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## KOMMISSIONEN FOR HAVUNDERSØGELSER

SERIE: FISKERI · BIND II

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- Nr. 6. JOHS. SCHMIDT: MARKING EXPERIMENTS ON PLAICE AND COD IN ICELANDIC WATERS. WITH 2 CHARTS
- Nr. 7. JOHS. SCHMIDT: ON THE POST-LARVAL DEVELOPMENT OF THE HAKE (*MERLUCCIUS VULGARIS* FLEM.). WITH ONE PLATE AND 4 FIGURES IN THE TEXT
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ON THE POST-LARVAL  
DEVELOPMENT OF THE HAKE  
(*MERLUCCIUS VULGARIS* FLEM.)

BY

JOHS. SCHMIDT

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WITH ONE PLATE AND 4 FIGURES IN THE TEXT

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FORSKNINGEN

ON THE POST-LARVAL  
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APPENDIX  
BY  
C. A. RITZEL

## I. INTRODUCTION

DURING the Atlantic cruises of the Danish investigation-steamer "Thor" in the years 1903—1906 inclusive, we have gradually obtained the pelagic young of most of the North Atlantic gadoids. On different occasions I have published descriptions of all the species of *Gadus* (including *Gadiculus*)<sup>1</sup> as also of *Brosmius*<sup>2</sup> and the two *Molva*-species, *M. molva* and *M. byrkelange*<sup>3</sup>. On the "Thor's" cruises in the last two years (1905—06), which extended further south than in the earlier years (to Bay of Biscay, Ireland, English Channel), we obtained specimens of the pelagic stages of the young of *Merluccius vulgaris*, *Raniceps raninus*, and of the deep-water ling, hitherto known for the most part only from the Mediterranean, *Molva elongata* Risso, a related species to the northern deep-water ling (*M. byrkelange*). If we except the rockling-genus (*Onos* or *Motella*), which requires a thorough revision even for the adult animals, we now know the pelagic young of all the North Atlantic gadoids which live in shallow water. In the present paper I shall only deal with the post-larval development of the hake (*Merluccius vulgaris*), leaving *Raniceps raninus* and *Molva elongata* till another occasion.

The majority of the stages of the hake described here have been collected by the "Thor". Two small stages of 4—5 mm. in length (Pl. I, figs. 1—2) were found in a collection of gadoid larvæ taken during the Irish fisheries investigations and sent me for determination by Mr. E. W. L. HOLT, Dublin, who has kindly permitted me to describe and figure them in this paper.

With regard to the terminology, I may refer to my previous papers (see note below). The following abbreviations have been employed here:

D<sup>1</sup> = 1st Dorsal Fin

D<sup>2</sup> = 2nd do.

A = Anal Fin.

## II. DESCRIPTION OF THE DEVELOPMENTAL STAGES

The eggs of the hake were first described by F. RAFFAELE<sup>4</sup> in his excellent memoir on the pelagic fish eggs and larvæ occurring in the Bay of Naples. According to RAFFAELE (l. c. p. 37) *Merluccius vulgaris* is ripe there at the end of January. The eggs are 0.94—1.03 mm. in diameter and have an oil-globule

<sup>1</sup> JOHS. SCHMIDT: The pelagic, post-larval stages of the Atlantic species of *Gadus*; Part I. Meddel. Komm. Havunders., Serie Fiskeri, Bind I, No. 4, 1905, Part. II. Ibid. Bind II, No. 2, 1906.

<sup>2</sup> Idem: On the larval and post-larval stages of the Torsk (*Brosmius brosme* [Ascan.]); *ibid.*, Bind I, No. 8, 1905.

<sup>3</sup> Idem: On the pelagic, post-larval stages of the lings (*Molva molva* [Linné] and *Molva byrkelange* [Walb.]); *ibid.* Bind II, No. 3, 1906.

<sup>4</sup> F. RAFFAELE: Le uova galleggianti et le larve dei Teleostei nel golfo di Napoli (Mitth. aus der Zool. Stat. zu Neapel, Vol. VIII, 1, 1888, p. 37, Pl. I, Fig. 28, 29, Pl. III, Fig. 1).

(diameter 0.27 mm.). By means of artificial fertilisation on May 3rd, 1886, RAFFAELE was able to determine that the development of the egg took 60—70 hours. The larva on hatching is but little developed. It has an ovoid yolk-sac with the pigmented oil-globule lying posteriorly. As is usual in gadoids the end of the gut does not reach to the margin of the embryonic fin. The early larva has both yellow and black pigment. The later development of the larvæ was not followed by RAFFAELE.

Some young stages of the hake have also been found. Thus, three young specimens were taken by E. W. L. HOLT during the Irish survey. These had a length of  $1\frac{1}{4}$  to  $1\frac{1}{2}$  inches (i. e. ca. 32—38 mm.) and were caught in a shrimp-trawl in August at a depth of 80 fms.

As the postlarval stages of the hake have not hitherto been described or figured in literature, the following pages are devoted to the description of the developmental history, which may now be considered as completely elucidated from the available material from the Bay of Biscay, Ireland, Scotland and the Skager Rak. Then follows a verification of the determinations and a summary of the characters by means of which the postlarval stages of the hake can most readily be distinguished from similar or related species.

Pl. I, Fig. 1

**Length:  $4\frac{1}{4}$  mm.** At this stage the form of the larva has no very special characteristics. The preanal portion is however comparatively thick, the notochord quite straight. Embryonic rays are present in the embryonic fin but there is not trace of true rays or interspinous rays. The pectorals are ray-less flaps and the ventrals have not yet appeared.

The pigment offers several characteristics which make the fish, in spite of its small size, easily recognizable from nearly related species. It is as usual the postanal pigment especially which is important for diagnostic purposes. With regard to the terminology used in the description of the pigment, see my earlier papers (p. 3, foot-note) on the developmental history of other gadoids. There are some large chromatophores on the neck and pectoral region. The abdominal pigment is conspicuous, and the ventral preanal pigment is also rather distinct.

As mentioned, the postanal pigment is specially characteristic, consisting as in so many other gadoids of 3 separate bars (I, II, III), the posterior (I) lying a little in front of the end of the notochord, the anterior (III) some distance behind the anus. Bar I consists of a large mediolateral chromatophore or also of several small. In any case the pigment bar I is quite restricted to the tail without extending out on to the fin (i. e. embryonic fin) as in several other gadoids (e. g. *Brosmius* and *Molva*, cfr. text-figure, p. 9). The ventral part of I is stronger than the dorsal. Bar III which as mentioned is some distance behind the anus, consists essentially only of a single large, stellate, mediolateral chromatophore. Bar II lies between I and III but nearer III than I. This bar is also mediolateral generally but may be somewhat prolonged dorsally. Sometimes also, it may consist of a dorsal and a ventral portion as well as the mediolateral, so that it almost surrounds the body like a ring. In general the dorsal part is more developed than the ventral. In this and the following stages II is the strongest and most distinct of the 3 postanal pigment bars.

Pl. I, Fig. 2

**Length: 5 mm.** The form is as in the previous stage or even a little thicker anteriorly. The end of the notochord is quite straight, and there is no sign of rays or interspinous rays in the fins. In the caudal region, however, under the posterior part of pigment bar I there is a slightly more opaque spot in the embryonic fin close up to the body contour. The pectorals also have no trace of rays or basal elements. The pigment is essentially as before.

Pl. I, Fig. 3

**Length: 6 mm.** The trunk is somewhat thicker than before. The notochord is quite straight. The first traces of interspinous rays are now seen both above and below in the caudal fin as an opaque part in the embryonic fin, though less in extent above. Otherwise all traces of interspinous rays and rays

are quite lacking in the unpaired fins and pectorals. The ventrals have now made their appearance as characteristic conical knobs with very black pigment, which are as yet scarcely so long as the diameter of the eye but still sufficiently long to show that the hake belongs to the group of gadoids having elongated ventral fins at an early stage of development. The pigment is essentially as before. In the specimen figured each of the three postanal bars consists mainly only of one large mediolateral, stellate chromatophore.

**Length: 8 mm.** The anterior part of the body is thick, just as is the case in certain other gadoids in the early postlarval stages (e. g. *Gadus aeglefinus* and *Gadiculus argenteus*). The notochord is still straight. In the caudal fin the hypural elements are distinct both above and below, but the rays are as yet not distinctly defined. In D<sup>2</sup> and A the interspinous region can be traced from the beginning of the fins backwards to a little behind pigment-bar II, but the rays are not yet formed. D<sup>1</sup> has already begun to separate off from the embryonic fin. It has some few (ca. 5) incipient rays which, however, are not yet distinctly formed. The anus lies a good distance behind the interspace between D<sup>1</sup> and D<sup>2</sup>. The ventrals are now distinctly longer than the diameter of the eye. They are strongly pigmented and reach posteriorly scarcely to the anus. The pigment is in the main unchanged. Pl. I, Fig. 4

**Length: 8<sup>3</sup>/<sub>4</sub> mm.** In spite of the slight difference in length between this and the previous stage the fish has increased in volume very considerably. It is very thick. Taken on the whole the specimen is much further on in development than the foregoing. The notochord is no longer quite straight. Rays are now present in a great part of the caudal fin, but there is still a somewhat considerable, ray-less part posteriorly. Rays are now beginning to appear in the second dorsal and anal fins with the exception of the posterior part in both. They are still short and thus do not extend out to the margin of the embryonic fin. In each of these fins ca. 27—28 rays could be counted. The embryonic fin is still broad between the caudal fin and the other unpaired fins. D<sup>1</sup> is not yet separated from D<sup>2</sup>; it has 7—8 distinct rays which are longer than those in D<sup>2</sup>. There is no pigment whatever on the unpaired fins. The ventrals which are covered with very black pigment reach backwards to the anus. As their rays are enclosed in a common skin they are very broad, almost like flippers. The pigment on the body is unchanged. Pl. I, Fig. 5

**Length: 9<sup>1</sup>/<sub>2</sub> mm.** The form is plump; the end of the notochord is now somewhat bent and reduced in thickness. In the caudal fin there is now only a small ray-less part above posteriorly. The rays in D<sup>2</sup> and A mostly extend out to the margin of the embryonic fin, which is still broad between the caudal fin and the other unpaired fins. D<sup>1</sup> is not yet separated from D<sup>2</sup>, but is higher than the latter. One characteristic is that D<sup>1</sup> has some black pigment spots; otherwise there is no pigment on the unpaired fins. 7 rays could be counted in the ventral fins. The pigment on the body is essentially unchanged. The sides of the abdomen are strongly pigmented. Pl. I, Fig. 6

**Length: 10<sup>1</sup>/<sub>4</sub> mm.** The form of the body is still very plump. The end of the notochord is much bent and considerably reduced. Most of the rays are now present in D<sup>2</sup> and A; some few only are still lacking posteriorly. The embryonic fin between the caudal fin and D<sup>2</sup> and A is now lower than in the previous stage, but there is still no separation. D<sup>1</sup> is higher than before and has already several dashes of black pigment anteriorly. The ventrals reach to behind the anus and are strongly pigmented with black. The pigment on the body is distinct. Some pigment (anterodorsal) has appeared under D<sup>1</sup>. The postanal pigment is essentially unchanged. Pl. I, Fig. 7

**Length: 12<sup>1</sup>/<sub>4</sub> mm.** The body is still very plump. Rays are present everywhere in the caudal fin and the hind margin of the posterior hypural element is now vertical and bears 6 rays. The embryonic Pl. I, Fig. 8

fin between the caudal fin and the other unpaired fins is very low and rays are present everywhere in  $D^2$  and A (ca. 35 rays could be counted in each). In  $D^1$  which is high and distinctly pigmented the rays are more clearly marked and further on in development than in  $D^2$  and A. The ventrals are as before; posteriorly they reach a little behind the anus. The pigment on the body is essentially unchanged. The ventral part of bar I is as a rule stronger than the dorsal and II may often be dorsolateral. On the other hand I is usually mediolateral. II is the most distinct of the three postanal bars.

Pl. I, Fig. 9

**Length: 15 mm.** No little change in the body has occurred since the preceding stage. The form is considerably more slender than in the specimens previously described, and is thus a transition to the older developmental stages which are remarkable just for their slenderness. The end of the notochord is much reduced and bent upwards. The caudal fin is of elongated form with a convex posterior margin. The embryonic fin is still present between the caudal fin and  $D^2$  and A, but is low. In A and  $D^2$  ca. 35 rays could be counted, the most posterior of which are very indistinct.  $D^1$  which as before is strongly pigmented with black is separated from  $D^2$  and contains ca. 9 rays. The pectorals are still rounded, fan-like and have traces of rays. The ventrals are dark-coloured and reach backwards to a little behind the anus. They contain 7 rays, the outermost of which is shortest and the fourth longest. The fins lack pigment with exception of  $D^1$  and the ventrals. The postanal pigment is not essentially altered in this specimen, though this may occur in other specimens of the same size. The changes that occur in the 3 postanal bars during the development of the pigment will be mentioned in describing the following stage.

The pigment mentioned earlier as occurring dorsally beneath  $D^1$ , has increased in extent and now forms quite a large patch. Looking at the fish from above we notice that there is a lighter, unpigmented part in the centre of this large, dorsal pigment patch, so that this is almost in the shape of a ring.

Further, a small group of pigment has been added under the anterior part of  $D^2$ , but this is situated lower down on the side (dorsolateral) than the large patch under  $D^1$ .

Pl. I, Fig. 10  
and 10 a

**Length: 16 $\frac{1}{2}$  mm.** As development advances the form of the body becomes gradually more and more slender and approaches nearer to that of the adult. The anus lies almost under the interspace between  $D^1$  and  $D^2$ . The caudal fin which is elongated and has a convex posterior margin, is now separated from A and  $D^2$ , the embryonic fin having disappeared. In  $D^1$  there were 8, in  $D^2$  ca. 37 and in A ca. 37 rays. The ventrals reach posteriorly to a little behind the anus. They are black pigmented which is also the case with  $D^1$ , whereas there is no pigment on the other fins.

The postanal pigment is now obviously altered and in a characteristic way, new elements having appeared. The three primary bars or groups are still present and are a little more pronounced than the remaining postanal pigment. The latter consists chiefly of two groups IIa and IIIa which have appeared behind bars II and III respectively. They are not situated medio-laterally like II and III but dorsally, as can be seen both from Fig. 10 and Fig. 10 a which represents the fish viewed from above. These two postanal, secondary groups IIa and IIIa are very characteristic of the older postlarval stages of the hake. Some few chromatophores in a row have also appeared mediolaterally in front of and behind bar III. The dorsolateral group mentioned under the previous stage as occurring below the beginning of  $D^2$  is still fairly well marked (cf. Fig. 10 a), as is also the large dorsal patch under  $D^1$ .

Pl. I, Fig. 11

**Length: 19 mm.** This specimen does not show any great changes. We notice, however, that the body is steadily becoming more slender. The anus is placed almost under the interspace between  $D^1$  and  $D^2$ . The pigmentation is on the whole as in the stages previously described. The pigment groups appearing in the stages of this size give the fish a characteristic, marbled appearance, but there may be great individual variation in the strength and degree of development of the pigment.

**Length: 26 mm.** The body is slender and the head has already the flat form which is characteristic of the hake. The anus is almost under the interspace between D<sup>1</sup> and D<sup>2</sup>. The caudal fin is long and narrow and its posterior margin is convex. It contains 40 rays. D<sup>1</sup> has ca. 9, D<sup>2</sup> ca. 36 and A 37 rays. Both D<sup>2</sup> and A are slightly concave. The pectorals are still broad, fan-shaped and relatively far back in development, the lower part having only embryonic rays. The ventral fins, which reach some distance behind the anus, contain 7 rays. They are more weakly pigmented than in the earlier postlarval stages. The pigmentation on the body has not essentially changed. Some dorsal pigment has been added, extending from the postoccipital region backwards along the base of D<sup>2</sup>. Pl. I, Fig. 12

**Length: 31 mm.** The body is slender and the head flat just as in older specimens. In the caudal fin there are 40 rays, but the numbers could not be determined in the other unpaired fins as these were contracted and pressed together. The pectorals are considerably narrower and further forward in development than in the preceding stage. The ventrals which reach some distance behind the anus are now only somewhat faintly pigmented. Of the unpaired fins only D<sup>1</sup> is pigmented, D<sup>2</sup>, A and the caudal fin lacking pigment. Pl. I, Fig. 13

With regard to the pigment, the three original bars (I, II, III) and also the two secondary ones (II a and III a) can still be recognised, but as so much pigment has been added they are no longer so prominent as they were before. A broad dorsal streak of pigment is now present, extending from the postoccipital region backwards to the caudal fin. It is broadest in front and consists of numerous, densely placed chromatophores. Further, the postanal pigment has been increased by some ventral or ventrolateral groups posteriorly (behind bar I) and by some few, large stellate chromatophores arranged medio-laterally in a row behind and in front of bar III. Altogether this arrangement of pigment gives the characteristic, marbled appearance already mentioned, which is so unusual in the young of gadoids but reminds one somewhat of what occurs, for example, in young gobies, various young cottoids etc.

The body in front of the anus is likewise densely pigmented; thus the abdominal pigment is very pronounced.

To describe and figure older stages seems superfluous as they so much resemble the adult fish in form, position of the fins etc., that their determination should be an easy matter.

### III. VERIFICATION OF THE DETERMINATIONS

In the ichthyological text-books of KRØYER<sup>1</sup>, DAY<sup>2</sup>, LILLJEBORG<sup>3</sup>, SMITT<sup>4</sup> and MOREAU<sup>5</sup> we find the following numbers given for the vertebræ and fin-rays in *Merluccius vulgaris*.

	Vertebræ, total no.	Vertebræ without hæmal arches	Vertebræ with arches	Rays in D <sup>1</sup>	Rays in D <sup>2</sup>	Rays in A	Rays in ventral
Krøyer				9-10	39-40	39-40	7
Day	51	25	26	10	36-40	36-38	7
Lilljeborg	50-52	24-25		10-11	37-40	37-40	7
Smitt	50-52			9-11	37-39	37-39	7
Moreau				10	36-40	36-38	7

<sup>1</sup> H. KRØYER: Danmarks Fiske, 3 vol., Kjøbenhavn, 1838-53.

<sup>2</sup> F. DAY: The Fishes of Great Britain and Ireland, 2 vol., London, 1880-84.

<sup>3</sup> W. LILLJEBORG: Sveriges och Norges Fiskar, 3 vol., Upsala, 1891.

<sup>4</sup> F. A. SMITT: Skandinavien's Fiskar, 3 vol., Stockholm, 1892.

<sup>5</sup> E. MOREAU: Poissons de la France, 3 vol., Paris, 1881.



The foregoing description shows that the number of fin-rays in these post-larval gadoids agrees well with what is given in the table for *Merluccius*.

Further, I have determined the number of vertebræ in a number of postlarval stages of 10–20 mm. in length. The specimens came from Scotland, the Skager Rak and the north coast of Spain, and the vertebræ were counted after the larvæ had been dehydrated in alcohol and cleared in xylol. The following table gives the numbers (the first indicate the vertebræ without, the second the vertebræ with hæmal arches).

Scotland .....	24/26	24/27	25/25	25/26	25/27	
Skager Rak .....	25/26	25/26	25/26	25/27	26/26	
North coast of Spain.....	24/26	25/26	25/26	25/26	25/27	25/27

We see from this that the number of vertebræ in these postlarval gadoids, which were characterized in external appearance by the three postanal pigment-bars, agrees exactly with the number of vertebræ in the hake and it is worth noting as a special characteristic, that there are almost as many vertebræ in the trunk as in the tail. Generally, the rule amongst gadoids is that there are considerably more caudal vertebræ than abdominal. There can therefore be not the slightest doubt that the series described really belongs to the developmental stages of the hake, especially as we have now gradually learnt to distinguish the postlarval stages of almost all the gadoids living in shallow water in the Northern Atlantic.

#### IV. DISTINCTION BETWEEN THE HAKE AND ALLIED SPECIES IN THE POSTLARVAL STAGES

On the basis of our present knowledge we may group together — for the sake of a summary — the North Atlantic gadoid genera occurring in shallow water in the following manner, according to the appearance of the earlier postlarval stages.

- I. Ventral fins not prolonged ..... *Gadus* (with *Gadiculus*).
- II. Ventral fins prolonged.
  - (1). Pigment behind the anus typically arranged in 3 bars (I, II, III), the most posterior (I) lying near the end of the tail<sup>2</sup>.
    - (a). Ventrals much prolonged, reaching far past the anus,
      - a.* Ventral rays free nearly throughout their entire length, swollen at their tips ..... *Brosmius*.
      - β.* Ventral rays united by a membrane, thin at their tips ..... *Molva*.
    - (b). Ventrals not very much prolonged, not reaching far beyond the anus *Merluccius*.
  - (2). Pigment behind the anus not arranged in 3 bars (I, II, III), the most posterior (I) lying near the end of the tail.
    - (a). No postanal pigment-bars present ..... *Raniceps*.
    - (b). 1 postanal pigment-bar present ..... *Onos*<sup>3</sup>.

<sup>1</sup> Of the species whose postlarval history is not well known, *Phycis blennioides* has <sup>16</sup>/<sub>35</sub> vertebræ, *Raniceps raninus* <sup>11</sup>/<sub>33–34</sub>, *Onos cimbrius* <sup>16–17</sup>/<sub>36–41</sub> (according to LILLJEBORG, l. c.).

<sup>2</sup> In *Molva molva* the most posterior of the 3 postanal bars is wanting but the two others are present and have the typical position.

<sup>3</sup> As far as the species are hitherto known.

As the hake has prolonged ventral fins there can be no question of confusing its postlarval developmental stages with any of the species under the genera *Gadus* or *Gadiculus*.

*Merluccius* is readily distinguished from *Molva molva* even in the earliest stages by the presence of pigment-bar No. I.

From *Molva byrkelange*, *Molva elongata* and *Brosmius brosme*, in which bar I is present, *Merluccius* is distinguished by the fact that bar I is restricted to the tail itself without as in these extending on to the caudal fin (see figures in text), and it further differs in the very plump form of the trunk, especially in the earlier postlarval stages, and lastly in that the ventral fins are by no means so prolonged as in the genera *Molva* and *Brosmius*.

*Merluccius* is distinguishable from *Onos* firstly by having three postanal pigment-bars, secondly by the older postlarval stages lacking the silvery sheen which characterizes the *Onos*-genus (also *Phycis* according to LÜTKEN, FACCIOLA a. o.); and lastly, it is distinguished from *Raniceps*, which in its early postlarval stages reminds one mostly of the species of the *Liparis*-genus, by having the three postanal bars mentioned whereas these are absent in *Raniceps*.

For the rest, we may take as important, general, diagnostic characters of *Merluccius* the plump form of the trunk in the earlier, postlarval stages, specially prominent at sizes between ca. 7 and ca. 15 mm., and in the older stages the pigmentation, which gives the fish a marbled appearance similar to that in the young of certain *Gobius*-species and various cottoids (e. g. *Triglops*) but which seems to be very uncommon in the gadoid group. In the earlier postlarval stages it is as mentioned the position of the 3 postanal pigment-bars which is so very characteristic (I, only on the tail itself and not on the caudal fin and which as a rule is most developed ventrally; II, either medio-lateral or dorsolateral; and III, as a rule mediolateral).

With the exception of the ventrals and the anterior part of D<sup>1</sup> the fins lack pigment even in the older postlarval stages.

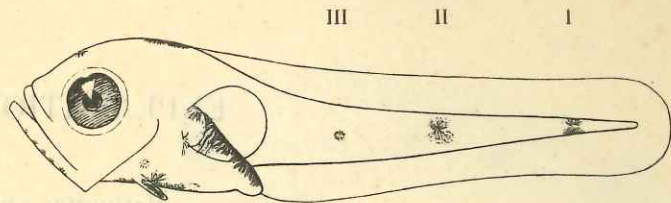


Fig. 1. *Merluccius vulgaris* (Length: 6 mm.)  
(Note that the most posterior bar (I) is quite restricted to the tail without extending on to the caudal fin (cf. figs. 3, 4).)

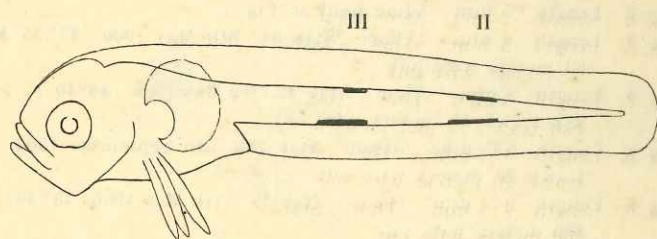


Fig. 2. *Molva molva* (Length: 6 mm.)  
Semidiagrammatic figure, in which the preanal pigment is not shown.  
(Note the absent of the posterior pigment bar I)

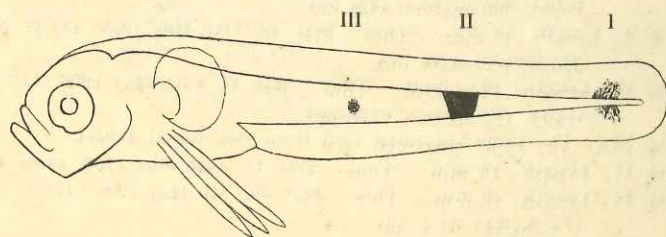


Fig. 3. *Molva byrkelange* (Length: 6 mm.)  
Semidiagrammatic figure, in which the preanal pigment is not shown.  
(Note that bar II is most developed dorsally and that there is no pigment at the end of the notochord.)

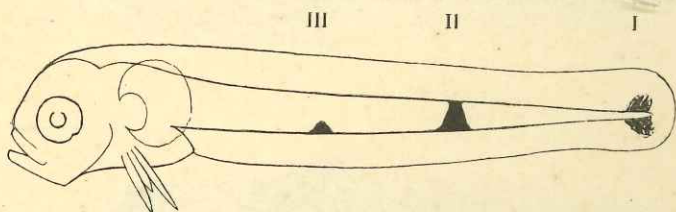


Fig. 4. *Brosmius brosme* (Length: 6 mm.)  
Semidiagrammatic figure, in which the preanal pigment is not shown.  
(Note the short preanal part, that bar II is most developed ventrally and that pigment is present right to the end of the notochord.)

## EXPLANATION OF PLATE

### *Merluccius vulgaris* Flem.

- Fig. 1. Length:  $4\frac{1}{4}$  mm. Irish investigation-steamer "Helga", Stat. S.R. 265, 2nd November 1905.  $51^{\circ}16' N$ ,  $8^{\circ}10' W$  (Ireland). Depth: 54 fathoms. Depth of apparatus: 25 fathoms.
- Fig. 2. Length: 5 mm. Same haul as Fig. 1.
- Fig. 3. Length: 6 mm. "Thor", Stat. 34, 8th May 1906.  $47^{\circ}55' N$ ,  $4^{\circ}52' W$  (Bay of Biscay). Depth: 50 meters. Young-fish trawl, 60 meters wire out.
- Fig. 4. Length: 8 mm. "Thor", Stat. 32, 7th May 1906.  $48^{\circ}40' N$ ,  $5^{\circ}04' W$  (Mouth of the English Channel). Depth: 113 meters. Young-fish trawl, 50 meters wire out.
- Fig. 5. Length:  $8\frac{3}{4}$  mm. "Thor", Stat. 289, 5th September 1904,  $58^{\circ}44' N$ ,  $3^{\circ}21' W$  (N. of Scotland), Depth: 95 meters. Young-fish trawl, 20 meters wire out.
- Fig. 6. Length:  $9\frac{1}{2}$  mm. "Thor", Stat. 39, 11th May 1906,  $43^{\circ}39' N$ ,  $2^{\circ}07' W$  (Bay of Biscay), Depth: 1420 meters. Young-fish trawl, 300 meters wire out.
- Fig. 7. Length:  $10\frac{1}{4}$  mm. "Thor", Stat. 168, 2nd September 1905.  $58^{\circ}42' N$ ,  $6^{\circ}13' W$  (N. of Scotland), Depth: 110 meters. Young-fish trawl 65 meters wire out.
- Fig. 8. Length:  $12\frac{1}{4}$  mm. "Thor", Stat. 39, 11th May 1906,  $43^{\circ}39' N$ ,  $2^{\circ}07' W$  (Bay of Biscay), Depth: 1420 meters. Young-fish trawl, 300 meters wire out.
- Fig. 9. Length: 15 mm. "Thor", Stat. 39, 11th May 1906,  $43^{\circ}39' N$ ,  $2^{\circ}07' W$  (Bay of Biscay), Depth: 1420 meters. Young-fish trawl, 300 meters wire out.
- Fig. 10. Length:  $16\frac{1}{2}$  mm. "Thor", Stat. 41, 14th May 1906,  $43^{\circ}23' N$ ,  $2^{\circ}01' W$  (N. coast of Spain), Depth: 102 meters. Young-fish trawl, 120 meters wire out.
- Fig. 10 a. The same specimen seen from the dorsal aspect.
- Fig. 11. Length: 19 mm. "Thor", Stat. 41, 14th May 1906, same trawl as Fig. 10.
- Fig. 12. Length: 26 mm. "Thor", Stat. 35, 8th May 1906,  $47^{\circ}05' N$ ,  $4^{\circ}26' W$  (Bay of Biscay), Depth: 146 meters. Young-fish trawl, 175 meters wire out.
- Fig. 13. Length: 31 mm. "Thor", Stat. 41, 14th May 1906,  $43^{\circ}23' N$ ,  $2^{\circ}01' W$  (N. coast of Spain), Depth: 102 meters, Young-fish trawl, 60 meters wire out.

**Note.** In the older postlarval stages the outlines of  $D^2$  and A are slightly concave. By the reproduction of the figures they have wrongly been made almost straight.

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## Misprints

Nr. 6, p. 12, line 10 from beneath and p. 21, line 2 from beneath; instead of: shore, read: share.

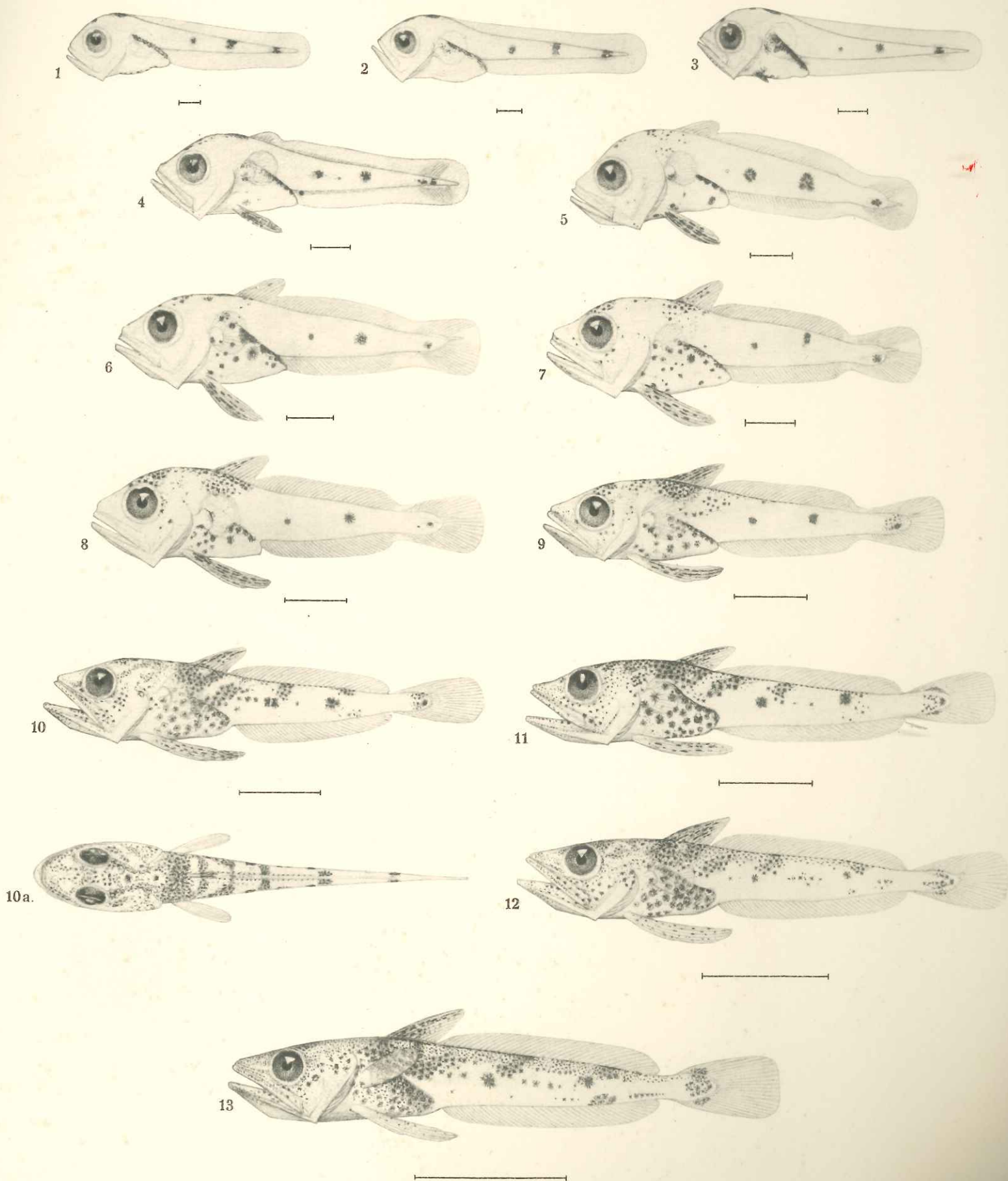


Fig. 1—13 *Merluccius vulgaris* Flem.