



# **IRISH FISHERIES INVESTIGATIONS**

SERIES B (Marine) No. 31 1988

**Roinn na Mara  
(Department of the Marine)**

Distribution of oyster *Ostrea edulis*, mussel *Mytilus edulis*  
and Anomiid larvae in Bertraghboy Bay, Co. Galway

by

John H. Wilson

DUBLIN:

PUBLISHED BY THE STATIONERY OFFICE

---

TO BE PURCHASED FROM THE  
GOVERNMENT PUBLICATIONS SALE OFFICE, SUN ALLIANCE HOUSE  
MOLESWORTH STREET, DUBLIN 2

---

Price: £1.10

# Distribution of oyster *Ostrea edulis*, mussel *Mytilus edulis* and Anomiid larvae in Bertraghboy Bay, Co. Galway

by

JOHN H WILSON, Shellfish Research Laboratory, Department of Zoology, U.C.G., Carna, Co. Galway

## ABSTRACT

Concentrations and shell lengths of *Mytilus edulis*, *Ostrea edulis* and Anomiid larvae were recorded from April to October 1985 in Bertraghboy Bay, Co. Galway. The gamete volume fraction of eggs in female mussels was recorded in an introduced cultivated population of mussels in the inner bay during 1985. Oyster larvae were commonest in July and September, but were concentrated in the upper bay. Mussel and Anomiid distributions were more variable. While the commercial stocks of mussels in the bay contribute to the larval pool, this input is small in relation to that from other sources.

## INTRODUCTION

The spatial and temporal distribution of larvae of *Ostrea edulis*L, *Mytilus edulis*L and Anomiids in Kilkieran Bay, Co. Galway, has been described in two previous papers (Wilson, 1987a and 1987b). Bertraghboy Bay lies approximately 10 km to the north-west of Kilkieran Bay and, like this bay, contains extensive natural shellfish stocks and fish farms. The bay once contained a highly productive oyster bed on the Cashel Bank in the upper part of the bay (Browne, 1904; Barry, 1975 and 1981), but this is now abandoned. Although the bay has a very small natural population of mussels, long-line and raft mussel farming in Leenagh Pool close to the oyster bed has introduced a sizeable mussel population of 20-30 tonnes (K. O'Kelly, pers. comm., 1987).

The potential settlement of mussels originating from mussel farms on oyster beds has been discussed in the context of Kilkieran Bay (Wilson, 1987b). Bertraghboy Bay, however, unlike Kilkieran Bay, has a farmed mussel population situated adjacent to the oyster grounds. Interest in the redevelopment of the Cashel oyster bed prompted an investigation of the possibilities of settlement of seed from mussel farming operations on the oyster grounds. The objective of this study was to examine the spawning cycle of farmed mussels in Leenagh Pool and the spatial and temporal distribution of mussel larvae in the bay in 1985, in order to relate the abundance of larvae to mussel farming operations. The distributions of larvae of oysters and Anomiids or saddle oysters were also monitored concurrently with this study to assess the dispersion of larvae from other bivalve populations within the bay.

## MATERIALS AND METHODS

### Location

Bertraghboy Bay is an enclosed bay approximately 7 km long and 2 km across at its widest point (Fig. 1). It opens through narrows to the south-west into the larger Big Sound. The bay is 20-30 m deep near the mouth gradually shelving to 5-10 m in the upper reaches. There is a 15-18 m pool at Leenagh to the east of the Cashel Bank. There are two main bays, Cloonisle and Cashel, on the northern shore. Three spate rivers, the Ballinahinch, the Gowla and the Gowlabeg, drain into the bay.

The bottom is mainly marl towards the mouth and muddy in the upper reaches and inlets. There are some isolated rocky outcrops in the centre of the bay, but in general the bottom is free of fouling.

A strong north-easterly tidal stream forms during flow-tide in the direction of the Cashel oyster bank. Eddies tend to form in the centre of the bay to the south of this stream.

### Gametogenesis of mussels

Samples of twenty mussels were collected from ropes in Leenagh Pool at approximately monthly intervals from 10 February to 1 October 1985. All mussels were mature and measured from 40 to 50 mm shell length.

A transverse section 6-8 mm thick was cut from the mantle of each mussel and fixed in Davidson's Fixative (Shaw and Battle, 1957). Tissues were then dehydrated in an ethanol series, cleared in xylene and embedded in 56° C wax. Sections of 12 µm thickness were cut and stained with Ehrlich's haematoxylin and eosin.

Planimetry was used to determine the progress of gametogenesis and spawning (Chalkley, 1943). Individual mantle sections were projected onto graph paper and the areas occupied by gametes calculated as fractions of the total area of tissue sampled. The pooled results of 24 quadrats, each of 250 × 250 µm, were calculated for each section. The mean for each mussel was estimated and arcsine transformed to ensure that the data was homoscedastic (Sokal and Rohlf, 1969). The mean for the population was the mean gamete volume fraction or GVF. The GVF can vary between zero, for complete sexual quiescence, and one, for complete ripeness.

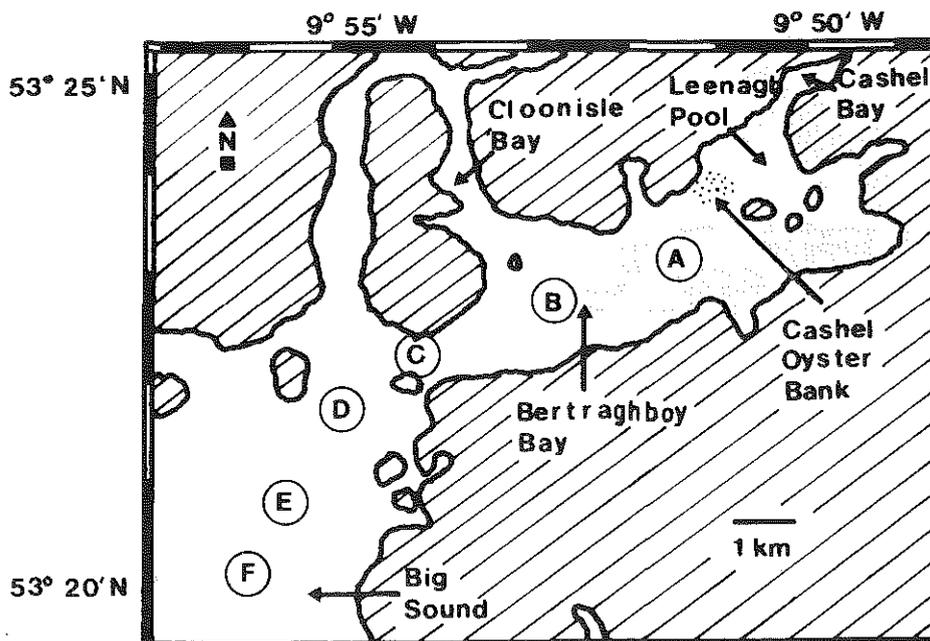


Figure 1. Map of Bertraghboy Bay area showing sampling stations A-F.

### Larval sampling

Larval samples were taken from 23 April to 1 October 1985 at 6 stations (A-F) situated from the middle of the bay to outside the mouth (Fig. 1). They were located in the main tidal stream of the inner and outer bays. All samples were taken at low water ± 1 h with a 90 µm mesh, 400 mm mouth diameter conical net. Vertical oblique hauls were made from a stationary boat by lowering the net, which was weighted at the apex, to near the bottom, and hauling it a measured distance to the surface. The amount of water filtered was quantified with a flow meter positioned in the mouth of the net. Between 3.17 and 4.88 m<sup>3</sup> were filtered by the net during hauls. Samples were stored in 1% neutral formalin.

Temperature and salinity readings were made at 5 m vertical intervals from surface to bottom concurrently with sampling at stations using a temperature/salinity bridge.

Bivalve larvae in samples were concentrated in the centre of a crystallising dish by gentle stirring. Mussel, oyster and Anomiid larvae were identified and measured under a microscope after pipetting the concentrated sample into a Sedgewick Rafter counting cell.

Counts were made of oyster larvae with shell lengths in excess of 150 µm, which corresponds to the minimum size of newly released larvae. Only mussel and Anomiid larvae, which had completed the early stages of development, were counted, that is, mussel larvae, which were counted were more than 220 µm shell length, and Anomiids more than 150 µm shell length. The term "mussel larva", therefore, includes stages before and after primary settlement up to shell lengths of about 300 µm.

There were two species of Anomiids, which dominated in the bay; *Anomia ehippium* and *Pododesmus (= Monas) patelliformis*. These were combined in counts for the purpose of this study.

## RESULTS

### Larval distributions

In Table 1 the temporal and spatial distributions of *M. edulis* larvae at the stations are shown. Combined larval counts for all stations peaked on 7 June and 1 October and were highest at the most seaward station F.

In Table 2 the temporal and spatial distributions of Anomiid larvae at the stations are shown. Combined larval counts for all stations peaked on 7 June and 9 September, and were highest at station F.

In Table 3 the temporal and spatial distributions of *O. edulis* larvae at the stations are shown. Concentrations were generally low, but there were significant peaks on 16 July and 9 September, and counts were highest at the inner bay station A nearest to Cashel Bank.

The average spatial distributions of the three larval types for the entire sampling season were calculated by first giving larval counts for each sampling date equal weighting to remove temporal variations in larval concentrations. Concentrations of each larval type recorded at each station on a sampling day were expressed as a percentage of the summed concentrations of that larval type recorded at all stations on that day. Means were then calculated for the entire season for each station after arcsine transformations of percentages. The backtransformed means and 95% confidence limits for the three larval types are presented in Fig. 2. The horizontal axis represents the distance of the stations from station A along the main tidal stream of the area.

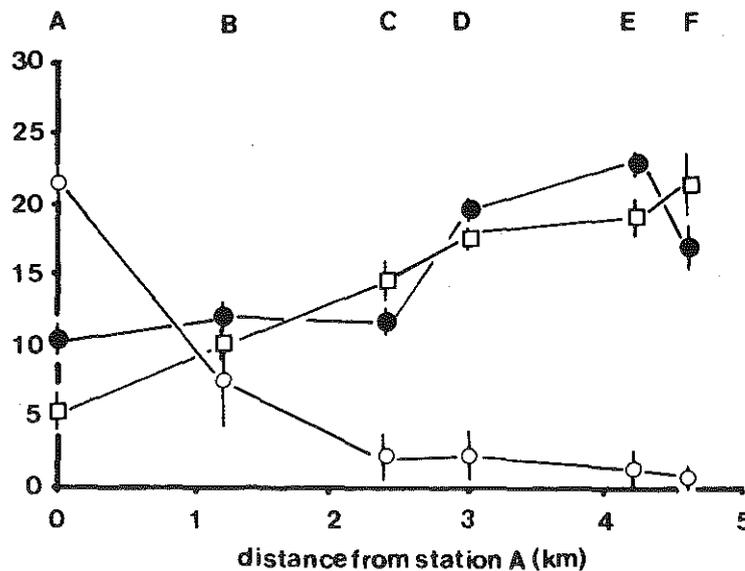


Figure 2. Mean percentage concentration of larvae at stations A-F with 95% confidence ranges. *Mytilus edulis* — o —; *Ostrea edulis* — • —; Anomiids — □ —.

In Fig. 2 there was an obvious increase in the mean percentage concentrations of mussel and Anomiid larvae to seaward. Oyster larvae tended to be commonest in the inner bay with mean percentage concentrations decreasing to seaward.

However, variations from these general trends were apparent between sampling dates and stations for all three larval groups. On some sampling dates mussel and Anomiid larval concentrations appeared to be higher at the inner stations than at the seaward stations, while not all stations showed synchrony with the general timing of larval peaks.

### Relative larval distributions and salinity profiles

The spatial distributions of larvae at stations on each sampling date were plotted with the prevailing salinity profiles in the bay (Figs. 3, 4 and 5). Larval concentrations were expressed as percentages of the totals for each date to give equal weighting to each date. Plots have not been included where total larval numbers on a sampling day were equal to or less than 1.0 larvae  $m^{-3}$ .

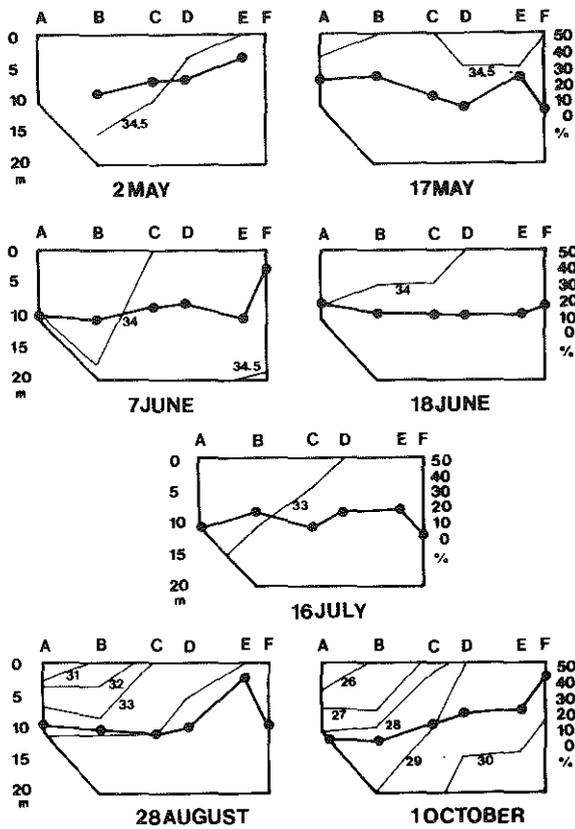


Figure 3. Mean percentage concentration of *Mytilus edulis* larvae at stations A-F for each sampling date with salinity profiles in p.p.t.

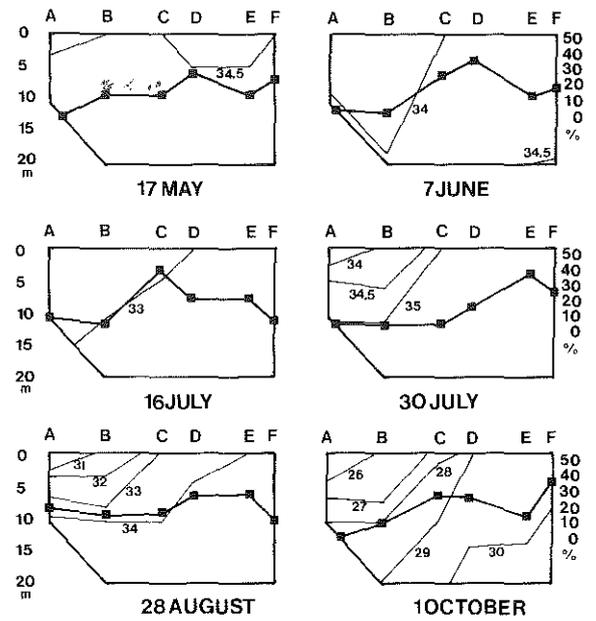


Figure 4. Mean percentage concentration of Anomiid larvae at stations A-F for each sampling date with salinity profiles in p.p.t.

In Fig. 3 mussel larvae concentrations showed variations in spatial distribution with time, but there was no general relationship with salinity for most sampling dates. When a marked salinity gradient was recorded, as on 28 August and 1 October, there was a tendency for relatively higher percentages of larvae to be found further down the bay. But on 2 May and 7 June seaward peaks occurred in the absence of marked salinity gradients.

In Fig. 4 Anomiid larval distributions in general peaked around stations C and D at the mouth of the inner bay. More seaward peaks were apparent, however, in 30 July, 28 August and 1 October samples, when salinity gradients were more pronounced.

In Fig. 5 oyster larval distributions corresponded well between sampling dates. The highest percentages of larvae were always encountered at station A; closest to the derelict oyster bed at Cashel Bank. The larval range down the bay and to seaward was reduced in times of marked salinity gradients as on 28 August and 1 October.

#### Temperature profiles

Temperature profiles for the bay and seaward area during larval sampling dates are shown in Fig. 6. Vertical temperature variations between stations were relatively minor on each sampling date, usually being little more than 1° C. There was neither an obvious relationship between temperature and salinity gradients nor larval distributions in the bay.

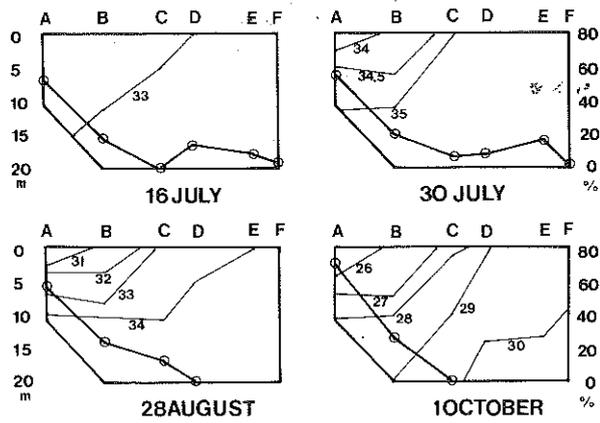


Figure 5. Mean percentage concentration of *Ostrea edulis* larvae at stations A-F for each sampling date with salinity profiles in p.p.t.

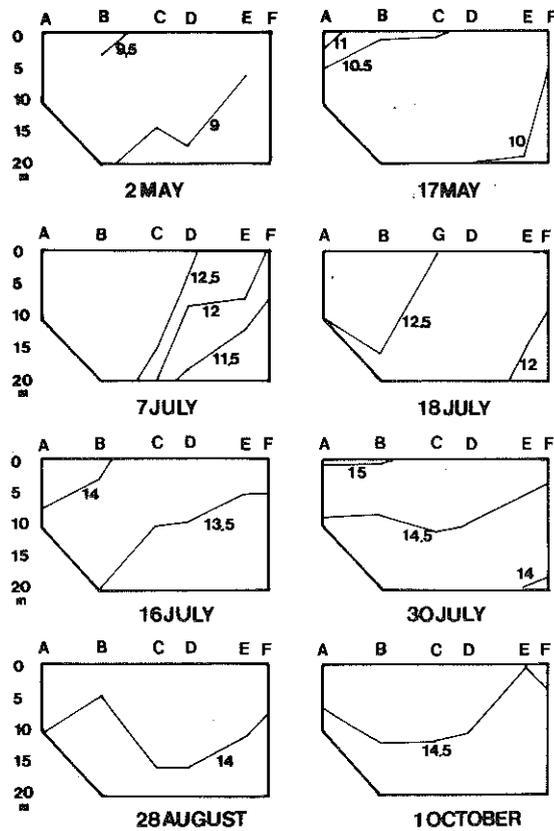


Figure 6. Temperature profiles in °C at stations A-F for each sampling date.

Spawning and mussel larval distributions

In Fig. 7 the mean concentration of mussel larvae and the GVF for female rope mussels in Leenagh Pool have been plotted against time. Only female mussels were used to derive a GVF as they provide a more precise index of the potential larval production due to spawning. Variations in GVF of males may indicate the spawning of large quantities of spermatozoa little of which is directly involved in larval production.

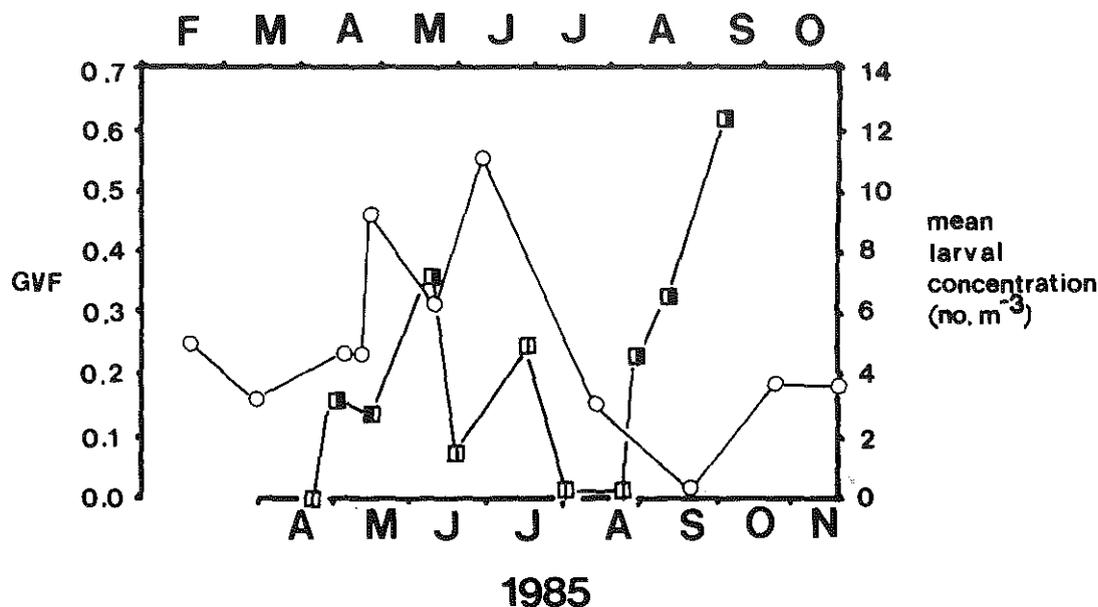


Figure 7. The mean concentration of *Mytilus edulis* larvae (number  $m^{-3}$ ) at stations A-F and the GVF of mussels in Leenagh Pool plotted against time. The time axis for larval concentrations (bottom) has been displaced 19 days to the left relative to the time axis of GVF (top). GVF of Leenagh Pool mussels — o —; larval concentration at A and E  $< 1.0m^{-3}$  — □ —; concentration of A and B  $> E$  and F — ■ —; concentration at A and B  $< E$  and F — ▣ —.

The relative distribution of larvae between inner (stations A and B) and outer stations (stations E and F) have been indicated on each sample date by one of three symbols to indicate the area where greater numbers of larvae were observed; at stations A + B, at E + F or where no significant difference exists between stations A + B and E + F. On 2 May stations A and F were not sampled, so that in this case a comparison was made between only stations B and E.

The statistical significance of differences between the inner and outer stations was tested by the chi-squared test, testing the null hypothesis that the percentage distributions at inner and outer stations did not differ significantly ( $p > 0.05$ ) from a uniform distribution (percentage mean at two combined stations = 33.33%).

In order to facilitate comparisons between spawning periods and peaks in larval concentrations the time axis for larval concentrations has been displaced 19 days to the left relative to the time axis of GVF. The overall average shell length of mussel larvae for all sampling dates was  $271.5 \mu m$  with a standard deviation of  $19.8 \mu m$ . It is generally accepted that the larval life of *M. edulis* is on average 3 weeks (Bayne, 1976). Assuming a high average growth rate of  $10.5 \mu m$  per day (Bayne, 1965) and an initial length of  $70 \mu m$ , the age of larvae of  $271.5 \mu m$  is approximately 19 days from fertilisation. Displacing the larval time axis to the left in Fig. 7 by 19 days allows a direct comparison to be made between spawnings as indicated by decreases in the GVF and the resultant larval concentrations in the bay which might be expected to arise from these spawnings.

Peaks in GVF were periods of maximum ripeness in the mussel population and decreases in GVF corresponded to periods of spawning. Spawning was, therefore, most marked from the end of April into May and mid-June to July. Mussels were largely spent by the end of August, when the GVF was at a minimum, after which the majority of the population began redevelopment of gametes.

In late April mussel larvae appeared in the bay, but it is unlikely that they originated from Leenagh Pool as mussels there were still relatively unripe at that time. These larvae were also commonest in the outer station. An inner bay concentration of larvae was observed in mid-May, which may have arisen in part from the spawning in late April. Larval concentrations peaked in early June, corresponding to a spawning in mid-May, but concentrations were higher at the seaward stations. A redevelopment period in the GVF in early June was associated with a drop in larval concentration in late June. There was an increase in larval numbers in July associated with a prolonged spawning in late June-July.

The steady increase in larval numbers in late August and September did not correspond with spawning activity in the Leenagh Pool population. At the time of the production of these larvae the GVF had either approached a minimum value or had begun a slow increase with redevelopment.

At this time there was also a significant shift in the relative distributions of larvae to the outer bay stations associated with the development of a marked salinity gradient (Fig. 3).

## DISCUSSION

In 1983 a survey of shellfish stocks in Bertraghboy Bay detected a small residual population of old oysters in lower Cashel Bay with a maximum density of  $0.25 \text{ m}^{-2}$  (Anon., 1983). No other oysters were found in the bay. Some small-scale oyster on-growing experiments were also located close to this area at the time of the present study, but as these oysters were at most 2 years old, their input to the larval pool may be considered as insignificant (Walne, 1964). It is surprising, therefore, that oyster larvae were detected in samples on a regular basis. Two peaks in larval numbers were recorded on 16 July and 9 September with total concentrations for all stations of 4.4 and 7.4 larvae  $\text{m}^{-3}$  respectively. On the other hand on the Roskeeda bed in Kilkieran Bay, where there was an estimated population of approximately 1 million oysters in 1983 (Anon, 1983), oyster larval concentrations at a single station in 1985 sometimes approached  $800 \text{ m}^{-3}$  (Wilson, 1987a). With the highest number of larvae recorded at a station in Bertraghboy Bay being  $2.5 \text{ m}^{-3}$ , the maximum concentration here is around 0.3% of the Kilkieran Bay levels. This would imply that the Bertraghboy Bay oyster population is very small compared with that in Kilkieran Bay.

Wilson (1987b) has discussed the distribution of Anomiid larvae in Kilkieran Bay, and concluded that larvae were dispersed throughout the bay as a result of the widespread distribution of the spawning adults. In Bertraghboy Bay Anomiid larvae occurred in highest numbers at the mouth and seawards of the bay. While subjective diving and dredge observations of adult Anomiids failed to indicate areas of highest densities, they appear to be less abundant in Bertraghboy Bay than in Kilkieran Bay. This conclusion is supported by differences in larval concentrations between Kilkieran and Bertraghboy Bays. Although concentrations were variable from year to year, in 1985 maximum concentrations of Anomiid larvae in Kilkieran Bay were  $116 \text{ m}^{-3}$  in September, whereas they were at a maximum of  $14.5 \text{ m}^{-3}$  in Bertraghboy Bay in the same month. Even allowing for considerable differential losses between the bays due to biotic and physical factors, the difference in Anomiid larval concentrations between the bays of almost an order of magnitude must be reflected in the size of adult stocks.

It has been shown in the present investigation that a small population of oysters isolated in the inner bay can produce a significant number of larvae, which tend to decrease in concentration as the bay is descended. It might be expected that a similar spatial distribution of mussel larvae would be evident in the bay, which originated from the Leenagh Pool population. After a spawning of the Leenagh Pool mussel stock, as indicated by a drop in GVF, larvae which may have originated from this event did not generally exhibit a similar decline in concentration with distance from the inner stations. On only one occasion (17 May) did such a situation arise, and here the differences in spatial distribution, although significant, were not great. Consideration must be made, however, of the different times the larvae of the two species spent in the plankton. The average age of mussel larvae in samples was around 19 days, whereas the average length of oyster larvae in samples was  $207.6 \pm 30.43 \mu\text{m}$ , which is approximately equivalent to an age of 6 days from release (Wilson, unpublished observations). The mussel larvae had been planktonic for three times longer than the oyster larvae. Hence mussel larvae would be expected to be more dispersed through the bay than oyster larvae.

The proportionately greater concentrations of mussel larvae at seaward stations leading on from periods of reduced spawning, as in September, would suggest that larvae from other sources are present in the area. It is unlikely that these larvae originated in the bay, as in most cases they began development when GVF of the Leenagh Pool population was at a minimum, while larval numbers were the highest recorded during the sampling season. Furthermore, possible displacement of a larval population originating in Leenagh Pool down the bay due to freshwater influx, as in late summer, does not account for seaward peaks in larval numbers at times of small salinity gradients as in early May and June.

Wilson (1987b) has shown that in Kilkieran Bay mussel larvae originating outside the bay are imported on the flow. There are sizeable quantities of rock mussels at the mouth and on islands in Big Sound (B. O'Sullivan, pers. comm., 1987), which may contribute larvae to the system. Seed (1969) in his study of rock mussels on the north-east coast of England found that they had a particularly extended spawning season of 4-6 months each year. It is possible that mussels on offshore islands in Big Sound make a significant and prolonged contribution to the larval pool in the outer bay. Some of these larvae will be imported into the bay on the flow, and retained in the bay by eddy currents.

It is clear, therefore, that while the commercial stock of mussels in Leenagh Pool contributes to the larvae of the bay, this input is small in relation to that of the offshore mussels. Not only do the offshore mussels contribute relatively large numbers of larvae to the system, but they also do so over a longer period.

## ACKNOWLEDGEMENTS

I wish to thank the crew of the R. V. *Iscaire* and local fishermen for helping in many ways during the sampling programme. Thanks are especially due to the staff of Beirtreach Teo. for the supply of mussel samples. I also thank Mr. Jim Simmons and Mr. Duncan Brown for technical assistance.

This work was partly funded by the National Board for Science and Technology.

REFERENCES

- Anon., 1983. *A survey of the oyster and scallop stocks in Kilkieran and Bertraghboy Bays*. Shellfish Research Laboratory, Carna. Unpublished report: 21 pp.
- Bayne, B. L., 1965. Growth and delay of metamorphosis of the larvae of *Mytilus edulis* (L.). *Ophelia*, 2: 1-47.
- Bayne, B. L., 1976. The biology of mussel larvae. In: *Marine mussels; their ecology and physiology*. Ed. B. L. Bayne, pp 81-120. Cambridge University Press, Cambridge.
- Barry, M. D., 1975. *Progress report of the N.S.C., U.C.G., Gael Linn Oyster Development Project*. Shellfish Research Laboratory, Carna. Unpublished report: 26 pp.
- Barry M. D., 1981. Distribution and ecology of oysters. *Ostrea edulis* (L.) in Kilkieran and Bertraghboy Bays, Connemara, Co. Galway. *Ir. Fish. Invest. Ser. B*. 24: 18pp.
- Browne, T. J., 1904. Shellfish layings on the Irish Coast. *Rept. Insp. Irish. Fish.*, 1904.
- Chalkley, H. W., 1943. Method for the quantitative morphological analysis of tissues. *Natl. Cancer Inst.*, 4: 47-53.
- Shaw, B. L. and Battle, H. I., 1957. The gross and microscopic anatomy of the digestive tract of the oyster *Crassostrea virginica* Gemlin. *Can. J. Zool.*, 55: 324-347.
- Seed, R., 1969. The ecology of *Mytilus edulis* (Lamellibranchiata) on exposed rocky shores. I. Breeding and settlement. *Oecologia*, 3: 277-316.
- Sokal, R. R. and Rohlf, F. J., 1969. *Biometry*. W. H. Greenman and Co., San Francisco. 776 pp.
- Walne, P. R., 1964. Observations on the fertility of the oyster. *J. mar. biol. Ass. U.K.*, 44: 293-310.
- Wilson, J. H., 1987a. Temporal and spatial distribution of *Ostrea edulis* larvae in Kilkieran Bay. *Ir. Fish. Invest.* B:29.
- Wilson, J. H., 1987b. The distribution of *Mytilus edulis* and Anomiid larvae in Kilkieran Bay, Co. Galway. *Ir. Fish. Invest.* B:30.

**Table 1. Larval concentrations (larvae m<sup>-3</sup>) of *Mytilus edulis* at stations A-F in Bertraghboy Bay in 1985 (-signifies no sample).**

Date	Stations						Totals
	A	B	C	D	E	F	
23 Apr.	0	0	0	0	0	0	0
2 May	—	2.25	3.09	3.49	4.80	—	13.63
15 May	3.45	4.12	2.40	1.37	4.80	0.69	16.83
7 June	3.77	3.14	6.13	7.86	5.19	18.08	44.17
18 June	2.30	1.37	1.37	1.20	1.37	1.72	9.33
16 July	2.94	6.60	3.62	7.55	7.70	1.26	29.67
30 July	0.21	0	0	0.31	0.31	0	0.83
21 Aug.	0	0.16	0.16	0.31	0.16	0.31	1.10
28 Aug.	2.52	2.52	2.52	3.46	13.21	3.14	27.37
9 Sept.	2.94	8.49	4.40	4.72	6.29	12.26	39.10
1 Oct.	2.93	4.72	10.06	14.78	16.04	27.04	75.57
Totals	21.06	33.37	33.75	45.05	59.87	64.50	257.60

**Table 2. Larval concentrations (larvae m<sup>-3</sup>) of Nnomiids at stations A-F in Bertraghboy Bay in 1985 (- signifies no sample).**

Date	Stations						Totals
	A	B	C	D	E	F	
23 Apr.	0	0	0	0	0	0	0
2 May	—	0	0	0	0	0	0
15 May	0	0.17	0.17	0.34	0.17	0.34	1.19
7 June	1.89	1.57	4.87	7.55	2.52	3.14	21.54
18 June	0	0	0	0	0	0	0
16 July	0.84	0.63	3.30	1.73	1.89	0.63	9.02
30 July	0.21	0.16	0.16	0.31	0.94	0.63	2.41
21 Aug.	1.47	2.04	2.52	1.42	0.63	0.79	8.87
28 Aug.	8.39	5.35	5.97	11.01	10.38	5.35	46.45
9 Sept.	3.77	11.01	8.81	6.29	11.95	45.28	87.11
1 Oct.	0.42	3.46	10.69	10.38	8.49	17.30	50.74
Totals	16.99	24.39	36.49	39.03	36.97	73.46	227.33

**Table 3. Larval concentrations (larvae m<sup>-3</sup>) of *Ostrea edulis* at stations A-F in Bertraghboy Bay in 1985 (-signifies no sample).**

Date	Stations						Totals
	A	B	C	D	E	F	
23 Apr.	0	0	0	0	0	0	0
2 May	—	0	0	0	0	—	0
15 May	0	0	0	0	0	0	0
7 June	0	0	0	0	0	0	0
18 June	0	0	0	0	0	0	0
16 July	2.52	0.63	0	0.79	0.31	0.16	4.41
30 July	1.68	0.63	0.16	0.16	0.63	0	3.26
21 Aug.	1.47	0.31	0.79	0.31	0.47	0.16	3.51
28 Aug.	1.26	0.63	0.31	0	0	0	2.2
9 Sept.	2.10	1.89	0.63	1.89	0	0.94	7.45
1 Oct.	0.84	0.31	0	0	0	0	1.15
Totals	9.87	4.40	1.89	3.15	1.41	1.26	21.98

### IRISH FISHERIES INVESTIGATIONS SERIES B (MARINE)

1967. 1. (1) Stocks of *Nephrops norvegicus* off the south coast of Ireland.  
F. A. Gibson, Ph.D.  
(2) Irish investigations on the lobster (*Homarus vulgaris* Edw.).  
F. A. Gibson, Ph.D.
2. Irish sprats and sandeels.  
John Molloy, B.Sc.
3. Notes on some Irish estuarine and inshore fishes.  
J. Bracken, Ph.D., and M. Kennedy, Ph.D. (with records of the distribution of shads by Eileen Twomey, M.Sc.).
1968. 4. The whiting fishery off Counties Dublin and Louth on the east coast of Ireland.  
1. The commercial catch.  
J. P. Hillis.
1969. 5. (1) Pelagic eggs and young stages of fishes taken on the south coast of Ireland in 1967.  
M. Kennedy and P. Fitzmaurice.  
(2) Age, growth and maturity of Irish lobsters.  
F. A. Gibson.
6. A review of the Dunmore East herring fishery, 1962-68.  
John Molloy, B.Sc.
1971. 7. (1) The whiting fisheries off Counties Dublin and Louth on the east coast of Ireland.  
2. Research vessel investigations.  
J. P. Hillis.
- (2) Occurrence of eggs of *Echidon drummondii* Thompson on the coast of Co. Kerry.  
M. Kennedy and T. Champ.
1973. 8. Pelagic eggs of fishes taken on the Irish Coast.  
M. Kennedy, P. Fitzmaurice and T. Champ.
9. The distribution and abundance of animals and plants on the rocky shores of Bantry Bay.  
G. B. Crapp, Ph.D.
10. The marine algal flora of Bantry Bay, Co. Cork.  
Michael D. Guiry, M.Sc.
1974. 11. Size distribution and food of Thornback Ray (*Raja clavata* L.) caught on rod and line on the Mayo coast.  
P. Fitzmaurice.
12. A diving study on Dublin Bay prawns *Nephrops norvegicus* (L.) and their burrows off the east coast of Ireland.  
J. P. Hillis.
13. Field observations on larvae of the Dublin Bay prawn *Nephrops norvegicus* (L.) in the western Irish Sea.  
J. P. Hillis.
14. Laboratory experiments on pumping and filtration in *Mytilus edulis* L. using suspensions of colloidal graphite.  
J. H. Wilson and R. Seed.
15. Reproduction in *Mytilus edulis* L. (Mollusca: Bivalvia) in Carlingford Lough, Northern Ireland.  
J. H. Wilson and R. Seed.
1975. 16. Captive rearing of larvae of *Nephrops norvegicus* (L.).  
J. P. Hillis.
1977. 17. The growth of *Mytilus edulis* from Carlingford Lough.
1979. 18. Observations on a bloom of *Gyrodinium aureolum* Hulbert on the South Coast of Ireland. Summer 1976, associated with mortalities of littoral and sub-littoral organisms.  
B. Ottway, M. Parker, D. McGrath, M. Crowley.
19. The exploitation of grey mullet *Chelon labrosus* (Risso) in the south east of Ireland.  
E. Fahy.
20. The cockle *Cerastoderma edule* (L.) on the South Bull, Dublin Bay: population parameters and Fishery potential.  
A. B. West, J. K. Partridge and A. Lovitt.
21. Laboratory investigations into the absorption of dissolved free amino acids by the gill of the mussel *Mytilus edulis* L.  
A. J. Elliott.
1980. 22. Benthic ecology of Dublin Bay in relation to sludge dumping: Fauna.  
A. J. M. Walker and E. I. S. Rees.
1981. 23. The rocky shore biology of Bantry Bay — a re-survey.  
J. M. Baker, S. Hiscock, K. Hiscock, D. Levell, G. Bishop, M. Precious, R. Collinson, R. Kingsbury, A. J. O'Sullivan.
1982. 24. Distribution and ecology of oysters, *Ostrea edulis* (L.) in Kilkieran and Bertraghboy Bays, Connemara, Co. Galway.  
M. D. Barry.
25. The scallop, *Pecten maximus* (L.) in Killary Harbour.  
Dan Minchin and F. Mathers.
26. The littoral fauna of Dublin Bay.  
J. G. Wilson.
1984. 27. Investigations in Bantry Bay following the Betelgeuse oil tanker disaster.  
R. J. R. Gainger, C. B. Duggan, D. Minchin and D. O'Sullivan.
28. Seasonal changes in the intertidal fish and crustacean populations of Aughinish Island in the Shannon Estuary.  
G. O'Sullivan.
1987. 29. Temporal and spatial distribution of *Ostrea edulis* larvae in Kilkieran Bay, Co. Galway.  
J. H. Wilson.
30. The distribution of *Mytilus edulis* and *Anomiid* larvae in Kilkieran Bay, Co. Galway.  
J. H. Wilson.
1988. 31. Distribution of *Ostrea edulis*, mussel *Mytilus edulis*, and *Anomid* larvae in Bertraghboy Bay, Co. Galway.  
J. H. Wilson.

*Irish Fisheries Investigations Series A (Freshwater)* deals with scientific research into all aspects of freshwater fisheries.