostly represented by subarctic species), are the zoogeographic characteristics of the region, apparently reflecting the presence of the cold, less saline Oyashio waters below the warm Kuroshio current flowing northward along the peninsula, as discussed extensively by Miya *et al.* (1995b). Similar zoogeographic characteristics have been more or less noted for bottom-trawl catches off Choshi, on the northernmost part of the Pacific coast of the peninsula (Miya *et al.*, 1995a), in which 18 species (7.0%) and 134 species (52.1%) had distribution centers located in northern and southern Japan, respectively. It should be noted that smaller percentages of the northern and southern faunal components off Choshi, compared with those in the present study, reflected the predominance of wide-

ranging species categorized as coastal fishes. In contrast, no northern species occurred amongst shallow coastal water fishes taken off Ainohama and Chitose (Miya *et al.*, 1994a, b), on the southernmost part of the peninsula, indicating that the effects of the Oyashio current are most pronounced in waters exceeding 200 m.

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房総半島産の魚類—IV

半島太平洋岸沖合の中・深層性魚類

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房総半島太平洋岸沖合で得られた計 54 ロット，9,350 個体からなる中・深層性魚類（仔魚を除く）のサンプルを精査した結果，本海域から 36 科に含まれる 120 種（未記載種と考えられる 5 種を含む）の出現を記録することができた．これら 36 科のうち，種数の最も多かったのがハダカイワシ科（47 種）で，ヨコエソ科（10 種）とムネエソ科（5 種）がそれに続いた．また，個体数の最も多かったのはヨコエソ科（83.4%）で，ハダカイワシ科（12.3%）とギンハダカ科（1.1%）がそれに続いた．一方，採集された 9,350 個体の圧倒的多数を占めたのはオニハダカ属（74.6%）で，上位 3 種は順にオニハダカ *Cyclothone atraria*（48.2%），ユキオニハダカ *C. alba*（13.9%），ハイイロオニハダカ *C. pseudopallida*（10.8%）といずれも本属魚類であった．また，100 個体以上採集されたものを上位から順にあげると，ヨコエソ科のヨコエソ *Gonostoma gracile*（8.6%），以下ハダカイワシ科のヒロハダカ *Diaphus garmani*（2.6%），ゴコウハダカ *Ceratoscopelus warmingii*（2.4%），ヨコエソ科の *C. pallida*（1.7%），再びハダカイワシ科のセッキハダカ *Stenobrachius nannochir*（1.3%），そしてイタハダカ *Diogenichthys atlanticus*（1.3%）であった．同定できた 115 種のうち 17 種（14.8%）は分布の中心を北日本（房総半島より北）にもつ北方種，81 種（70.4%）は分布の中心を南日本（房総半島より南）にもつ南方種，また残りの 17 種（14.8%）は南北日本に広く分布する広域種であった．このように南方種が優占し、北方種が少数出現する傾向は銚子沖合の底生性魚類相にもみられ，房総半島沖合沿いを北上する黒潮とその下層に存在する親潮系水の影響を受けたものであると考えられた．