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CONTENTS

PELAGIC EGGS AND YOUNG STAGES OF FISHES TAKEN ON THE SOUTH COAST OF IRELAND IN 1967

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INTRODUCTION

Ernest W. L. Holt was one of the pioneers of research on the spawning and early development of marine fishes, and collections of pelagic eggs and young stages of fishes made by him on the west coast of Ireland were the basis of some major contributions to the then young science of fisheries biology (Holt 1891, 1893, 1899). Much more recently Fives (1967a) has worked on pelagic young stages of fishes taken in the plankton on the coasts of Galway and Clare.

Collections of eggs and young stages of clupeoids have been made on the south coast of Ireland in winter during the years 1960-1962 (Burd and Bracken, 1965; Bracken and Kennedy, 1967). Hitherto, however, no collections of eggs or young stages of other fishes appear to have been made on the south coast.

As part of a programme of research by the Inland Fisheries Trust into the biology of the bass, *Dicentrarchus labrax* (L.) in Irish waters, tow-netting for bass eggs was carried out at four centres on the south-east and south coasts of Ireland during the period April to June 1967. Pelagic eggs of a variety of species of fish, including bass, were obtained, as well as larvae, post-larvae and fry. The tow-netting was done close to shore and in estuaries—areas not as a rule sampled as extensively as the offshore waters where the major commercial fishes spawn.

The results of the tow-nettings help, therefore, to fill in some of the gaps in existing data on the reproduction of fishes on the Irish coast.

THE CENTRES

Tow-netting was carried out at four centres in 1967, namely:—(1) The Splaugh Rock, near Rosslare, Co. Wexford; (2) Dungarvan Harbour, Co. Waterford; (3) Youghal Harbour, Co. Cork; (4) Baltimore Harbour, Co. Cork. Their location is shown in Fig. 1. They are all inshore situations, but each has certain distinctive features.

Splaugh Rock

The Splaugh Rock (Fig. 2) is a shallow reef about ¾ mile south-east of Greenore Point, Co. Wexford. This is an area of reefs and sand-banks and swift tides. Clupeoid fry and sand-eels abound and, as a consequence, bass "shoal" there in large numbers.

Salinity determinations were made as follows:—

June 1, 1967	Neaps.	Early ebb (current still running north)	32.1‰
June 2, 1967		Late flood	34.5‰

Dungarvan Harbour

Dungarvan Harbour (Fig. 3) is a shallow bay with extensive sand banks in its outer portion. The inner portion, largely cut off by a long sand-spit, is very shallow and muddy. The small Colligan R. flows into the Harbour through the town of Dungarvan, and a number of small creeks also empty into the Harbour. Sand-eels abound. Grey mullet, bass, flounders, turbot and spur dogfish are the typical fishes, but blue shark are plentiful at the seaward limits of the bay. No salinity determinations were made.

Youghal Harbour

Youghal Harbour (Fig. 4) is the mouth of the estuary of the Cork Blackwater, one of the major rivers of the south coast of Ireland. At the mouth of the Harbour, which is about ½ mile wide, the channel is 3 to 5 fathoms deep. Above the Ferry Point, where the Harbour widens to over a mile, it is much shallower, and there are extensive sand and mud banks. The Bay outside is shallow; the 5-fathom line, at its nearest point, being about 1½ miles from the mouth of the Harbour and the 10-fathom line, 3 miles. Tides in the Harbour are swift and in parts of the Bay are fairly strong.

Salinity determinations were made as follows:—

May 30, 1967	Station 2	Neaps, H.W.	33.7‰
do.	do.	4 hours of ebb	24.35‰
do.	do.	L.W. .....14.35‰	
June 8, 1967	Station 4	Springs, Half ebb.....	31.1‰
do.	do.	L.W.	10.2‰

The May 30 determinations were made following a month of wet weather, with intermittent floods in the R. Blackwater. The June 8 determinations were made following a week of anticyclonic weather.

Baltimore Harbour

Baltimore Harbour (Fig 5) is a natural harbour through which the estuary of the R. Ilen discharges to the sea. There are numerous islands, large and small, in the Harbour, and at its mouth. In the inner part of the Harbour, in the Ilen estuary, there are extensive areas of mud and sand which dry out at low water but in the outer part of the Harbour there are depths of up to 6 fathoms. In a channel to the west of Spanish Island there are depths of up to 10 fathoms. In Baltimore Bay, into which the Harbour opens between the mainland and the eastern tip of Sherkin Island, the water deepens rapidly to over 20 fathoms.

Salinity determinations were made as follows:—

June 6, 1967	Station 1	Springs, H.W.	33.95‰
June 7, 1967	Station 2	,, H.W.	35.5‰

THE RESULTS OF TOW-NETTING

Table 1 lists the hauls made and the eggs and young stages of fishes taken in each; while Table 2 summarises the results by types of eggs or young stages captured.

Each series of hauls represents 1 to 2 hours' fishing with a standard marine zooplankton tow-net. Some of the hauls were made at varying depths down to 3 metres (series 1—5) or 2 metres (series 8—14), while the remainder were all surface hauls. In slack water the hauls were made from a slowly-moving boat. When tides were swift the boat was either anchored or driven just fast enough to stem the tide. The net was left out for ten minutes to an hour at a time, depending on the amount of plankton present. When the net was hauled its contents were inspected, portion by portion, in a "viewer" made in the form of a miniature, narrow tank out of two sheets of perspex measuring 18 x 9 cm, with narrow strips of 1.2 cm thick perspex cemented between them at the sides and bottom. All eggs which could be detected were removed with a pipette and transferred to small jars of sea water. Any advanced post-larvae or fry which appeared undamaged were also removed and retained alive. Formalin was then added to the remainder of the sample to preserve the invertebrates, any undetected eggs, and any fish larvae present (usually slightly damaged and, therefore, unlikely to survive.)

When samples of live eggs were brought back to the laboratory, they were sorted, classified, and put in Petri dishes of sea water. Examples of each type were measured by eyepiece micrometer and described. When the eggs hatched examples of the larvae were anaesthetised with MS 222 and placed in watch glasses of water on the horizontal stage of a Bausch and Lomb microprojector. Tracings were made directly from the projected image and measurements were made by superimposing on the tracing the projected image of a stage micrometer. The specimens were then preserved for future reference. Other examples were reared for as long as possible, and drawings made of later larval stages where practicable. There were no facilities for rearing to the post-larval stage, as it was not feasible to collect or maintain adequate supplies of suitable plankton. However, advanced post-larvae brought to the laboratory alive were in some instances kept in aquarium tanks for varying periods.

Any larvae which died in the laboratory became shrunken and distorted, presumably as a result of osmotic dehydration. In extreme cases they shrank to nearly half their original size. In the figures of young stages of fish in this paper, the specimens illustrated are described variously as *live, recently-dead,* or *preserved.* "Live" indicates that the drawings were made from live, anaesthetised examples. "Recently-dead" indicates that the specimens were moribund but their tissues were still clear when the drawing was made. Some shrinkage and distortion may therefore have occurred but it is unlikely that the dimensions or shape of the specimens have greatly altered. "Preserved" indicates that the drawings were made from material to which formalin

had been added after inspection of a haul. When this was done at once little shrinkage is likely but samples to which preservativ was not added until some time had elapsed may have shrunk somewhat. This is noted where it applies. Damaged specimens were drawn as viewed and no reconstructions or restorations were attempted.

EGGS AND YOUNG STAGES OF FISHES COLLECTED

Clupeoids

Post-larvae of clupeoids were present in varying amounts in six out of the thirty series of hauls. They were not critically examined, as the early development stages of the sea-spawning species found in British and Irish waters have been described and figured in detail in the literature.

The winter-period herring larval surveys of 1960-1962 showed that there was a substantial winter spawning of sprat, *Sprattus sprattus* (L.), on the south coast of Ireland. Only small numbers of eggs and post-larvae of pilchard, *Sardina pilchardus* (Walbaum), were taken and post-larvae captured in January had fully-formed fins suggesting an earlier spawning than in the case of the sprat (Bracken and Kennedy, 1967). A single sprat egg was present in haul 17 (Youghal Harbour, May 18, 1967) but large numbers of eggs of both sprats and pilchards were taken in haul 30 (Baltimore, Station 2, June 7, 1967) indicating a summer spawning of both these species in at least one section of the area covered by the 1960-1962 winter surveys.

Syngnathus rostellatus, Nilsson

This species of pipefish was not distinguished in the past from the larger *S. acus* L. It has previously been identified from Blacksod Bay (Wheeler, 1957) and from Mornington (Boyne estuary), Howth and Passage East (Bracken and Kennedy, 1967). A fry, 2.5 cm long, was taken in a surface haul (No. 30) at Baltimore on June 7, 1967. It was kept alive for some time. In life it looked like a piece of black thread, with some pale transverse bands at widely spaced intervals. The swim-bladder was very large, distending the abdominal region. After death the melanophores contracted to small, round, separate spots and it became almost white.

"Gadus" spp.

The former genus *Gadus* has now been split into a number of separate genera. Six of the species commonly occur as O-group fry in shallow water along the shore, namely:—

Cod, *Gadus morhua* (L.)
Pollack, *Pollachius pollachius* (L.)
Coalfish, *P. virens* (L.)
Pouting, *Trisopterus luscus* (L.)
Poor Cod, *T. minutus* (L.)
Whiting, *Merlangius merlangus* (L.)

In some areas, e.g. Dublin Bay, the small fry of all six species are frequent in the shallows; in other areas pollack and/or coalfish are of most frequent occurrence.

Post-larval *"Gadus" spp,* 30 in all, occurred in six different hauls. They ranged in length from 2.2 to 7.8 mm and were of several different types. They were not critically examined, as the early development stages have been described and figured in detail in the literature.

Raniceps raninus (L.) Lesser forkbeard or tadpole-fish.

Holt obtained eggs on the west coast of Ireland (Holt, 1891) and later at Plymouth (Holt, 1897) which he tentatively ascribed to the greater forkbeard, *Phycis blennoides* (Brünnich) (Holt, 1899). These eggs, which had a small oil-globule, yielded larvae characterised by a bold pattern of vivid yellow pigment. Ehrenbaum (1905-1909) subsequently obtained similar eggs at Heligoland. He, however, attributed them to the lesser forkbeard, *Raniceps raninus* (L.). Hefford (1910) obtained further eggs at Plymouth and he also attributed them to *R. raninus.*

The lesser forkbeard is a northern species not found in the Mediterranean. It frequents inshore waters. It is infrequently captured but this is probably because of its small size and the fact that it lives on rough ground beyond tide-marks rather than because of genuine scarcity. It has been recorded on a number of occasions from various parts of the Irish coast and it has been caught in lobster pots and, on one or two occasions, by shore anglers. The greater forkbeard, a much larger fish, is more southern in its distribution and occurs in the Mediterranean though it is not abundant there. It is on the whole a deep-water species and is rarely taken close to shore. Its capture in Irish waters is erratic. Occasional solitary specimens are recorded, though on one occasion large numbers were taken together in a trawl on the south-west coast (O'Riordan, 1961, 1962).

The places where eggs of the type under consideration have been taken—the west coast of Ireland, Heligoland and Plymouth—are places where the lesser forkbeard occurs. The eggs have been taken inshore where this species is found. This type of egg has not been recorded from the Mediterranean where the greater forkbeard occurs but the lesser forkbeard is unknown. It seems likely therefore that the eggs belong to the lesser forkbeard, as was believed by Ehrenbaum (1905-1909) and Hefford (1910), rather than to the greater forkbeard as suggested by Holt (1899). This is also the view of D'Ancona (1933). In the Naples Monograph in the section on *Phycis blennoides,* he says that Holt had "doubtfully attributed to *Ph. blennoides"* the eggs which the latter obtained at Plymouth between June 30 and August 28, 1895. D'Ancona goes on to refer to Kyle's description of ripe ovarian eggs of an example of *P. blennoides* taken at Banyuls-sur-Mer in May 1898, which were 0.80 to 0.88 mm in diameter, devoid of an oil-globule, and very similar to those of the poor cod, *Trisopterus minutus* (L.) though a little bigger. Marion (1894) believed that gadoid larvae 2.0 to 2.2 mm long, which were taken in the Mediterranean and which lacked an oil-globule in the yolk-sac, were larvae of the greater forkbeard.

Three eggs as described by Holt (1891,1897, 1899), Ehrenbaum (1905-1909) and Hefford (1910) were taken on the south coast of Ireland during the present investigations. They were obtained at Youghal (Station 2, haul 24) early on the ebb tide on June 1, 1967, at Baltimore on June 6, 1967, and again at Baltimore on June 7, 1967. One of these eggs measured 0.925 mm in diameter, with an oil-globule of 0.17 mm. The other two eggs were approximately the same size. All three eggs were hatched out in the laboratory within 2 to 4 days of capture. In the advanced embryo bright lemon-yellow pigment is developed on the body and in a band on the tail, giving the egg a very distinctive appearance. Dimensions for previously recorded eggs are as follows:—

Holt: West Coast of Ireland	: 0.775 mm	Oil-globule	0.14 mm
Holt: Plymouth	: 0.78—0.91 mm	„ „	0.15—0.17 mm
Ehrenbaum: Heligoland	: 0.75—0.91 mm	„ „	0.14—0.19 mm
Hefford: Plymouth	: 0.78—0.84 mm	„ „	0.145—0.165 mm

A recently-hatched larva (Fig. 6, A) was 2.7 mm long. The oil-globule was posteriorly located in the yolk-sac, and the gut ended close behind the yolk-sac. The vent had not yet split the marginal fin. On the head, body and anterior two-thirds of the tail, fine, ramifying greyish melanophores were developed. The bright, diffused, lemon yellow pigment was distributed over most of the head and body, on the oil-globule, and on the anterior third of the tail. In addition there was a yellow band across the tail about two-thirds of the way back. Patches of yellow occurred posteriorly on the yolk-sac and on the marginal fin behind the oil-globule. On the marginal fin behind the head there was a conspicuous splash of yellow associated with which was a dendritic melanophore.

The larva illustrated in Fig. 6 A was a little more advanced than a larva figured by Holt (1899). The latter, presumably from a small egg, measured only 2.02 mm and its head was bent down over the front of the yolk-sac. The present example was a little longer than a 12-hour old larva measuring 2.68 mm from the west coast of Ireland which Holt (1891) listed as "Species VIII". However, its snout did not project so far and it lacked a small projection of the marginal fin at the pigment splash behind the head, which was present in Holt's example. Ehrenbaum (1905-1909) gives the length of a recently-hatched larva as 2.9 mm. This was hatched from an egg measuring 0.85 mm from Heligoland.

Attempts were made to rear the other two larvae but unsuccessfully. Both died after a few days and became distorted and shrunken. However, the egg taken at Youghal on June 1, which contained an advanced embryo when examined on June 2, hatched over the week-end (June 3/4). Examination of the living specimen on June 6 showed that the eye was pigmented and that the yolk had been largely absorbed. The body had become not only deep but thick, so that in dorsal view the little fish had the somewhat tadpole-like appearance characteristic of

young lumpsuckers, *Cyclopterus lumpus* L. and dragonets, *Callionymus* spp. The bright yellow pigment was diffused generally over the head and body, over the vent, and for a short distance over the anterior part of the tail. The pigment splash on the marginal fin behind the eye was still conspicuous. The yellow cross-band, far back on the tail, was also still present and, in addition, there was a yellow patch on the ventral part of the tail some distance in front of the cross-band. The pectoral fins were yellow with black rays. The specimen was not measured as it was extremely active. It appeared, however, to be a little over 3 mm long. In general appearance it resembled the early post-larva, 3.0 mm long, shown in Ehrenbaum's figure 104 C, hatched from an egg from Heligoland.

Ehrenbaum (1905-1909) figures a planktonic post-larva of 7 mm from Heligoland, and also young specimens of 9.5 and 12.25 mm taken by Schmidt in 80 metres south-west of Ireland and in 72 metres off the Scilly Isles. A post-larva 4.5 mm long was taken in the plankton in Quinsheen Bay, Co. Galway (Fives, 1967 a).

Rocklings

The pelagic eggs of rocklings are of common occurrence in plankton hauls from April to August. They are very small (some are as small as 0.6 mm) and they contain a single oil-globule. In addition to the oil-globule there is a curious refractive patch in the yolk, (McIntosh and Masterman, 1897). It was at one time believed that only three species of rocklings occurred in British and Irish waters, namely the 3-bearded rockling, *Gaidropsarus vulgaris* (Cloquet), the 4-bearded rockling, *Rhinonemus cimbrius* (L.), and the 5-bearded rockling, *Ciliata mustela* (L.). Earlier workers distinguished three main types of rockling eggs and larvae, which they ascribed to the three known species of British and Irish rocklings (McIntosh and Masterman, 1897). However, it is now known that the number of species of rockling is greater than was believed. At least five species occur in Irish waters (Wheeler, personal communication). In addition to the three species mentioned above, the Irish rocklings include *Gaidropsarus mediterraneus* (L) which is an inshore species and *Ciliata septentrionalis* (Collett) which is offshore in habitat (Wheeler, 1965). Until detailed descriptions of eggs and young stages of known parentage are available for more than one or two species of rocklings, it would be futile to attempt to diagnose material taken in tow-nets. Acordingly no attempt was made to bring to species the eggs of rocklings taken during the present investigations.

Of a total of 657 pelagic fish eggs obtained during the period April to June 1967, 406 were eggs of species other than clupeoids. Of the non-clupeoid eggs 252 (62 per cent) were eggs of rocklings. The rockling eggs varied in diameter from 0.6 to 0.75 mm. Some had yellow oil-globules and some had colourless oil-globules. It is more than likely that more than one species of rockling was involved. Fig. 6 B to E shows examples of larvae hatched from the eggs. Fig. 6 B illustrates one of the larger types of larvae. This example on hatching measured 2.1 mm and was characterised by extensive dark pigmentation. At lower magnifications the pigmentation appeared somewhat

diffused and charcoal in tint. At higher magnifications the pigmentation was seen to consist of extensive ramifying melanophores which were locally aggregated to form blackish patches within the dark areas. In the smaller types of larvae the dark pigment was more localised in distribution and the melanophores more discrete. The oil-globule was yellow in some larvae, but otherwise the rockling larvae were devoid of coloured pigment.

Two post-larval rocklings measuring 4.2 and 4.7 mm were taken at Youghal on May 18 (haul 17) and they are illustrated in Figs. 6 F and G.

Dicentrarchus labrax (L.) = *Morone labrax* (L.). Bass

Captures of bass eggs during the 1967 survey and larvae hatched from them have been described in detail elsewhere (Kennedy and Fitzmaurice, 1968). Only brief mention of them is made here in order to complete the record.

A total of 25 bass eggs was obtained at stations 2 and 3 in Youghal between May 8 and June 1, 1967. They were taken on the flood tide, at high water and on the early ebb. A total of 6 bass eggs was taken at the Splaugh Rock on June 1 and 2, 1967. Bass eggs had not previously been taken in tow-nets on the Atlantic coasts of Europe. The eggs obtained ranged in diameter from 1.20 to 1.39 mm. The oil-globule measured 0.36 to 0.42 mm. The Irish bass eggs were thus larger than eggs described from the Mediterranean by Raffaele (1888) and Bertolini (1933) but were smaller than eggs spawned by bass in the tanks of the Plymouth Aquarium and described by Jackman (1954). Fig. 7 A shows a larva less than 12 hours old and measuring 4.45 mm which was hatched from one of the bass eggs taken at Youghal. The Irish larvae differed from those from the Mediterranean described by Bertolini (1933) in that the pigment by reflected light was brownish-yellow rather than clear yellow. At lower magnifications the combination of black and coloured pigment in the Irish material produced a grey-green effect by reflected light.

Ctenolabrus rupestris (L.) Goldsinny Wrasse.

The goldsinny is a small wrasse which, like other small fish frequenting rough ground beyond tide-marks, is probably much commoner than its infrequent capture would suggest. The eggs of the goldsinny, which are pelagic, have been taken on the west coast of Ireland (Holt, 1891) and have frequently been taken in tow-nets in inshore waters at Plymouth (Holt, 1897; Holt and Scott, 1897-1899; Hefford, 1910). The spawning period is prolonged and the eggs occur in the plankton during many months of the year. During the 1967 survey a total of 70 eggs of this species was taken in hauls series 1, 2, 4, 15-21, 23, 24, 26, 30, in addition to 12 young larvae taken in hauls 2 and 7.

Eggs taken during the 1967 survey ranged in diameter from 0.87 to 1.00 mm. They had a small perivitelline space, a simple yolk and

lacked an oil-globule. During incubation little specks of black pigment developed along the body and tail of the embryo. No coloured pigment was developed. Fig. 7 B shows a larva less than 12 hours old measuring 2.9 mm from an egg taken in Youghal Harbour on May 18. It was glass-clear with specks of black pigment but was still devoid of coloured pigment. The eye lacked pigment, as was also the case in all the other larvae of this species which were examined.

In this last connection there appears to be an error in the Naples Monograph. Neither Ehrenbaum (1905-1909) nor Hefford (1910) refer to pigment in the eye of the recently-hatched larva. Sparta (1956) in his description of *C. rupestris* (pp 593-4) reproduces Ehrenbaum's figure of a recently-hatched larva 2.2 mm long, in which no pigment is indicated in the eye. However, in his key to the eggs of wrasse (p 597) Sparta gives as an embryonic character—"eye pigmented". Pigmentation in the eye before hatching is a character of some of the wrasses which have a demersal egg and a long incubation period but not of genera, such as *Coris*, which have a pelagic egg and a short incubation period.

A total of 67 larvae and post-larvae were taken in plankton hauls in Killeany Bay, at Carricknamacken and in Kilkieran Bay on the west coast of Ireland (Fives, 1967 a).

Sand-eels

Four species of sand-eels have been recorded from the Irish Sea (Molloy, 1966) and five species from the west coast of Ireland (Fives, 1967 b). The eggs are demersal and are buried in the sand. The larval and post-larval stages are pelagic. A key to the young stages has been published by Macer (1967).

Two sand-eel eggs were taken in a tow-net haul at station 6 in Dungarvan Harbour (off the tip of the Cunnigar sand-spit) on May 16, 1967 (haul 15). They were presumably scoured out of the sand by the swift tide. A post-larval sand-eel was present in haul 4 at Dungarvan on April 16.

Trachinus vipera Cuvier. Lesser Weever

The adult lesser weever is common in shallow, sandy situations in many places. The egg, larva and early post-larva have been described and figured by Holt (1891) and his figures have been reproduced by McIntosh and Masterman (1897).

During the 1967 survey, 7 lesser weever eggs were taken in three hauls, viz., Dungarvan, station 6, May 17 (haul 16); Youghal, station 2, May 31 (haul 24) and Splaugh Rock, June 1 (haul 26). The eggs and larvae hatched from them agreed in general with published descriptions, but there were some differences in detail. The eggs, which are pelagic, have been described as being 1.25 to 1.37 mm in diameter and containing 11 to 30 small oil-globules "of a greenish-yellow hue". They

take 9 to 11 days to hatch. Holt refers to pale yellow pigment, in minute round flecks, in the developing embryo, later becoming stellate and a brilliant orange. The yellow colour, except for touches on the marginal fin, is stated to disappear by the post-larval stage.

One of the lesser weever eggs taken in the 1967 survey measured 1.34 mm and the others were about the same size. The oil-globules in all the examples were not greenish-yellow but a rich, deep gold by both transmitted and reflected light. This was also the colour of the globules in the yolk-sac of the larvae. Eggs which were in an early stage of development when netted took up to 9 days to hatch, as against 3 to 4 days for bass eggs of the same size taken during the same period.

The newly-hatched larva, as has been pointed out by other workers, is in a relatively very advanced condition, with pigmented eyes and well-developed pelvic fins. Fig. 7 C shows a larva less than 12 hours old and 4.0 mm in length. From Holt's figure and description it differs in the rich gold colour of the oil-globules in the yolk-sac, in the more extensive development of black pigment on trunk and tail, in the development of patches of black pigment in the thoracic region and on the yolk-sac and in the absence of any coloured chromatophores, other than in two touches on the dorsal edge of the marginal fin and one touch on the ventral edge. The pigment in these touches was light grey by reflected light and brown by transmitted light.

Scomber scombrus L. Mackerel

The main spring spawning of mackerel takes place in deep water off the south west coast of Ireland.

During the 1967 survey, two mackerel eggs were taken at station 2 in Youghal Harbour on May 18, one at high water and the other on the early ebb. This was a period of neap tides. When examined at mid-day on May 19 both eggs contained advanced embryos. The eggs measured 1.20 mm in diameter; the oil-globule in one measured 0.25 mm and in the other 0.32 mm. There were melanophores distributed along the trunk and tail of the embryos and some on the oil-globule. The globules were clear, not "cloudy" or "smoky" as some workers have reported. Behind the eyes of the embryo and on the protoplasmic "stalk" conecting the oil-globule to the yolk-sac there were patches of pigment, which were grey brown by transmitted light, but vivid green by reflected light.

The eggs hatched during the night of May 19. Fig. 8 A shows one of the larvae as it appeared at noon on May 20. It measured 4.55 mm, the eye was unpigmented and the vent had not as yet quite reached the edge of the marginal fin. It was glass clear, as was also the oil-globule. The distribution of the melanophores differed somewhat from those in Holt's (1893) figure which is reproduced by McIntosh and Masterman (1897). The melanophore distribution, however, differed somewhat in the two larvae. The most striking features were the pig-

ment patches behind each eye, and on the posterior aspect of the oil-globule. As in the embryo, the pigment was grey-brown by transmitted light but vivid green by reflected light.

The nature of the coloured pigment in the embryo and larva appears to have been the subject of some confusion in the literature. McIntosh and Masterman, discussing the embryo, say: "At this stage (5th day) bright green pigment in patches occurs, first behind the eyes and on the tail, near the oil-globule. This pigment and the absence of all yellow colour would at once distinguish the species from any of the gadoids or pleuronectids. Holt described the pigment as of a yellow colour by reflected light and in a later paper Cunningham explained the "green" appearance as being due to the admixture of black and yellow chromatophores. This is not a surprising result when we recollect that the black pigment in this species is of a "blue-black" tint. The green appearance does not lose diagnostic value on account of its being only an effect and not due to the presence of actual pigment. By transmitted light Holt found that the yellow pigment appeared to be 'reddish-brown' ".

The green pigment often seen on the back of an adult mackerel is a texture colour due to the juxtaposition of black and yellow chromatophores. Reference has been made above to the grey-green effect produced, at lower magnifications, by combinations of black and yellow —brown pigments in larval bass. In the mackerel larvae examined, however, no trace of black could be detected in the green pigment patches at magnifications of up to 50 diameters.

The capture of mackerel eggs in the estuary at Youghal, even at high water, was somewhat unexpected. According to Cunningham (1896), however, the incubation period lasts 6 days at a mean temperature of 14.5°C. Surface temperatures at Youghal in mid-May 1967 were lower than this. The eggs could, therefore, have drifted some distance between spawning and capture. Nevertheless, it seems likely that some sporadic spawning by mackerel may take place close to land on the south coast.

Gobies

The former genus *Gobius* has now been split up into a number of genera and sub-genera. Ten or more species of gobies occur in Irish waters. Some are rare or local but others are common and widely distributed (O'Riordan, 1965). The eggs of gobies are demersal and are deposited in empty shells and are guarded by the male. The larval and post-larval stages are pelagic and are of common occurrence in inshore waters. The fry of the freckled goby, *Pomatoschistus* (*Pomatoschistus*) *minutus* (Pallas) do not become demersal until they attain a length of about 14 mm while the two-spotted goby, *Chaparrudo flavescens* (Fabricius), even as an adult, swims clear of the bottom (Bracken and Kennedy, 1967).

During the 1967 survey a total of 17 post-larvae were taken in hauls

6, 12, 13, 15, 18 and 28. The length-range was 3.3 to 5.5 mm, and more than one type was present but the material was not critically examined.

Dragonets (*Callionymus spp*)

Three species of dragonets occur in Irish waters, namely *Callionymus lyra* L., *C. maculatus* Rafinesque and *C. reticulatus* Valenciennes. Of these species, *C. lyra*, the common dragonet, is much the commonest and most widely distributed. The eggs and young stages have been described and figured by Holt (1893).

A total of 16 *Callionymus* post-larvae were taken during the 1967 survey. They occurred in hauls 18, 26 and 27 (all surface hauls) and ranged in length from 2.5 to 6.2 mm. They formed part of the preserved material and were not critically examined, as descriptions of young stages of species other than *C. lyra* were not to hand. In addition 3 small fry were taken in a surface haul (No. 26, Splaugh Rock, June 1) and these were brought back alive to the laboratory. They were kept in tanks for some weeks. One measured 10 mm on capture and was identical with the specimen shown as No. 8 on Plate VII by McIntosh and Masterman (1897). The two others were 15 mm long and were broader anteriorly, without conspicuous bands of pigment.

When the fry were first put into an aquarium tank, they only occasionally descended to the bottom. Mostly they hovered in the water. The stream of air from the diffuser in the tank created appreciable horizontal as well as vertical currents. The fry used their pectoral fins to counteract the current, and spread their large pelvic fins out sideways and slightly angled to provide lift—a method of maintaining position in the water not noted in other species. After a week or two the young dragonets went to the bottom and thereafter they spent most of their time there. They proved surprisingly aggressive and repeatedly attacked and eventually killed other fish kept in the tank with them, including some flatfish bigger than themselves.

Atherina presbyter Valenciennes. Atherine or Sand-Smelt.

The atherine produces large eggs with adhesive filaments which are attached to weeds, including eel-grass (*Zostera*). The spawning period in Ireland appears to be June and July (Bracken and Kennedy, 1967). The larvae are large and relatively advanced on hatching. The young stages have been figured by Holt (1899).

No young stages were taken in tow-nets during the 1967 survey but on July 25, 1967, numbers of small fish were seen swimming near the surface in two rock pools at St. Helen's Harbour, Co. Wexford. The fish in one pool were bigger than those in the other. Examples were captured in both pools with a hand-net and proved to be post-larvae of *Atherina presbyter*, the only species recorded from Ireland. They ranged in length from 10 mm to 18 mm. An example, 11.5 mm long,

is shown in Fig. 8 B. It was transparent with diffused yellow pigment on the head and dorsum and a good deal of pigmentation in the body cavity region. The melanophores on the head and thoracic regions were very large and some were rosette-like. The caudal fin was terminal in position and rays were developing in the anal fin. No dorsal fin rays were developed and there was no trace of pelvic fins. A remarkable feature is the anterior position of the vent and its wide separation from the anal fin. As development proceeds the vent moves progressively further back. This is discussed in some detail by Holt (1897-99).

Sea Scorpions

The former genus *Cottus* has now been split up. Two species of sea scorpions are common in Irish waters, namely:—

(1) *Taurulus bubalis* (Euphrasen). Long-Spined Sea Scorpion.

(2) *Myoxocephalus scorpius* (L.). Short-Spined Sea Scorpion.

The eggs, which are demersal and adhesive, are deposited in clumps amongst rocks and weeds and are guarded by the male. Descriptions of the young stages of both species have been published by Holt (1893). In the post-larval stage the upper part of the body cavity region is yellow sprinkled with rather large stellate melanophores, producing a rather striking leopard-skin waistcoat effect. Two post-larval sea scorpions, in which even in the preserved condition this feature was conspicuous, were taken in tow-nets hauls at Dungarvan in 1967. One was obtained on April 16 (haul 4) and the other on the following day (haul 7).

Liparis montagui (Donovan). Sea Snail.

Two species of *Liparis* have been recorded from Ireland. One *L. montagui* (Donovan) is common and widely distributed and frequents shallow water and tide pools. The other, *L. liparis* (L.), which is a more northern species and, in our latitudes, is essentialy sub-littoral in habitat, is much less frequently taken (Bracken and Kennedy, 1967).

The eggs of *L. montagui,* which are demersal and stick in clumps to zoophytes and weeds, have been known since the beginning of systematic research into the reproduction of marine fishes. They have, on occasions, been mistaken for herring eggs. The spawning period of *L. montagui* is prolonged.

A late larval or early post-larval stage was taken at Youghal on May 8, 1967 (station 3, haul 9). It measured after preservation only 2.7 mm, though it did not appear to have shrunk appreciably. McIntosh and Masterman (1897) give the newly-hatched larval length as 4.5 mm (though elsewhere they refer to larval forms of less than 4 mm taken in October). However, a larva from the west coast of Ireland (Fives, 1967a) measured only 3.25 mm. There may therefore be a good deal

of variation in size. The Youghal example possessed the large, rounded, finely-speckled pectoral fins characteristic of the young stages. The hinder part of the abdomen was also finely speckled. There were some scattered melanophores on the trunk superiorly, as well as a series of melanophores along nearly the whole of the ventral edge of the tail.

Topknots.

The topknots are small flatfishes which appear to have a preference for rough ground. Their capture, either in trawls or on hook and line, is, therefore, infrequent. Consequently it is difficult to get any real idea of their actual abundance. In some areas they are probably not as scarce as the very few records of their occurrence might seem to suggest.

Three species have been recorded from British and Irish waters namely, the common topknot, *Zeugopterus punctatus* (Bloch), Ekstrom's topknot, *Phrynorhombus regius* (Bonnaterre) = *Zeugopterus unimaculatus* Day and the Norway topknot *Phrynorhombus norvegicus* (Günther) (Went, 1957; O'Riordan, 1965). There has been a good deal of confusion in the literature as to the identity of eggs and young stages of topknots. The actual position appears to be as set out in Table 3.

During the 1967 survey, eggs and young stages of topknots were taken on several occasions.

Haul 19, (Youghal Harbour, May 30) included an egg measuring 1.04 mm, with an oil-globule of 0.18 mm. The developing embryo had both black and yellow pigment and resembled that of other topknots presently to be described. The dimensions suggest *Z. punctatus* but it died before hatching and therefore its identity could not be confirmed. Two post-larvae were taken at Dungarvan in Hauls 6 and 7 on April 17. They are shown in Fig. 9 D. and E. Both were damaged and possibly shrunken. One measured 3.0 mm, the other, with part of its tail missing, 2.9 mm. The dark touches on the marginal fin identified them as *Z. punctatus*.

A total of 37 other topknot eggs were taken in hauls 8, 15-19, 24, 26 at Youghal, Dungarvan, and the Splaugh Rock (one only at the Splaugh). These eggs were all much the same size measuring 0.86 mm, with an oil-globule of 0.13 to 0.14 mm. The developing embryo was characterised by specks of black pigment and by widely distributed yellow pigment, at first speck-like, later diffused.

Fig. 9 A shows a newly-hatched larva from one of these eggs. It was 2.3 mm long. Yellow pigment (diffused at fairly high powers of magnification) was generally distributed over head, trunk and tail (except for its tip). The oil-globule was yellow. Black pigment occurred as minute specks scattered over the oil-globule, yolk-sac and marginal fin. The yolk-sac was very large. Many other larvae hatched and examined were essentially similar.

Fig. 9 B shows a slightly damaged larva in a more advanced condition with pigmented eyes. It was 2.8 mm long. The black pigment, now more widely distributed on the marginal fin, is still speck-like on yolk-sac, body and fin, but the yellow pigment is becoming aggregated into spots and touches. While there was a tendency for the yellow pigment on the marginal fin to be grouped along its edge, there was no "fringe" of black or yellow chromatophores such as is characteristic of *P. norvegicus*. Other advanced larvae examined were essentially similar. None showed any trace of the epidermal network referred to by Holt (1893), which was probably a morbid condition, though he doubted this at the time.

The eggs in question were too small to be those of *Z. punctatus* and the later larvae showed no signs of developing the black touches on the marginal fin characteristic of that species. The speck-like character of the melanophores, and the absence of a "fringe" on the marginal fin, do not fit *P. norvegicus*. In both size and pigmentation the early larvae, however, are in close agreement with Holt's description of the larvae of *P. regius*. It seems likely, therefore, that the whole series of topknot eggs (other than the 1.04 mm example in haul 19), were those of Ekstrom's topknot, *P. regius*=*Z. unimaculatus*.

Ten topknot larvae taken in hauls 2 and 7 at Dungarvan in April 1967, appeared also to be *P. regius* but they were rather badly damaged and could not be diagnosed with certainty.

In April and May, 1968 some eggs of the type attributed in 1967 to *P. regius* were taken in tow-nets in Cork Harbour, and one of the young fish hatched from them was reared to the post-larval stage. Post-larvae 2.85 mm and 4.1 mm long which appeared to belong to the same series were present in preserved material from tow-net hauls made in Cork Harbour in May 1968. These young stages and other material obtained in 1968 will be described elsewhere.

Limanda limanda (L.). Dab.

A semi-metamorphosed post-larva of the dab was taken in a surface tow-net haul (haul 30) at Baltimore on June 7, 1967. It was kept alive until its metamorphosis was completed. When compared with young soles and flounders of about the same stage of development it appeared much paler and more transparent.

Platichthys flesus (L.). Flounder.

Flounder post-larvae in varying stages of metamorphosis were taken in hauls 1, 8, 12 and 13. Most of them were kept alive until they had completed their metamorphosis.

Microstomus kitt (Walbaum) = *Pleuronectes microcephalus* Day. Lemon Sole.

An egg of this species was taken in the tow-net at Station 2, Youghal Harbour, on the flood tide on May 9, 1967 (haul 13). A larva was

hatched from it and kept alive for some days. The close agreement of the early and later larval stages with figures 6 and 8 of Plate XV in McIntosh and Masterman (1897) left little doubt as to its identity.

Solea solea (L.). Common Sole.

Detailed descriptions of the early development stages have been given by various workers including Ehrenbaum (1905-1909) and Padoa (1956). Metamorphosing post-larvae of the common sole in a fairly advanced stage were taken in hauls 13 and 20 (Youghal, 9 May and 30 May) while a symmetrical post-larva 7 mm long was taken in a surface haul at the Splaugh Rock on June 2 (haul 28). This was kept alive until it had completed its metamorphosis.

Buglossidium luteum (Risso). Solenette.

Descriptions and figures of the early development stages of this species are given by Ehrenbaum (1905-1909). On June 2, 1967 a symmetrical post-larva of this species, a little over 6 mm long, was taken in a surface tow-net haul at the Splaugh together with a similar post-larva of the common sole (see above). It corresponded more or less to Ehrenbaum's figure 65 e, but was a little more advanced in that the permanent tail-fin was already nearly terminal. It was yellow in colour, with a beautiful pattern of blackish-brown stellate melanophores on head, trunk and tail. It had a well-developed swim-bladder and, when transferred to a tank, it swam up in the water and on an even keel. It swam mainly with its pectorals, though sometimes with undulations of its body and flexed its body considerably before snapping at food (live brine shrimp larvae). By June 6 it occasionally descended to the bottom where it rested on its left side, though when swimming it still did so in the vertical position. The post-anal region of the body was deepening but the eyes were still on opposite sides of the head. By June 13 it was typically sole-like in outline and spent nearly all its time on the bottom. When it swam up through the water it did so in the horizontal position with the characteristic rippling movement of a sole.

On June 15, it was found in a moribund condition. It then measured 6.5 mm. The left eye was on top of the head and the "shoulder" in front of the dorsal fin jutted out slightly above the left eye. The turned-up tip of the urostyle still projected a little from the outline of the fish above the tail fin. The head, trunk and the central muscular part of the tail were sprinkled closely with stellate melanophores, scattered amongst which were some spots of rusty orange pigment. Along the region of the interspinous bones was a row of melanophores, associated with which were flecks of orange pigment. The dorsal and anal fins had rows of black and/or orange pigment forming a basal, marginal and median series. The basal parts of the caudal rays were dark.

Clingfishes

Four species of clingfishes or suckers, family Gobiesocidae, are known to occur in Irish waters namely *Lepadogaster* (*Lepadogaster*)

lepadogaster (Bonnaterre)=*Lepadogaster gouani* Lacépède; *Lepadogaster* (*Mirbelia*) *candollei* Risso; *Diplecogaster bimaculata* (Bonnaterre) and *Apletodon microcephalus* (Brook). Though not listed by Went (1957) or O'Riordan (1965), *A. microcephalus* is probably the commonest Irish species (Bracken and Kennedy, 1967).

Two post-larvae of clingfishes were taken in the 1967 survey, one at Dungarvan on May 17 (haul 7) and the other at the Splaugh on June 1 (haul 27). The former was 3.7 mm long, the latter 3.3 mm. Both were slender with numerous melanophores on the trunk and anterior part of the tail and a few melanophores on top of the head but with none on the sides of the head or the posterior half of the tail. Both were somewhat damaged and were not diagnosed to species.

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SUMMARY

(1) During the period April-June 1967 tow-netting was carried out at four centres on the south-east and south coasts of Ireland, namely the Splaugh Rock, near Rosslare, Co. Wexford; Dungarvan Harbour, Co. Waterford; Youghal Harbour, Co. Cork; and Baltimore Harbour, Co. Cork.

(2) Tow-netting was carried out close to shore and in estuaries. Some hauls were made at depths varying from near the surface down to 3 metres. The remainder were surface hauls only.

(3) A total of 30 series of hauls was made. These hauls yielded a total of 657 pelagic fish eggs representing 12 species or groups and 174 larvae, post-larvae and fry representing 19 species or groups.

In addition to the eggs and young stages of fishes taken in tow-nets during April-June, a sample of pelagic post-larvae of atherines was captured by hand-net in July 1967 on the Wexford coast.

(4) Of the eggs taken, 150 were eggs of pilchard and 101 were eggs of sprats. With the exception of one sprat egg obtained in Youghal on May 18, all the clupeoid eggs were taken at Baltimore on June 6 and 7, 1967.

(5) Of the 406 non-clupeoid eggs taken, eggs of rockling (more than one species) were the most numerous (252 eggs). Other eggs taken in fair numbers were those of the goldsinny wrasse, *Ctenolabrus rupestris* (70 eggs); Ekstrom's topknot, *Phrynorhombus regius* (37 eggs); and bass, *Dicentrarchus labrax* (31 eggs).

(6) Young stages of fishes taken in greatest numbers in tow-nets were clupeoids (49); gadoids other than rocklings (30); dragonets *Callionymus sp* (19); gobies (17); rocklings (14); goldsinny wrasse *Ctenolabrus rupestris* (12); topknots, *Phrynorhombus regius* and *Zeugopterus punctatus* (12) and flounders (8).

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TABLE 1. TOW-NET HAULS, SOUTH COAST OF IRELAND, APRIL/JUNE 1967.

HAULS SERIES	REF.	CENTRE	DATE	STATION	TIDE	TEMP. °C.	FISH EGGS (Nos. in brackets)	LARVAE, POST-LARVAE AND FRY (Nos. in brackets)	OBSERVATIONS
1	P/1	Dungarvan	15 April	5	Neaps, various stages		Rocklings (12) **Ctenolabrus rupestris** (10)	Symmetrical pleuronectid (p.l.) (1)	Surface haul
2		do.	do.	2			Rocklings (10) **C. rupestris** (8)	Rocklings (l.) (11) **C. rupestris** (l.) (6) Clupeoids (p.l.) (10) **Phrynorhombus regius** (?) (l) (5)	10 feet deep
3	P/2	do.	16 April	6	Ebb	10.5 — 11.0	Nil	Rockling (l.) (1)	Surface
4		do.	do.	1			Rocklings (25) **C. rupestris** (20)	Clupeoids (30) Sand-eel (p.l.) (1) **"Cottus" sp.** (p.l.) (1)	Surface to 10 feet
5		do.	do.	4			Nil	Nil	
6	P/3	do.	17 April	7	H. W.		Nil	**"Gadus" sp.** (p.l.) (1) **"Gobius" sp.** (p.l.) (1) **Zeugopterus punctatus** (p.l.) (1)	
7		do.	do.	3	Ebb		Rocklings (8)	**C. rupestris** (1) (6) **P. regius** (?) (l) (5) **Z. punctatus** (p.l.) (1) **"Cottus"** sp. (p.l.) (1) **Lepadogaster "sp."** (p.l.) (1)	
8	M67/1	Youghal	8 May	2	Springs, flood	10.5	**Dicentrarchus labrax** (6) **Phrynorhombus regius** (1)	**Platichthys flesus** (semi-metamorphosed) (1)	
9	P/4	do.	do.	3	Late flood	—	**D. labrax** (2)	**"Gadus" sp.** (p.l.) (3) **Liparis montagui** (p.l.) (1)	Surface to 6 feet
10	—	do.	do.	2	H. W.	—	Nil	Nil	
11	—	do.	do.	1	H. W.	—	Nil	Nil	
12	P/5	do.	9 May	4	Ebb	11.5	Nil	**P. flesus** (semi-metamorphosed) (3) **"Gobius"** sp. (8)	
13	M67/2	do.	do.	2	Flood	11.0	**D. labrax** (7) **Microstomus kitt** (1)	**P. flesus** (semi-metamorphosed) (3) **Solea solea** (do.) (1) **"Gobius"** sp (1) Clupeoids (2)	
14	—	do.	do.	3	H. W.	—	Nil	Nil	
15	M67/3	Dungarvan	16 May	6	Neaps, ebb	—	Rocklings (10) **P. regius** (8) **C. rupestris** (3) Sand-eels (2)	**"Gobius"** sp (p.l.) (3)	Surface
16	M67/6	do.	17 May	6	H. W.	—	Rocklings (15) **P. regius** (10) **C. rupestris** (3) **Trachinus vipera** (1)	Nil	
17	M67/5	Youghal	18 May	2	Neaps, H. W.	10.5	**D. labrax** (1) **Scomber scombrus** (1)	**"Gadus" spp** (p.l.) (7) Rocklings (p.l.) (2)	

16	M67/6	do.	17 May	6	H. W.	—	Rocklings (15) **P. regius** (10) **C. rupestris** (3) **Trachinus vipera** (1)	Nil	
17	M67/5	Youghal	18 May	2	Neaps. H. W.	10.5	**D. labrax** (1) **Scomber scombrus** (1) **Sprattus sprattus** (1) Rocklings (10) **P. regius** (5) **C. rupestris** (11)	**"Gadus" spp** (p.l.) (7) Rocklings (p.l.) (2)	
18	M67/4	do.	do.	2	Early ebb	10.5	**S. scombrus** (1) Rockling (1) **P. regius** (8) **C. rupestris** (2)	**"Gadus" spp** (p.l.) (15) **"Gobius" sp** (p.l.) 1 Clupeoids (p.l.) 4 **Callionymus sp** (p.l.) (6)	
19	M67/7	do.	30 May	2	Neaps, H. W.	13.2	**D. labrax** (1) Rocklings (21) **P. regius** (3) **Zeugopterus punctatus** (?) (1) **C. rupestris** (3)	Nil	Surface
20	M67/8	do.	do.	3	Early ebb	—	Rocklings (4) **C. rupestris** (1)	**Solea solea** (semi-metamorphosed) (1)	
21	P/6	do.	do.	2	Late ebb	—	Rockling (1) **C. rupestris** (1)	Nil	
22	—	do.	31 May	4	Flood and ebb	—	Nil	Nil	
23	M67/9	do.	1 June	2	Late flood	11.8	**D. labrax** (8) Rocklings (3) **C. rupestris** (2))	Clupeoids (p.l.) (2)	
24	M67/10	do.	do.	2	Early ebb	11.8	Rocklings (7) **T. vipera** (3) **R. regius** (1) **C. rupestris** (4) **Raniceps raninus** (1)	Clupeoid (p.l.) (1)	
25	—	do.	do.	2	Late ebb	—	Nil	Nil	
26	M67/11	Splaugh	1 June	—	Neap, early ebb	—	**D. labrax** (3) **T. vipera** (3) **P. regius** (1) **C. rupestris** (1)	**Callionymus sp** (p.l. and fry) (5)	
27	—	do.	do.	—	do.	—	Nil	**Callionymus sp** (p.l.) (8) **"Gadus" sp** (p.l.) (2) **"Lepadogaster" sp** (p.l.) (1)	Surface
28	M67/12	do.	2 June	—	Late flood	—	**D. labrax** (3) Rocklings (5)	**"Gadus" sp** (p.l.) (2) **Gobius spp** (P.l.) (3) **Solea solea** (symmetrical p.l.) (1) **Buglossidium luteum** (do.) (1)	
29	M67/13	Baltimore	6 June	1	H. W.	—	Rocklings (70) **Raniceps raninus** (1)	**Sardina pilchardus** (l.) (1)	
30	M67/14	do.	7 June	2	H. W.	—	**Sardina pilchardus** (150) **Sprattus sprattus** (100) Rocklings (50) **Ctenolabrus rupestris** (1) **R. raninus** (1)	**Syngnathus rostellatus** (fry) (1) **Limanda limanda** (semi-metamorphosed) (1)	Surface

TABLE 2. TOTAL NUMBERS OF EGGS AND YOUNG STAGES OF FISHES TAKEN IN TOW-NETS.

April—June 1967

SPECIES	EGGS		LARVAE, POST-LARVAE AND FRY	
	No.	Present in hauls series	No.	Present in hauls series
Sprat, **Sprattus sprattus** (Linn.)	101	17, 30	—	—
Pilchard, **Sardina pilchardus** (Walbaum)	150	30	1	29
Clupeoids (not identified)	—	—	49	2, 4, 13, 18, 23, 24
Pipefish, **Syngnathus rostellatus** Nilsson	—	—	1	30
"Gadus" spp	—	—	30	6, 9, 17, 18, 27, 28
Lesser forkbeard **Raniceps raninus** (Linn.)	3	24, 29, 30	—	—
Rocklings	252	1, 2, 4, 7, 15, 16, 17, 18, 19, 20, 21, 23, 24, 28, 29, 30	14	2, 3, 17
Bass, **Dicentrarchus labrax** (Linn.)	31	8, 9, 13, 17, 19, 23, 26, 28	—	—
Goldsinny, **Ctenolabrus rupestris** (Linn.)	70	1, 2, 4, 15, 16, 17, 18, 19, 20, 21, 23, 24, 26, 30	12	2, 7
Sand-eels	2	15	1	4
Lesser Weever, **Trachinus vipera** Cuvier	7	16, 24, 26	—	—
Mackerel, **Scomber scombrus** Linn.	2	17, 18	—	—
Gobies, **"Gobius" spp**	—	—	17	6, 12, 13, 15, 18, 28
Dragonets, **Callionymus sp.**	—	—	19	18, 26, 27
Sea Scorpions, **"Cottus" spp.**	—	—	2	4, 7
Sea Snail, **Liparis montagui** (Donovan)	—	—	1	9
Common Topknot, **Zeugopterus punctatus** (Bloch)	1 (?)	19	2	6, 7
Ekstrom's Topknot, **Phrynorhombus regius** (Bonnaterre)	37	8, 15, 16, 17, 18, 19, 24, 26	10 (?)	2, 7
Dab, **Limanda limanda** (Linn.)	—	—	1	30
Flounder, **Platichthys flesus** (Linn.)	—	—	8	1, 8, 12, 13
Lemon Sole, **Microstomus kitt** (Walbaum)	1	13	—	—
Sole, **Solea solea** (Linn.)	—	—	3	13, 20, 28
Solenette, **Buglossidium luteum** (Risso)	—	—	1	28
Clingfish, **"Lepadogaster" sp**	—	—	2	7, 27
TOTALS	657		174	

TABLE 3. DIAGNOSTIC CHARACTERS OF EGGS AND LARVAE OF TOPKNOTS.

Species	Eggs		Larva (recently hatched)		Remarks
	Diam. (mm)	Oil-globule (mm)	Length (mm)	Pigmentation	
Z. punctatus	1.0—1.07 (a) or 0.92—1.05 (b)	0.18—0.20 (a) or 0.17—0.19 (b)	2.90—2.93	Stellate or cruciform yellow chromatophores. Melanophores mostly stellate also. (**Note:** within a day or two of hatching, the marginal fin pigmentation develops into a series of dark touches).	McIntosh and Prince (1890) described ripe ovarian eggs. Holt (1893) describes eggs from the west coast of Ireland as "species X—allied to Trigla" (p. 96) and illustrates eggs and larvae on Plate II, figs. 17-21. He describes further eggs and larvae as "Species XI—Sinistral Pleuronectid" (p 99) and illustrates them on Plate VIII, figs. 62-64. Ehrenbaum (1905-1909) refers Holt's "Species X" and "Species XI" to **Z. punctatus** and describes original material from Heligoland. The egg dimensions marked (a) are according to Ehrenbaum. The dimensions marked (b) are from Hefford (1910) who described material from Plymouth. Hefford separated topknot eggs into two size categories. The smaller eggs (see below) he attributed to **P. norvegicus** and the larger eggs mainly to **Z. punctatus.** Some of the larger eggs he described may, in fact, have been those of **P. regius.**
P. regius	0.75—0.99	0.14—0.18	2.38	Melanophores small and scattered.	Holt (1897) succeeded in artificially fertilising a few eggs of this species at Plymouth. He subsequently figured the eggs and a larva hatched from one of them (Holt 1899). Holt (1893) also described as "Species XII—Sinistral Pleuronectid" (p 101) eggs and larvae from Scotland and Valentia which he subsequently (1897) attributed to **P. regius.**
P. norvegicus	0.72—0.92	0.094—0.157	2.52—2.76	Chromatophores (both black and yellow) generally spidery-stellate, with a "fringe" of pectinate or dendritic melanophores on the edge of the marginal fin.	Ehrenbaum (1905-1909) has described eggs and larvae from Heligoland and Hefford (1910) has described eggs and larvae from Plymouth. Hefford considered that the eggs of this species occurred further offshore than those of **Z. punctatus.**

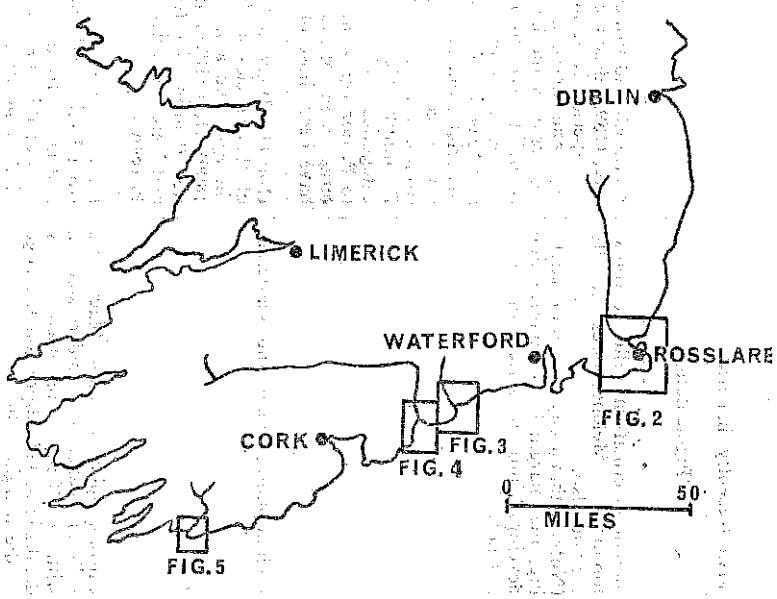

Fig. 1. Centres where tow-netting was carried out in 1967.

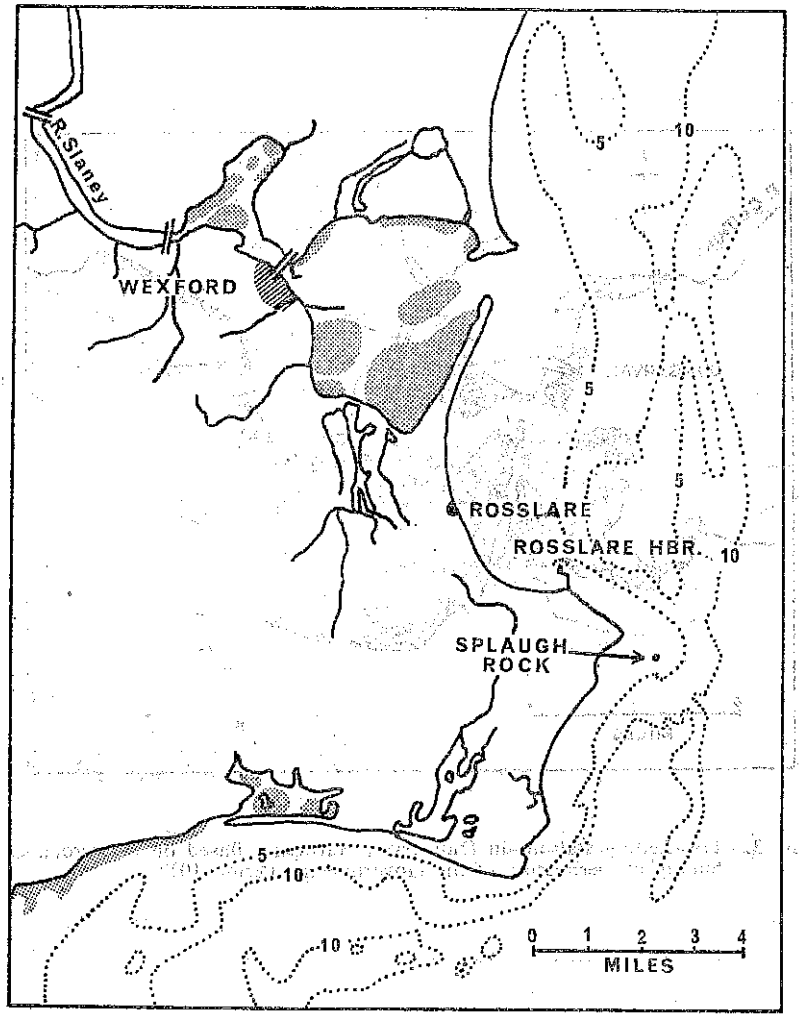

Fig. 2. Splaugh Rock. Based on the Ordnance Survey by permission of the Government. Permit 1022.

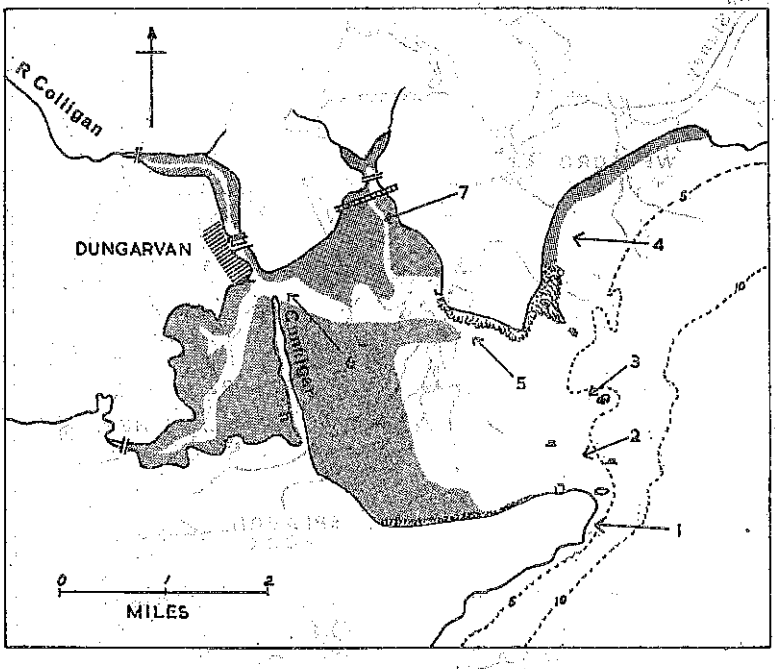

Fig. 3. Tow-netting stations in Dungarvan Harbour. Based on the Ordnance Survey by permission of the Government. Permit 1022.

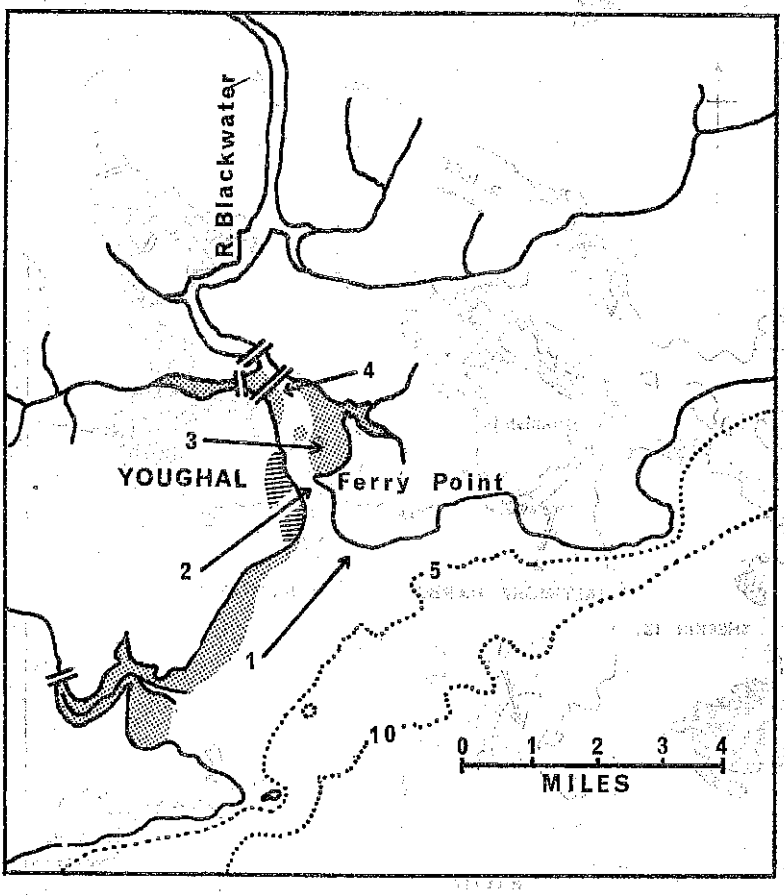

Fig. 4. Tow-netting stations in Youghal Harbour. Based on the Ordnance Survey by permission of the Government. Permit 1022.

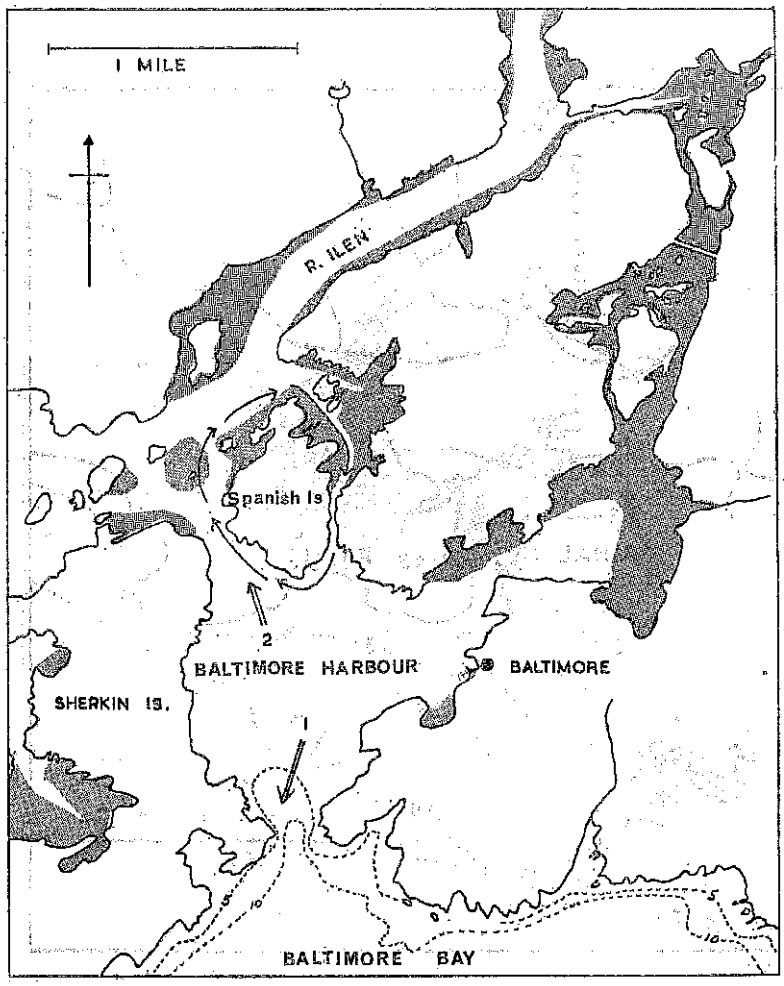

Fig. 5. Tow-netting stations at Baltimore. Based on the Ordnance Survey by permission of the Government. Permit 1022. "Station 2" hauls were made during a circumnavigation of Spanish Island.

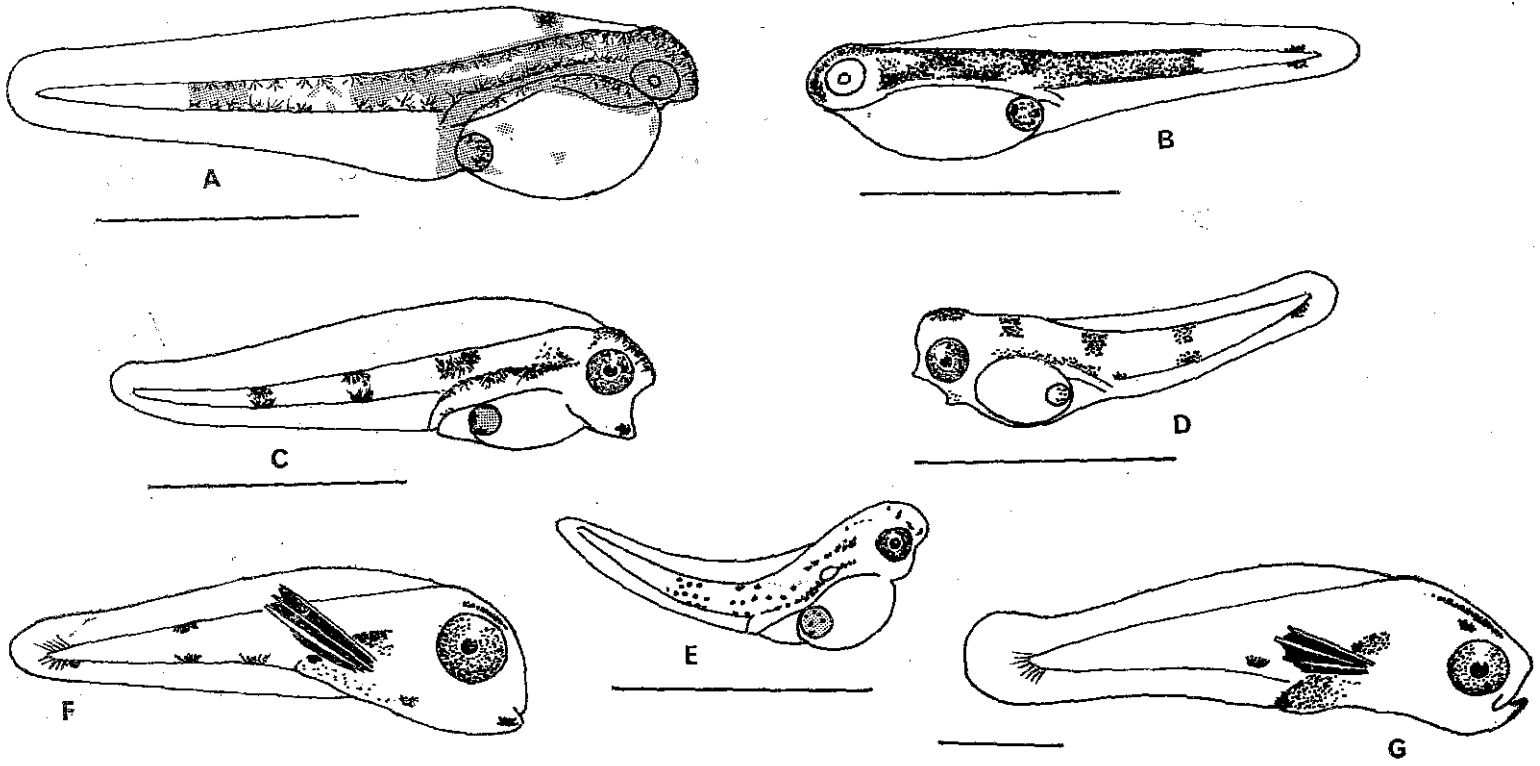

Fig. 6. A, larval lesser forkbeard, **Raniceps raninus**, less than 12 hours old, 2.7 mm, live; from an egg obtained at Baltimore, 6. VI. 1967 (ref. M67/13). B, newly-hatched larval rockling, 2.1 mm, live; from an egg obtained at Dungarvan 16. V. 1967 (ref. M67/3). C, more advanced larva, eye pigmented, from another egg from the same haul, 2.1 mm, recently dead; D, rockling larva, eye pigmented, from another egg from the same haul, 1.65 mm, recently dead. E, rockling larva, eye pigmented, small swim-bladder developed, 1.6 mm, recently dead; from an egg obtained at Dungarvan 17. V. 1967 (ref. M67/6). F, post larval rockling, preserved, 4.2 mm. G, another do., 4.4 mm. Both taken at Youghal 18. V. 1967 (ref. M67/5). The horizontal lines represent in each case an actual length of 1 mm.

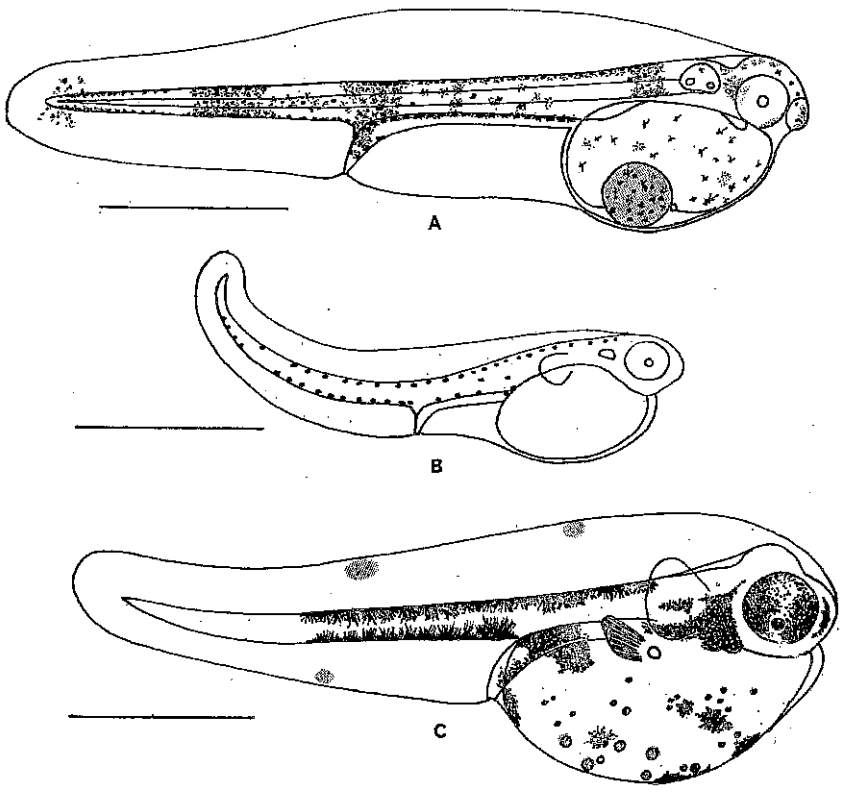

Fig. 7. A, Larval bass, **Dicentrarchus labrax,** less than 12 hours old, 4.45 mm, live; from an egg obtained at Youghal 8. V. 67 (ref. M67/1). B, larval goldsinny wrasse **Ctenolabrus rupestris,** less than 12 hours old, 2.9 mm, live; from an egg obtained at Youghal 18. V. 1967 (ref. M67/4); C, larval lesser weever, **Trachinus vipera,** recently hatched, 4.0 mm, live; from an egg obtained at Dungarvan 17. V. 1967 (ref. M67/6). The horizontal lines represent in each case an actual length of 1 mm.

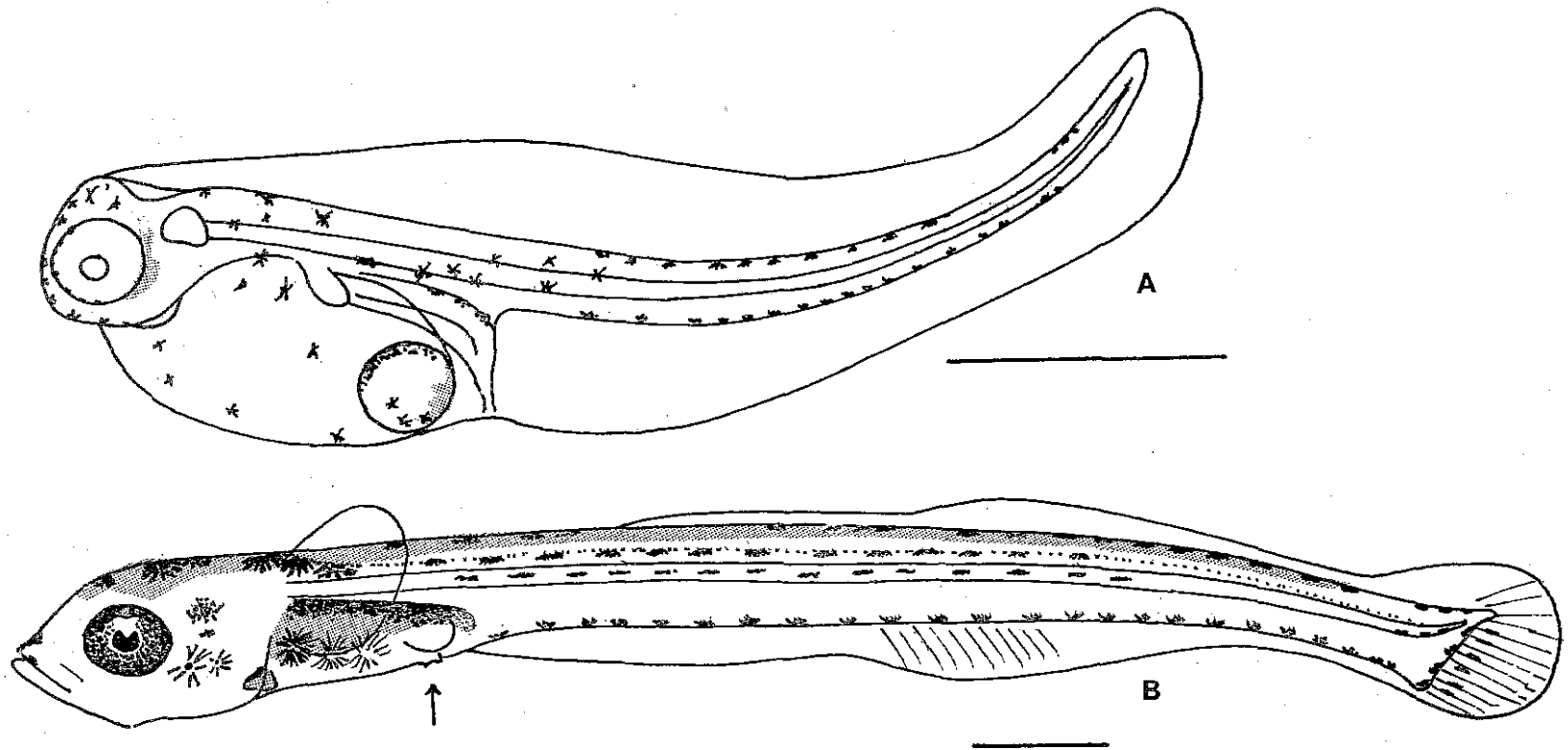

Fig 8. A, larval mackerel **Scomber scombrus**, recently hatched, 4.55 mm, live; from an egg obtained at Youghal 18. V. 1967 (ref. M67/5); B, post-larval atherine, **Atherina presbyter**, 11.5 mm, live; captured in a rock-pool at St. Helen's Harbour, near Rosslare, 25. VII. 1967 (ref. M67/15). The arrow indicates the position of the vent. The horizontal lines represent in each case an actual length of 1 mm.

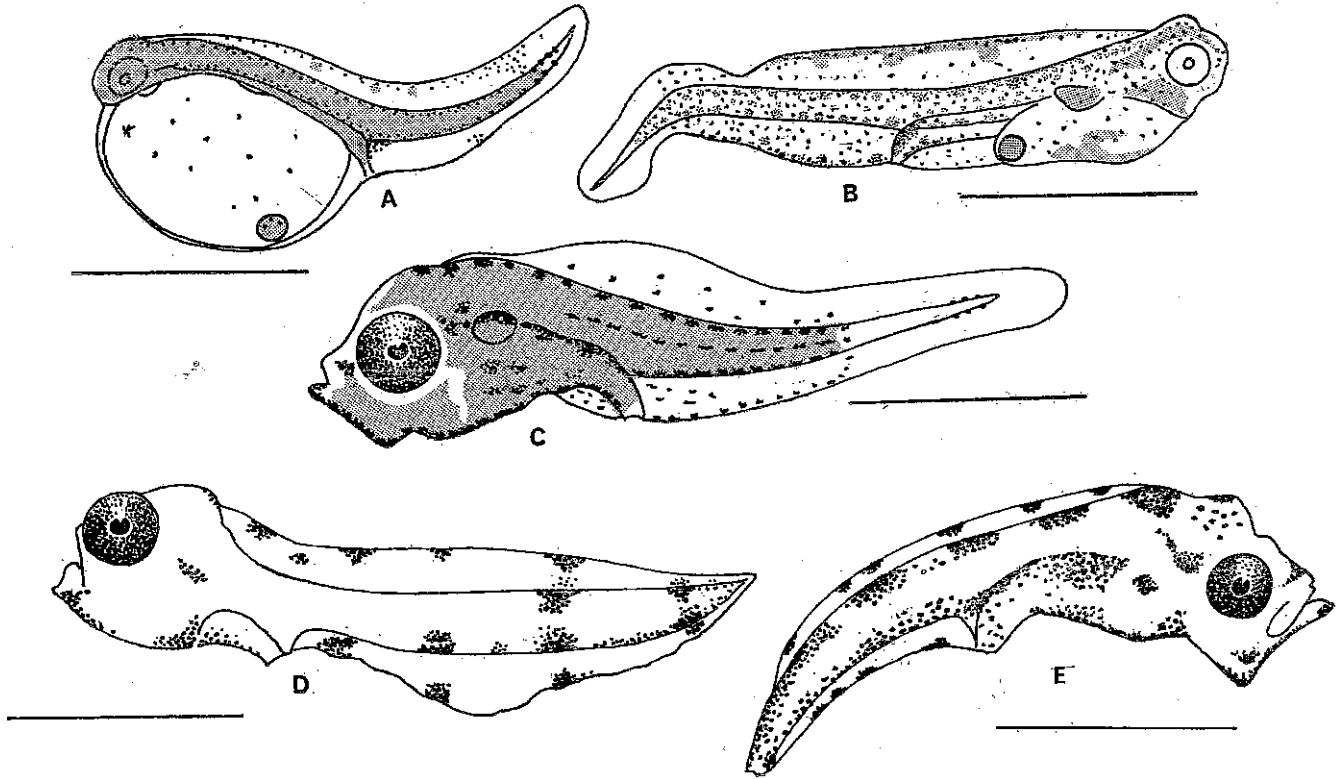

Fig. 9. Young stages of topknots and dragonet. A, recently-hatched larva of Ekstrom's topknot, **Phrynorhombus regius (Zeugopterus unimaculatus),** 2.3 mm, live; from an egg obtained at Dungarvan 16. V, 1967 (ref. M67/3). B, more advanced larva of same, 2.8 mm, live, slightly damaged; from an egg from the same collection; C, post-larval dragonet, 3.2 mm, preserved; captured at Youghal 18. V. 1967 (ref. M67/4); D, post-larval common topknot, **Zeugopterus punctatus,** 3.0 mm, preserved, damaged, probably shrunken; captured at Dungarvan 17. V. 1967; E, another post-larval do., 2.9 mm excluding missing portion, preserved, damaged, probably shrunken; also taken at Dungarvan 17. V. 1967. The horizontal lines represent in each case an actual length of 1 mm.