



IRISH FISHERIES INVESTIGATIONS

SERIES B (Marine)

No. 25 (1982)

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THE ESCALLOP, *PECTEN MAXIMUS* (L.), IN KILLARY HARBOUR

by

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The scallop, *Pecten maximus* (L.), in Killary Harbour

by

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ABSTRACT

Escallops (843) collected by SCUBA diving ranged from one year to an estimated seventeen years old and varied in shell height from 17mm to 164mm. They were predominantly found on the slopes on either side of the Harbour at depths between 6m and 35m; very few specimens were observed on the soft mud in the centre of the Harbour. The density of scallops increased towards the mouth of the Harbour.

The greatest numbers of specimens of less than 50mm were observed at the mouth of Killary. Variability in age frequency distributions along either side of the harbour could be explained by differences in settlement intensity from year to year. Settlement appeared to be more successful on the southern side than on the northern side. It also appeared that local dispersion from settlement areas occurred rather than active migration. Escallops four years old or less swam regularly while swimming was less frequently seen in individuals exceeding five years of age.

It was concluded that Killary Harbour was unsuitable for the collection of spat but may be a suitable area for scallop cultivation.

INTRODUCTION

The scallop, *Pecten maximus* (L.) is frequently encountered along the west coast of Ireland in bays and inlets (Gibson, 1956, 1959; Lee, 1973). Killary Harbour is a 15.7km long inlet on this coast where scallops are known to occur and have occasionally been fished by commercial dredge.

Many scallop surveys have involved the use of dredges to sample a population. Baird and Gibson (1956), however, demonstrated that the use of a dredge was inefficient for sampling an scallop population representatively, since a greater proportion of younger scallops could be taken by diving than by using a commercial dredge. A number of underwater observations have since been made by diving (Baird, 1966; Hartnoll, 1967; Mathers, 1976 and Chapman, Mason and Kinnear, 1977).

Underwater television and submersibles (Cameron, 1955; Caddy, 1970) are valuable for surveying deep water populations of scallops, where diving time is so limited as to be valueless, or where diving is not possible. In shallow water, however, diving enables the collection of material and permits a wide angle of vision; also the detection of very young scallops and studies of behaviour are often possible only by diving.

This paper describes a population of scallops based on collections and observations made by diving between 28 May and 20 August, 1974 and on 22 March, 1978.

MATERIALS AND METHODS

Diving stations were selected throughout most of the length of Killary Harbour and outside it as far as Inishdegilmore, an island 2.75km west north west of the Harbour mouth (Figure 1). Many of the stations were located close to land promontories or bays as this facilitated the recording of the precise location on a chart. Standard SCUBA equipment was used and all measurements of depth were made using a Spirotechnique helium depth gauge and later adjusted, to the nearest metre, to mean low water level. Most of the observations were made in depths less than 30m, although dives as deep as 40m were made, and as a result diving time varied from station to station. Transects at each station were made at right angles to the shoreline.

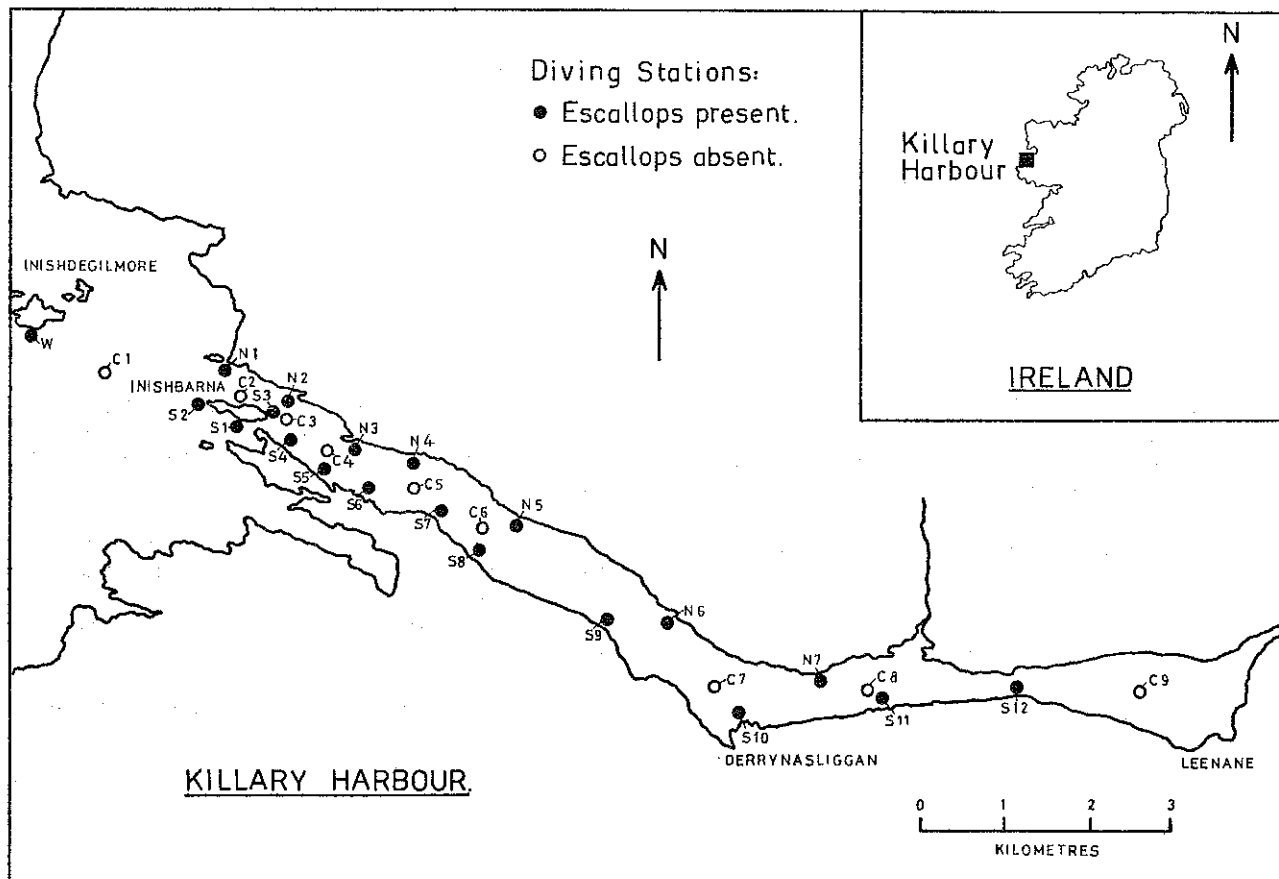


FIGURE 1. Diving stations about Killary Harbour.

At the point where the greatest concentrations of scallops occurred on each transect, an estimate of the density was made against a hand held meter rule (numbers/m²) to give the figure for the "maximum density" encountered. Observations commenced at the deeper end of each transect and then proceeded inshore along the sea floor to the shallower end. Where specimens were plentiful they were collected from within a 2m wide transect; elsewhere a wider area was searched to provide an adequate sample. At stations where scallops were sparsely distributed searching was continued at the same depth as the point of maximum density. This extended searching was usually conducted close to the base of boulders or rock outcrops. All scallops collected were placed in sacks, and on return to the surface many were measured and released.

Those that were not examined in the field were deep frozen and measured later. At S7 one large sample (unaged) was collected from an area of approximately 1,000 square metres without reference to a transect. Swimming behaviour was studied mostly at Inishdegilmore; all those scallops seen to swim were marked by damaging the ventral edge of the shell with a diver's knife.

D. Minchin and N. F. Mathers: The scallop *Pecten maximus* (L.) in Killary Harbour.

The criteria used by Mason (1957) for the ageing of the left shell were adopted. Rings on the right shell, which were more easily read, were used to cross check the estimated age and year class of each individual. The rings of the right shell only were used for age estimation in old or heavily fouled scallops.

RESULTS

The underwater visibility at Inishdegilmore and Inishbarna was approximately 6m. It was less within the Harbour (2m) but adequate to observe scallops. Diving stations are shown in Figure 1.

Distribution

The scallops were unevenly distributed along both the north and south slopes for most of the length of the Harbour and were most common adjacent to rocky headlands and on the south side of the Harbour. The distribution was usually limited to substrates of gravel/shell, shell sand, muddy sand and the firmer mud with some shell on slopes. Off Derrynasluggan (S10) scallops appeared to be concentrated within a transition zone of shell and mud which lay between mud and a mixture of pebbles with shell debris. Scallops were seldom found at the foot of the slopes where there is mud. They were not observed on the gently undulating soft mud which extends centrally up the Harbour (C2 to C9). A similar area also devoid of scallops was found between Inishbarna and Inishdegilmore (C1).

At all stations where juveniles (less than 50mm height) were found adults were present, juveniles never being observed on their own. Adults were recorded in the absence of juveniles at all stations except S1, S2, S3, S6 and N1, N2, N3. The juveniles were more common in water of less than ca 17m especially when close to the base of rock outcrops. Adults were also found near the rock outcrops but their range extended down slopes into deeper water where they were generally more numerous.

Density

Population density varied throughout the Harbour (Table 1). It was often greatest close to rock outcrops. Local concentrations could be found in gullies on patches of muddy sand or mud between rocks. The areas of high density were near the mouth of the Harbour at S1 to S4 and at S7 and S8 and also at N4. The greatest density was found at S2, and this sample consisted predominantly of juveniles. The greatest numbers were found within 5km of the mouth of the Harbour. The scallops occurred over a greater depth range within this region which was also the deepest section of the harbour. Densities were low close to Rosroe pier (S5 and S6), on the north side at N1 and N2, and also within the inner regions of the Harbour (S9 to S12, N6 and N7). Further within the Harbour the depth range was restricted to a few metres, usually close to rock.

Age distribution

Figure 2 shows the year class structure determined for each station from samples collected from May to June 1974. Individuals with four or fewer rings were plentiful near the Harbour mouth as far in as S3 (although rings of scallops at S7 were not counted, no '0' or '1' ring scallops were found). They were scarce east of S8 and absent east of N3. Scallops with four rings were the most common at S6 and S8 and specimens with eleven rings were dominant at S10 and N3. During March 1978, only S3 was revisited and no scallops with fewer than four rings (1973 settlement) were found.

No scallop spat (here, '0' ring scallops) were seen during 1974. Because of the presence of large numbers of individuals of the 1973 year class with one ring at S2 (up to eight per metre square), further studies at this station from May to October 1974 were made. The cliff face was examined for the byssally attached stage of the scallop but the only live pectinids found were *Chlamys distorta* (da Costa) and *C. varia* (L.). At the cliff base some damaged scallop shells (6mm to 11mm height) were found on muddy sand with broken shell.

Behaviour

Scallops were usually seen recessed into the substrate with sediment covering the left valve; if the valves were closed swimming could not be induced, even with tactile stimulation. Young scallops would usually swim when approached within a distance of approximately two metres by a diver. This distance could be reduced to a few centimetres if approached without exhaling and with minimal fin movement. Scallops normally swam away from the diver. When one of a number of scallops began to swim others would do so, resulting in some dispersion. Some scallops were seen to swim two or three times after brief intervals of rest. The distance covered by most individuals during the first period of swimming was normally the greatest. They seldom swam more than an estimated three metres.

Before swimming the valves 'gaped' slowly and the mantle curtain distended. After two or three rapid contractions of the adductor muscle, which cleared the upper valve surface of sediment, adults swam from a recessed position into the water column with their dorsoventral axis at an angle of approximately 30° to 40° to the horizontal. This angle usually decreased with continued contractions above the sea floor. The maximum distance above the substrate, estimated with the use of a metre rule, did not exceed 80cm to 90cm. When swimming terminated the scallop descended to the sea floor, coming to rest on the right valve. Most scallops with four or fewer rings were seen to swim actively (Table 2). Those with one and two rings swam with more rapid adductor contractions and often at a greater distance above the sea floor.

Scallops within the Harbour exceeding 125mm in shell height seldom swam but some did so with comparatively slow adductor contractions and 'hopped' along the sea floor on their hinge line. When on mud they often disturbed the bottom to produce a muddy suspension so that after swimming they were not always visible. Large scallops with five or more rings were seldom seen to swim and were normally well recessed into the substrate. Those collected from Inishdegilmore (W) less than 105mm height swam, and further, more than one-third of the total population captured were seen swimming (Table 2). More scallops swam at this station than any other.

Scallops found deepest on the slopes on the edge of the soft mud had more epifauna on the left valve than those in shallow water. Those heavily fouled with sponges, tunicates and *Alcyonium*, were never observed to swim. The few observed recessed in soft mud often had their right valves highly curved towards the ventral margin.

DISCUSSION

Scallops were located along most of the length of Killary Harbour, contrasting with the observations of Lee (1973) who found none. It would however appear that he sampled, using a dredge, the soft mud along the centre of the harbour which supports a facies of the *Amphiura chiajei* (Forbes) community. In the present study scallops were observed on either side from Inishbarna to N7 on the north slope and to S12 on the south slope, a maximum distance of approximately 9 kilometres. A similar type of distribution occurs in some of the fjords and bays of Norway (K.F. Wiborg—pers. comm.). Scallops were also found outside the Harbour on the southern side on Inishdegilmore.

The population density was generally greater near the mouth than further into the Harbour. The very low figures at S5 and S6 could be explained by the closeness of these stations to Rossroe Pier, an area known to be exploited.

In many of the other areas examined within the Harbour it was considered that scallops could not be easily exploited by dredge because of the nature of the slope of the seafloor and the presence of rock outcrops. Scallop density appeared to increase close to the small land promontories within the harbour where there was stronger current movement. On the slopes of the harbour scallops were absent where large local concentrations of either *Ophiothrix fragilis* (Abildgaard) or *Ophiocomina nigra* (Abildgaard) extending from shallow and into deeper water occurred. Densities were highest close to rocks and lowest on the soft mud in the centre of the harbour.

In the absence of known fishing by dredge in most of these areas, the distribution suggests that the presence of rock or the coarser substrate often found adjacent to the rock has some influence on the local abundance of scallops. This may be either because scallops experience less 'need' to swim away from such a substrate once having arrived or be due to the proximity to a region where settlement is likely to take place. The soft mud along the centre of the harbour may be unsuitable for scallops although they have been seen on similar substrate types in Berehaven Sound and Mulroy Bay (Minchin, unpublished). Their densities were also low, as in Killary Harbour, and all were large scallops.

There was an increase in the mean age of scallops from S2 to S10 (Figure 2). This type of distribution could arise as a result of scallop movement from an area of settlement near the harbour entrance or from annual variation between years of settlement within the harbour. It could also be a result of predation which, although not investigated, was not considered to vary greatly over the length of the harbour, a contention supported by the fact that old scallops (having more than ten rings) were noted at most stations.

Movements have been noted in various pectinid species. Should swimming occur during periods of strong tidal flow, as has been found in *Argopecten irradians* Lamarck (Moore and Marshall, 1967), displacement from the place of settlement is possible. Should swimming take place predominantly during tidal inflow, it could result in the eastward dispersion of scallops in Killary Harbour. This

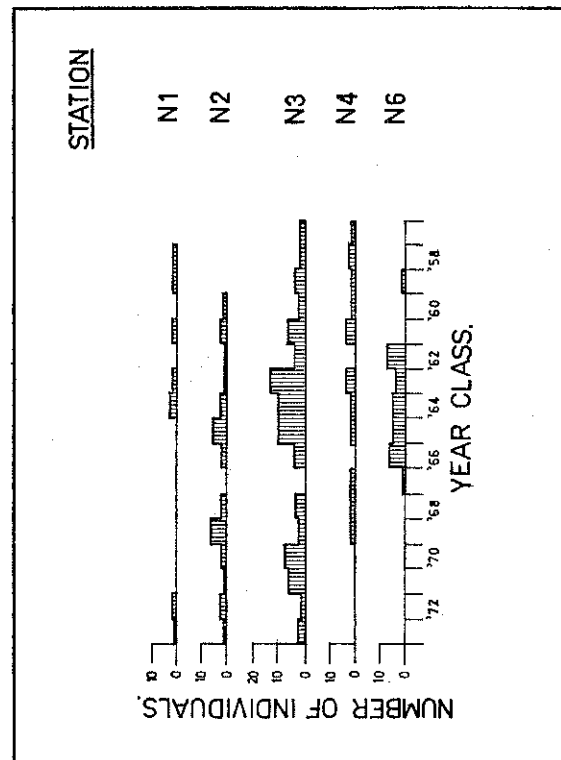
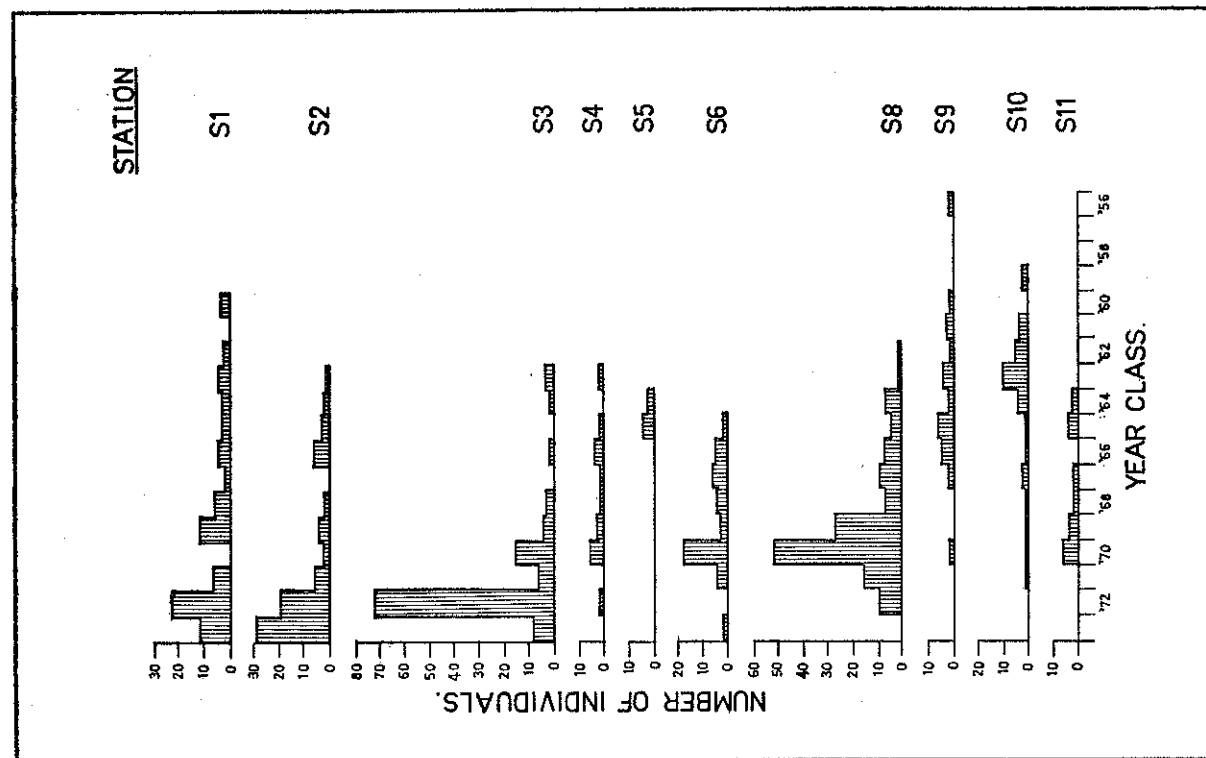


FIGURE 2. Age distribution of samples collected from May to August 1974.

could result in the age distribution pattern that exists at S1 to S8 (Figure 2), particularly since escallops with four and less rings were found to be most active (Table 2). Although there is a suggestion that escallops may move into the harbour, it does not fully explain the nature of the distribution pattern obtained; because the density of escallops along the southern slope is highly variable with few escallops present off Rosroe (S4 to S6) and areas of abundance at S2, S3 and S7. There are also areas devoid of escallops where there are communities of brittlestars and so a 'migration' into the harbour would appear to be unlikely. Local movements are, however, thought to occur, and dispersion of escallops into deeper water may take place; most single ringed escallops were taken in shallow water. This could result from settlement having occurred predominantly in shallow water with dispersion into deeper water by swimming as the escallops become older.

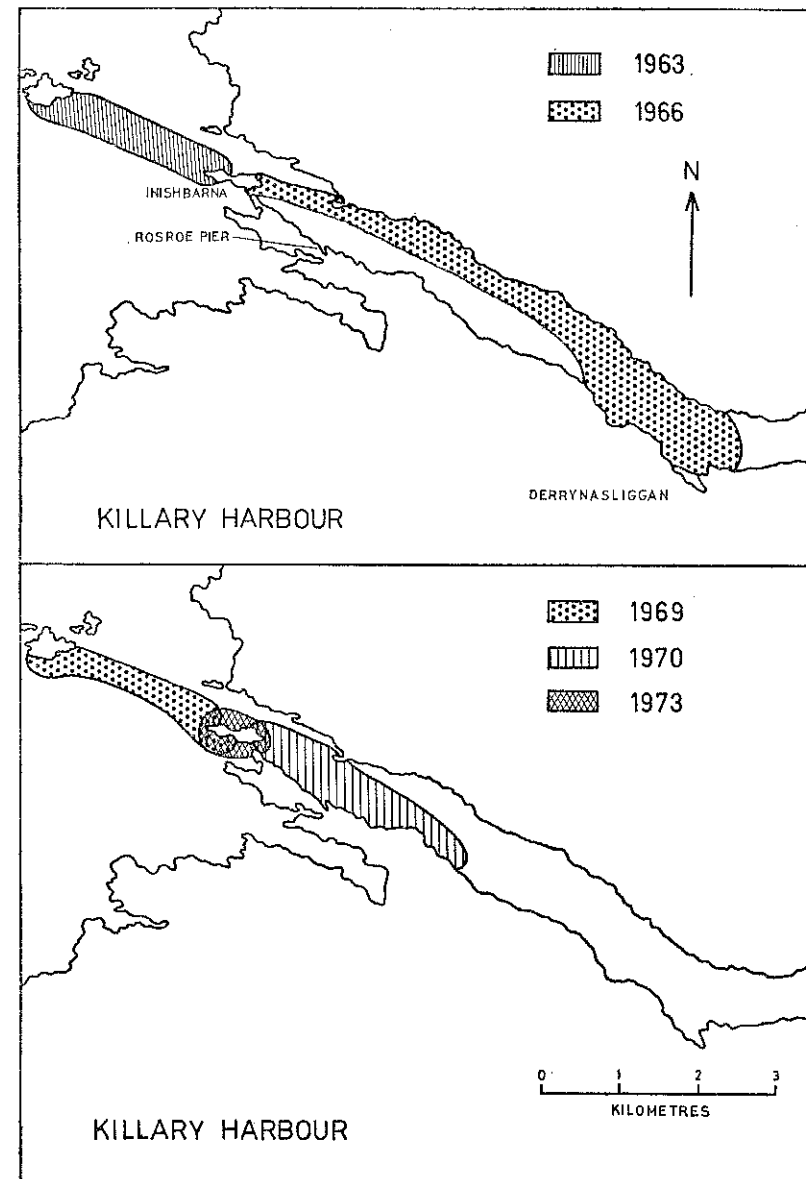


FIGURE 3. Distributions of larval concentration at times of settlement during 1963, 1966, 1969, 1970 and 1973, based on age determinations of samples taken in 1974.

The frequently reported scarcity of juvenile *P. maximus* from adult beds has been well documented by Tang (1941), Baird (1952), Baird and Gibson (1956), Mason (1957), Eggleston (1962), and Mathers (1976); some have suggested that this is due either to inadequate sampling technique or to poor representation of juveniles in some places. Gibson's (1953) tagging studies demonstrated

little movement and those few that were thought to have moved were less than 100mm in shell height. Baird and Gibson also cite a tagging experiment by Mason which indicated no escallop movement. Faure (1956) on the other hand records distances travelled of up to 4km in seven months; however, no mention of the size or ring groups of these escallops was made. The absence of juveniles on adult beds has been noted in other members of the genus; in *Pecten ziczac* L. (T. Waller—pers. comm.); also in *Pecten novaezelandiae* Reeve (Tunbridge, 1968) and *P. (Notovola) meridionalis* (Tate) (Fairbridge, 1953). Tunbridge suggested that this may be due to poor recruitment at the time of his survey.

The distribution patterns obtained in this study may be due also in part to uneven recruitment between years. Recruitment of escallops is known to be variable (Baird, 1966; Rolfe, 1969 and J.C. Dao and D.Buestel—pers. comm.) possibly partly because they have a relatively long planktonic period, and during this time are subjected to the combined effects of variable meteorological and hydrographic conditions. Laboratory studies of larvae to the time of settlement indicate that they may exist in the plankton for up to 38 days depending on sea water temperature, (Gruffydd and Beaumont, 1972; Comely, 1972). Should settlement occur at different intensities in different places within the Harbour each year, it would be possible to obtain the distribution observed. It appears that there was a good survival of escallops which settled within the harbour during 1963 and 1970 and near the harbour entrance in 1969, 1972 and possibly 1973 (Figure 3). Should annual mortalities of settled escallops be relatively constant, then a predominant age class may reflect a year of successful settlement.

How the intensity of settlement could vary about the harbour is not fully understood, but could be explained by the larvae becoming concentrated into certain parts of the harbour by hydrographic and meteorological conditions before the time of settlement. The larvae could behave in such a way as to occupy a certain position in the water column which may enhance such an effect. The intensity and time of spawning of adult escallops may also determine the nature of this distribution. In the present study escallops with one ring were encountered at S8, S10 and N3, which suggests that conditions can be suitable within the harbour for settlement. In 1973 settlement conditions appeared to be most favourable about Inishbarna as large numbers of one ring escallops were encountered in this region. Dead shells of 6mm shell height were found in drift lines at the base of rock at S2. This would suggest that settlement occurred nearby. Spat are known to attach to a number of substrates including various algae (Elmhirst, 1945; Mason, 1958), bryozoans and hydroids (Brand, Paul and Hoogestager, 1980). Algae are abundant at S2 ranging in depth from the surface down to 25m. However, near the Bundorragha river the algal zone was encountered down to only 4m and as a result the settlement surfaces available to escallop pediveligers may be much more limited well within the harbour. This may explain the presence of smaller numbers of adults there and why settlement about Inishbarna has been more consistent and successful.

Gruffydd (1973) in his studies on escallops from unexploited areas in the north Irish Sea found that the age structure varied at different stations, suggesting an effect of uneven recruitment between years. However the combination of all of his samples produced a curve that suggested that recruitment throughout a wide area was constant. Thus variation in the place of settlement could produce different age frequency patterns (Figure 2) and such patterns may also be further complicated by variations in spawning intensity from year to year.

The possible variation of settlement intensity at each locality for each year would indicate that Killary Harbour would be unsuitable for collecting escallop spat onto collectors.

The substrates present on the slopes within the harbour have varying numbers of escallops present. The mud along the centre of the Harbour is probably unsuitable for settlement and the absence of escallops from this region may be due to the principal settlement regions being confined to the edges of the Harbour, and also because it may be less suitable for adults. The limiting factor to the presence of large numbers of escallops being present is possibly the variability of settlement between years and areas and greater densities could be sustained if settlements were more consistent. It is likely that the sowing of young escallops could enhance production in a region such as Killary Harbour but such a hypothesis has yet to be tested.

Areas which may be suitable are S1 to S2, S4 to S5 and small regions in shallow water between S6 and S8. The flat deltaic alluvial fan on the Derrynasluggan river which extends into the sea is a shallow area which could also be examined.

The deep relatively sheltered harbour could provide suitable areas for the suspended cultivation of escallops but the economics of such a plan need to be examined in the light of some experimental trials.

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TABLE 1. The minimum and maximum depths (m) below low water where scallops were observed, population density (numbers/m²), and sampling data.

South Slope Stations	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11	S12
Minimum depth	12	15	6	4	2	6	6	9	5	6	9	8
Maximum depth	18	21	30	20	20	25	25	22	11	12	13	9
Maximum density	3	8	4	3	<1	<1	4	3	1	2	<1	<1
Number of <i>P. maximus</i> <50mm	11	30	13	0	0	1	3	0	0	1	0	0
Total sample size	71	66	112	15	6	45	161	93	26	35	15	3
Number of scallops per 60 minutes diving	178	208	164	45	9	93	261	155	32	50	16	5

North Slope Stations	N1	N2	N3	N4	N5	N6	N7	W (Inishdegilmore)
Minimum depth	10	10	5	12	12	4	7	10
Maximum depth	15	20	30	18	18	15	13	18
Maximum density	<1	<1	1	3	<1	1	<1	4
Number of <i>P. maximus</i> <50mm	0	0	2	0	0	0	0	0
Total sample size	7	17	38	16	5	17	4	81
Number of scallops per 60 minutes diving	10	30	76	32	6	27	8	180

TABLE 2. Shell height and numbers of rings on the shell of swimming and non-swimming scallops collected at Inishdegilmore.

Shell height mm	Swimming	Not swimming	Number of rings	Swimming	Not swimming
75—79	1		2	1	—
80—84	2		3	15	—
85—89	4		4	10	5
90—94	3		5	6	18
95—99	6		6	—	4
100—104	10		7	1	6
105—109	4	11	8	—	8
110—114	2	4	9	—	5
115—119	2	11	10	—	—
120—124		5	11	—	2
125—129		8			
130—134		3			
135—139		2			
140—144		2			

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