



# IRISH FISHERIES INVESTIGATIONS

**SERIES B (Marine)**

**No. 8**  
**(1973)**

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M. KENNEDY, P. FITZMAURICE AND T. CHAMP

**PELAGIC EGGS OF FISHES TAKEN ON THE IRISH COAST**

# Pelagic Eggs of Fishes taken on the Irish Coast

by

M. KENNEDY, P. FITZMAURICE AND T. CHAMP

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## Abstract

During the years 1967 to 1971 inclusive, tow-netting for pelagic fish eggs was carried out at 13 stations on the east, south and west coasts of Ireland. Sampling was limited to the period late April to mid-June. Sampling stations included estuaries, bays and the open coast.

A total of 16,902 identified eggs was taken, belonging to 27 species or groups. Most abundant eggs were those of pilchard *Sardina pilchardus*, rocklings, goldsinny wrasse *Ctenolabrus rupestris*, mackerel *Scomber scombrus* and sprat *Sprattus sprattus*. Less numerous, but of frequent and widespread occurrence, were eggs of lesser weever *Trachinus vipera*, dragonets *Callionymus* spp. and topknots *Zeugopterus punctatus* and *Phrynorhombus* spp. Eggs recorded for the first time from the Irish coast were those of bass *Dicentrarchus labrax*, pearlfish *Echiodon drummondi* and the flatfish *Arnoglossus thori*.

Some drift bottles were released to obtain data on direction of transportation of eggs from the stations sampled.

## Introduction

As part of a programme of research on the biology of the bass *Dicentrarchus labrax* in Irish waters, tow-netting for pelagic fish eggs was carried out at various places around the Irish coast in each of the years 1967 to 1970 inclusive. A variety of fish eggs and also some larval and post-larval fishes was obtained.

Information about the spawning of fishes on the Irish coast is meagre and the material resulting from the bass investigations, limited though it was, represented a useful supplement to existing data, derived mainly from the work of Holt (1891, 1893, 1899) on eggs and young stages from the West coast; Fives (1971) on the young stages of fishes in the plankton on the coasts of Mayo, Galway and Clare; and studies of the reproduction of clupeoids, especially herring, on the south coast (Burd and Bracken, 1965; Bracken and Kennedy, 1967).

In 1971, the Inland Fisheries Trust's survey boat *Finola* was stationed at Belmullet, Co. Mayo, and it was decided to avail of the opportunity of its presence there to carry out some tow-netting for fish eggs in the area, for purpose of comparison with the other centres worked in previous years.

An account of the eggs and young stages of fishes collected in 1967 has previously been published (Kennedy and Fitzmaurice, 1969). The present paper deals with the eggs obtained during the entire period 1967 to 1971 inclusive.

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### Centres where eggs were obtained

Tow-netting, the results of which are considered in this paper, was carried out at thirteen places around the Irish coast, the location of which is shown in Fig. 1. The following are brief descriptions of the conditions at the different centres. Indicated salinities are all surface salinities.

#### Dublin Bay

A large bay into the head of which the River Liffey discharges. Shallow, with slack tides, in inner portion. Deeper in outer portion, with strong tides in some places. Tow-netting carried out in Scotchman's Bay (just east of Dun Laoghaire Harbour) and in Dalkey Sound.

Salinities:— Scotchman's Bay, 1968 June 12 L W 33.9‰

Dalkey Sound, 1968 June 12 L W 34.5‰

Date of collections:— 1968 June 12 Temperature not recorded.

#### Splaugh Rock

Tide rips over reefs in an area of shoals and sand banks, about  $\frac{1}{2}$  mile south-east of Greenore Point, Co. Wexford. On the open coast, but probably affected at some stages of the tide by the discharge from Wexford Harbour (Slaney Estuary) about eight miles to the north-west.

Salinities:— Neap tides. Early ebb 32.1‰  
Late flood 34.5‰

Dates of collections:— 1967 June 1, 2 Surface temperature 12°C.  
1970 May 4, 5 Temperature not recorded.

#### Dunmore East (Waterford River)

Mouth of common estuary of three major rivers (Barrow, Nore and Suir). About three miles wide, narrowing to two miles at Creadon Head. Depth in channel about five fathoms. Strong tides, with overfalls near Hook Head. Tow-netting carried out in area between Creadon Head and Hook Head.

Salinities:—	Creadon Head.	Springs	Late ebb	30.3‰
		Neaps	1 hour of ebb	30.8‰
Mouth.	Springs	1½ hours of flood	27.6‰	
		2 hours of ebb	30.7‰	
	Neaps	H W	34.85‰	

Dates of collections:— 1970, May 6, 12, 13  
Surface temperature 10.1—12.75°C.

#### Dungarvan Bay

A shallow bay, with extensive sand banks in its outer portion. The inner portion, largely cut off by a long sand-spit, is shallow and muddy. The small Colligan River flows in through the town of Dungarvan and a number of small creeks also enter the bay. Tides, on the whole, moderate. Tow-netting carried out in the outer bay and at and outside its mouth.

Salinities:— 33.6—34.85‰ over tidal cycle, neap tides.

Dates of collections:— 1967 April 15, 16, 17  
Surface temperature 10.5—11°C.  
(very fine, warm weather).

1969	May 16, 17	Temperature not recorded.
	May 7, 8, 9, 13, 14, 15, 21, 22	Surface temperature 10.25—12°C
	June 4, 5, 10, 11	Surface temperature 12.25—16.8°C.

#### Youghal Harbour

Mouth of estuary of a major river (River Blackwater). About  $\frac{1}{2}$  mile wide at mouth, narrowing to  $\frac{1}{4}$  mile at Ferry Point, above which it widens to over 1 mile. Depth in channel 3 to 5 fathoms. Youghal Bay, into which the estuary opens, is shallow; the 5 fathom line, at its nearest, about  $1\frac{1}{2}$  miles from the Harbour mouth and the 10 fathom line 3 miles. Tides very strong in the Harbour and fairly strong in parts of Youghal Bay. Tow-netting carried out from mouth to about  $\frac{1}{2}$  mile above Ferry Point, but mainly in the "narrows" between Ferry Point and the town of Youghal.

Salinities:—	May 1967	Neaps	H W	33.7‰
			four hours of ebb	24.35‰
May 1970		Springs	L W	14.35‰
			3½ hours of flood	28.8‰
			4½ hours of flood	30.5‰
			2 hours of ebb	34.2‰
			2½ hours of ebb	34.0‰
			4½ hours of ebb	29.3‰

The May 1967 determinations were made following a month of wet weather, with intermittent floods in the River Blackwater.

Dates of collections:—	1967 May 8, 9, 18, 30,	Surface temperature 10.5—13.2°C.
	June 1	Surface temperature 11.8°C.
	1969 June 12	Surface temperature 15.5—17.3°C.
	1970 May 7, 8	Surface temperature 10.5°C.

#### Cork Harbour

Large land-locked natural harbour into the head of which the River Lee discharges. Several streams flow in also. Several islands, large and small.

Tow-netting carried out in the inner part of Harbour, mostly in the channel between Great Island and the western mainland.

Salinities:— Ranging from about 23.0‰ at L W neaps to 30—31‰ at H W neaps.

Collections made:—	1968 April 24	Surface temperature 11°C.
	May 7, 9, 22, 23	Surface temperature 9.5—12.5°C.
	June 5	Surface temperature 13.5—14.5°C.

#### Baltimore

A natural harbour through which the estuary of the small River 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 Sherkin

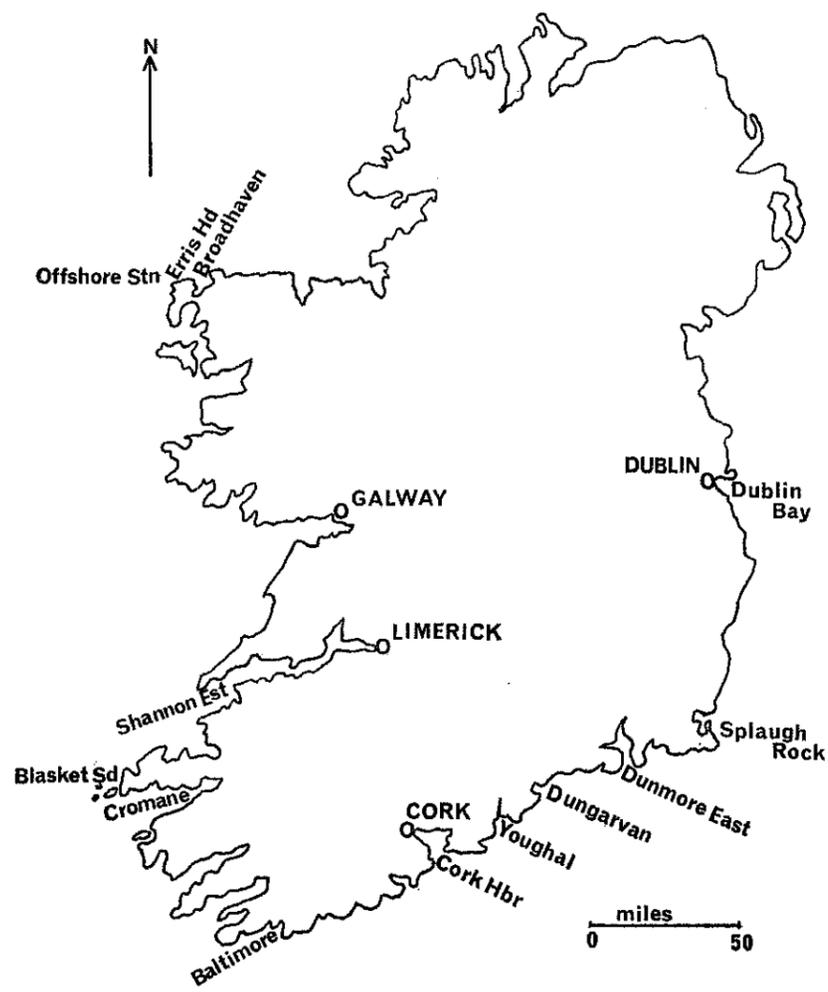


Fig. 1. Stations at which tow-netting was carried out.

Island, the water deepens rapidly to over 20 fathoms.

Tow-netting carried out at Spanish Island.

Salinities:— H W Springs 33.95—35.0‰

Collections made:— 1967 June 6, 7. Surface temperature not recorded.

#### Blasket Sound

The Blasket Islands lie off the tip of the Dingle Peninsula. The outermost islands are about 8 miles offshore. The largest island, the Great Blasket, is nearest shore, separated from the mainland by Blasket Sound, which is about 1 mile wide. The islands stand on a narrow tongue of sea bed bounded by the 20 fathom line and extending south-westwards from the mainland. To the north and south and still more rapidly to the west, the sea bed slopes away quickly to 40 fathoms and over. Depths in the Sound are variable and there are several shoals. Tides are strong and there are overfalls under certain conditions of wind and tide.

Tow-netting was carried out in the Sound and in the vicinity of the Great Blasket.

Salinity:— 35.2‰

Collections made:— 1970 May 11, 12, 13, 14, 25, 26, 27 Surface temperature 10.9—13.5°C.

#### Cromane

Channel between converging sand-spits, which separate the deep water of Dingle Bay from Castlemaine Harbour, at its head, into which the River Laune and River Maine discharge. Swift tides.

Salinities:— Neaps Late flood 33.1‰  
H W 34.0‰  
4 hours of ebb 29.4‰

Collections made:— May 28, 1970. Surface temperature 14.8—16.4°C.

#### Shannon Estuary

The Shannon, Ireland's largest river, is tidal for about 45 miles. Tow-netting was carried out in the mouth of the estuary proper in the area from some miles upstream of Kilrush down to Kilcredaun Point. The estuary here varies from  $2\frac{1}{4}$  to  $4\frac{3}{4}$  miles in width. Depths are variable, from 5 to 19 fathoms, in the section sampled; some distance further up-river, there are depths of over 30 fathoms. Tides are strong and turbulent in places where there are shoals.

Salinities:— H W 30.5—33‰  
L W 30.5‰

Collections made:— 1970 May 18, 19, 20, 26, 27, 28 Surface temperatures 10.8—12.75°C.

#### Broadhaven Bay

A large, north-facing bay on the Mayo coast. In its inner portion there is a channel about  $\frac{3}{4}$  mile wide and 6 miles long, leading back to the narrow isthmus joining the Mullet Peninsula to the mainland. Depths at the mouth of the channel are 4 to 6 fathoms. The open, outer portion of the Bay is about 6 miles wide, with depths varying for the most part from 12 to 30 fathoms. Two small rivers discharge into the east side of the Bay. Tow-netting was carried out in the mouth of the channel and in all parts of the Bay. Tides, on the whole, moderate.

Salinities:— 35.0 to 35.2‰

Collections made:— 1971 June 9, 10, 11, 14, 15, 16 Surface temperature 10.5—12°C.

#### Erris Race

Erris Head is at the north-west corner of Broadhaven Bay. Along the open coast past the Head there is a strong race of tide which is, at times, a noted angling mark for big coalfish *Pollachius virens*, cod *Gadus morhua* and other species. Hauls were made past the Head in a N E direction, partly across and partly away from the mouth of Broadhaven Bay, in depths of 25 to 34 fathoms.

Salinity:— 35.2‰

Date of collection:— June 17, 1971. Surface temperature 10.5—13°C.

Only one haul—with deep and surface nets towed simultaneously—was made, lasting 30 minutes.

### "Offshore, Belmullet"

One 30 minute haul—with deep and surface nets towed simultaneously—was made along the 50 fathom line to seawards of Erris Head. The haul was made in a N E direction from a starting position about 6 miles offshore, from which the bearing of Eagle Island Light was 168° true.

Salinity:— 35.2‰  
Date of collection:— June 17, 1971. Surface temperature 12°C.

### Other Collections

Some other tow-net collections were made, the results of which have been excluded from the analyses given in this paper because (a) they were too cursory to be significant or (b) they were carried out in places, or at stages of the tide, which proved to be unproductive because of low salinity or other factors. The results are given briefly here to complete the record:—

- (1) Malahide inlet. Small inlet in north Co. Dublin, into the head of which two small streams discharge. Salinity H W 33.85‰. Collection made June 13, 1968. 2 eggs of rockling; 1 egg of goldsinny *Ctenolabrus rupestris*.
- (2) Mouth of Wexford Harbour. Late ebb, May 5, 1970. Salinity not determined. 11 eggs of sprat *Sprattus sprattus*; 1 egg of dragonet *Callionymus* sp.
- (3) Youghal. May 31, 1967. Old bridge, about 3 miles from open sea. All stages of tide. Salinity not determined but probably low, as there was a good deal of fresh water in the river. Net took fragments of freshwater plants (*Ranunculus* sp) and of Ephemeropteran nymphs. No eggs nor young stages of fishes.
- (4) Youghal. May 5, 1970. "Narrows". Late ebb tide. 4 rockling eggs.
- (5) On June 1, 1971, on passage up the west coast to Belmullet, three surface hauls, were made from the *Finola*, each of 15 to 20 minutes duration. All material was preserved. Details as follows:—
  - (a) 5 miles S E of Eeragh Light; 3 miles S W of Inishmore (Aran Islands). 40 fathoms. 22 eggs, apparently of turbot *Scophthalmus maximus*; 2 large (0.825 mm) rockling eggs.
  - (b) 2 miles W of Slyne Head. 44 fathoms. 1 egg of brill *Scophthalmus rhombus*; 2 eggs of topknots; 5 rockling eggs.
  - (c) 1 mile W of Achill Head. 40 fathoms. A few eggs of goldsinny *Ctenolabrus rupestris* and of rockling; some topknot eggs; and several hundred recently shed gurnard eggs, mostly 1.22 mm, but some 1.386 mm.

### Materials and methods

The hauls which provided the material the subject of this paper were made with a zooplankton tow-net, 45 cm diameter, with approximately 25 meshes per cm. During the years 1967 to 1970 most of the hauls were taken at the surface, but a few alternate hauls were taken at depths of 2 to 3 metres. In swift tides, as in the "narrows" at Youghal, the boat was sometimes anchored and the net streamed in the tide. Elsewhere the net was towed at 2 to 3 knots through the water. The 1971 hauls in and off Broadhaven were made simultaneously with two nets, one towed at the surface and the other sunk to 4 to 5 metres by means of an improvised depressor. The 1971 hauls were made at 3 to 4 knots.

While there were some differences in the quantity and occasionally in the type of invertebrate plankton taken in the surface and sub-surface hauls, the same kinds of fish eggs, in approximately the same ratios, were taken in the shallow and deep hauls. More eggs were usually taken in surface than in sub-surface hauls, save in one or two instances where the efficiency of the surface net was affected by following seas in rough weather.

Each haul was usually of about 30 minutes duration, unless plankton was particularly scarce, in which case the fishing time was sometimes extended to one hour.

When the net was brought in, the catch was examined and such fish eggs as could be detected were removed with a pipette and placed in jars of clean sea water. Formalin was then added to the balance of the sample, to preserve it.

The jars in which the live eggs were placed were brought back to the laboratory at the end of each week, i.e. within six hours to four days of capture, depending on the day of capture. Some eggs had usually hatched on arrival and the larvae were identified and counted. Unhatched eggs were sorted and counted and examples of the different types were measured by eye-piece micrometer and placed in small glass dishes to hatch. Where time permitted, examples of various larvae were anaesthetised with MS 222 and placed in small glass dishes on the horizontal stage of a micro-projector. Tracings were made of the projected images and the larvae were then preserved. Pressure of other work precluded attempts to rear young fish beyond the end of the larval stage.

The preserved plankton hauls were examined at a later stage and eggs and young stages of fishes were removed, sorted and counted.

A few live eggs which failed to hatch, as well as a dozen or so preserved eggs whose diagnostic characters would fit more than one species, could not be positively identified. Such eggs have been omitted from the analyses in this paper.

The sampling programme was qualitative rather than quantitative, since the hauls varied in duration and speed and the number of hauls made per day depended, not only on distance from port to sampling station, but on the time needed to sort plankton between hauls. However, the amount of fishing time per day at different stations was roughly comparable in many instances. The most notable exceptions were the collections made off Erris Head and along the 50 fathom line off Belmullet, each of which consisted of a 30 minute haul of a pair of nets. This represents a much smaller unit of sampling effort than at any other station on any given day.

### Results

The results of tow-netting for pelagic eggs of fishes during the years 1967 to 1971 are summarised in Table 1. Tow-netting was carried out on 63 occasions at a total of 13 centres. A total of 16,902 identified eggs was obtained, belonging to 27 different types of fishes. Eggs of rocklings, dragonets, gurnards and *Phrynorhombus* spp. were not in all cases identified to species and each of these groups is consequently listed as a single "type". More than one species, in fact, occurred in many instances.

### Family Clupeidae

A total of 2,221 eggs of sprat *Sprattus sprattus* (13.1 per cent of all eggs) was taken. They occurred at 10 centres and on 28 days. The bulk of the sprat eggs (1803) came from Blasket Sound, but appreciable numbers were also obtained in the mouth of the Shannon (211) and at Baltimore (100).

An extensive winter spawning of sprat takes place on the south coast of Ireland (Bracken and Kennedy, 1967), and Fives (1971) obtained larvae with yolk-sacs not fully absorbed in Galway Bay in March.

A total of 4,396 eggs of pilchard *Sardina pilchardus* was taken. They were the most numerous of any eggs obtained and made up 25.9 per cent of the total of all types of eggs. While they occurred at 7 centres and on 13 days, the bulk of the pilchard eggs (4,198) was taken in Broadhaven Bay. The only other place where they occurred in significant numbers was at Baltimore, where 150 were taken in one day.

During June 1971, pilchard eggs were taken in every haul and in every part of Broadhaven Bay. They were in varying stages of development, but mostly were recently shed. Only 7 pilchard eggs were taken in the Erris Race and only 5 in the deep water offshore, which was in marked contrast to the position as regards mackerel *Scomber scombrus* (see below). It was unlikely that all the pilchard eggs were being carried into the Bay from deep water. Spawning may well have been taking place in Broadhaven Bay itself.

Fives (1970) considered that spawning of pilchard occurred possibly through the period early April to early November on the Galway coast.

#### Family Gadidae

The total number of rockling eggs taken was 3,533. They made up 20.9 per cent of all the eggs obtained and were taken at all 13 centres; they were present on 59 of the 63 days on which tow-netting was carried out. More than one kind of rockling egg was present in the collections, but specific identification was not attempted (Kennedy and Fitzmaurice, 1969).

A total of 52 eggs of the lesser forkbeard or tadpole-fish *Raniceps raninus* was obtained. They occurred at 7 centres and on 13 days. The eggs are small (some examples measured 0.93 mm) with a small oil globule (0.17 mm). Both embryo and larva are immediately distinguishable by the very vivid yellow pigment occurring in dense patches and bands. Greyish-black pigment is also present, but it is not conspicuous.

Only one egg of cod *Gadus morhua* was taken. This occurred in a haul taken at Dungarvan in early May 1969. It was probably in a late stage of development when obtained, as it had developed into a larva with partly-absorbed yolk sac when examined a few days later. Spawning of cod is probably largely completed before the period during which the tow-netting operations were carried out each year.

Eggs of pouting *Trisopterus luscus* totalled 95. They occurred at 5 centres and on 14 days. Ehrenbaum (1905-9) gives the egg diameter as 0.97—1.23 mm, rarely as small as 0.9 mm. Eggs examined by the present authors were mostly near the upper limits of this range. Some obtained in Blasket Sound in 1970 were as large as 1.25 mm. There is no oil-globule. Ehrenbaum has aptly described the pigmentation of the larva as "black with a yellow shimmer". Larvae hatched from Irish eggs had greyish-black, rather spidery melanophores and a golden shimmer particularly noticeable about the head and the anterior portion of the yolk sac. No discrete spots of yellow pigment could be detected in these regions under the lower powers of the microscope.

Eggs of poor cod *Trisopterus minutus* were less numerous, totalling only 17. They occurred at only 4 centres and on 9 days. Ehrenbaum (1905-9) gives the egg diameter as 0.95-1.07. Eggs examined by the present authors mostly ranged from 0.99 to 1.09 mm; an occasional egg was as large as 1.11 mm. Greyish-black spidery melanophores like those of the pouting occurred in the larva, but yellow pigment occurred as discrete spots on body, yolk sac and marginal fin.

#### Family Serranidae

A total of 73 eggs of bass *Dicentrarchus labrax* was obtained. They occurred at only five centres and on seventeen days, but were present, if only in small numbers, on each of the days on which tow-netting was carried out at Youghal and at the Splaugh Rock.

Eggs examined were 1.20 to 1.39 mm in diameter; the oil globule measured 0.36 to 0.42 mm. Embryo and larva were distinguished by the occurrence of black and yellow pigment in bands; the vent in the larva opened well behind the yolk sac. The eggs and larvae have been described elsewhere in more detail (Kennedy and Fitzmaurice, 1968). Bass eggs had not previously been found in British or Irish waters.

#### Family Labridae

The goldsinny *Ctenolabrus rupestris* is a small wrasse which is infrequently captured. In Dublin Bay, ballan wrasse *Labrus bergylta* are caught in large numbers from boats and from the shore and corkwing *Crenilabrus melops* are common along the shore and in harbours. However, in many years' fishing, one of us (M.K.) caught a solitary goldsinny in Dun Laoghaire Harbour and saw only one other example, which had been taken in Scotchman's Bay. The apparent scarcity of the species is deceptive, since one of us (P.F.) saw it frequently while diving on the Connemara Coast—usually in rocky situations at depths of 7 fathoms and over, where it frequently occurred in company with the leopard-spotted goby *Gobius (Zebrus) fosteri*, a species whose existence in either British or Irish waters was unknown before scuba-diving became popular!

The tow-netting showed that the goldsinny is both widely distributed and common, for its eggs occurred at all thirteen centres and on 49 out of 63 days. The total number of goldsinny eggs taken was 3,042 (18 per cent of all eggs), making it the third most abundant species in the collections.

Eggs examined ranged from 0.83 to 1.00 mm in diameter. There is no oil globule. Black pigment only is developed in the embryo and larva.

#### Family Trachinidae

A total of 268 eggs of the lesser weever *Trachinus vipera* was obtained. They occurred at 9 centres and on 23 days, but the only time they occurred in numbers was on June 12, 1969 when 136 were taken at Youghal.

Eggs examined averaged about 1.34 mm in diameter. The distribution throughout the yolk of up to two dozen or more oil globules, which are rich gold by both reflected and transmitted light, render the eggs conspicuous and easily identifiable. Extensive dark pigment develops on the embryo and the embryonic yolk sac bears numerous stellate chromatophores, which are grey by transmitted light and primrose by reflected light. In oblique light, an orange speck can sometimes be seen at the nucleus of these chromatophores. The eggs take much longer to hatch, and the larva is much more advanced on hatching, than is the case with bass, mackerel and other species, with an egg of comparable size (Kennedy and Fitzmaurice, 1969).

#### Family Scombridae

A total of 2,047 eggs of mackerel *Scomber scombrus* was taken (15.7 per cent of all eggs). They occurred at 7 centres and on 22 days. The greatest numbers were obtained in Broadhaven Bay, where 915 were taken in 6 days. The greatest densities, however, were at the offshore (50 fathom) station, where 680 occurred in a single tow with a pair of nets and in the Erris Race, where 351 eggs were taken in a single tow with a pair of nets.

Most of the eggs at the Belmullet offshore station were in an early stage of development, but the eggs obtained in Broadhaven Bay were in all stages of development, from recently shed to ready to hatch. Mackerel eggs taken in Dungarvan Bay in May 1969 were also in varying stages of development and shoals of mackerel, which were found to be in a partially spawned condition, were present in Dungarvan Bay at the time. Though it is likely that mackerel eggs found close inshore have in many instances drifted in from deeper water, the indications are that a good deal of spawning is also taking place close to shore on various parts of the coast. Mackerel are fractional spawners and probably shed their eggs over a period in a variety of situations.

In the eggs examined, the oil globule was golden in material preserved when in an early stage of development (occasionally two, as yet unfused, oil globules were present). In live eggs, the oil globule was sometimes smoky, sometimes quite clear; it tended to become clear with development of the embryo in eggs in which it was originally smoky. There was some variation in the arrangement of the melanophores on the body of the embryo and the larva and it was noted that melanophores were sometimes present, sometimes absent, on the yolk sac. The distinctive coloured pigment patches behind the eye and on the oil globule were grey by transmitted light, while by reflected light they varied from pea green to vivid green. Only in certain oblique lights did they show the yellow colour indicated in Holt's (1893) figure.

#### Family Callionymidae

Eggs of dragonets *Callionymus* spp. totalled 235. They occurred at 9 centres and on 27 days.

The eggs of dragonets are immediately identifiable because of the reticulated pattern of ridges on the surface of the capsule. Ehrenbaum (1905-9) attributes to the common dragonet *Callionymus lyra* eggs of 0.69-0.94 mm with relatively coarse reticulations and to the spotted dragonet *C. maculatus* he attributes eggs of 0.66 to 0.79 mm with finer reticulations. He describes the pigment of newly-hatched larvae of *C. lyra* as greyish-yellow and black and that of *C. maculatus* as yellow.

The Irish material was not critically examined in all cases, but the presence of both "*lyra*" and "*maculatus*" type eggs was noted in some collections and some measurements were made. In samples from Dungarvan, the larger eggs were 0.86 mm and the smaller eggs, which had much finer reticulations, were 0.80 mm. Two types of larvae hatched from eggs collected—a grey larva which had some yellowish as well as black pigment and a yellow larva which lacked black pigment. Eggs which hatched out into yellow larvae were obtained at Dungarvan, Youghal, Blasket Sound and Broadhaven.

A third species of dragonet, the reticulated dragonet *Callionymus reticulatus*, has in recent years been recorded from the coast of Connemara and Co. Louth. No descriptions of its eggs or larvae were available and, accordingly, it cannot be assumed that all the small eggs which gave rise to yellow larvae were attributable exclusively to *C. maculatus*.

Family Carapidae

The pearlfishes, formerly family Fierasferidae, are small, slender fishes which, as adults, are found sheltering in sea-cucumbers or, in some instances, in bivalve molluscs. One species, *Echiodon drummondii*, has been recorded infrequently from Ireland.

In May 1970, a total of 58 eggs of *E. drummondii* occurred on two consecutive days in hauls made in Blasket Sound. The eggs, which when first shed are probably joined together by mucus, were apparently free and separate when taken. They were ellipsoidal and ranged in size from 1.254 x 1.079 mm to 1.32 x 1.079 mm; a small oil globule was present. They were in an advanced stage of development and yielded slender larvae with widely spaced touches of black pigment. Soon after hatching, the larvae developed a slender, projecting process behind the head. This was the first recorded occurrence of eggs of this species on the Irish coast. The eggs and larvae have been described elsewhere in more detail (Kennedy and Champ, 1971).

Family Triglidae

The collections analysed in Table 1 yielded a total of 43 eggs of gurnards. They occurred at 6 centres and on 10 days.

Three species of gurnard are common on the Irish coast, namely the grey gurnard *Eutrigla gurnardus*; the tub gurnard *Trigla lucerna*; and the red gurnard *Aspitrigla cuculus*. Another species, the streaked gurnard *Trigloporus lastoviza*, occurs sporadically on the south and south-west coasts, while a fifth species, the piper *Trigla lyra*, is not uncommon locally in deep water on the south coast.

The eggs and larvae of gurnards are difficult to separate. The following dimensions for the eggs of the three common species have been given by McIntosh and Masterman (1897) and Ehrenbaum (1905-9):—

	McIntosh & Masterman		Ehrenbaum	
Grey gurnard	1.42—1.52 mm.	Oil globule 0.28 mm. smoky or sometimes salmon-coloured.	1.16—1.63 mm.	Oil globule 0.19—0.33 mm. yellowish or reddish.
Tub gurnard	—	—	1.10—1.54 mm.	Oil globule 0.22—0.31 mm.
Red gurnard	1.47—1.61 mm.	Oil globule 0.33 mm. copper coloured.	1.45—1.61 mm.	Oil globule 0.28—0.33 mm.

The present authors pressed ripe eggs out of a very large tub gurnard caught on the Mayo coast in June 1970 and found that they measured 1.45 mm. A pinkish-gold oil-globule measuring 0.26 mm was present. These dimensions would not necessarily be identical with those of fertilised eggs.

Only a few gurnard eggs were hatched out. A larva 4.1 mm long from one of the hatched eggs (taken in Blasket Sound on May 27, 1970) is shown in Fig 2. Black pigment was associated with the coloured pigment on the marginal fin, but elsewhere was limited to a few melanophores on the trunk and some beneath the tail, towards its tip. The coloured pigment was sepia brown by transmitted light, greenish-yellow by reflected light. The oil globule was pale and gold. Two larvae hatched from eggs taken in Broadhaven Bay in June 1971. The eggs were 1.48 mm diameter, with a smoky oil globule 0.30 mm across. By reflected light the pigment on the body and sac of the larvae was yellow and there was extensive grey and yellow pigment on the marginal fin.

The eggs obtained could not be attributed with absolute certainty to particular species of gurnard. All that can be done is to indicate the dimensions of some of the measured eggs, which were as follows:—

Blasket Sound, May 1970.	Eggs with copper-coloured oil globules. 1.21 mm; 1.25 mm; several 1.29 mm; 1.32 mm (o.g. 0.35 mm); 1.32 mm (o.g. 0.28 mm); 1.35 (o.g. 0.40 mm).
Splough Rock, May 1970.	1.35 mm (copper o.g. 0.36 mm).
Broadhaven Bay, June 1971.	1.25 mm (o.g. 0.18); 1.48 mm (o.g. 0.30 mm); 1.49 mm (o.g. 0.30 mm); 1.49—1.52 mm (o.g. 0.33—0.36 mm).
“Belmullet, Offshore”, June 1971	1.78 mm (o.g. 0.40 mm); 1.58 mm (o.g. 0.33 mm).

As has already been mentioned, a brief surface haul made in 40 fathoms off Achill Head on June 1, 1971 yielded several hundred recently-shed gurnard eggs, mostly 1.22 mm but some 1.39 mm.

No young stages of gurnards occurred amongst the larval and post-larval fishes taken in the tow-nets except on the Mayo coast. In the 1971 hauls, 54 post-larval gurnards were present in the Broadhaven Bay hauls; 5 in the Erris Race hauls; and 3 in the offshore hauls. The length-range was 3 to 4.8 mm. They occurred in both surface and deep (4 to 5 metre) hauls.

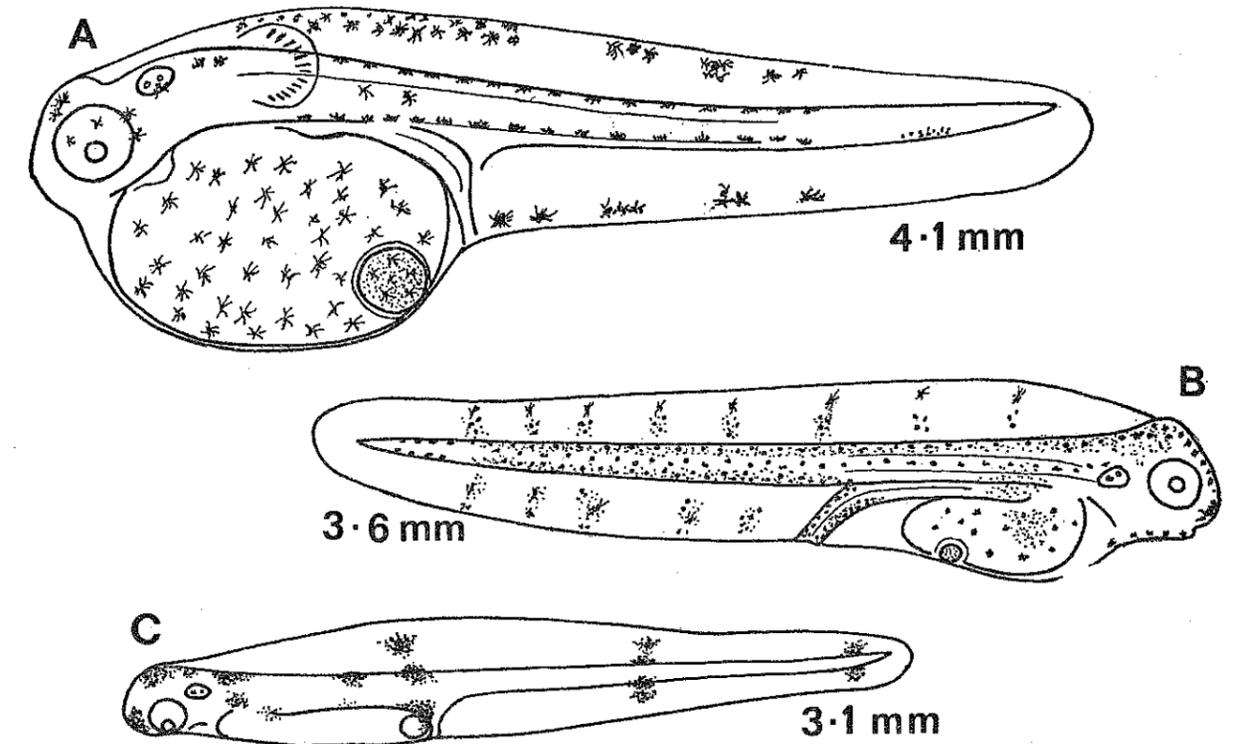


Fig. 2. A, larval gurnard (family Triglidae) 1-2 days old, from an egg taken in Blasket Sound May 27, 1970. B, larval common topknot *Zeugopterus punctatus* 3-4 days old, from an egg taken at Dungarvan May 15, 1969. C, larval *Arnoglossus thori* 1-2 days old, from an egg taken in Broadhaven Bay June 9, 1971. Pigmentation (reflected light):— A, greenish-yellow and some black; B, black and yellow; C, orange-gold.

Family Bothidae

A total of 11 eggs of turbot *Scophthalmus maximus* occurred in the systematic hauls (Table 1). They occurred at only 4 stations, namely Blasket Sound and the three Mayo stations. As already mentioned, 22 turbot eggs were taken in a brief surface haul in 40 fathoms S.W. of the Aran Islands on June 1, 1971. Ehrenbaum (1905-9) gives the dimensions of the eggs as 0.912—1.195 mm (oil globule 0.15 to 0.22 mm). Unhatched eggs in the Irish material measured 0.99 to 1.19, with an oil globule usually of 0.18 mm. The dense and extensive blood-red and black pigmentation of the embryo and larva are diagnostic.

A total of 8 eggs of brill *Scophthalmus rhombus* occurred in the systematic hauls. They were taken at only two stations—Blasket Sound and Broadhaven Bay. A single brill egg occurred in a brief surface haul taken in 44 fathoms west of Slyne Head on June 1, 1971. The egg is larger than that of the turbot. Ehrenbaum (1905-9) gives the dimensions as 1.24—1.50 mm (oil globule 0.21—0.25 mm). Unhatched Irish eggs measured 1.452 mm to 1.49 mm. As in the turbot, the pigmentation of the embryo and larva is dense and extensive, but the coloured pigment is tawny orange rather than blood-red.

The topknots are small flatfishes, mostly living at some little distance from the shore and possibly having a preference for rough ground. As a consequence, they are seldom captured, but the wide distribution and

frequency of occurrence of their eggs indicate that they are by no means rare. Three species occur on the Irish coast, namely the common topknot *Zeugopterus punctatus*; the Norway topknot *Phrynorhombus norvegicus*; and Eckstrom's topknot *Phrynorhombus regius*. There has been some confusion in the literature concerning the eggs and young stages of the topknots, but the recorded egg dimensions appear to be as follows (Kennedy and Fitzmaurice, 1969):—

<i>Z. punctatus</i>	0.92—1.07 mm; oil globule 0.17—0.20 mm.
<i>P. regius</i>	0.75—0.99 mm; oil globule 0.14—0.18 mm.
<i>P. norvegicus</i>	0.72—0.92 mm; oil globule 0.094—0.157 mm.

Eggs of *Z. punctatus* in the Irish collections were noticeably larger than those of *Phrynorhombus* spp. occurring in the same hauls. They ranged from 0.9 to 1.09 mm, with an oil globule measuring 0.16 to 0.17 mm. The admixture of black and yellow pigment in the embryo and early larva gave it a "pepper and salt" appearance under the lower powers of the microscope. In the larvae, the black pigment became progressively more dominant and soon the characteristic streaks began to develop on the marginal fin (Fig. 2). A total of 295 *Z. punctatus* eggs was taken. They occurred at 8 stations and on 27 days.

Eggs of *Phrynorhombus* spp. in the Irish material ranged from 0.83 mm to 0.90 mm. The oil globule measured 0.15 mm. Though both black and yellow pigments were present, the embryo and larva appeared decidedly yellow under the lower powers of the microscope. Time did not permit of critical examination of all the material, but a majority of the larvae developed the fringe of pectinate or dendritic chromatophores on the marginal fin which is diagnostic of *P. norvegicus* (Fig. 3). Eggs which could thus be attributed definitely to this species occurred at all the stations where *Phrynorhombus* eggs were taken. Some larvae, which might perhaps be attributable to *P. regius*, are also shown in Fig. 3. They hatched from eggs obtained at Dungarvan in 1967 and 1969. A few similar larvae hatched from eggs taken in Broadhaven Bay in 1971. The total number of *Phrynorhombus* eggs (irrespective of species) was 356; they occurred at 11 stations and on 39 days. They were taken in the rather brackish water of Cork Harbour as well as in the open Atlantic on the west coast.

Some reduction in the length of topknots appear to take place during the later stages of larval development.

Fifteen eggs of scaldfish *Arnoglossus laterna* were collected. A single egg was obtained in Dungarvan Bay and 14 in Blasket Sound. Ehrenbaum (1905-9) gives the egg dimensions as 0.6—0.7 mm (oil globule 0.11—0.13). No comparable Irish measurements can be given, as all the eggs had hatched before they could be examined. The small, slender larva is characterised by several touches of pigment of a distinctive vin rosé colour.

*Arnoglossus thori* has been regarded as rare in Irish waters, as only a few examples had been recorded from Bantry Bay, Ballynakill and Killybegs (Went and Kennedy 1969). In June 1971, 8 eggs were obtained in Broadhaven Bay (where they occurred on 3 days) and 2 eggs were taken in the Erris Race. The eggs had hatched on arrival in the laboratory, so no dimensions can be given. A larva from an egg taken in Broadhaven on June 9, 1971 is shown in Fig. 2. This larva was drawn when alive on June 12, 1971 and measured 3.1 mm. It was more advanced than the newly-hatched larva measuring 2.3 mm illustrated by Raffaele (1888) and was probably at least a day old. It resembled the larva of the scaldfish in general appearance, but had touches of pigment near the tip of the tail which are lacking in *A. laterna*. As in that species, only coloured pigment was present, but the colour was different—a reddish brick colour by transmitted light; orange-gold by reflected light. In a larva (not measured) which was three to four days old, the yolk sac was greatly reduced and the eyes were pigmented. The only other change in coloration was the appearance of melanophores inferiorly associated with the pigment patch over the rectum and that mid-way along the tail. At this stage there was as yet no prolongation of the beginning of the dorsal fin as a filament, which is a feature of certain phases in the early life history of this and some related species.

#### Family Pleuronectidae

A total of 23 eggs of lemon sole *Microstomus kitt* was taken. They occurred at 4 centres and on 10 days. The greatest number (16) was obtained in the mouth of the Shannon. Ehrenbaum (1905-9) gives the dimensions as 1.13—1.45 mm. Irish eggs examined measured 1.25—1.29 mm.

A total of 55 eggs of witch *Glyptocephalus cynoglossus* was taken. They occurred at 4 centres on 15 days. Most were taken in Blasket Sound (30) and at Dungarvan (22). The egg is smaller than that of the lemon sole. Ehrenbaum gives the dimensions as 1.07—1.25 mm. The Irish material examined averaged 1.22 mm. The various larval stages are suggestive of the corresponding stages of the lemon sole, but there are differences in the actual colours of the pigments and in their precise arrangement. The larvae of the lemon sole have been illustrated by McIntosh and Masterman (1897) and the larvae of the witch by Holt (1893).

During May 1970, 15 eggs of flounders *Platichthys flesus* were taken. They occurred at 5 centres and on 7 days. It is likely that on the south and west coasts most flounders have finished spawning before May.

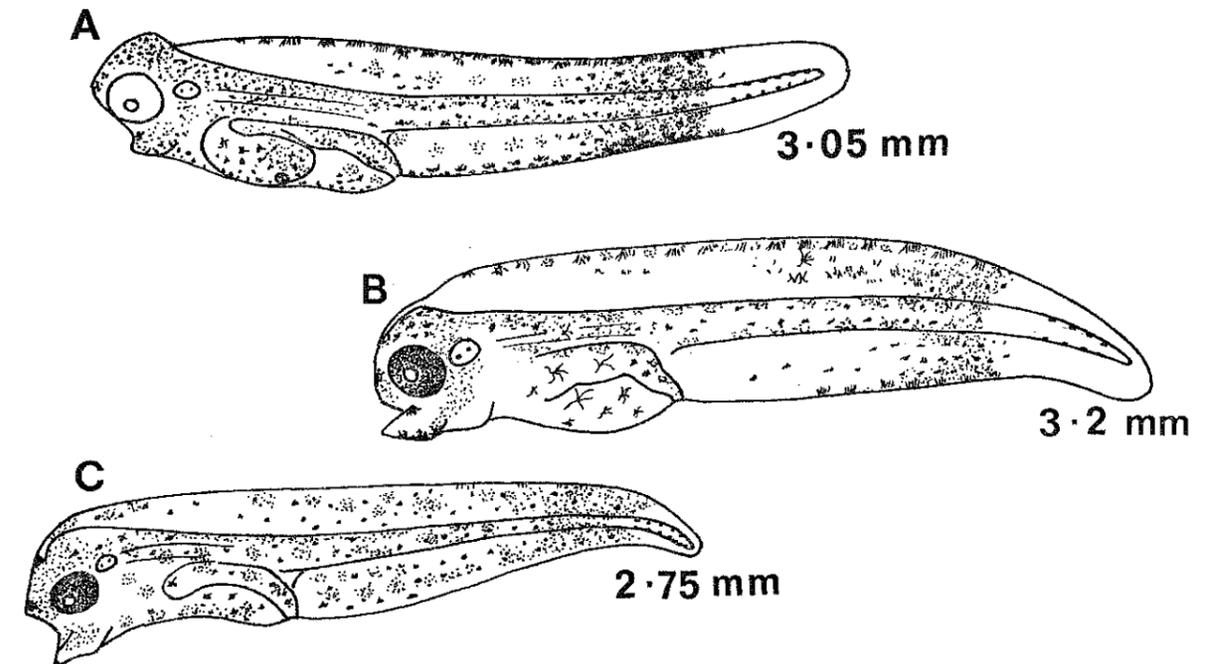


Fig. 3. A, larval Norway topknot *Phrynorhombus norvegicus*, about 3 days old, from an egg taken at Dungarvan May 15, 1969. B, post-larval do., 5-6 days old, from an egg taken at Dungarvan on the same day. C, post-larval *Phrynorhombus* sp. (*P. regius* ?), 5-6 days old, from an egg taken at Dungarvan on May 21, 1969. Pigmentation (reflected light):— A, B, C, yellow and black.

#### Family Soleidae

Eggs of common sole *Solea solea* totalled 11. They occurred at 3 centres (Dunmore East, Blasket Sound and Broadhaven) and on 5 days. Ehrenbaum (1905-9) gives the egg dimensions as 0.95—1.38 mm. Irish eggs examined measured 1.16 to 1.29 mm. The segmented yolk and presence of numerous clusters of tiny oil globules are obvious diagnostic characters.

Eggs of the sand sole *Pegusa lascaris* totalled 14. They occurred at 5 centres—Splough Rock, Blasket Sound and the three Mayo stations—and on 8 days. They are larger than the eggs of the common sole. Ehrenbaum, on the authority of Holt, gives the dimensions as 1.36—1.38 mm. Dimensions of eggs examined by the present authors were 1.39 mm (Broadhaven Bay, 1971) and 1.39—1.44 mm (Splough Rock, 1970). The oil globules are much less numerous than in the eggs of the common sole and are more variable in size; some are tiny, others much larger. The larvae exhibited the peculiar projection of the dorsal marginal fin in front of the head shown in Holt's (1891) figure, which does not seem to occur in the other soles.

Eggs of the thickback sole *Microchirus variegatus* totalled 15. They occurred at 5 centres (Splough Rock, Dungarvan, Blasket Sound, Broadhaven and Erris Race) and on 7 days. Ehrenbaum gives the dimensions as 1.28—1.36 mm. Eggs examined by the authors measured 1.32—1.35 mm. The oil globules are much larger and less numerous than in the two previous species.

A total of 20 eggs of solenette *Buglossidium luteum* was taken. They occurred at only 2 centres (Dungarvan and Broadhaven) and on 7 days. A single live symmetrical post-larva was, however, taken at the Splough Rock in 1967 (Kennedy and Fitzmaurice, 1969). Ehrenbaum gives the dimensions of the solenette egg as 0.69—0.94 mm. An egg examined by the authors measured 0.825 mm. The oil globules are relatively large and not numerous.

Table 1. Pelagic eggs of fishes

Numbers of eggs taken at each centre

Centre	Dublin Bay	Splough Rock	Dunmore East	Dungarvan	Youghal	Cork Harbour	Baltimore	Basket Sound	
	1968	1967, 1970	1970	1967, 1969	1967, 1969, 1970	1968	1967	1970	
Years tow-netted									
Days	1	4	3	17	8	6	2	7	
Sprat <i>Sprattus sprattus</i>	—	46 (2)	27 (2)	8 (2)	11 (3)	—	100 (1)	1,803 (7)	
Pilchard <i>Sardina pilchardus</i>	—	—	—	7 (2)	—	—	150 (1)	1 (1)	
Rocklings*	7 (1)	61 (2)	202 (3)	742 (17)	185 (6)	115 (6)	120 (2)	159 (7)	
Lesser forkbeard <i>Raniceps raninus</i>	—	—	—	4 (2)	1 (1)	—	2 (2)	11 (5)	
Cod <i>Gadus morhua</i>	—	—	—	1 (1)	—	—	—	—	
Pouting <i>Trisopterus luscus</i>	—	—	—	—	—	—	—	48 (4)	
Poor cod <i>T. minutus</i>	—	—	—	9 (4)	—	—	—	6 (3)	
Bass <i>Dicentrarchus labrax</i>	—	10 (4)	2 (1)	—	32 (8)	—	—	26 (3)	
Goldsinny <i>Ctenolabrus rupestris</i>	4 (1)	2 (2)	25 (2)	1,452 (16)	379 (5)	3 (2)	1 (1)	503 (7)	
Lesser Weever <i>Trachinus vipera</i>	1 (1)	3 (1)	—	18 (7)	136 (1)	—	—	8 (3)	
Mackerel <i>Scomber scombrus</i>	—	—	1 (1)	31 (4)	5 (3)	—	—	64 (6)	
Dragonets <i>Callionymus spp.*</i>	7 (1)	24 (1)	5 (2)	45 (7)	3 (2)	—	—	121 (6)	
Pearlfish <i>Echiodon drummondii</i>	—	—	—	—	—	—	—	58 (2)	
Gurnards Fam. <i>Triglidae</i>	—	1 (1)	—	—	1 (1)	—	—	25 (4)	
Turbot <i>Scophthalmus maximus</i>	—	—	—	—	—	—	—	7 (2)	
Brill <i>S. rhombus</i>	—	—	—	—	—	—	—	7 (4)	
Common topknot <i>Zeugopterus punctatus</i>	—	—	21 (2)	2 (2)	2 (2)	2 (2)	—	127 (6)	
Topknots <i>Phrynorhombus spp.*</i>	2 (1)	1 (1)	14 (2)	64 (11)	19 (5)	3 (2)	—	93 (5)	
Scald fish <i>Arnoglossus laterna</i>	—	—	—	1 (1)	—	—	—	14 (4)	
<i>A. thori</i>	—	—	—	—	—	—	—	—	
Lemon sole <i>Microstomus kitt</i>	—	—	—	—	1 (1)	—	—	3 (2)	
Witch <i>Glyptocephalus cynoglossus</i>	—	—	2 (1)	22 (7)	—	—	—	30 (6)	
Flounder <i>Platichthys flesus</i>	—	2 (1)	1 (1)	—	8 (2)	—	—	2 (2)	
Sole <i>Solea solea</i>	—	—	2 (1)	—	—	—	—	8 (3)	
Sand sole <i>Pegusa lascaris</i>	—	3 (2)	—	—	—	—	—	1 (1)	
Thickback sole <i>Microchirus variegatus</i>	—	1 (1)	—	1 (1)	—	—	—	4 (1)	
Solenette <i>Buglossidium luteum</i>	—	—	—	6 (3)	—	—	—	—	
TOTALS	Eggs	21	154	302	2,413	783	123	373	3,129
	Types*	5	11	11	16	13	4	5	24

\* Eggs of rocklings, dragonets, gurnards and *Phrynorhombus* spp. were not in all cases identified to species. Each group is listed as a single "type" in this table, even though more than one species may have been present.

taken on the Irish coast 1967-1971

(number of days on which taken given in brackets)

Cromane	Shannon	Broad-haven Bay	Erris Race	Belmullet Offshore	TOTALS			Percentage of total eggs
					Eggs	Centres	Days	
1970	1970	1971	1971	1971				
1	6	6	1	1	16,902	13	63	
—	211 (6)	10 (3)	2 (1)	3 (1)	2,221	10	28	13.1
—	1 (1)	4,198 (6)	7 (1)	5 (1)	4,369	7	13	25.9
4 (1)	634 (6)	1,270 (6)	33 (1)	1 (1)	3,533	13	59	20.9
—	—	27 (5)	5 (1)	2 (1)	52	7	17	
—	—	—	—	—	1	1	1	
—	2 (2)	33 (6)	9 (1)	3 (1)	95	5	14	
—	1 (1)	1 (1)	—	—	17	4	9	
3 (1)	—	—	—	—	73	5	17	
3 (1)	35 (4)	365 (6)	160 (1)	110 (1)	3,042	13	49	18.0
28 (1)	3 (2)	69 (6)	2 (1)	—	268	9	23	
—	—	915 (6)	351 (1)	680 (1)	2,047	7	22	15.7
—	1 (1)	26 (6)	3 (1)	—	235	9	27	
—	—	—	—	—	58	1	2	
—	—	11 (2)	2 (1)	3 (1)	43	6	10	
—	—	2 (2)	1 (1)	1 (1)	11	4	6	
—	—	1 (1)	—	—	8	2	5	
—	34 (6)	100 (6)	7 (1)	—	295	8	27	
—	18 (4)	103 (6)	25 (1)	14 (1)	356	11	39	
—	—	—	—	—	15	2	5	
—	—	8 (3)	2 (1)	—	10	2	4	
—	16 (4)	3 (3)	—	—	23	4	10	
—	—	1 (1)	—	—	55	4	15	
—	2 (1)	—	—	—	15	5	7	
—	—	1 (1)	—	—	11	3	5	
—	—	5 (3)	4 (1)	1 (1)	14	5	8	
—	—	8 (3)	1 (1)	—	15	5	7	
—	—	14 (4)	—	—	20	2	7	
38	958	7,171	614	823	16,902			
4	12	22	16	11	27			

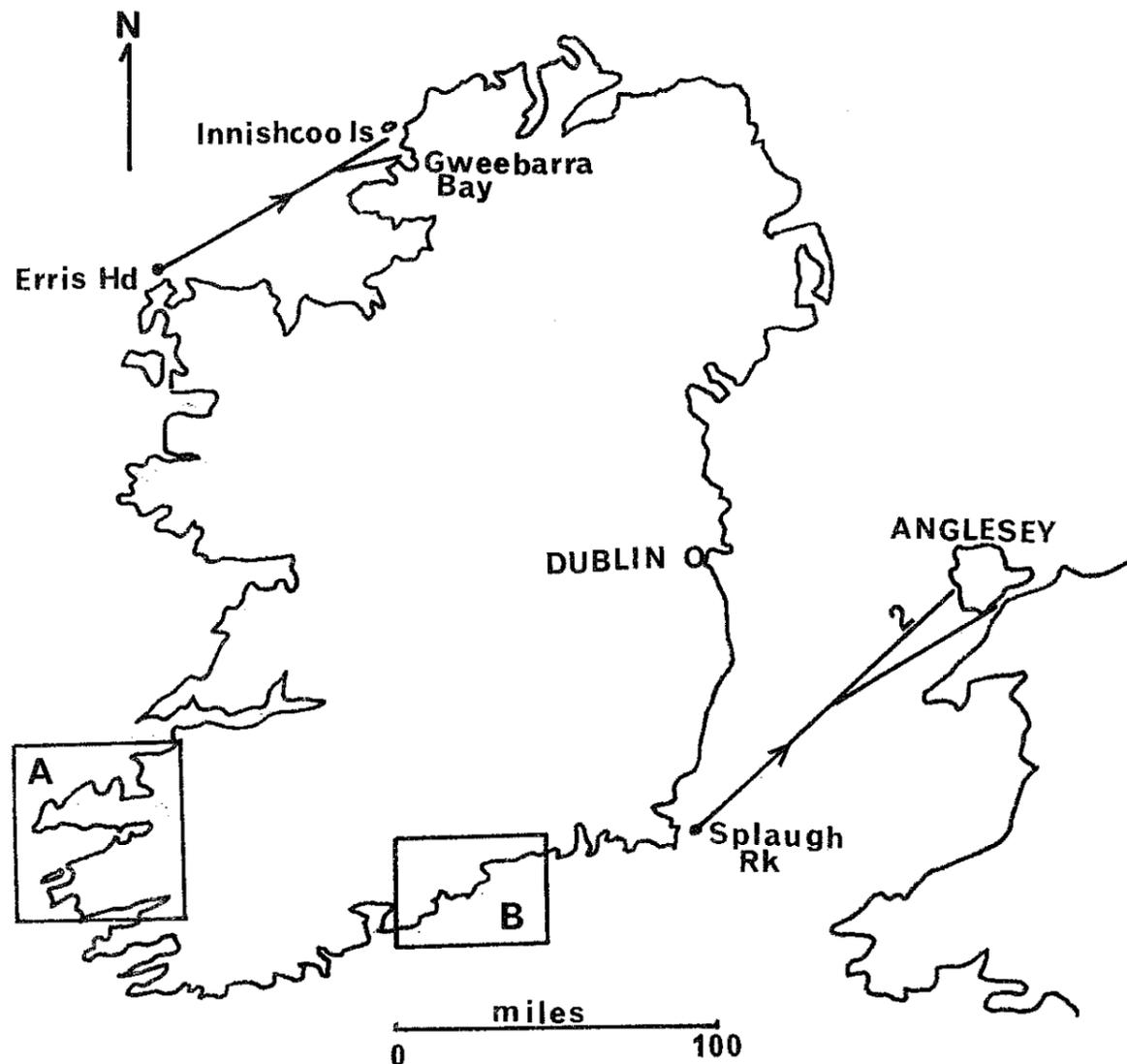


Fig. 4. Direction of drift of surface drift bottles released at the Splaugh Rock (Wexford) and off Erris Head (Mayo). For releases in areas A and B, see Figs. 5 and 6.

#### Drift Bottle experiments

The general pattern of residual-drift currents on the Irish coast is fairly well established, but more specific information about drift from particular points would be helpful in some instances. In connection with the fish egg investigations, a minor experiment with surface drift bottles was carried out in 1970 and 1971. Bottles were released as follows:—

Splaugh Rock	July 13-18, 1970.	12 bottles released, 3 recovered.
Dungarvan	July 6-August 18, 1971.	14 bottles released, 5 recovered.
Valentia	June 6, 1971.	10 bottles released, 1 recovered.
Blasket Sound	May 25-27, 1971.	8 bottles released, 2 recovered.
"Offshore Belmullet"	June 17, 1971.	4 bottles released, 2 recovered.

Details of recoveries are given in Table 2 and the tracks of the bottles are shown in Figs. 4, 5 and 6. As might be expected, the drift in most cases was to the NE or ENE, but a few comments are necessary.

The Splaugh Rock bottles drifted to Wales. It seems likely, however, that objects set adrift near the Splaugh would for a time be swept north and south in the very strong tides between the Tuskar Rock and the Wexford coast and that sometimes, especially in east winds, they might be set in towards the Wexford coast or be carried into Wexford Harbour. More experiments in this area would be desirable.

Table 2. Recovery of surface drift bottles

Place	RELEASED			RECOVERED		General Direction	DRIFT Distance (miles)	Days
	Date	Tide	Wind from	Place	Date			
¼ mile W. of Splaugh Rock	July 16, 1970	½ ebb	NW	Caernarvon Shore, Menai Straits, 1 mile N. of Port Dinorwic	November 11, 1970	NE	105	118
1½ miles S. of Splaugh Rock	July 16, 1970	2 hours of flood	SW	Rhosneigr, Anglesey	August 15, 1970	NE	98	30
Splaugh Rock	July 17, 1970	½ flood	W	Silver Bay, Anglesey	August 13, 1970	NE	98	27
½ mile off Mine Head	July 21, 1971	LW	No wind	E. side of Colligan estuary at Abbeyside (Dungarvan)	September 4, 1971	NNE then NW	9	45
Helvic Head	July 27, 1971	3 hours of ebb	W	Tranaleice, Knockmahon	August 3, 1971	E NE	10	7
Helvic Head	July 28, 1971	3 hours of ebb	S	Annestown	August 1, 1971	E NE	12	4
Helvic Head	August 1, 1971	HW	S	Clonea Strand	August 3, 1971	N	3	2
1 mile S. of Helvic Head	August 18, 1971	HW	NE	Ballycroneen Strand (Co. Cork)	September 25, 1971	SW	29	38
2 miles off Binnaclearig (Valentia Island)	June 6, 1971	1 hour of flood	SW	Gleann Liain, Valentia Island	July 13, 1971	NE	9	37
200 yards off Dunmore Head (Blasket Sound)	May 25, 1970	½ hour of ebb	W	Ballyheige Strand	June 1, 1970	E NE	35	7
Beginish (Blaskets)	May 26, 1970	3½ hours of flood	W	Ardkeragh (Ballyheige)	June 1, 1970	E NE	35	6
6 miles NW of Erris Head	June 17, 1971	HW	—	Innishcoo Island	August 19, 1971	NE	75	63
do.	June 17, 1971	HW	—	Dooey Strand, Gweebarra Bay	August 23, 1971	NE	75	67

In the Dungarvan experiment, the bottle released off Mine Head (west of Dungarvan Bay) was carried into Dungarvan Bay and stranded in the estuary of the Colligan River. Three of the bottles released off Helvic Head stranded on the Co. Waterford coast east of Dungarvan Bay; but the fourth was transported 29 miles to the south-west, to Ballycroneen, which is between Ballycotton and Cork Harbour. At first glance, this last bottle would seem to have gone the wrong way, against the anticipated general NE trend of residual drifts. However, of a number of bottles set adrift at distances of 2 to 5 miles off Mine Head in September, 1972, the 4 which were recovered were picked up on the coast of West Cork between Clonakilty Bay and Bantry Bay. This indicates that, at least at certain times of the year, there is a drift to the SW along parts of the south coast of Ireland. Close inshore tidal effects may over-ride this SW drift, while well offshore the drift is probably to the NE or ENE.

Bottles are not necessarily discovered and reported the moment they come ashore and the experiments, therefore, do not provide data on the speed, as distinct from the direction, of transportation by the residual drift currents. The Blasket Sound experiment, however, indicates an eastwards drift along the north of the Dingle Peninsula of at least the order of 6 miles per day.

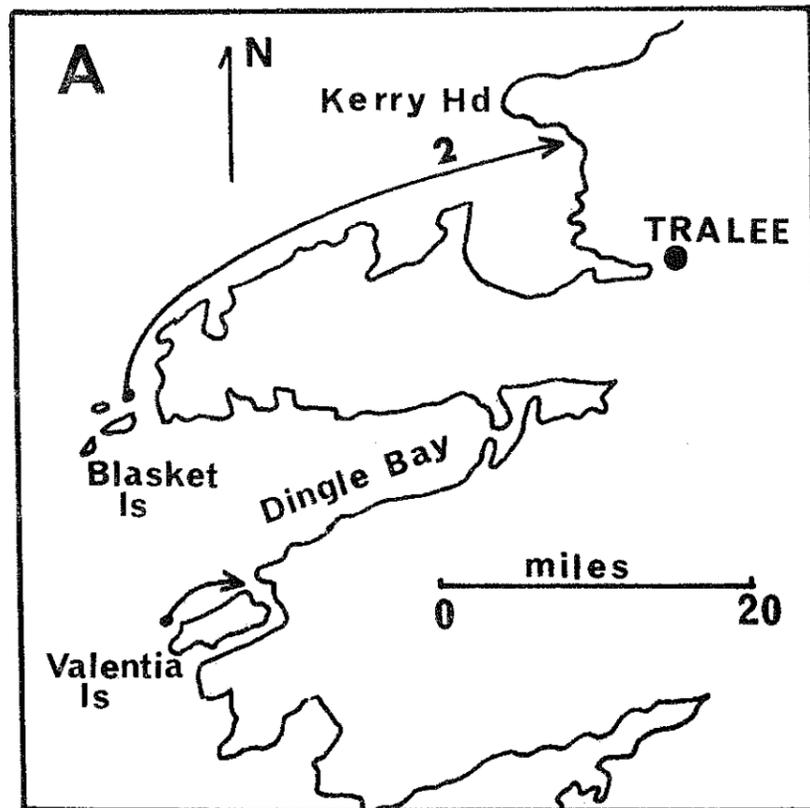


Fig. 5. Direction of drift of surface drift bottles released off Valentia Island and in Blasket Sound

While eggs and perhaps just-hatched fry may drift passively in the surface water layers, the larval stages of fishes may descend to deeper levels, where the drift is probably slower and may even differ somewhat in direction. It was noteworthy that, though small, fine-meshed tow-nets are not very efficient at catching small fish, the great majority of the young fishes caught in the surface and near-surface tow-nets were post-larvae (often well advanced) rather than larvae. Since the smaller and less active larvae could less easily avoid capture than advanced post-larvae, their extreme scarcity in the tow-net hauls would seem to indicate their absence from the water layers sampled. Allowance for possible or even probable descent of the larvae to deeper levels must be made in deciding, from drift bottle experiments, where young fish produced from eggs found floating in a particular place will find themselves in a given period of time.

#### Discussion

In drawing inferences from the results of tow-netting during the years 1967 to 1971, allowance must be made for the fact that sampling was limited to a rather restricted period of the year. The earliest date on which netting was carried out in any year was April 15 and the latest date was June 17. The number of days' netting in each month over the entire period was as follows:—

April	4 days
May	39 days
June	20 days

It was unlikely, therefore, that eggs of fishes which spawn in the early months of the year would have occurred and their absence from the collections is easily explained. Such species as spawn mainly in late summer would not come within the scope of the sampling programme either.

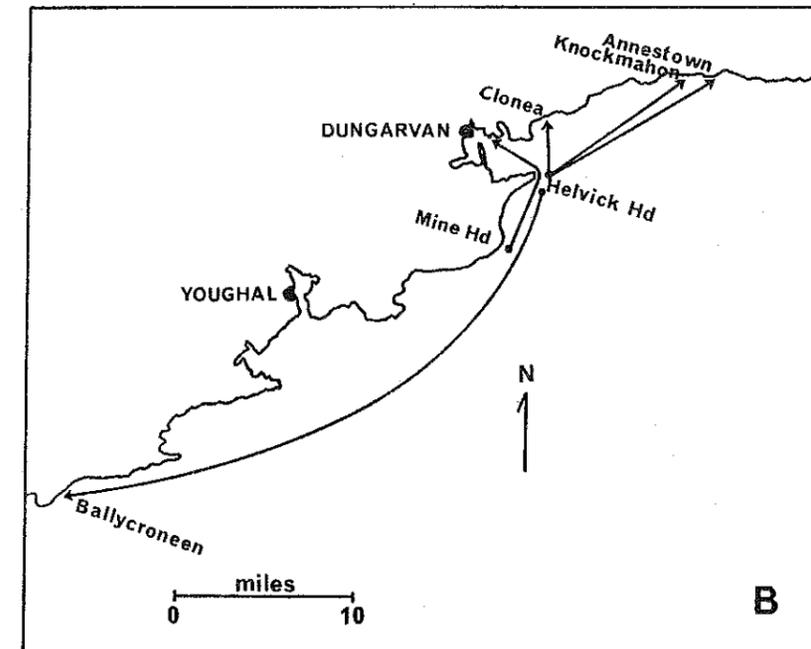


Fig. 6. Direction of drift of surface drift bottles released off Helvic Head (4 bottles) and Mine Head (1 bottle).

The most productive stations, in terms of variety as well as numbers of eggs, were Blasket Sound (3,129 eggs of 24 types in 7 days) and Broadhaven Bay (7,171 eggs of 22 types in 6 days). Both could be described as "Atlantic" stations, even though Broadhaven is a bay, not the open coast. These two stations show some interesting similarities and differences as regards the types of eggs collected at them. Cork Harbour and Dublin Bay (the latter admittedly sampled on only one day) were the least productive stations. Cromane yielded only a limited variety of eggs (4 types) on the one day it was fished, but these included eggs of bass, *Dicentrarchus labrax*, which was an important, though anticipated, discovery. A point of interest was that, at estuarine stations, very few eggs of any species were obtained in situations, or at stages of the tide, where the salinity was less than about 30‰.

Five species or groups of fishes provided, collectively, 93.6 per cent of all the eggs obtained.

In descending order of abundance, they were:—

Pilchard <i>Sardina pilchardus</i>	4,369 eggs (25.9 per cent of total).
Rocklings	3,533 eggs (20.9 per cent of total).
Goldsinny <i>Ctenolabrus rupestris</i>	3,042 eggs (18.0 per cent of total).
Mackerel <i>Scomber scombrus</i>	2,047 eggs (15.7 per cent of total).
Sprat <i>Sprattus sprattus</i>	2,221 eggs (13.1 per cent of total).

Eggs of pilchard, mackerel and sprat tended to occur in large numbers at certain stations only. Eggs of rocklings and of goldsinny were of much more widespread distribution and regular occurrence and were a feature of practically every haul at every station. Other species which, though much less numerous, were of widespread and fairly regular occurrence were lesser weever *Trachinus vipera*; dragonets *Callionymus* spp; and topknots *Zeugopterus punctatus* and *Phrynorhombus* spp.

The tow-netting programme was not an exhaustive study of the spawning of fishes on the Irish coast, nor was it intended to be. At the same time, it yielded the eggs of most of the common species of fishes whose

spawning season falls within or overlaps the period April to June. It also yielded eggs of some species which have been regarded as scarce or rare, e. g. *Echiodon drummondi* and *Arnoglossus thori*. Even allowing for the limitations of the programme, the absence of eggs of certain species from the collections may be significant, notably ling *Molva molva*; hake *Merluccius merluccius*; and grey mullet *Crenimugil labrosus*. These species may spawn too far offshore for their eggs to be taken within a few miles of the shore even on the west coast, where the drift towards land may be 3 to 6 miles per day.

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#### Summary

- (1) During each of the years 1967 to 1971 inclusive, tow-netting for pelagic eggs of fishes was carried out at various points around the Irish coast. Sampling was limited to the period late April to about mid-June. The stations sampled were Dublin Bay; the Splaugh Rock (Wexford); Dunmore East (Waterford River); Dungarvan; Youghal; Cork Harbour; Baltimore; Blasket Sound; Cromane (Dingle Bay); mouth of the Shannon; Broadhaven Bay; Erris Head; and a deep-water station off Erris Head. The situations netted included estuaries, bays, the open coast and an offshore station.
- (2) A total of 16,902 identified eggs was taken, belonging to 27 species or groups.
- (3) The most numerous eggs were those of pilchard *Sardina pilchardus*, rocklings, goldsinny wrasse *Ctenolabrus rupestris*, mackerel *Scomber scombrus* and sprat *Sprattus sprattus*. Collectively these fishes yielded 93.6 per cent of all the eggs obtained. Less numerous, but of fairly widespread occurrence, were the eggs of lesser weever *Trachinus vipera*, dragonets *Callionymus* spp. and topknobs *Zeugopterus punctatus* and *Phrynorhombus* spp. Eggs recorded for the first time from Irish waters were those of bass *Dicentrarchus labrax*, pearlfish *Echiodon drummondi* and the flatfish *Arnoglossus thori*.
- (4) Some drift bottles were released to obtain data on the probable direction of transportation of eggs at some of the stations sampled.

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