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MACROURIDAE OF THE EASTERN NORTH ATLANTIC

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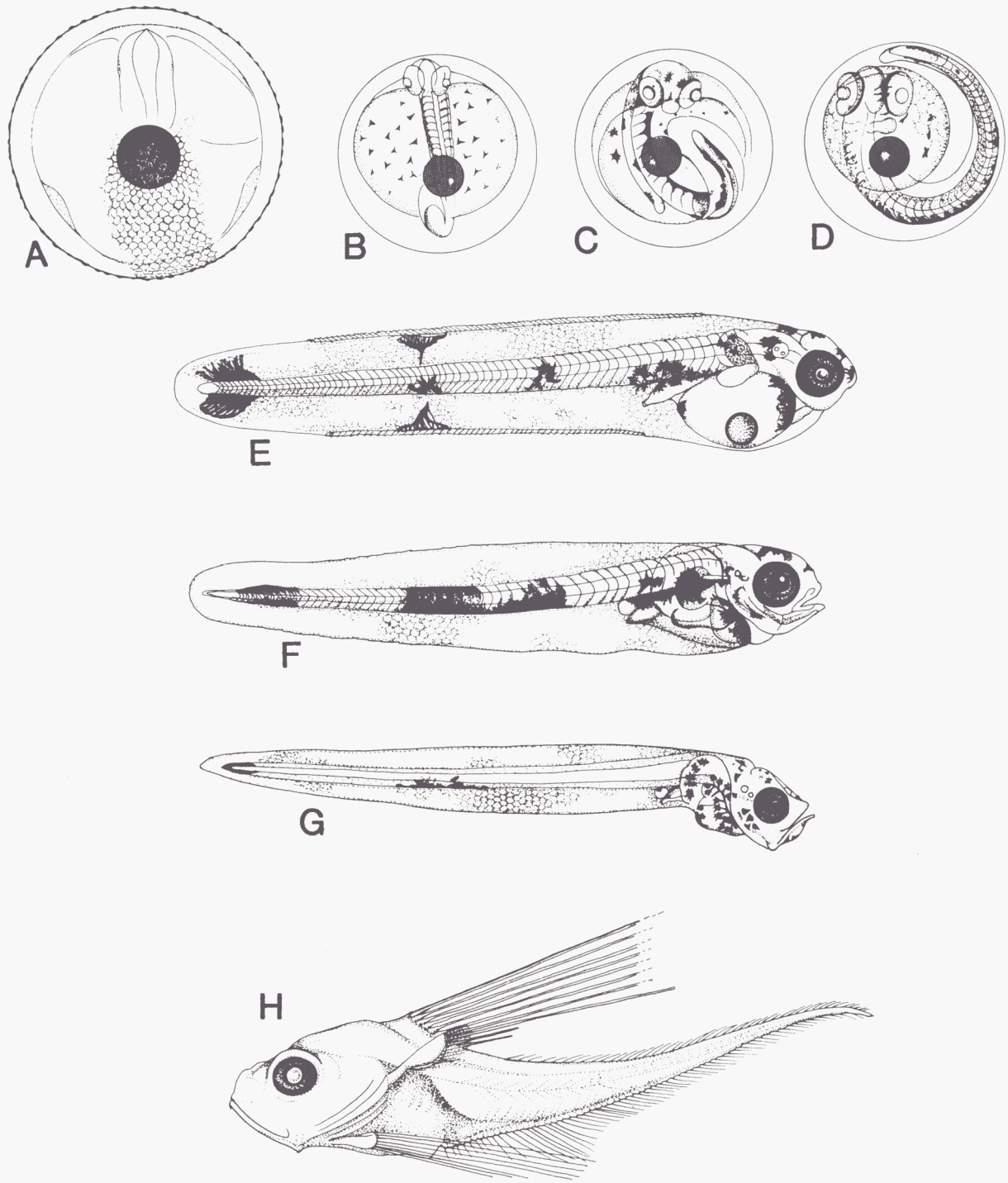

Figure 1. Egg and larval stages of *Coelorinchus coelorinchus*. (A) Egg from the Strait of Messina (1·20 mm diameter); (B) same on 4th day of incubation; (C) between 6th and 7th day; (D) at the end of 1 week; (E) newly hatched larva (4·21 mm TL); (F) larva 8 days old (3·88 mm TL); (G) larva 15 days old (4·64 mm TL) (redrawn from Sanzo, 1933); (H) 5·0 mm HL larva, "Thor" Stn 168 (51°30′N 11°37′W).

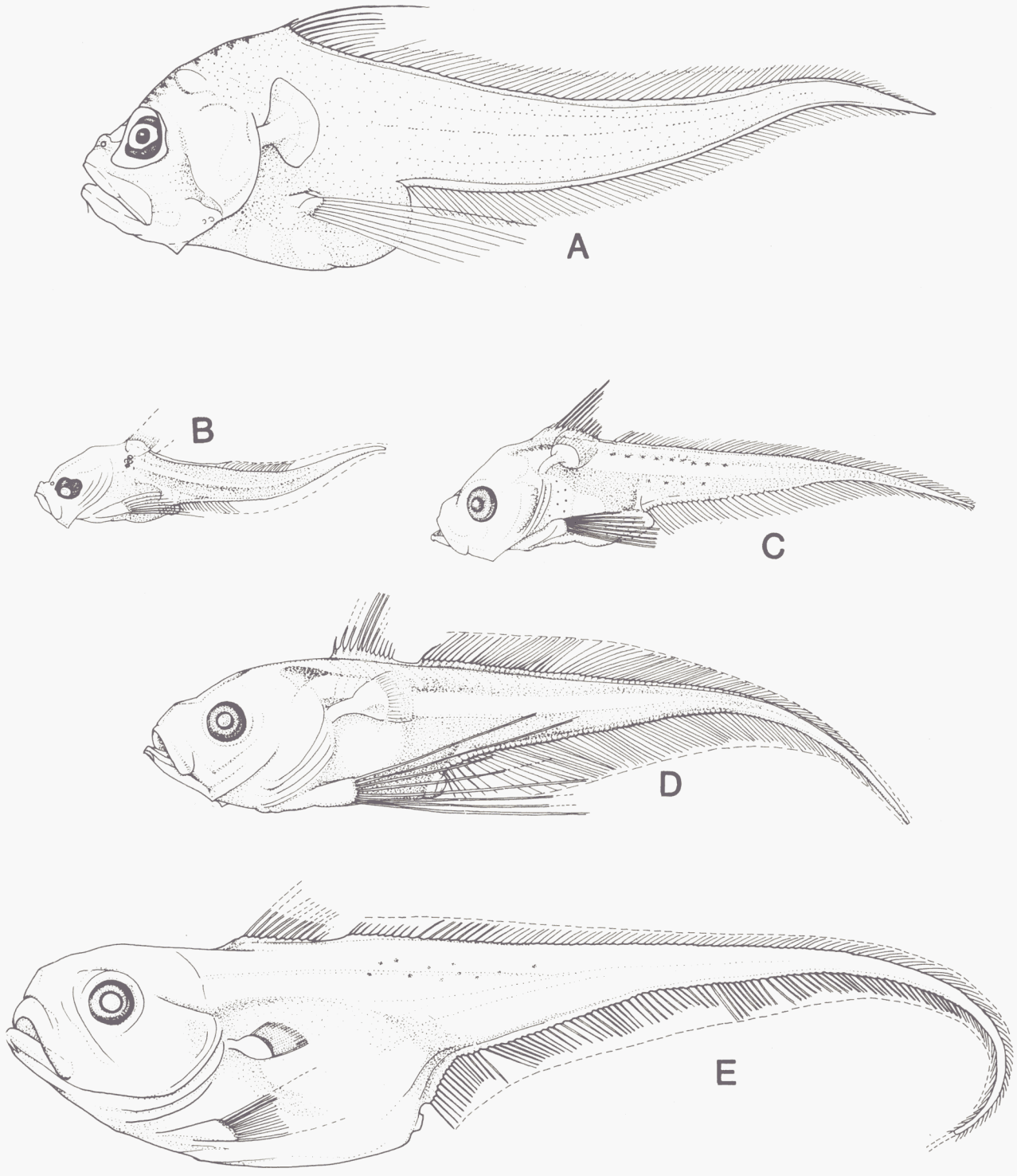

Figure 2. (A) Bathygadine, *Gadomus* sp.: 30+ mm TL (redrawn from Fahay and Markle, 1984, Fig. 140B); *Macrourus berglax:* (B) 3·0 mm HL, "Dana" Stn 11995 (63°17′N 58°11′W); (C) 4·5 mm HL, "Dana" Stn 13044 (63°37′N 55°30′W); (D) 6·5 mm HL "Dana" Stn 13092 (58°45′N 42°14′W); (E) 10·9 mm HL, "Dana" Stn 9985 (61°56′N 37°30′W).

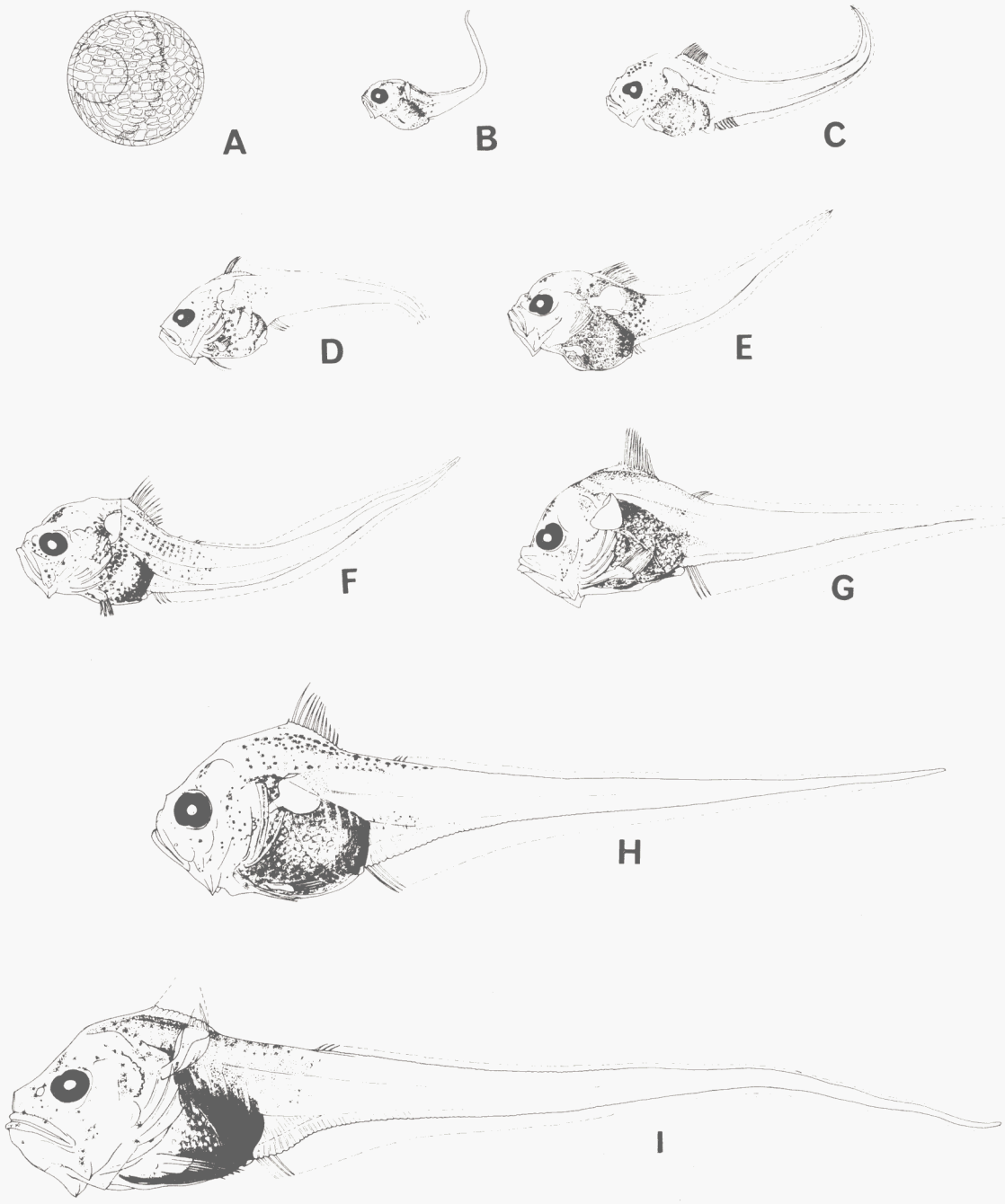

Figure 3. *C. (Coryphaenoides) rupestris:* (A) preserved egg (2·5 mm diameter) under transmitted light (redrawn from Grigor'ev and Serebryakov, 1981); (B) 1·6; (C) 2·5; (D) 3·1; (E) 3·3; (F) 4·0; (G) 5·0; (H) 5·1; and (I) 6·9 mm HL, collected from 53°N and 60°N 20°W (from Merrett, 1978).

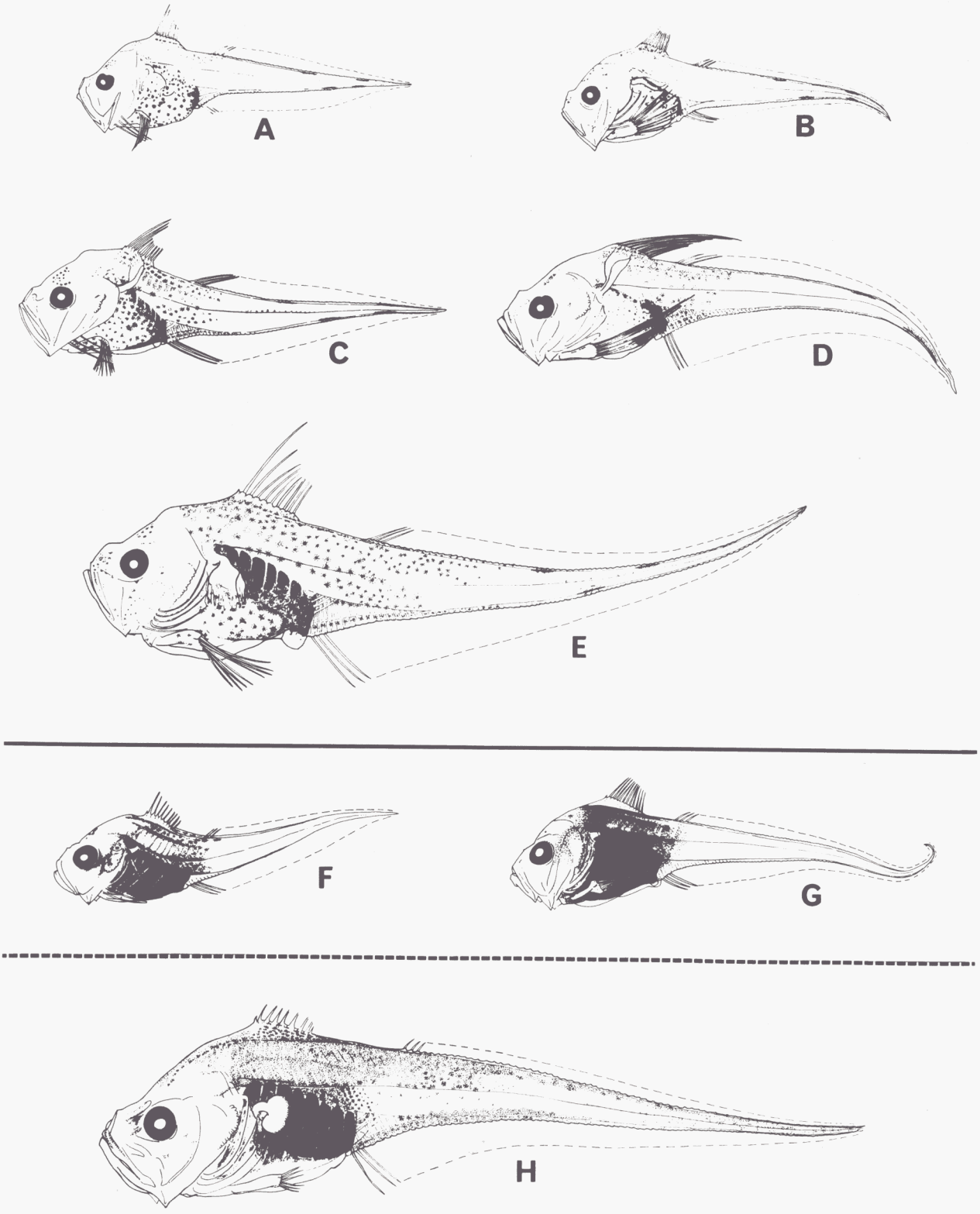

Figure 4. *C. (Lionurus)* species collected from 53°N and 60°N 20°W. Species A:(A) 2·5; (B) 3·5; (C) 4·0; (D) 5·2; and (E) 6·3 mm HL. Species B: (F) 3·5 and (G) 4·5 mm HL. Species?A: (H) 7·5 mm HL (From Merrett, 1978).

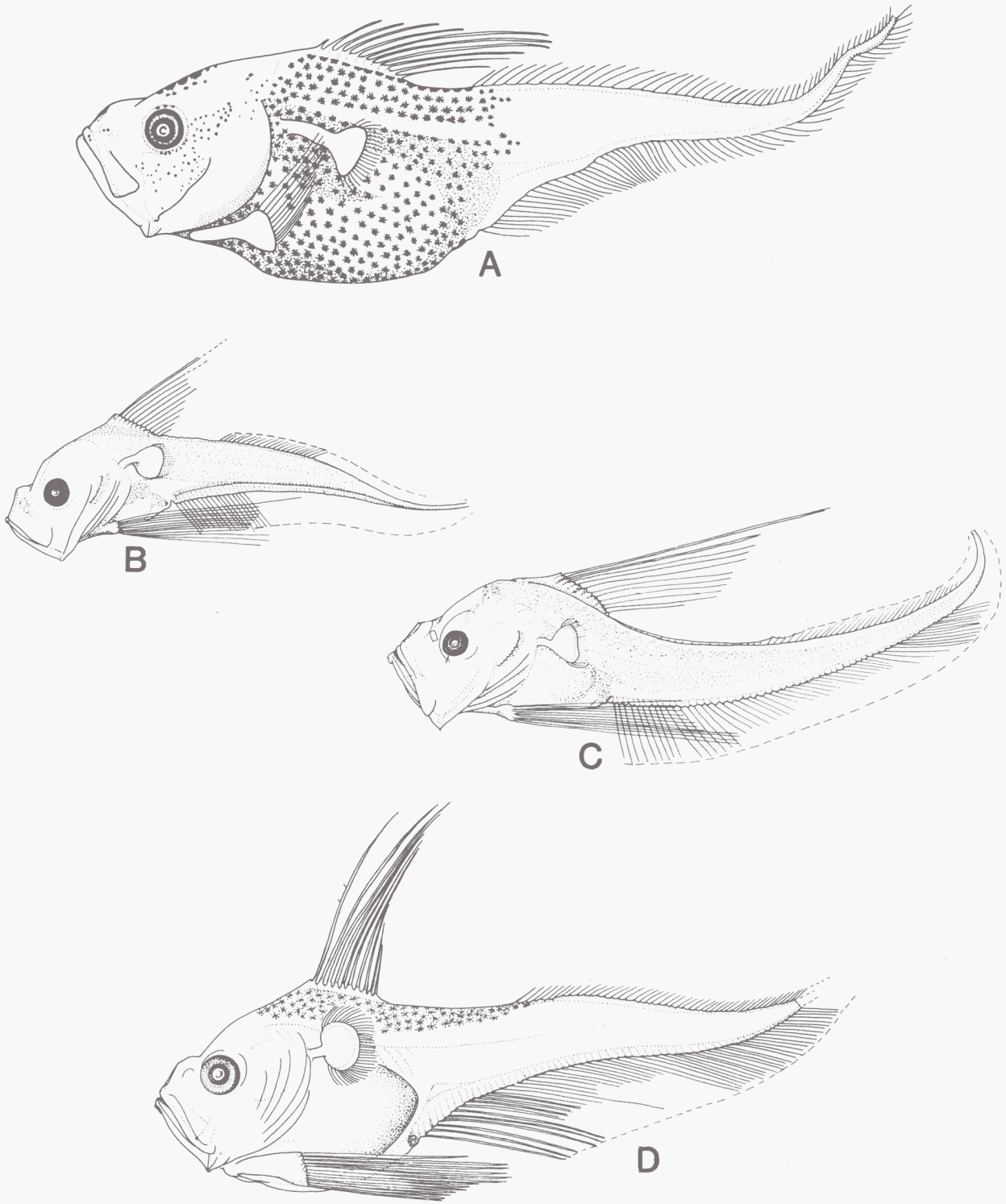

Figure 5. (A) *C. (Chalinura) leptolepis:* 6·2 mm HL (redrawn from Stein, 1980). *C.(Chalinura) mediterraneus:* (B) 2·9; (C) 3·8 mm HL, "Thor" Stn 81 (51°32′N 12°03′W); (D) 6·0 mm HL, "Discovery" Collection Stn No. 50607#3 (51°03·2′N 14°14·2′W).

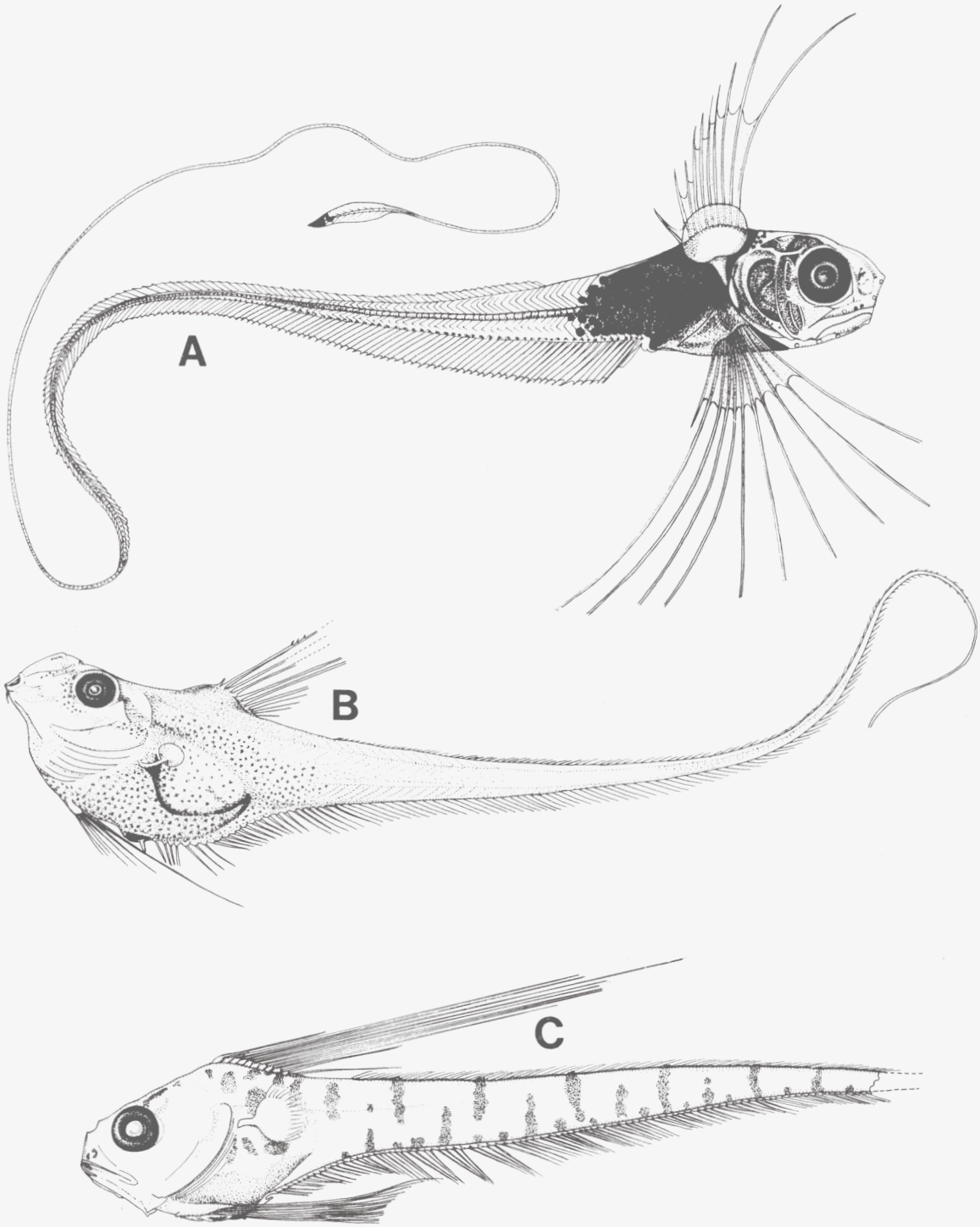

Figure 6. (A) *Hymenocephalus italicus:* 10·2 mm TL, from the Strait of Messina (redrawn from Sanzo, 1933). (B) *Sphagemacrurus hirundo:* 9·0 mm HL, "Discovery" Stn 10376#5 (33°20·6′N 33°23·9′W). (C) *Malacocephalus laevis:* 8·0 mm HL, "Discovery" Stn 10379#24 (35°03·2′N 33°03·6′W).

Macrouridae of the eastern North Atlantic

The Macrouridae are a family of deep-sea gadiform fishes comprising about 300 species. The majority of species are benthopelagic continental slope dwellers in tropical to temperate regions of the world ocean. In species richness and adult biomass the family is among the most successful of this habitat, yet relatively little is known of the early life history of its members. Some few free eggs to have been described (e.g. Sanzo, 1933; Grigor'ev and Serebryakov, 1981) are, in common with those of most gadiforms, pelagic. They incorporate an oil globule, and the eggs are encased in a characteristic hexagonally patterned chorion. Some evidence suggests that larval development can take place above the permanent thermocline with subsequent ontogenetic descent to adult living depths.

Of the 46 reported species from the eastern North Atlantic, only some 10 (22 %) have been positively identified to the larval stage. This relative dearth of known developmental series of specimens precludes the formulation of a key based on transient larval characters. Instead the tentative key given below largely utilizes those adult features known so far to be present in early larvae and derives in part from the works of Marshall (1973) and Marshall and Iwamoto (1973). The rather limited diagnostic scope of such characters in some cases renders identification by process of elimination possible only to species group level. Nonetheless, it is hoped that this key, while not fully dichotomous, will provide a serviceable framework for identification which will be sufficiently flexible to accommodate new information as it becomes available.

Evidence from gonad examination of eastern North Atlantic macrourid species indicates that many are potential breeders in the area. The distributions of juveniles and adults, delimited by latitudinal and sounding ranges (Table 1) should coincide, broadly speaking, with the likely areas of occurrence of the respective eggs and larvae of such species. Yet, as these earliest stages in the life history are planktonic, exceptional horizontal distributions may result from varying hydrographic influences. While this key incorporates those macrourids hitherto reported from the region, a cautionary note is appropriate about such possible extensions in range, coupled with a likelihood of discovering larvae of novel species of this relatively inaccessible family.

The family Macrouridae is sub-divided into four sub-families, of which larval representatives of only two have been reported. Most known larval types are from the sub-family Macrourinae, the most diverse group, while only two members of the Bathygadinae (one a tentative diagnosis) have been reported (*Gadomus* sp.: Fahay and Markle, 1984;? *Bathygadus* sp.: Johnsen, 1927). Pre-transitional trachyrincine and macrouroidine macrourids have yet to be described.

Features used for identification

Macrourid larvae are characterized by their tadpole-like appearance in all but the earliest stages. The depth of the head and abdomen is considerable relative to the tapering tail, and this is often exaggerated by a gorged stomach. The tail may be moderate to very elongate and lacks a differentiated caudal. The pectoral fins are typically pedunculate. Transition from larval to juvenile stages is marked by the loss of this peduncle with the appearance of the adult pectoral fin form. Simultaneous changes occur in the head region (development of the snout and concomitant realignment of the jaw from close to vertical to approaching horizontal), which renders the specimen recognizably adult. It is only pre-transitional macrourids, therefore, that are the subject of this key.

In addition to such family characteristics are those of value in sub-familial diagnosis. Of importance here is the possession of a single long-based dorsal fin or two fins, the anterior one being short-based; the relative length of dorsal and anal fin rays; the degree of restriction of the gill slits; and the form and relative length of the gill rakers.

Within the macrourine macrourids there is a considerable suite of important diagnostic features differentiated in the larval phase. Some indication of the developmental sequence of many of these is given by Merrett (1978). Externally, they are:

1. Relative tail length.
2. Position of the anus relative to the pelvic bases and insertion of the anal fin.
3. Relative position of the origin of the second dorsal fin (DII).
4. Number of rays in the pelvic (Pv) and first dorsal (DI) fins.
5. Spination of the second ray in the DI is important, but may be undifferentiated at very small size. Nonetheless, possession of this character is helpful diagnostically.

6. Possession of a mental barbel.
7. Number of branchiostegal rays – fundamentally important among macrourines.
8. Number of gill rakers on the outer edge of the second gill arch.
9. Pigmentation – often a valuable character.
10. Possession of a light organ, recognized by a dermal window.

There are also internal features of considerable value in the diagnosis of macrourid larvae:

1. Possession of a functional swimbladder.
2. Number of gas glands and retia mirabilia in the swimbladder.
3. Number of abdominal vertebrae.

Where possible a size range of larvae is drawn, and all eastern North Atlantic species whose larvae have been recorded are represented. Drawings have been made from the "Thor" collection from the Zoologisk Museum, Copenhagen, and IOS material and are also taken from the following published accounts: Sanzo, 1933; Merrett, 1978; Stein, 1980; Grigor'ev and Serebryakov, 1981; Fahay and Markle, 1984.

KEY TO SUB-FAMILIES

(1) First gill slit restricted by a fold of skin across its upper and lower extent. Six to seven branchiostegal rays. Gill rakers tubercular. Anal rays longer than dorsal rays.

MACROURINAE

(1a) First gill slit unrestricted. Seven branchiostegal rays. Gill rakers lathlike. Dorsal rays longer or similar in length to anal rays.
(2) A single long-based dorsal fin. Pelvic fins small (5-rayed) or absent. Swimbladder with three retia mirabilia.

MACROUROIDINAE

(2a) Two dorsal fins, first short-based followed by a long-based posterior fin. Pelvic fins well developed. Swimbladder with two or four retia mirabilia.
(3) Jaws relatively long (terminal in adults). Swimbladder with two or four retia mirabilia. Abdominal vertebrae 11–13.

BATHYGADINAE (Fig. 2(A))

(3a) Jaws short (markedly inferior to triangular snout in adults). Swimbladder with two retia mirabilia. Abdominal vertebrae 14.

TRACHYRINCINAE

The Macrourinae are easily distinguishable in the larval phase. Macrouroidine larvae likewise should present no difficulty. Early Bathygadine and Trachyrincine larvae, on the other hand, may need the recognition of further larval characters to separate them easily.

SUB-FAMILY MACROUROIDINAE

(1) Pelvic fins absent — *Macrouroides inflaticeps* Smith and Radcliffe, 1912
(Lateralis canals very wide, producing a massively inflated head in adults; abdominal vertebrae 12 or 13; no barbel; anus at anal fin; no light organ)

(1a) Pelvic fins small, 5-rayed — *Squalogadus modificatus* Gilbert and Hubbs, 1916
(Apart from presence of pelvic fins, adult characters broadly similar to those of *M. inflaticeps* above)

The collection of at least one adult of each of these species in the equatorial region of the eastern Atlantic suggests that larvae may occur in the area.

SUB-FAMILY BATHYGADINAE

(1)	Barbel elongate, retia mirabilia 4	(2)
(1a)	Barbel small or absent, retia mirabilia 2	(3)
(2)	Gill rakers 27–29 on lower limb of first arch	*Gadomus longifilis* (Goode and Bean, 1886) (Barbel relatively short (32–40 % head length (HL)) in adults, outer ray of each pelvic fin prolonged*)
(2a)	Gill rakers 18–21 on lower limb of first arch	*Gadomus arcuatus* (Goode and Bean, 1886) (18–21 rakers on lower limb of first arch; barbel moderate (65–87 % HL) in adults, outer two rays of each pelvic fin prolonged*) *Gadomus dispar* (Vaillant, 1888) (20–21 rakers on lower limb of first arch; barbel long (84–103 % HL) in adults, outer ray only of each pelvic fin prolonged*)
(3)	Pelvic fins with 9 (10) rays, eye small in adults	*Bathygadus favosus* Goode and Bean, 1886 (Barbel absent)
(3a)	Pelvic fins with 7 (8) rays, eye large in adults	(4)
(4)	Barbel absent	*Bathygadus melanobranchus* Vaillant, 1888 (Outer gill filaments of 1st gill arch darkly pigmented in adults)
(4a)	Small barbel usually present	*Bathygadus macrops* Goode and Bean, 1886 (Barbel 0·9 % HL in adults, outer gill filaments of 1st gill arch unpigmented in adults also)

* This character may well not be evident in larval forms; all rays may be elongate in the undamaged state.

The most northerly extent of the known ranges of adults of this sub-family is from the Irish continental slope (one specimen, *B. melanobranchus;* Holt and Byrne, 1908, but the bulk of the population of this and those of the other species are centred south of Portugal).

SUB-FAMILY TRACHYRINCINAE

Enlarged scales dorsally behind the anus (8–10) and ventrally anterior to the anus (5–11) separate adults of *Trachyrincus murrayi* from *T. trachyrincus* (23–42 and 0, correspondingly), but no distinguishing features are known for the larvae, both of which are as yet unreported.

SUB-FAMILY MACROURINAE

(1)	Branchiostegal rays 6	(2)
(1a)	Branchiostegal rays 7	(9)
(2)	Barbel present	(3)
(2a)	Barbel absent	*Odontomacrurus murrayi* Norman, 1939 (DI 2nd ray smooth; Pv 7–8; pectoral 9–11; anus between Pv and anal; black naked fossa between Pv fins. Very elongate juvenile stage has developed marked caudal pigmentation of lateral patches or bars of melanophores – *"pantherinus"* form.)
(3)	Light organ present	*Coelorinchus coelorinchus* (Risso, 1810) (Pv 7; DI 2nd ray smooth. Fig. 1)
(3a)	Light organ absent	(4)
(4)	DI 2nd ray smooth*	*Coelorinchus occa* (Goode and Bean, 1885) (Pv 7; (snout long in adult); Pv origin posterior to DI origin) *Coelorinchus abditilux* Merrett, 1980 (Pv 7; (snout short in adults); Pv origin anterior to DI origin; tail of juveniles, at least, with four vertical pigment bands)
(4a)	DI 2nd ray serrated*	(5)
(5)	Retia mirabilia 4	(6)

(5a)	Retia mirabilia 5–6	(8)
(6)	Abdominal vertebrae 16–18	*Macrourus berglax* Lacépède, 1802 (Trunk noticeably long relative to overall length; DII origin anterior to anus. Fig. 2 (B))
(6a)	Abdominal vertebrae 11–12 (13)	(7)
(7)	Pv rays 7–8 (9)	*Coryphaenoides (Coryphaenoides) guentheri* (Vaillant, 1888) (Gill rakers (2nd arch) 7) *C. (Coryphaenoides) rupestris* Gunnerus, 1765 (Gill rakers (2nd arch) 1–2+1+14–17. Fig. 3) *C. (Coryphaenoides) thelestomus* Maul, 1951 (Gill rakers (2nd arch) 2+7)
(7a)	Pv rays 8–11	*C. (Coryphaenoides) marshalli* Iwamoto, 1970 (Gill rakers (2nd arch) 8–9; premaxillary teeth with enlarged outer row (DII origin posterior to anal insertion in adults)) *C. (Coryphaenoides) paramarshalli* Merrett, 1983 (Gill rakers (2nd arch) 11–12; premaxillary teeth with no enlarged outer row (DII origin anterior to anal insertion in adults)) *C. (Coryphaenoides) macrocephalus* (Maul, 1951) (Gill rakers (2nd arch) 8–9) *C. (Coryphaenoides) zaniophorus* (Vaillant, 1888) (Gill rakers (2nd arch) 1+10) *C. (Coryphaenoides) rupestris* (see above)
(8)	Pv rays 8–9 (Abdominal vertebrae 12–13)	*Coryphaenoides (Chalinura) brevibarbis* (Goode and Bean, 1896) (Mandibular teeth in single row; gill rakers (2nd arch)1+1+9−10) *C. (Chalinura) leptolepis* (Günther, 1877) (Mandibular teeth in single row; gill rakers (2nd arch) 1+0−1+9−12, (barbel length 1·3–0·9 in interorbital width over adult size range 41–120 mm HL). Diagnostic pigment pattern see Fig. 5(A)) *C. (Chalinura) profundicola* (Nybelin, 1957) (Mandibular teeth in single row, gill rakers (2nd arch) 0−1+1+10−11 (barbel length 5·1–1·5 in interorbital width over adult size range 52–215 mm HL)) *Coryphaenoides (Lionurus) carapinus* (Goode and Bean, 1883) (Mandibular teeth in two or more rows; gill rakers (2nd arch) 0−1+0−1+4−8; 2–4 caudal melanophores sometimes present. Fig. 4). (N.B. Larvae of the *C. (Lionurus)* type occur in a caudally pigmented and unpigmented form in the area.)
(8a)	Pv rays 10–11 (abdominal vertebrae 12–15)	*C. (L.) carapinus* (see above) *Coryphaenoides (Nematonurus) armatus* (Hector, 1875) (Abdominal vertebrae 13–15; (head length > 2 times in preanal length in juveniles and adults))
(8b)	Pv rays 12–14 (abdominal vertebrae 12–13)	*C. (Chalinura) mediterraneus* (Giglioli, 1893) (Fig. 5 (B))
(9)	Swimbladder absent	*Echinomacrurus mollis* Roule, 1916
(9a)	Swimbladder present (retia mirabilia 2-4)	(10)
(10)	Light organ present	(11)
(10a)	Light organ absent (peritroct only present if developed in larval phase)	(16)
(11)	Anus at anal fin origin	(12)
(11a)	Anus between Pv and anal fins	(13)
(12)	Pv rays (7)–8–(9)	*Hymenocephalus gracilis* Gilbert and Hubbs, 1920 (Gill rakers (2nd arch) 2−3+11−15)
(12a)	Pv rays 10–11 (rarely 12)	*Hymenocephalus italicus* Giglioli, 1884 (Gill rakers (2nd arch) 2−4+1+17−20, Fig. 6 (A))

(13)	DI 2nd ray smooth	*Malacocephalus laevis* (Lowe, 1843) (Caudal probably elongate; distinct *"pantherinus"* markings; barbel present; light organ developed; Pv8/8; gill rakers (2nd arch) 0+1+7 – data from 1 specimen, Fig. 6(C))
(13a)	DI 2nd ray serrated	..... (14)
(14)	Abdominal vertebrae usually 11–12 (range 10–14) (Pyloric caeca in adults > 40 and branched)	*Ventrifossa occidentalis* (Goode and Bean, 1885) (Dermal window of light organ level with outer pelvic rays) *Ventrifossa africana* Iwamoto, 1970 (Dermal window of light organ level with inner pelvic rays)
(14a)	Abdominal vertebrae 13–14 (Pyloric caeca in adults < 40, not branched)	..... (15)
(15)	Pv rays (6) 7	*Nezumia bairdii* Goode and Bean, 1877
(15a)	Pv rays (7) 8–10	*Nezumia aequalis* (Günther, 1887) (Gill rakers (2nd arch) (8) 9–11 (12)) *Nezumia sclerorhynchus* (Valenciennes, 1838) (Gill rakers (2nd arch) 9–11) *Nezumia micronychodon* Iwamoto, 1970 (Gill rakers (2nd arch) 13–17)
(15b)	Pv rays (10) 11–13	*Nezumia longebarbatus* (Roule and Angel, 1933) (Barbel long in adults, 17–23 % HL) *Nezumia duodecim* Iwamoto, 1970 (Barbel relatively short in adults, 8–16 % HL)
(16)	Anus between Pv and anal fin	*Kumba dentoni* Marshall, 1973
(16a)	Anus at anal fin origin (distanced only by peritroct)	..... (17)
(17)	DI 2nd ray smooth	*Trachonurus villosus* (Günther, 1877)
(17a)	DI 2nd ray serrated	..... (18)
(18)	Pv rays 6–7	*Paracetonurus flagellicauda* (Koefoed, 1927)
(18a)	Pv rays 8–12	..... (19)
(19)	Anal origin opposite or anterior to dorsal I origin	*Sphagemacrurus hirundo* (Collett, 1896) (Very elongate (HL 8 times in total length); barbel present; Pv 10/9; gill rakers (2nd arch) 0+0+9; no *"pantherinus"* markings – even overall pigmentation – data from one specimen, Fig. 6(B))
(19a)	Anal origin posterior to dorsal I origin	..... (20)
(20)	Pv rays 8–10	*Cetonurus globiceps* (Vaillant, 1888) (Abdominal vertebrae 10; gill rakers (2nd arch) 1+1+9–11)
(20a)	Pv rays 11–12	*Macrosmia phalacra* Merrett, Sazonov, and Shcherbachev, 1983 (Abdominal vertebrae 12; gill rakers (2nd arch) 1–2+1+9)

* This character may not be developed in early larvae.

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Table 1. Distribution of macrourid species (juveniles and adults) in the eastern North Atlantic from known latitudinal and sounding ranges. (* – present also in the Mediterranean; 0 → – distribution extends southwards beyond the equator)

Species	Latitudinal range (°N)	Sounding (depth) range (m)	Species	Latitudinal range (°N)	Sounding (depth) range (m)
Macrouroides inflaticeps	0 →	(Bathypelagic)	*C. (C.) zaniophorus*	52–03	410–2 380
Squalogadus modificatus	10–0 →	(Bathy/benthopelagic to ca. 1 500 m)	*C. (Chalinura) brevibarbis*	60–34	1 500–4 460
			C. (C.) leptolepis	50–18	1 900–5 120
Gadomus arcuatus	35–25	610–1 700	*C. (C.) mediterraneus*	60–10*	740–2 650
G. dispar	35–30	550–1 100	*C. (C.) profundicola*	49–20	3 900–5 120
G. longifilis	40–17	550–2 160	*C. (Lionurus) carapinus*	60–0 →	1 440–5 610
Bathygadus favosus	32–22	550–1 850	*C. (Nematonurus) armatus*	66–20	2 170–4 880
B. macrops	14–04	200–990	*Echinomacrurus mollis*	45–37	4 080–5 410
B. melanobranchus	51–0 →	450–1 660	*Hymenocephalus gracilis*	35	420–440
Trachyrincus murrayi	66–51	510–1 880	*H. italicus*	49–0*→	200–800
T. trachyrincus	55–15*	400–1 500	*Malacocephalus laevis*	58–0 →	200–750
Odontomacrurus murrayi	36–0 →	(Epi/bathypelagic)	*Ventrifossa occidentalis*	21–0 →	150–580
			V. africana	09–04	640–780
Coelorinchus abditilux	57–51	770–1 040	*Nezumia aequalis*	66–0*→	200–2 320
C. coelorinchus			*N. bairdii*	38 (Azores Is.)	ca. 100–700
sub. sp. *coelorinchus*	66–15*	200–1 310	*N. duodecim*	24–0 →	330–1 260
sub. sp. *geronimo*	04–0 →	200–510	*N. longebarbatus*	32–31	1 140–1 700
C. occa	60–09	460–2 540	*N. micronychodon*	24–0 →	400–1 260
Macrourus berglax	80–59	100–820	*N. sclerorhynchus*	38–04*	400–1 200
Coryphaenoides (Coryphaenoides) guentheri	66–20*	1 000–2 740	*Kumba dentoni*	47	1 200
			Trachonurus villosus	39–08	510–1 590
C. (C.) macrocephalus	32–24	600–2 380	*Paracetonurus flagellicauda*	50–45	2 460–3 180
C. (C.) marshalli	23–0 →	1 130–1 700	*Sphagemacrurus hirundo*	38–15	550–2 330
C. (C.) paramarshalli	21–0 →	1 130–2 160	*Cetonurus globiceps*	45–0 →	1 000–4 200
C. (C.) rupestris	66–20	400–1 900	*Macrosmia phalacra*	27	1 650–1 700
C. (C.) thelestomus	32–29	1 340–1 390			

REFERENCES

Fahay, M.P., and Markle, D.F. 1984. Gadiformes: development and relationships. *In* Ontogeny and systematics of fishes, pp. 265–283. Ed. by H.G. Moser. U.S., N.O.A.A., National Marine Fisheries Service Spec. Publ. (1). Allen Press for American Society of Ichthyologists and Herpetologists.

Grigor'ev, G.V., and Serebryakov, V.B. 1981. Eggs of roundnose grenadier, *Coryphaenoides rupestris* Gunnerus, 1765. J. Northwest Atlantic Fish. Sci., 2: 73–74.

Holt, E.W.L., and Byrne, L.W. 1908. Second report on the fishes of the Irish Atlantic slope. Fisheries, Ireland, Scientific Investigations, 1906, V. (1908): 63 pp.

Johnsen, S. 1927. On some bathypelagic stages of the macrourid fishes. Nytt Magasin for Naturvidenskaberne, Oslo, 65: 221–241.

Marshall, N.B. 1973. Family Macrouridae. *In* Fishes of the western North Atlantic. Ed. by D.M. Cohen. Memoir, Sears Foundation for Marine Research, (1), part 6: 496–665.

Marshall, N.B., and Iwamoto, T. 1973. Genera *Coelorhynchus, Coryphaenoides, Hymenocephalus* and *Nezumia*. *In* Fishes of the western North Atlantic (N.B. Marshall,

Cont'd

Cont'd

Family Macrouridae). Ed. by D.M. Cohen. Memoir, Sears Foundation for Marine Research, (1), part 6: 538–580, 601–612, and 624–649.

Merrett, N.R. 1978. On the identity and pelagic occurrence of larval and juvenile stages of rattail fishes (Family Macrouridae) from 60°N, 20°W and 53°N, 20°W. Deep-Sea Res., 25: 147–160.

Sanzo, L. 1933. Macrouridae. *In* Uova, larve e stadi giovanili di Teleostei. Fauna Flora Golfo Napoli, 38: 255–265. (English translation: Jerusalem: Israel Program for Scientific Translations, 1969).

Stein, D.L. 1980. Description and occurrence of macrourid larvae and juveniles in the northeast Pacific Ocean off Oregon, U.S.A. Deep-Sea Res., 27A: 889-900.