



Title	Larval and Juvenile Fishes Collected from the Northern Pacific Ocean by T/S OSHORO-MARU : Part 1: Salmoniformes, Clupeiformes, Myctophiformes, Cyprinodontiformes, Lophiiformes and Lampriformes
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**Larval and Juvenile Fishes Collected from the Northern
Pacific Ocean by T/S OSHORO-MARU**
**Part 1: Salmoniformes, Clupeiformes, Myctophiformes,
Cyprinodontiformes, Lophiiformes and Lampriformes**

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Abstract

Descriptions are made of twenty-one species of larval and juvenile fishes collected in the northern Pacific Ocean by larval net survey from 1980 to 1986; *Engraulis japonicus*, *Bathylagus ochotensis*, *Tactostoma macropus*, *Lestidiops ringens*, *Lestidiops pacificum*, *Lampanyctus regalis*, *Ceratoscopelus townsendi*, *Tarletonbeania taylori*, *Myctophum nitidulum*, *Symbolophorus californiensis*, *Diaphus gigas*, *Ceratoscopelus warmingii*, *Cololabis saira*, *Hirundichthys (Hirundichthys) speculiger*, *Hirundichthys (Hirundichthys) oxycephalus*, *Hirundichthys (Danichthys) rondeletii*, *Cypselurus (Procypselurus) katoptron*, *Ezocoetus monocirrhus*, *Chaenophryne* sp., *Gigantactis* sp. and *Desmodema lorum*. Among them, prejuvenile specimens of *Lestidiops pacificum* (33.0 mm SL) and *Desmodema lorum* (24.8 mm SL) are described for the first time.

Introduction

Since 1980, T/S Oshoro Maru of Hokkaido University has been conducting the larval-net surveys from June through August in the northern Pacific Ocean, including the Bering Sea. During these surveys, an enormous collection of larval and juvenile fishes was accumulated from a total of about 450 sampling stations (Fig. 1). These high productivity waters support a rich fauna and maintain important fisheries. Because ichthyoplankton plays a very important role in the food web, taxonomic studies of the larval and juvenile fishes are regarded as one of the primary requirements for understanding the ecosystem of the region. Such studies of larval fishes in the North Pacific Ocean have been made by numerous authors (e.g. Uchida et al. 1958; Gorbunova, 1970; Moser and Ahlstrom, 1970; Ahlstrom, 1971; Moser et al. 1977, 1984; Richardson and Washington, 1980; Kendall and Vinter, 1984). Recently, these studies were reviewed and summarized by Ozawa (1986) and Okiyama (1988a) for the north-western Pacific, and by Matarese et al. (1989) for the north-eastern Pacific. The present study is intended to further document taxonomic information on larval and juvenile fishes, and to clarify fish composition from early to middle summer in northern North Pacific waters. Larval and juvenile

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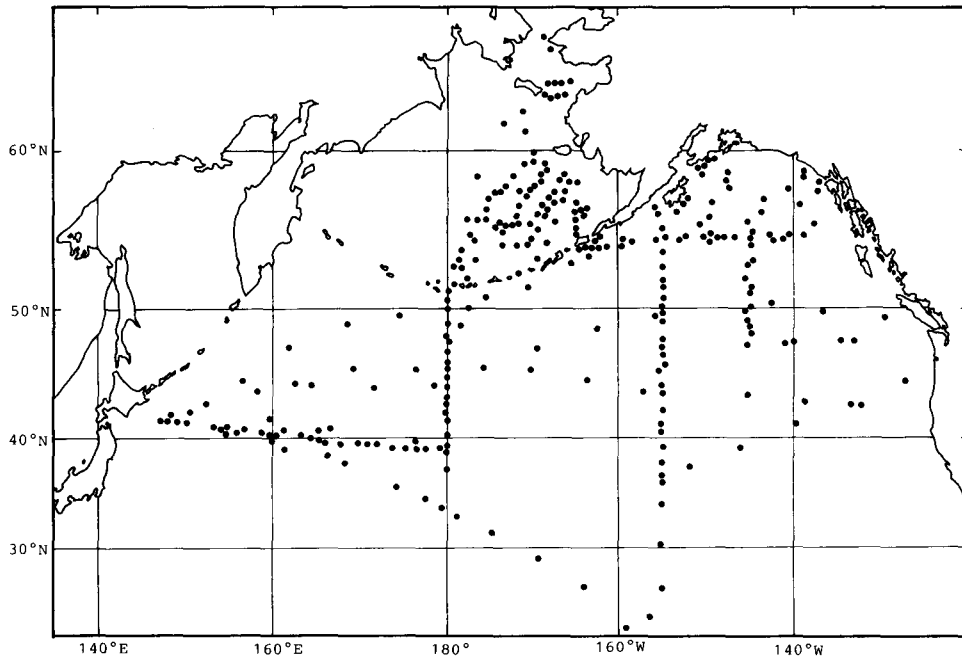


Fig. 1. Locations of total sampling stations of the larval-net survey executed by T/S Oshoro-Maruru during 1980-1986.

fishes, and a few adult specimens, of 21 species belonging to Salmoniformes, Clupeiformes, Myctophiformes, Cyprinodontiformes, Lophiiformes and Lampriformes that were included in the Oshoro Maru's larval net survey collections are described and illustrated with brief comments.

Materials and Methods

Materials were collected during cruises in the northern North Pacific of the T/S Oshoro Maru, during 1980-1986. Horizontal surface tows were carried out with a larval net of 1.3 m ring diameter. The larval net was towed for 10 minutes at a speed of about three knots. Most tows were conducted one hour after sunset or one hour before sunrise. Date and sampling area of each station are shown in Fig. 1 and Table 1. The specimens were preserved in 5% formalin, and are deposited in the Laboratory of Marine Zoology, Faculty of Fisheries, Hokkaido University (HUMZ or HUMZ-L). Observations and measurements were made under binocular microscope. Higher taxonomy follows Nelson (1984). Terminology chiefly follows Matarese et al. (1989). The following abbreviations were used in the tables; standard length (SL), head length (HL), body depth (BD), preanus length (PAL), snout length (SnL), eye diameter (ED), dorsal fin rays (D), anal fin rays (A), pectoral fin rays (P_1), pelvic fin rays (P_2), vertebrae (V), and myomeres (MN). The abbreviations for photophores in the Myctophidae follow Wisner (1976) and are shown in Fig. 9.

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Table 1. Sampling data of larval net surveys made by T/S Oshoro Maru.

 Remarks show the occurrence of following species : Cs, *Cololabis saira* ; Mn, *Myctophum nitidulum* ; Sc, *Symbolophorus californiensis* ; Tt, *Tarletonbeania taylori*.

Locality No.	Date	Position		Water temperature (surface ; Celsius)	Remarks
		lat.	long.		
80-1	Jun. 6, 1980	41-21.0N	148-10.2E	9.7	Cs, Tt
80-3	Jun. 8, 1980	40-50.2N	159-37.1E	14.4	Cs
80-5	Jun. 9, 1980	39-49.6N	165-04.6E	15.1	Cs
80-6	Jun. 10, 1980	39-40.6N	166-45.9E	14.9	Cs
80-7	Jun. 10, 1980	39-17.6N	170-57.0E	16.3	Cs, Mn, Sc
80-8	Jun. 11, 1980	39-01.1N	172-30.7E	12.4	Cs
80-9	Jun. 11, 1980	39-01.1N	176-24.7E	14.1	Cs
80-12	Jun. 12, 1980	40-08.6N	179-58.4E	11.6	Tt
80-14	Jun. 15, 1980	43-03.5N	179-57.9W	—	Tt
80-15	Jun. 16, 1980	44-05.3N	179-59.3W	7.1	Tt
80-39	Jul. 15, 1980	48-25.9N	144-59.4W	12.1	Tt
80-40	Jul. 16, 1980	50-16.5N	142-41.0W	11.3	Tt
80-42	Jul. 17, 1980	55-50.1N	137-44.8W	12.4	Tt
80-58	Aug. 1, 1980	46-04.2N	179-59.1E	12.4	Sc, Tt
80-59	Aug. 2, 1980	45-00.0N	179-59.6E	15.0	Sc, Tt
80-60	Aug. 3, 1980	43-39.7N	179-52.2W	—	Tt
80-61	Aug. 4, 1980	41-54.2N	179-58.3E	—	Cs, Sc
80-62	Aug. 5, 1980	41-00.9N	179-58.8W	—	Cs, Tt
80-63	Aug. 6, 1980	40-02.7N	179-53.5E	19.9	Cs
80-64	Aug. 7, 1980	39-00.0N	180-00.0	21.2	Cs
80-65	Aug. 8, 1980	40-50.0N	174-44.2E	21.1	Cs, Mn
80-66	Aug. 9, 1980	40-49.8N	175-54.9E	20.5	Cs
80-67	Aug. 9, 1980	40-52.3N	168-44.4E	20.5	Cs
80-69	Aug. 10, 1980	40-55.5N	162-58.9E	21.5	Cs
80-70	Aug. 11, 1980	40-55.2N	161-01.6E	20.0	
80-71	Aug. 11, 1980	40-53.6N	156-46.4E	15.8	Cs, Tt
81-1	Jun. 6, 1981	41-27.9N	147-29.0E	7.3	Tt
81-4	Jun. 8, 1981	40-45.2N	154-34.9E	9.2	Tt
81-6	Jun. 9, 1981	40-19.2N	160-14.9E	10.7	Sc, Tt
81-8	Jun. 10, 1981	39-54.4N	165-53.9E	13.2	Tt
81-13	Jun. 11, 1981	38-53.3N	179-59.3E	14.6	Cs
81-19	Jun. 16, 1981	42-56.2N	179-50.3E	8.4	Tt
81-23	Jun. 20, 1981	47-30.4N	179-58.7W	7.9	Tt
81-57	Jul. 20, 1981	49-05.5N	145-01.9W	12.4	Tt
81-58	Jul. 21, 1981	48-08.8N	144-56.6W	13.5	Tt
81-60	Jul. 23, 1981	47-14.9N	140-58.7W	15.0	Tt
81-62	Jul. 24, 1981	47-28.6N	134-34.3W	14.5	Tt
81-66	Aug. 4, 1981	50-02.5N	148-59.8W	12.7	Tt
81-67	Aug. 5, 1981	49-22.3N	155-41.0W	12.1	Tt
81-68	Aug. 6, 1981	48-32.9N	162-37.1W	11.7	Tt
81-69	Aug. 7, 1981	47-04.2N	169-08.1W	11.8	Tt
81-72	Aug. 11, 1981	44-00.1N	171-27.7E	17.0	Cs
81-74	Aug. 13, 1981	43-45.3N	158-06.8E	19.4	Cs
83-3	Jun. 10, 1983	39-12.2N	167-55.7E	9.8	
84-4	Jun. 10, 1984	39-49.9N	170-08.3E	11.7	
84-6	Jun. 11, 1984	39-25.6N	179-57.5E	11.2	
84-38	Jul. 25, 1984	44-02.7N	154-54.9W	13.5	

Table 1. continued

Locality No.	Date	Position		Water temperature (surface; Celsius)	Remarks
		lat.	long.		
84-45	Aug. 1, 1984	30-48.1N	154-58.9W	25.5	
84-48	Aug. 10, 1984	22-40.2N	159-43.5W	26.3	
84-50	Aug. 12, 1984	28-46.8N	169-27.1W	27.3	
84-52	Aug. 14, 1984	33-05.9N	178-22.8W	25.6	
84-53	Aug. 14, 1984	33-46.9N	179-51.6E	25.7	
84-60	Aug. 19, 1984	40-19.4N	155-40.9E	20.9	
85-1	Jun. 7, 1985	41-20.9N	148-35.6E	—	Tt
85-2	Jun. 8, 1985	40-59.5N	154-37.3E	—	Tt
85-4	Jun. 13, 1985	39-16.2N	177-41.6E	13.3	Cs, Mn, Tt
85-5	Jun. 14, 1985	41-03.4N	179-55.2E	11.2	Tt
85-6	Jun. 15, 1985	42-51.3N	179-58.7W	10.5	Tt
85-7	Jun. 17, 1985	48-00.1N	179-58.8E	5.5	Tt
85-15	Jun. 25, 1985	55-00.5N	164-59.0W	4.9	Cs
85-18	Jul. 4, 1985	53-54.6N	154-59.8W	8.5	Cs
85-19	Jul. 5, 1985	53-04.1N	155-06.7W	8.1	Cs
85-23	Jul. 9, 1985	48-59.3N	154-59.8W	8.4	Tt
85-24	Jul. 10, 1985	47-00.4N	155-00.5W	10.1	Tt
85-25	Jul. 11, 1985	47-00.4N	155-02.1W	10.5	Tt
85-26	Jul. 12, 1985	45-29.3N	155-06.1W	11.6	Cs, Tt
85-27	Jul. 13, 1985	43-54.4N	155-59.8W	12.0	Sc, Tt
85-28	Jul. 14, 1985	42-33.3N	154-54.5W	13.4	Tt
85-29	Jul. 15, 1985	41-05.9N	154-55.3W	13.8	Cs, Tt
85-30	Jul. 16, 1985	39-34.5N	154-57.0W	16.0	Cs
85-31	Jul. 17, 1985	38-05.5N	154-56.4W	17.4	Cs
85-32	Jul. 18, 1985	36-33.6N	154-58.0W	18.4	Cs
85-33	Jul. 19, 1985	37-31.0N	151-42.9W	19.0	Cs
85-34	Jul. 20, 1985	39-15.3N	145-48.8W	—	Cs
85-35	Jul. 21, 1985	41-00.6N	139-47.5W	—	Cs
85-36	Jul. 22, 1985	42-43.8N	133-09.5W	—	Cs
85-37	Jul. 23, 1985	44-18.6N	127-18.2W	—	
85-38	Aug. 1, 1985	42-24.5N	132-35.7W	—	Cs
85-39	Aug. 2, 1985	43-01.2N	138-45.4W	—	Cs
85-40	Aug. 3, 1985	43-36.7N	145-07.1W	—	Cs, Tt
85-41	Aug. 5, 1985	43-36.4N	157-01.5W	14.6	Tt
85-42	Aug. 6, 1985	44-43.1N	163-27.4W	—	Cs, Tt
85-43	Aug. 7, 1985	45-18.4N	170-08.7W	—	Cs, Sc, Tt
85-44	Aug. 9, 1985	45-46.9N	176-35.8E	9.8	Sc, Tt
85-45	Aug. 11, 1985	45-11.0N	169-23.7E	—	Sc, Tt
85-46	Aug. 12, 1985	44-26.2N	162-19.5E	—	Tt
86-1	Jun. 12, 1986	37-00N	179-59E	15.0	Tt
86-2	Jun. 12, 1986	38-03N	179-59E	15.1	Cs
86-3	Jun. 13, 1986	39-07N	179-54W	14.2	Tt
86-4	Jun. 15, 1986	40-56N	179-54E	13.0	Tt
86-5	Jun. 16, 1986	42-03N	179-52E	9.0	Tt
86-11	Jun. 24, 1986	54-21N	173-31W	5.9	Cs

Results and Discussion

Order Clupeiformes Family Engraulididae

1. *Engraulis japonicus* (Houttuyn, 1782) (Fig. 2)

Material. 3 specimens. HUMZ-L 1800, prejuvenile, 12.2 mm SL, locality no. 80-67; HUMZ-L 1801, juvenile, 25.2 mm SL, locality no. 80-69; HUMZ-L 1802, juvenile, 24.4 mm SL, locality no. 80-70.

Diagnosis. Dorsal fin rays 14, anal fin rays 16-19, pelvic fin rays 7, vertebrae 46-47. Body elongate, slightly compressed. Mouth large, upper jaw extending below and posterior to pupil. Gut developed. Prejuveniles: Dorsal fin placed between 21st and 29th myomeres, anal fin between 27th and 34th myomeres. Preanal length 75% SL. Melanophores on occiput, isthmus, ventral margin of body and caudal peduncle. Juveniles: Snout rounded. Dorsal fin and anus situated anterior to prejuvenile position. Preanal length 64-67% SL. Pelvic fin on pyloric portion of stomach. Pectoral fin rays obscure. A row of melanophores along posterior half of lateral midline.

Remarks. Identification follows Uchida et al. (1958).

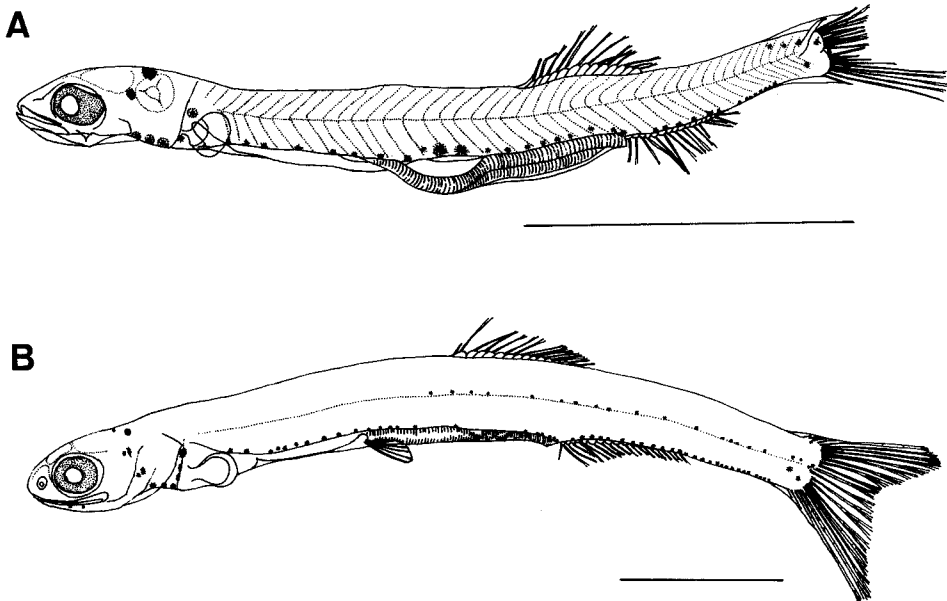


Fig. 2. *Engraulis japonicus*. A; prejuvenile, HUMZ-L 1800, 12.2 mm SL. B; juvenile, HUMZ-L 1802, 24.4 mm SL. Scale bars = 5 mm. Drawings by Y. Karita.

Order Salmoniformes

Family Bathylagidae

2. *Bathylagus ochotensis* Schmidt, 1938

(Fig. 3, Table 2)

Material. 27 specimens. HUMZ-L 3640, prejuvenile, 20.8 mm SL, locality no. 83-3; HUMZ-L 3641, prejuvenile, 20.9 mm SL, locality no. 84-4; HUMZ-L 3642, prejuveniles, 15.6-21.3 mm SL, locality no. 84-6; HUMZ-L 4755, HUMZ-L 4873, HUMZ-L 4874, prejuveniles, 15.9-27.4 mm SL, locality no. 86-4.

Diagnosis. Body elongate, slightly compressed. Head depressed. Eye stalk developed, its length equal to (16.5 mm SL) or less than (21.1 mm SL) snout length. Palatine teeth present. Anus well back on body, preanal length about 85% SL. Median fins formed in fin fold, connected to body margin by a series of hyaline strands. Pelvic fin level with a vertical line through dorsal fin insertion. A series of melanophores developed on hypaxial myomeres. Epaxial melanophores limited to a series posterior to dorsal fin. A large melanophore on operculum.

Remarks. Four other species of *Bathylagus* are known from the northern North Pacific; *B. milleri* Jordan et Gilbert, *B. pacificus* Gilbert, *B. wesethi* Bolin and *B. bericooides* (Borodin). Early stages of these species were described by Ahlstrom et al. (1984). The present specimens were identified as *B. ochotensis* on the basis of their long eye stalks and unique formation of melanophores.

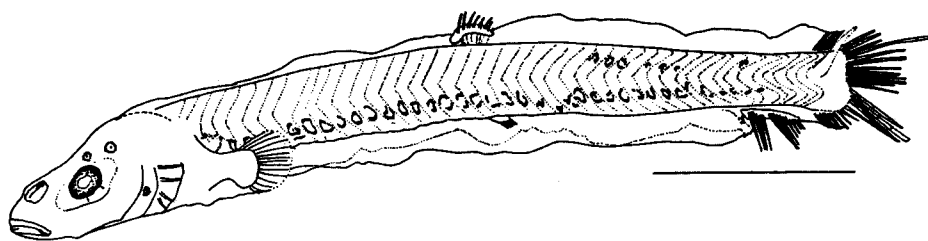


Fig. 3. *Bathylagus ochotensis*, juvenile, HUMZ-L 4874, 21.1 mm SL. Scale bar=5 mm. Drawing by M. Fujita.

Table 2. Measurements and meristic counts of *Bathylagus ochotensis*.

SL (mm)	Proportional measurements (% of SL)					Counts			
	HL	BD	PAL	SnL	ED	D	A	P ₁	P ₂
16.5	18.0	13.5	86.2	5.3	3.8	4	8	—	—
18.9	14.9	14.2	85.3	3.0	3.7	6	10	—	—
20.6	15.3	16.9	85.9	3.0	3.9	7	12	10	3
21.5	16.3	15.8	86.7	3.0	4.0	8	14	12	4
27.4	16.8	17.5	84.3	2.9	4.0	9	17	13	5

Family Melanostomiidae

3. *Tactostoma macropus* Bolin, 1939

(Fig. 4, Table 3)

Material. 55 specimens. HUMZ-L 3643, HUMZ-L 3644, juveniles, 18.2–29.6 mm SL, locality no. 84–60.

Diagnosis. Body elongate. Head flat on dorsal surface. Lower jaw longer than upper, directed upwards. Teeth on both jaws. Eye oval, protruding above dorsal profile of head. Anus placed well back on body, preanal length more than 76% SL. Gut slender, somewhat enlarged posteriorly, not trailing from body. Dorsal and anal fins level with each other, originating well back on body. Finfold developed anterior to dorsal fin. A series of melanophores developed on hypaxial myosepta. One or two melanophores per myomere along dorsum. Some melanophores on lower jaw, isthmus, base of pectoral fin and caudal peduncle. No melanophores on finfold.

Remarks. Identification follows Kawaguchi and Moser (1984), Ozawa and Aono (1986), and Matarese et al. (1989). Kawaguchi and Moser (1984) reported that

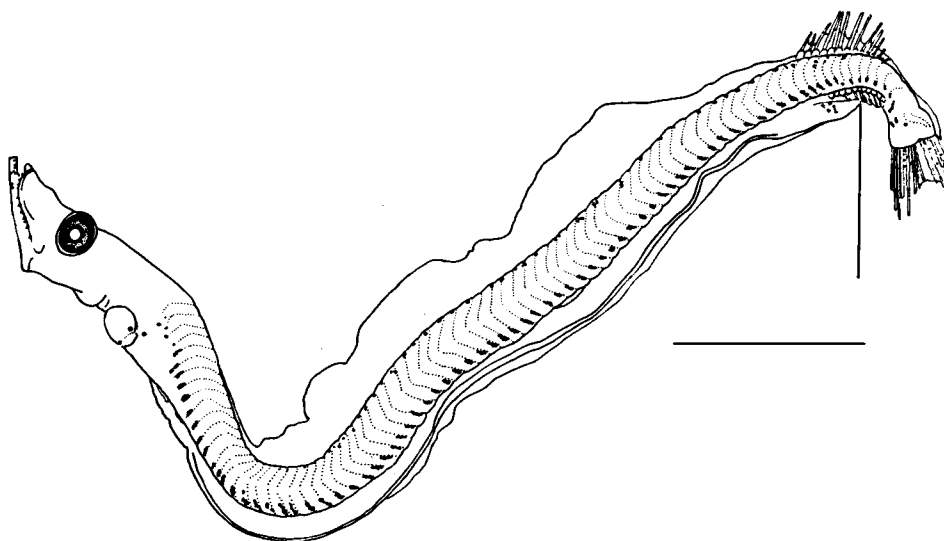


Fig. 4. *Tactostoma macropus*, juvenile, HUMZ-L 3643, 29.6 mm SL. Scale bar=3 mm. Drawing by M. Nishiya.

Table 3. Measurements and meristic counts of *Tactostoma macropus*.

SL (mm)	Proportional measurements (% of SL)					Counts		
	HL	BD	PAL	SnL	ED	D	A	MN
18.2	16.5	3.1	76.5	5.2	2.8	14	19	81
23.5	16.4	3.2	95.6	6.2	2.5	15	19	80
29.6	14.6	3.8	90.5	5.3	2.1	16	19	81

melanophores along the dorsum are gradually lost in postflexion larvae in this species. However, all specimens examined (less than 29.6 mm SL) still had melanophores along the dorsum.

Order Myctophiformes

Family Paralepididae

4. *Lestidiops ringens* (Jordan et Gilbert, 1881)

(Fig. 5; Table 4)

Material. 8 specimens. HUMZ-L 3645, 37.0 mm SL, juvenile, locality no. 84-38; HUMZ-L 4923, 26.4-27.5 mm SL, prejuveniles, locality no. 85-29; HUMZ-L 4925, 25.7-32.7 mm SL, prejuveniles, locality no. 85-32; HUMZ-L 4926 and 4927, 25.4-26.6 mm SL, prejuveniles, locality no. 85-33; HUMZ-L 4928, 23.3 mm SL, prejuvenile, locality no. 85-36.

Diagnosis. Body extremely elongate, slightly compressed. Snout elongate, pointed. Eye large, not protruding above dorsal profile of head. Mouth large. Small conical teeth on anterior part of upper jaw. A row of conical teeth along lower jaw. Anus somewhat posterior to midpoint of body. Dorsal fin originating posterior to a vertical line through anus. Anal fin originating well back on body. Pelvic fin positioned about midpoint of body. Finfold developed between anus and anal fin origin. Six or seven peritoneal melanophores patches. Melanophores scattered on snout, jaws, occiput, isthmus, and fin rays of median fins. A faint patch of melanophore on bases of dorsal and anal fins, dorsum behind dorsal fin, and between anus and anal fin; two similar patches on caudal peduncle.

Remarks. Identification follows Rofen (1966), Okiyama (1984) and Matarese et al. (1989).

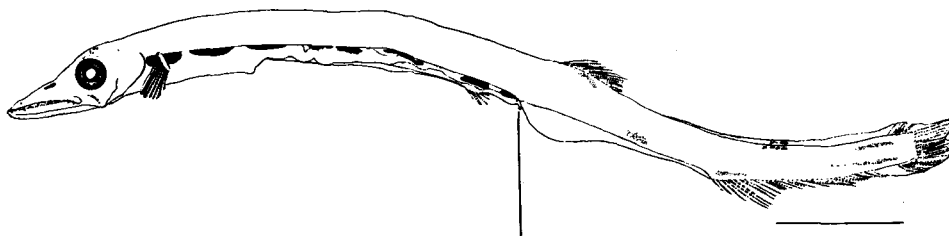


Fig. 5. *Lestidiops ringens*, juvenile, HUMZ-L 3645, 37.0 mm SL. Scale bar=5 mm. Drawing by M. Nishiya.

Table 4. Measurements and meristic counts of *Lestidiops ringens*.

SL (mm)	Proportional measurements (% of SL)					Counts				
	HL	BD	PAL	SnL	ED	D	A	P ₁	P ₂	MN
25.2	14.4	6.7	66.6	5.5	4.9	—	31	9	—	86
32.6	15.3	7.5	64.2	5.6	5.1	8	33	10	—	82
37.0	15.6	4.6	56.8	7.9	3.5	12	28	10	8	88

5. *Lestidiops pacificum* (Parr, 1931)
(Fig. 6)

Material. 1 specimen. HUMZ-L 4924, prejuvenile, 33.0 mm SL, locality no. 85-31.

Diagnosis. Head length 16.7% of SL, pelvic fin origin 55.2%, dorsal fin origin 59.1%, anus 60.6%, anal fin origin 78.5%. Dorsal fin rays 9, anal fin rays 28, caudal fin rays 18 on hypurals, vertebrae 39+44=83. Body extremely elongate, slightly compressed. Snout long, pointed. A row of conical teeth on both jaws, teeth on lower jaw longer than those on upper. Anus on posterior half of body. Dorsal fin originating somewhat anterior to a vertical line through anus. Pelvic fin base anterior to a vertical line through dorsal fin origin, horizontal distance between pelvic and dorsal fin origins 3.8% SL. Anal fin originating well back on body. Finfold developed before anal fin. Eleven peritoneal patches of melanophores. A row of melanophores along ventral midline between anus and anal fin origin, not forming a patch. A crescentic row of melanophores on infraorbital region. Melanophores scattered on lower jaw, occiput, isthmus, caudal peduncle, and bases of dorsal and anal fins.

Remarks. The present specimen differs from *Lestidiops ringens* by having 11 peritoneal melanophore patches (6 or 7 in the latter), the dorsal fin originating before the anus (behind), and melanophores scattered on the caudal peduncle (forming a pair of faint patches). The specimen was identified as *L. pacificum* after comparison with larval data on this family compiled by Rofen (1969), Ozawa (1986), and Matarese et al. (1989).

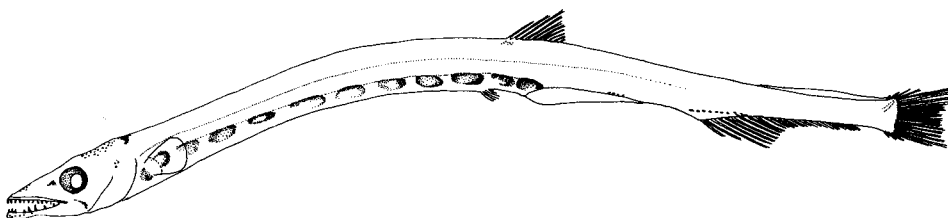


Fig. 6. *Lestidiops pacificum*, prejuvenile, HUMZ-L 4924, 33.0 mm SL. Scale bar=5 mm.
Drawing by M. Yabe.

Family Myctophidae

6. *Lampanyctus regalis* (Gilbert, 1892)
(Fig. 7)

Material. 2 specimens. HUMZ-L 4797, juvenile, 15.3 mm SL, locality no. 85-32; HUMZ-L 4872, prejuvenile, 8.3 mm SL, locality no. 85-36.

Diagnosis. Head length 34.0% of SL, body depth 33.7%, preanus length 61.2%, snout length 13.2%, eye diameter 8.5%. Dorsal fin rays 14, anal fin rays 18, pectoral fin rays 15, vertebrae 16+21=37. Body deep, compressed. Head and mouth large. Snout elongate. Teeth developed on both jaws. Eye rounded. Anus somewhat posterior to midpoint of body. Pectoral fin moderate in size. Pelvic fin elongate. A spot of pigment anteriorly on base of adipose fin. Melanophores on tip of jaws, occiput, operculum, base of pectoral fin, dorsum before dorsal

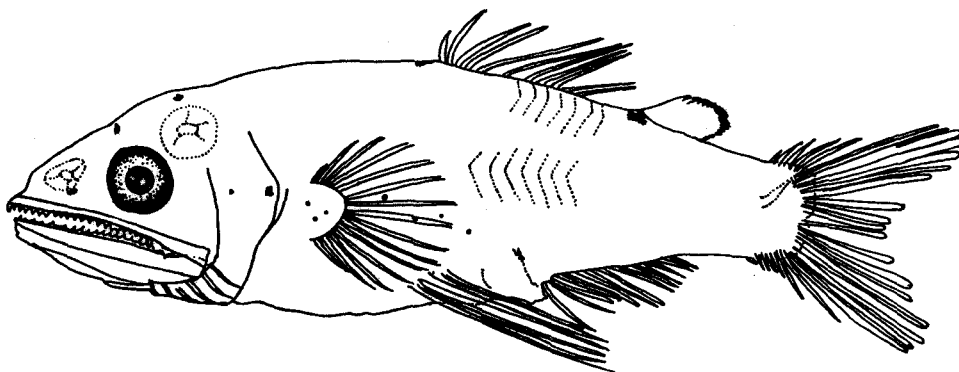


Fig. 7. *Lampanyctus regalis*, juvenile, HUMZ-L 4797, 15.3 mm SL. Scale bar=5 mm.
Drawing by M. Fujita.

fin, and abdomen.

Remarks: According to Matarese et al. (1989), this species has a photophore Br-2 during its larval period. Such a photophore was absent or lost in the material examined.

7. *Ceratoscopelus townsendi* (Eigenmann et Eigenmann, 1889)
(Fig. 8; Table 5)

Material. 3 specimens. HUMZ-L 4920, juvenile, 14.0 mm SL, locality no. 85-31; HUMZ-L 4921, prejuvenile, 9.8 mm SL, locality no. 85-33; HUMZ-L 4922, juvenile, 15.4 mm SL, locality no. 85-33.

Diagnosis. Body elongate, fusiform. Head rather small. Eye almost round. Snout short, slightly rounded. Mouth large; short conical teeth on jaws. Anus placed somewhat posterior to midpoint of body, distance between snout and anus about 60% SL. Dorsal fin originating before midpoint of body. Pelvic fin base just posterior to a line through dorsal fin origin. Anal fin originating just behind anus. Photophores: Br 2, Vn, Po 5 and PLO (on pectoral fin base) present. A melanophore present on occiput and posterior end of anal fin base. A pigment spot

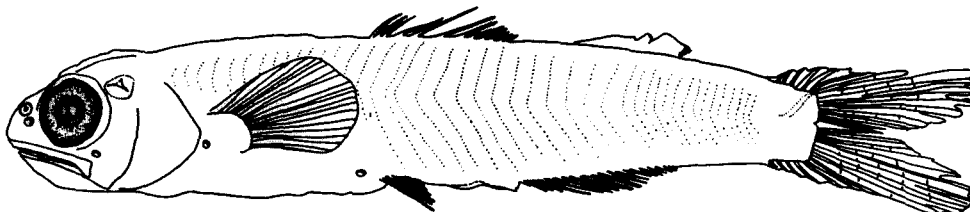


Fig. 8. *Ceratoscopelus townsendi*, juvenile, HUMZ-L 4922, 15.4 mm SL. Scale bar=3 mm.
Drawing by M. Fujita.

Table 5. Measurements and meristic counts of *Ceratoscopelus townsendi*.

SL (mm)	Proportional measurements (% of SL)					Counts				
	HL	BD	PAL	SnL	ED	D	A	P ₁	P ₂	V
9.8	24.2	20.4	63.7	6.0	10.0	12	13	12	5	18+20
14.0	22.9	—	59.9	—	—	13	15	12	8	18+20
15.4	23.4	21.1	61.3	6.7	8.7	13	14	13	8	18+19

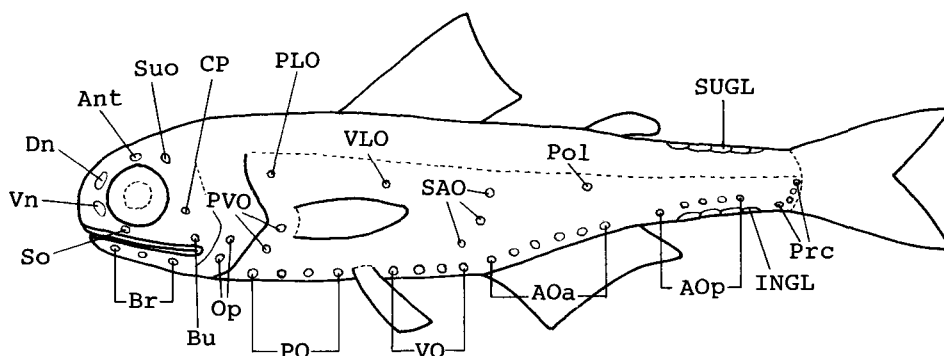


Fig. 9. Diagram showing the location and terminology of photophores in the Myctophidae. Abbreviations: Ant, antorbital organ; AOa, anterior anal organs; AOp, posterior anal organs; Br, branchiostegal organs; Bu, buccal organ; Dn, dorsonasal organ; INGL, infracaudal luminous gland; Op, opercular organs; PLO, suprapectoral organ; PO, thoracic organs; Prc, precaudal organs; PVO, subpectoral organ; SAO, supraanal organs; So, suborbital organ; SUGL, supracaudal luminous gland; Suo, supraorbital organ; VLO, supraventral organ; Vn, ventronasal organ; VO, ventral organs.

embedded in posterior portion of gut.

Remarks. The specimens examined had photophore PLO on the pectoral fin base. According to Matarese et al. (1989), photophore PLO migrates dorsally to just below the lateral line at transformation (16.6–21.0 mm SL or larger) in this species.

8. *Tarletonbeania taylori* Mead, 1953

(Fig. 10; Table 6)

Material. 986 specimens. HUMZ-L 4665, 4669–4699, 4794, 4798, HUMZ 94306–94805, 17.6–87.7 mm SL. For localities, see Table 1.

Diagnosis. Dorsal fin rays 11–14, anal fin rays 17–19, pectoral fin rays 11–14, pelvic fin rays 8, gill rakers 5 + 1 + 10, anal luminous organs (anterior + posterior) 10–12 + 3–6. Caudal peduncle slender, its depth less than orbital diameter. Lateral line poorly developed. Base of anal fin considerably longer than that of dorsal fin. Adipose fin anterior to a vertical line through anal fin insertion. Photophores: One Prc, PLO lower than upper origin of pectoral fin. In males more than 23.4 mm SL, short luminous glands on upper and lower margins of caudal peduncle. Caudal luminous glands absent in females.

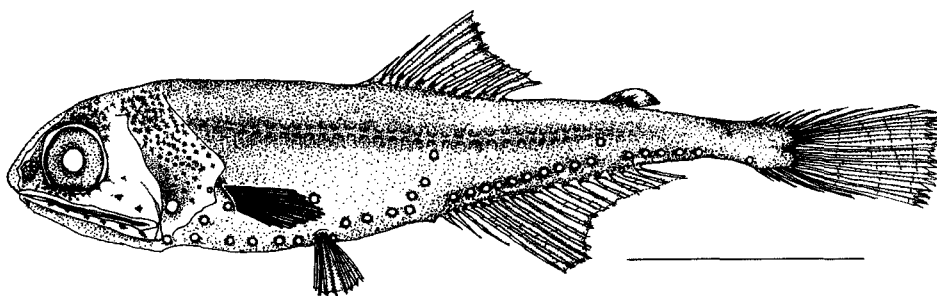


Fig. 10. *Tarletonbeania taylori*, HUMZ 94438, 33.7 mm SL. Scale bar = 10 mm. Drawing by Y. Karita.

Table 6. Measurements and meristic counts of *Tarletonbeania taylori*.

SL (mm)	Proportional measurements (% of SL)						Counts			
	HL	BD	PAL	SnL	ED	UJL	D	A	P ₁	P ₂
21.9	30.6	21.6	50.6	7.3	7.8	21.4	14	18	13	8
22.9	28.2	21.2	55.0	5.4	7.4	18.8	13	19	14	8
26.6	29.7	24.2	56.0	5.7	8.2	18.8	12	17	13	8
28.7	26.4	22.4	56.6	5.0	7.8	18.5	13	18	14	8
34.9	29.2	24.3	58.0	3.7	8.9	19.2	14	18	14	8
35.0	29.7	23.5	57.9	5.6	8.3	18.2	14	19	14	8
36.0	29.0	24.6	56.4	5.1	8.6	18.6	13	17	13	8
45.5	28.9	25.4	58.8	3.4	8.2	18.1	14	18	12	8
46.7	29.7	24.3	57.3	3.6	8.0	17.3	14	19	14	8
51.5	28.5	25.7	57.4	3.4	8.1	18.0	14	19	14	8

Remarks. *T. taylori* differs from *T. crenularis* (Jordan et Gilbert) in the condition of the caudal luminous glands of males (Wisner, 1976). However, any differences between females of these species have not been recorded. The females examined here were identified as *T. taylori* because most of them were collected with males of *T. taylori*, and because no males of *T. crenularis* were collected during the surveys.

9. *Myctophum nitidulum* Garman, 1899

(Fig. 11)

Material. 30 specimens. HUMZ-L 4795-4796, HUMZ 94280-94305, 20.5-55.8 mm SL. For localities, see Table 1.

Diagnosis. Head length 25.6-29.4% of SL, body depth 21.3-22.7%, preanal length 54.5-59.2%, snout length 18.9-22.7%, eye diameter 8.1-8.9%, upper jaw length 14.5-18.3%. Dorsal fin rays 14-15, anal fin rays 20-21, pectoral fin rays 13-15, pelvic fin rays 8, gill rakers 5+1+14, lateral line scales 40-41, anal luminous

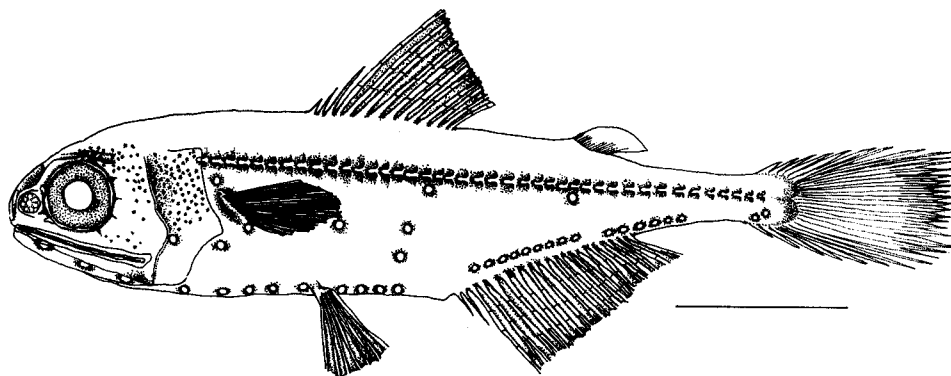


Fig. 11. *Myctophum nitidulum*, HUMZ 94303, 46.6 mm SL. Scale bar = 10 mm. Drawing by Y. Karita.

organs 8-9+5-7. Posterodorsal margin of operculum angulate. Photophores: Two Prc, one Pol. SAO series in a straight line, SAO 1 placed over Vo 4. Pol almost below base of adipose fin.

Remarks. Identification follows Wisner (1976).

10. *Symbolophorus californiensis* (Eigenmann et Eigenmann, 1899)

(Fig. 12)

Material. 23 specimens. HUMZ-L 4701-4704, HUMZ 94815-94827, 26.7-141.1 mm SL. For localities, see Table 1.

Diagnosis. Head length 19.5-25.0% of SL, body depth 19.6-23.8%, preanal length 57.2-60.4, snout length 4.4-4.7%, eye diameter 7.6-8.1%, upper jaw length 15.3-16.3%. Dorsal fin rays 13-15, anal fin rays 21-22, pectoral fin rays 16-18, pelvic fin rays 8, gill rakers 7+1+17, lateral line scales 41-43, anal luminous organs 7-8+9-11. Palatine teeth not enlarged, in a narrow band. Adipose fin anterior to

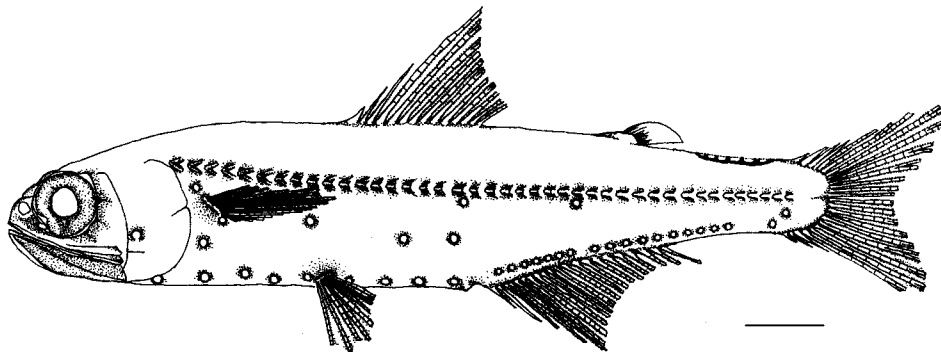


Fig. 12. *Symbolophorus californiensis*, HUMZ 94822, 104.8 mm SL. Scale bar = 10 mm. Drawing by Y. Karita.

a vertical line through end of anal fin. Photophores: Two Prc, one Pol. SAO markedly angulate. Pol anterior to a vertical line through origin of adipose fin. Four to five AOp above base of anal fin. Supracaudal glands with 5-6 small luminous scales in males. Infracaudal glands with 3 separate spots in females.

Remarks. According to Wisner (1976), the caudal luminous glands begin to appear on males of 55 to 60 mm and on females of 65 to 70 mm. In the present study they were observed in specimens greater than 78 mm SL.

11. *Diaphus gigas* Gilbert, 1913
(Fig. 13)

Material. 4 specimens. HUMZ 94806-94807, 57.7-80.2 mm SL, locality no. 80-7; HUMZ 94808, 74.0 mm SL, locality no. 80-9; HUMZ 94809, 57.7 mm SL, locality no. 80-63.

Diagnosis. Head length 27.0-28.6% of SL, body depth 20.0-20.4%, snout length 4.4-4.7%, eye diameter 7.5-8.2%, upper jaw length 18.5-19.9%. Dorsal fin rays 16, anal fin rays 14-15, pectoral fin rays 11-12, pelvic fin rays 8, gill rakers 8 + 1 + 16, lateral line scales 35-37, anal luminous organs 6 + 6 - 5. Body rather slender, depth of caudal peduncle 41-43% of its length. Photophores: Four Prc. Small Ant present. Dn and Vn contiguous. SAO 3 and Pol close to but not on lateral line. PLO about midway between lateral line and upper origin of pectoral fin. A luminous scale present below PLO, its length almost equal to pupil diameter. Caudal luminous glands absent.

Remarks. Identification follows Wisner (1976).

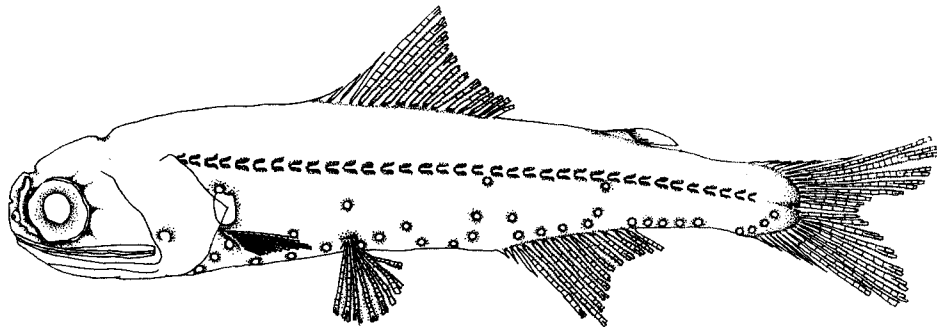


Fig. 13. *Diaphus gigas*, HUMZ 94809, 57.7 mm SL. Scale bar=10 mm. Drawing by Y. Karita.

12. *Ceratoscopelus warmingii* (Lütken, 1892)
(Fig. 14)

Material. 5 specimens. HUMZ 94810-94814, 48.3-66.9 mm SL, locality no. 80-7.

Diagnosis. Head length 29.4-31.3% of SL, body depth 18.9-19.6%, snout length 5.5-6.1%, eye diameter 8.2-8.9%, upper jaw length 20.2%. Dorsal fin rays 13-15, anal fin rays 14, pectoral fin rays 13-14, pelvic fin rays 8, gill rakers 4 + 1 + 10, lateral line scales 36-39, anal luminous organs 5-6 + 6. Pectoral fin long.

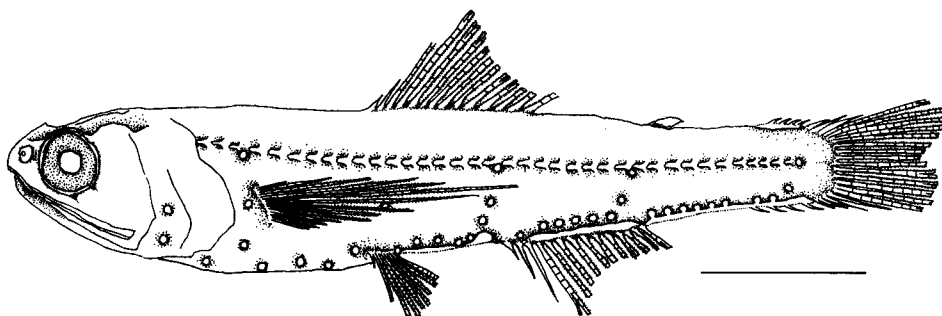


Fig. 14. *Ceratoscopelus warmingii*, HUMZ 94810, 50.7 mm SL. Scale bar = 10 mm. Drawing by Y. Karita.

Anterior 3 or 4 procurrent caudal rays stiff and sharp, their bases covered by luminous tissue. Photophores: Dn absent, Vn present, two Pol, four Prc. Luminous scale-like structure at bases of dorsal and anal fins. Median series of luminous scalelike structures present between base of pelvic fin and anus, and along ventral margin of caudal peduncle.

Remarks. Identification follows Wisner (1976) and Nafpaktitis et al. (1977).

Order Cyprinodontiformes

Family Scomberesocidae

13. *Cololabis saira* (Brevoort, 1856)

(Fig. 15)

Material. 477 specimens. HUMZ-L 1804-1832, 4643-4651, 4654-4700, prejuveniles and juveniles, 7.3-114.1 mm SL. For localities, see Table 1.

Diagnosis. Dorsal fin rays 16-17 (finlets included), anal fin rays 20 (finlets

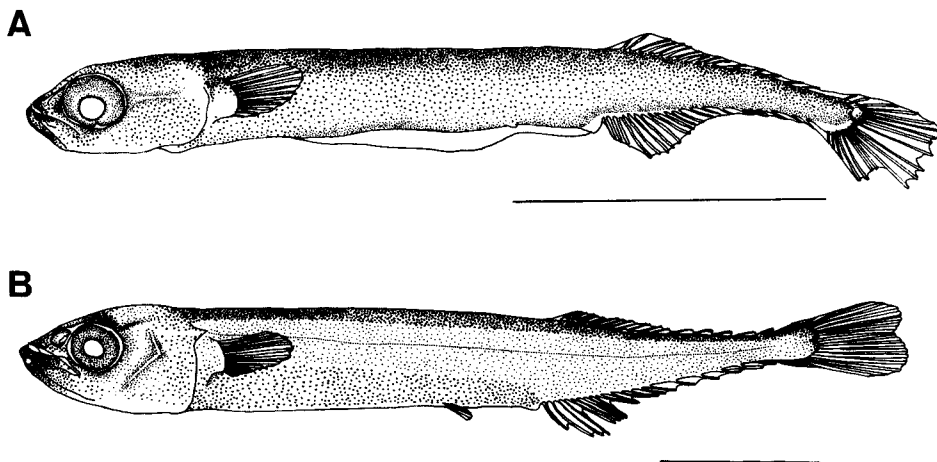


Fig. 15. *Cololabis saira*. A; prejuvenile, HUMZ-L 1812, 13.3 mm SL. B; juvenile, HUMZ-L 1823, 24.15 mm SL. Scale bar = 5 mm. Drawing by Y. Karita.

included), pectoral fin rays 11-12, pelvic fin rays 6, vertebrae $40+27=67$. Body elongate, and compressed. Head rather small, 20-24% of SL. Dense pigments covering body. Prejuveniles (7.3-23.8 mm SL): Lower jaw slightly protruding. Opercular margin rounded. Pelvic fin obscure. Preanal length 65-75% of SL. Preanal finfold developed. Juveniles (23.4 mm SL <): Lower jaw protruding but not forming beak. Opercular margin angulate. Pelvic fin somewhat posterior to midpoint of body. Preanal length 62-67% of SL.

Remarks. These specimens were identified on the basis of their slender body, dense distribution of pigments over the whole body and meristic counts, which conformed to those recorded by Uchida et al. (1958).

Family Exocoetidae

14. *Hirundichthys (Hirundichthys) speculiger* (Valenciennes, 1846)

(Fig. 16)

Material. 9 specimens. HUMZ-L 1833, juveniles, 17.0-21.5 mm SL, locality no. 80-65; HUMZ-L 1834, juvenile, 18.3 mm SL, locality no. 80-69; HUMZ-L 1835-1837, juveniles, 14.1-17.5 mm SL, locality no. 80-71.

Diagnosis. Head length 19.6-22.8% of SL, body depth 14.8-18.6%, preanus length 58.5-67.1%, snout length 2.9-4.4%, eye diameter 7.9-9.6%, upper jaw length 5.9-7.9%. Dorsal fin rays 10-12, anal fin rays 11-12, pectoral fin rays 17-18, pelvic fin rays 6, vertebrae $28+17=45$. Body elongate. No barbels on lower jaw. Pectoral fin large, fin membrane between first and second rays broader than successive interspaces. Pelvic fin posterior to midpoint of body, extending well behind anal fin origin. Melanophores scattered on occiput, operculum, base of pectoral fin, abdomen and caudal peduncle. Larger melanophores on lateral surface of body behind base of pelvic fin. A band of melanophores along distal margin of pectoral fin. A melanophore spot on distal margin of pelvic fin. Melanophores absent from jaws and snout.

Remarks. Identification follows Chen (1988).

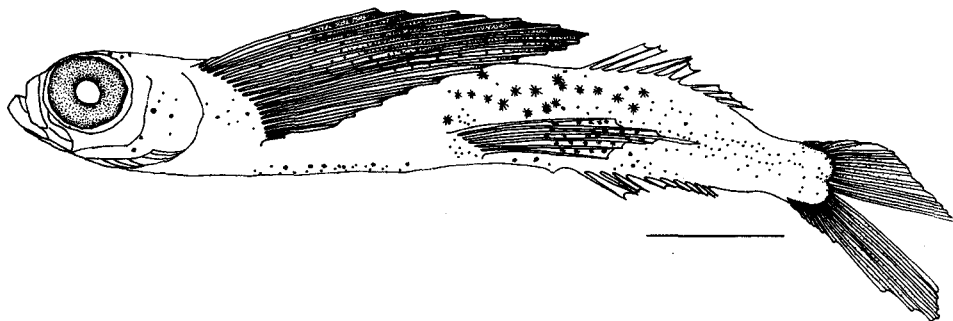


Fig. 16. *Hirundichthys (Hirundichthys) speculiger*, juvenile, HUMZ-L 1835, 17.5 mm SL. Scale bar=3 mm. Drawing by Y. Karita.

15. *Hirundichthys* (*Hirundichthys*) *oxycephalus* (Bleeker, 1852)
(Fig. 17)

Material. 1 specimen. HUMZ-L 1845, prejuvenile, 5.4 mm SL, locality no. 80-69.

Diagnosis. Dorsal fin rays 10, anal fin rays 11, pectoral fin rays 15, pelvic fin rays 6. Head length 33.0% of SL, prepelvic length 59.3%, predorsal length 72.4%, preanal length 70.4%, pectoral fin length 29.6%, pelvic fin length 13.0%. Body rather robust. Head large. No barbel on lower jaw. Melanophores scattered on snout, lower jaw, occiput, operculum, abdomen and caudal fin. Six irregular rows of melanophores on side of body.

Remarks. This species differs from *Hirundichthys* (*H.*) *speculiger* by having some melanophores on the snout and lower jaw (Chen, 1988).

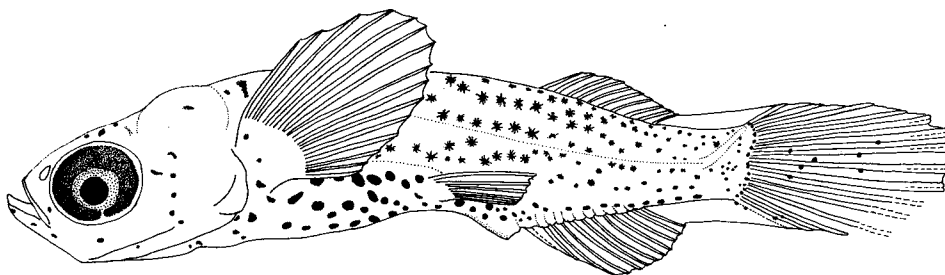


Fig. 17. *Hirundichthys* (*Hirundichthys*) *oxycephalus*, prejuvenile, HUMZ-L 1845, 5.4 mm SL. Scale bar=1 mm. Drawing by M. Yabe.

16. *Hirundichthys* (*Danichthys*) *rondeletii* (Valenciennes, 1846)
(Fig. 18)

Material. 16 specimens. HUMZ-L 1838, juveniles, 6.4-9.9 mm SL, locality no. 80-63; HUMZ-L 1839, juveniles, 6.3-12.1 mm SL, locality no. 80-64; HUMZ-L 1840, juveniles, 12.0-12.8 mm SL, locality no. 80-65; HUMZ-L 1841-1842, juve-

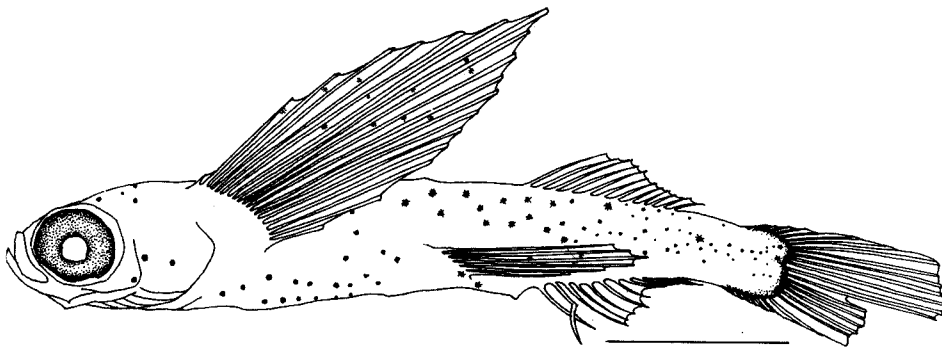


Fig. 18. *Hirundichthys* (*Danichthys*) *rondeletii*, juvenile, HUMZ-L 1841, 12.6 mm SL. Scale bar=3 mm. Drawing by Y. Karita.

niles, 11.3–12.8 mm SL, locality no. 80–66; HUMZ-L 1843, juveniles, 12.7 mm SL, locality no. 80–67; HUMZ-L 1844–1845, juveniles, 11.2–12.0 mm SL, locality no. 80–69.

Diagnosis. Dorsal fin rays 11–12, anal fin rays 11–12, pectoral fin rays 17, pelvic fin rays 6. Head length 23.0–28.1% of SL, prepelvic length 52.7–57.1%, predorsal length 68.0–71.9%, preanal length 64.3–69.2%. Body elongate. Barbels absent from lower jaw. Pectoral fin large. Pelvic fin somewhat posterior to midpoint of body. Dorsal fin origin slightly behind a vertical line through anal fin origin. Melanophores scattered on occiput, operculum and abdomen. Four or 5 irregular rows of melanophores on side of body. Several melanophores scattered on pectoral and pelvic fins, but not forming bands or blotches.

Remarks. Identification follows Chen (1988).

17. *Cypselurus (Procypselurus) katoptron* (Bleeker, 1855)
(Fig. 19, Table 7)

Material. 5 specimens. HUMZ-L 3649, 3650, juveniles, 13.7–30.2 mm SL, locality no. 84–50; HUMZ-L 3651, juveniles, 17.8–18.9 mm SL, locality no. 84–53.

Diagnosis. Dorsal fin rays 13–14, anal fin rays 9–11, pectoral fin rays 13–14, pelvic fin rays 6, vertebrae 42–43. Body elongate, slightly compressed. A pair of tapering barbels with laminal margins on lower jaw; barbel not fused to its antimer. Pelvic fin somewhat posterior to midpoint of body, extending well posterior to anal fin origin. Dorsal fin high. Origin of anal fin posterior to a vertical line through dorsal fin origin. Melanophores scattered on dorsal surface of body. Six bands on ventrolateral surface of body from base of pectoral fin to caudal peduncle. Dorsal fin with many melanophores. Two irregular bands on pectoral and pelvic fins. Laminal margin of barbel with melanophores.

Remarks. Identification follows Chen (1988).

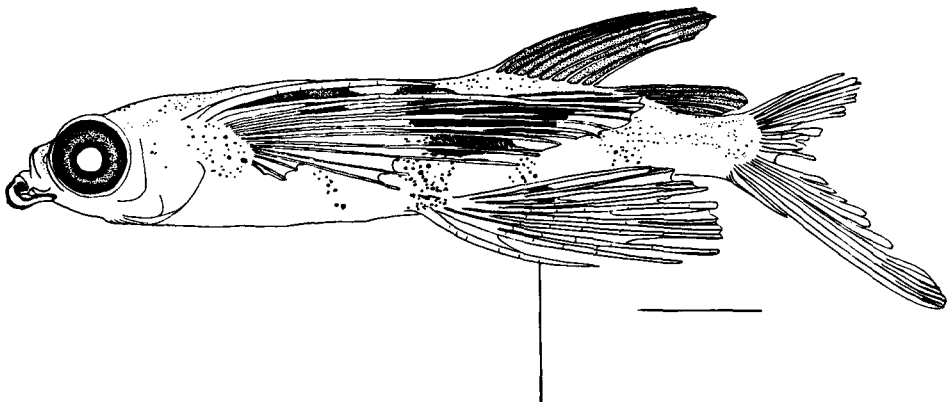


Fig. 19. *Cypselurus (Procypselurus) katoptron*, juvenile, HUMZ-L 3650, 30.2 mm SL. Scale bar=5 mm. Drawing by M. Nishiya.

Table 7. Measurements and meristic counts *Cypselurus* (*Procypselurus*) *katoptron* and *Exocoetus monocirrhus*.

SL (mm)	Proportional measurements (% of SL)					Counts				
	HL	BD	PAL	SnL	ED	D	A	P ₁	P ₂	V
<i>C. (P.) katoptron</i>										
13.7	23.6	13.5	69.1	5.9	9.9	13	9	14	6	42
17.8	25.2	13.6	72.6	5.8	9.8	13	10	14	6	42
30.2	25.6	15.8	70.6	5.2	10.3	14	11	13	6	43
<i>E. monocirrhus</i>										
18.8	24.8	18.9	64.9	4.8	9.7	14	14	15	6	43
21.4	26.4	20.3	60.1	3.9	8.0	13	13	15	6	43

18. *Exocoetus monocirrhus* Richardson, 1846

(Fig. 20, Table 7)

Material. 2 specimens. HUMZ-L 3647, juvenile, 21.4 mm SL, locality no. 84-45; HUMZ-L 3648, juvenile, 18.8 mm SL, locality no. 84-52.

Diagnosis. Dorsal fin rays 13-14, anal fin rays 13-14, pectoral fin rays 15, pelvic fin rays 6, vertebrae 43. Body rather robust. Head large, anterodorsal profile very steep. A short barbel on lower jaw. Pectoral fin large, its distal tip reaching base of caudal fin. Pelvic fin base anterior to midpoint of body. Origin of anal fin posterior to a vertical line through dorsal fin origin. Many melanophores scattered over entire body. Pelvic fin very dark. Dorsal fin with a dark spot posteriorly.

Remarks. Identification follows Chen (1988).

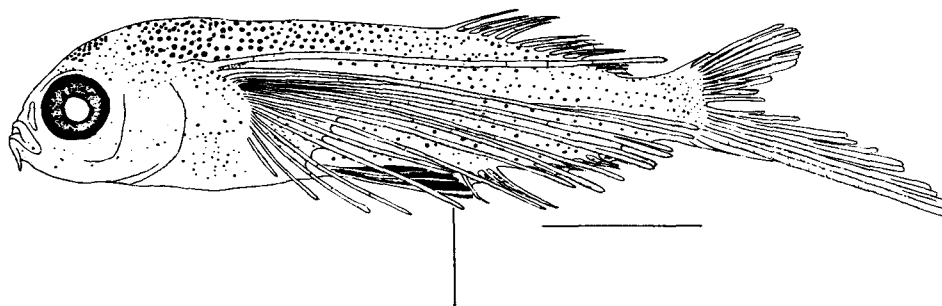


Fig. 20. *Exocoetus monocirrhus*, juvenile, HUMZ-L 3647, 21.4 mm SL. Scale bar = 5 mm. Drawing by M. Nishiya.

Order Lophiiformes

Family Oneirodidae

19. *Chaenophryne* sp. (*drace*-group)

(Fig. 21)

Material. 1 specimen. HUMZ-L 3665, prejuvenile, 3.4 mm SL, locality no.

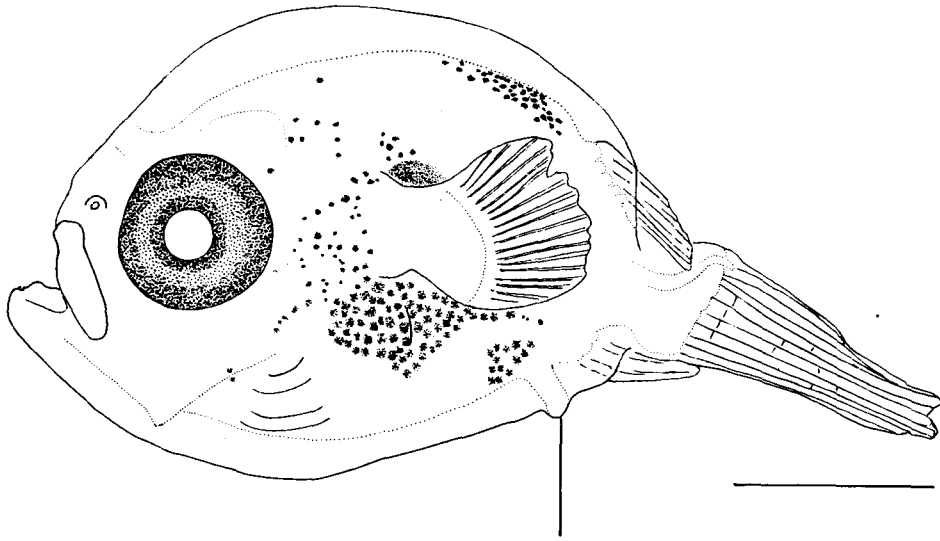


Fig. 21. *Chaenophryne* sp. (*draco*-group), prejuvenile, HUMZ-L 3665, 3.4 mm SL. Scale bar = 1 mm. Drawing by M. Nishiya.

84-50.

Diagnosis. Dorsal fin rays 5, anal fin rays 3, pectoral fin rays 18, branchiostegal rays 6. Body short, plump, covered with inflated, colorless skin. Head large, rounded, its length 54% of SL. Eye large, rounded, its diameter 23% of SL. Small gill opening below pectoral fin base. Pectoral fin short with rather narrow base. Pelvic fin absent. Melanophores arranged separately on dorsum, operculum and peritoneum. Pigments on gill membrane very faint, absent from caudal peduncle.

Remarks. Bertelsen (1951) described two larval morphotypes for this genus; *Chaenophryne longiceps* group and *C. draco* group. The present specimen differs from the former group by lacking pigments on the caudal peduncle.

Family Gigantactidae

20. *Gigantactis* sp.

(Fig. 22)

Material. 1 specimen. HUMZ-L 3666, prejuvenile, 4.3 mm SL, locality no. 84-48.

Diagnosis. Dorsal fin rays 5, anal fin rays 4, pectoral fin rays 20, branchiostegal rays 6. Body short, plump, covered with inflated skin. Head large, rounded, its length 42% of SL. Eye large, rounded, its diameter 17% of SL. Papilliform illicium and basal bone present. Conical teeth on both jaws. Small gill opening below pectoral fin base. Pectoral fin large with a broad base, reaching beyond dorsal and anal fins. Pelvic fin absent. Melanophores absent except for several on anterodorsal part of peritoneum.

Remarks. Bertelsen (1951) described three larval types for the genus *Gigantactis*. The present specimen may be identical to his "type B", owing to its

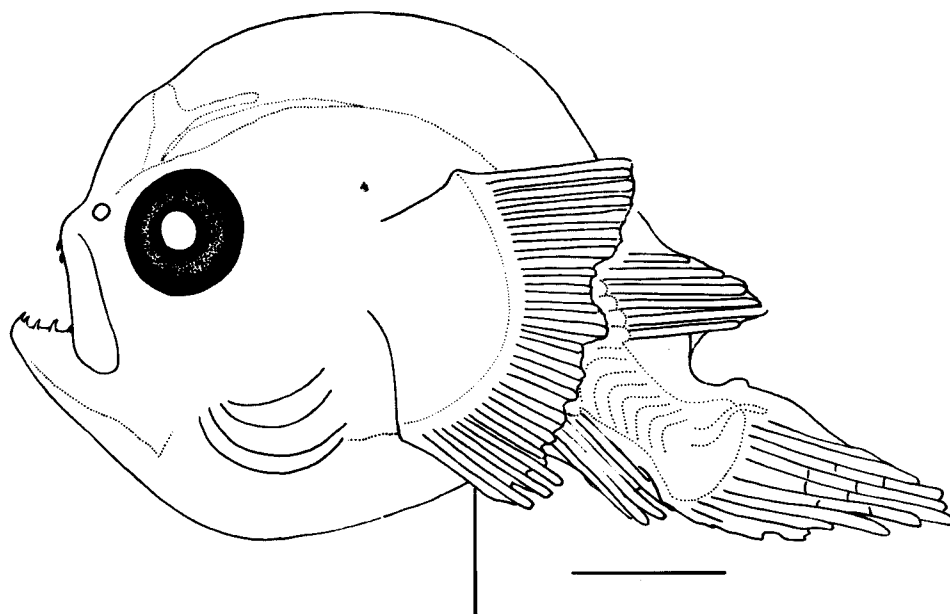


Fig. 22. *Gigantactis* sp., prejuvenile, HUMZ-L 3666, 4.3 mm SL. Scale bar = 1 mm. Drawing by M. Nishiya.

low dorsal and anal fin ray counts and weak pigmentation.

Order Lampriformes

Family Trachipteridae

21. *Desmodema lorum* Rosenblatt et Butler, 1977

(Fig. 23)

Material. 1 specimen. HUMZ-L 3669, prejuvenile, 24.8 mm SL, locality no. 84-45.

Diagnosis. Dorsal fin rays before 65th centrum 96 (succeeding rays undeveloped), pectoral fin rays 14, pelvic fin rays 7, caudal fin rays 7, branchiostegal rays 5, gill rakers 9, vertebrae 108. Body extremely compressed anteriorly, constricted posteriorly to form a slender tail. Head large, anterodorsal profile steep, with long ascending process of premaxilla. Occiput well protruded. Mouth oblique. Body cavity well extended posteriorly; distance from snout to posterior end of cavity about 80% of SL. Dorsal fin developed, originating above eye and reaching caudal fin; fin rays elongate with minute spinous prickles, anteriormost 6 rays rather stout. Pectoral fin small. Pelvic fin developed. Caudal fin very small. Anal fin absent, but finfold present along ventral margin of tail. Melanophores on dorsal surface of head and jaws. Internal pigments scattered along dorsal pterygiophores and upper peritoneum.

Remarks. The present specimen was damaged, the eyes and abdominal skin being lost, and the pelvic fins and anterior part of the dorsal fin being broken. Okiyama (1988b) described a prejuvenile (27.5 mm SL) of *Desmodema polystictum*

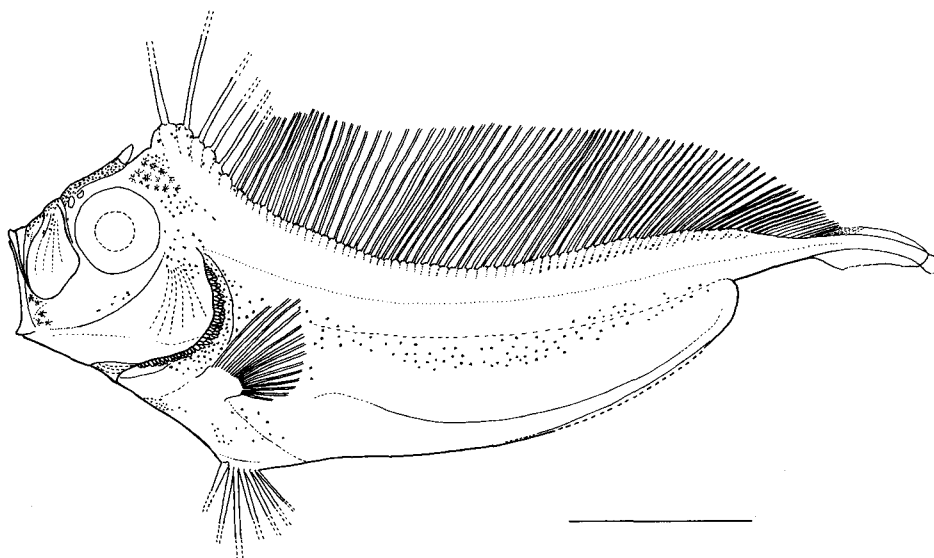


Fig. 23. *Desmodema lorum*, prejuvenile, HUMZ-L 3669, 24.8 mm SL. Scale bar=5 mm.
Drawing by M. Yabe.

(Ogilby). The present specimen closely resembles the latter, but differs by having high vertebral counts (108 vs. 75 in *D. polystictum*), and a more slender tail (Rosenblatt and Butler, 1977; Olney, 1984).

Acknowledgments

We wish to express our sincere gratitude to all officers and crew of T/S Oshoro Maru of Hokkaido University for their various efforts during this long-term research. We are especially grateful to following three former students of the Laboratory of Marine Zoology, Faculty of Fisheries, Hokkaido University, without whose generous assistance this study could not have been completed: Yutaka Karita, Momoko Nishiya (Nishikawa) and Maasa Fujita.

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