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GROWTH AND DEVELOPMENT OF THE ESCALLOPS IN  
IRISH WATERS.



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Irish Waters.

There is an extensive fishery for escallops (Pecten maximus) in Bantry Bay, County Cork, chiefly in Berehaven Sound, and on the Connemara Coast between Galway and Cleggan. The present paper is intended to compare the growth and development of escallops from these two areas, and is in the nature of a progress report.

Material and Methods:

The material so far obtained has not been collected continuously month by month throughout the year. Samples have been received mainly during the fishing season which extends from October to June. The open season in Connemara is from November to May, while it lasts from October to April in Bantry Bay. From 1946 to 1949 samples of escallops were subjected to a routine examination which was concerned primarily with the following details:

- (a) The length of each shell.
- (b) The proportion of shell to flesh.
- (c) The condition of the gonad.

Material received since 1949 was more closely examined with respect to age, growth and maturity.

Sample batches of escallops, composed of legal sized Connemara fish (usually in four dozen lots), were received at intervals through the Sea Fisheries Association from their Galway Depot. The samples from Bantry Bay were taken by the writer while dredging with the local fishermen. The latter samples were of all size groups.

Each escallop was measured from the umbo to the greatest marginal extremity using vernier calipers. Then each was weighed entire, after which the shell was opened and the flesh extracted and weighed. Lastly the inedible fleshy parts were removed and the remaining adductor muscle with gonad was weighed. The gonad was examined, and its degree of maturity noted. Lastly the upper (flat) shell was given an appropriate number to identify it, and from which age determinations were made subsequently.

Sexual Maturity.

A very few scallops of less than a half year old(O-group) were dredged in Bantry Bay, and they showed no development of a gonad. However a large number of scallops of more than one year old but less than two years old (O-group) were examined from this area and found to contain well developed, albeit proportionately small gonads, which always showed a preponderance of the male part. Scallops of the I-group class had larger gonads, and here again the male parts comprised the major part of the organ. It is not until we come to the II-Group fish that the normal large gonad is found. No positive records are available as to whether fish in the O-group and the I-group spawn, but it seems unlikely that the former are sufficiently developed to be able to do so. In the case of the I-group fish, it was noted that circa 40% of their gonads were of a flabby consistency being dull of colour and somewhat similar to adult spents, while the remainder had gonads much like the adult in the ripening condition. The immature gonad of the O-group fish, and the observed "spent" gonads of the I-group fish, suggest that there must be some critical break-down of the former, possibly coinciding with the adult spawning season, which is not necessarily described as spawning, and probably does not result in fertilisation. It must, however, represent an early commencement of the sexual rhythm.

Adult gonads are devisable into five conditions as follows:

- (1) Recovering spents. The outline of the gonad is sharply angled, and its consistency is flabby. The female part is a dull orange or brown, and the male part a dirty grey.
- (2) Developing stage. The outline loses most of its angles and becomes more tongue shaped. The apex is sharply pointed and always transparent. The female portion becomes a bright orange, and the male a very pale cream or ivory colour.

- (3) Full stage. The outline becomes very rounded. The transparency at the tip of the apex disappears, and the general consistency becomes very solid. The female portion being a bright pink, and the male a rich cream colour.
- (4) Running condition. There are coloured ova present in the duct on the right hand side of the gonad. A bulge develops in that portion containing the intestinal loop.
- (5) Spents. The gonad is almost colourless and transparent.

Prior to 1949 it was the practice to divide the gonads into three groups, namely, spents (including recovering spents) or 0-types, filling or +-types, and full or spawning that is I-types. Therefore 0-types were similar to types 1 and 5, +-types similar to type 2 and I-types similar to types 3 and 4 of the grouping mentioned above. A greater part of this material was collected prior to 1949, and the older grouping of the gonads has been used throughout and is shown collectively in figures 1 and 2 which determines observed sexual maturity.

The histograms in figure 1 show that Bantry Bay scallops mature somewhat earlier than those from Connemara. The difference in time may be as much as six weeks. For example in December it can be seen that 95% of Bantry Bay scallops have gonads of the +-types or I-types, while these conditions only attained in 65% of the Connemara fish in the same month. That is to say that in the former 30% were well advanced towards spawning as early as December, and this advantage was maintained throughout the spawning season as shown by subsequent histograms in this figure. Figures 2A and B have been compiled by combining the occurrence of the maturity stages obtained for the various months, and plotting them as an average percentage of the 0-, +- and I-types. It can be seen from figure 2A that as regards Bantry Bay scallops during February/March there is an increase in the number of spents, and a rapid decrease in the number of +-types, while the I-types comprise over 70% of samples. This increase of spents implies that in March, spawning has already commenced while the predominance of the I-type fish suggests that the maximum spawning period is about to begin. Figure 2A also shows that in November only 20% of the samples contained spent fish while 80% are recovering and



full. This represents an early maturity amongst some of the Bantry Bay samples, and suggests that spawning may commence even in February under suitable conditions. In figure 2B, which refers to Connemara material, it can be seen that over 40% of the fish were spents in December (and therefore presumably there were a greater percentage of spents in November). The number of spents progressively lessens till it becomes zero in May, when at least in 1949 (see figure 1) spawning must have commenced because all samples were then composed of either +- or 1-types. From the comparison of the two groups of curves in figure 2 it may be concluded that the maximum spawning occurs in (hypothetical production of the 1-type curve in figure 2A) at Bantry Bay, while it does not reach a maximum until May, at the earliest, in Connemara. The maximum spawning periods may vary slightly from year to year in both centres, depending upon prevailing conditions of weather and temperature.

#### Growth rate.

It was comparatively easy to measure the distances between the rings on the flat shells for the first eight growth zone formations in all samples where they occurred. However, the outside rings on these fish showing nine growth zones, and older fish, were very indistinct, and readings of them have been omitted from this report. Growth curves are shown for both areas in figure 3. The distance between the rings was measured along the antero-posterior axis starting from the umbo. As illustrated there is a close similarity in the curves for the first four ring formations, but a marked difference appears from the fifth to the eighth rings. Bantry Bay scallops are almost 2 cms. larger than those from Connemara at the end of the formation of eight growth zones. The difference in size between the 5 to 8 growth zone fish for these two areas has not yet been explained, but in the coming year it is intended to transplant tagged Connemara scallops to the Bantry Bay area to observe the change, if any, in their growth rate. If as a result of this experiment Connemara scallops are recaptured after some period of time, in the places where they were distributed and are found to have

made growth comparable to the Bantry Bay fish, then it may be concluded that their new environment afforded them better feeding, or better conditions for the assimilation of food than was to be found in their native waters.

Up to 5% of the scallops landed from Bantry Bay have shells with more than 9 growth zones, but measurements of these have not been included in this report owing to the difficulty experienced in measuring the distances between the closely laid down outside rings.

Each ring represents a growth check, and probably is formed just prior to the spawning period. It is unlikely that any of the scallops which at the end of the formation of the first growth zone are 2.2 and 2.4 cms. respectively from Bantry Bay and Connemara are capable of reproduction because they would be only very little larger at the time when the adults are spawning. The ring formed at this early stage must represent therefore the commencement of the spawning rhythm, which in older fish occurs annually in the Spring and early Summer.

TABLE I.

<u>Rings</u>	<u>Table A.</u>		<u>Rings</u>	<u>Table B.</u>	
	<u>Range in cms.</u>	<u>Average Size in cms.</u>		<u>Range in cms.</u>	<u>Average Size in cms.</u>
1	1.8-3.2	2.4	1	1.4-3.0	2.2
2	2.0-4.7	3.3	2	2.0-4.5	3.2
3	1.5-4.7	2.8	3	1.9-4.0	2.8
4	0.6-3.0	1.6	4	0.7-3.7	1.4
5	0.5-1.9	1.0	5	0.3-1.5	0.8
6	0.3-1.1	0.7	6	0.2-0.8	0.5
7	0.3-0.6	0.5	7	0.2-0.5	0.3
8	0.1-0.5	0.3	8	0.1-0.5	0.2
9	0.1-0.3	0.2			

Table IA shows the average growth increments during the first nine seasons in Bantry Bay, and it can be seen that the greatest increment is made between the first and the formation of the second ring, while the growth up to the formation of the first

ring is comparable to that made between the second and the third ring. After the third ring the growth progressively decreases, when after seven growth zones, increments are less than half a centimetre down to a millimetre. Table IB shows also that the greatest growth is made in Connemara scallops between the first and second ring formations, and that subsequent to this the increments decrease as for Bantry Bay, although at a somewhat greater rate. In both Bantry Bay and Connemara it might be said that there is a rapid increase in size to approximately 10 cms. in length, during the first four ring formations (representing at least three years of life). Subsequently this rate decreases. However when nine growth zones have been formed by Bantry Bay scallops, their length is approximately 13 cms. while at the same age Connemara samples are more than a centimetre smaller. It will be remembered that these lengths refer to the antero-posterior axis. To date no comparisons have been made in respect of the relationship of this axis to the lateral, or the dorso-ventral axes. Such measurements will be taken in future, when it may be found that their extent will add considerably to the larger proportions of Bantry Bay scallops.

#### Age Compositions:

Figure 4 shows the age composition of the commercial landings at both areas not including those fish with more than nine growth zones, which as stated above form only 5% of the landings at Bantry Bay, and considerably less at Connemara. In general the series of curves here show that commercial landings are mainly composed of fish with four and five growth zones from Connemara, and those with five and six growth zones in Bantry Bay (i.e. III and IV Group, and IV and V Group fish respectively). The curve representing Bantry Bay also shows that there is a greater proportion of scallops outside those which comprise the bulk of the landings (i.e. 35% are II, III, VI and VII Group fish) than at Connemara where those scallops outside the bulk landings comprise only 22% and consist of the I, II, V, VI and VII Group fish.

Proportion of shell to flesh:

The edible portion of the scallop is composed of the adductor muscle and the gonad. The proportion of these therefore to the rest of the animal is important. The series of histograms in figure 5A show the regularity of the proportion of shell to the flesh and edible parts from all samples in Bantry Bay between 1946 and 1952. In figure 5B the results from Connemara samples indicate that these proportions are even more constant. However, figure 5C which combines both areas at (a) and defines them at (b) and (c) for Bantry Bay and Connemara respectively indicates that the former gave 41% as flesh and 27% as edible flesh, whilst compatible figures for the latter were 36% and 20% respectively. This means that a greater proportion of the Connemara scallops is occupied by shell and furthermore that there is at least 7% less of edible parts than in the Bantry Bay samples.

Length/Weight ratio:

The length/weight ratios for both areas for 1950 (which was taken as the best year to assess this ratio because of the large numbers of scallops sampled) is given in figure 6.

Tagging:

In March 1952, 140 scallops from Bantry Bay were tagged and distributed in known parts of Berehaven Sound. The average size of these fish was 8.4 cms., and they were therefore 2½ to 3½ years old. The tag used was a celluloid disc upon which the legend "Fisheries Dublin" appeared, and a number was printed. A length of silver wire was passed through a hole bored in the tag, and secured upon itself. In tagging, the free end of this wire was passed through a hole bored in the left ear of the upper shell, by means of an archimedes drill. The wire was twisted upon itself and the free end snipped off. This type of tagging did not interfere with the normal movement of the scallop and should prove a successful method.

Summary:

- (1) Escallops in Irish waters probably reach maturity after the second growth zone is laid down, and definitely when the third growth zone appears.



(2) Spawning commences in Bantry Bay in March, probably reaching a maximum in April. On the other hand Connemara scallops mature later in the season, and spawning does not reach a maximum until May or June. The annual spawning period in Bantry Bay appears to take place over a more prolonged period than in Connemara, but may be of more regular occurrence.

(3) There is a close similarity in the growth rate during the first four years in both areas, and subsequent to this the Bantry Bay scallops maintain a considerably higher rate up to (and probably beyond) the formation of eight growth zones. Certain factors which may be concerned in this are:

- (a) Bantry Bay scallops spawn earlier in the season and therefore the adolescent fish are better equipped to take more advantage of the early summer and autumn months, so that at the end of the formation of the first growth zone they are slightly larger than those from Connemara, and this advantage is maintained and increased throughout life.
- (b) There may be better feeding in Bantry Bay.
- (c) It seems likely that there is a migration shorewards of larger fish from the deeper off-shore waters during the summer and autumn at Bantry Bay. It is known that scallops dredged in deep water around the Irish coast (~~11-20 fathoms~~) are substantially larger than those caught in-shore. There is evidence from one area near Schull, County Cork on the south coast, that these beds of scallops in deep water are unable to withstand a concentration of fishing. The deep water Schull beds yielded large numbers of fish well above average size in 1946 and 1947, but failed to yield an economical return in 1948. The writer has seen scallop shells of upwards of 20 cms. in length which had been taken by trawl fishermen in place fishing grounds situated in deep water off the ~~Wexford~~ coast.

The greatest growth was found, in scallops from both areas, to be up to the formation of their second growth zone, while growth up to the formation of the first and third zones was similar.

Thereafter growth tails off. During the formation of the fourth and fifth zones in Bantry Bay samples, growth was 65% greater than in the four subsequent years. While at Connemara growth over the same period was only 45% greater than in the three subsequent years.

(4) The Bantry Bay fishery depends chiefly upon the IV and V group scallops with a length range of 10-12 cms., while the Connemara fishery depends upon the III and IV group scallops ranging from 9.0 to 10.5 cms. in length. However there is a greater selection of lower and higher groups in the former fishery. Size limits of 11.4 and 10.8 cms. are imposed in these two districts respectively. Fish passing through rings of these diameters are deemed undersized. For this purpose the greater size across the lateral axis is used, and the size groups measured in this way are 1 to 1.5 cms. greater than the length along the antero-posterior axes.

(5) Roughly 27% of the Bantry Bay scallops are composed of edible flesh, ~~while~~ in those from Connemara this proportion only amounts to 20%.

(6) The length/weight ratio has been indicated for fish examined in 1950 in figure 6.

(7) Small scallops numbering 140 have been tagged in Bantry Bay. To date no recaptures have been made. Transplantation of tagged fish from Connemara to Bantry Bay has been mentioned above. The general objects of tagging will be, (a) to compare the effect of Bantry Bay environment upon the growth and development of Connemara scallops, (b) to discover what annual migrations, if any, are made by scallops in general, and (c) to estimate the local fishing intensities.



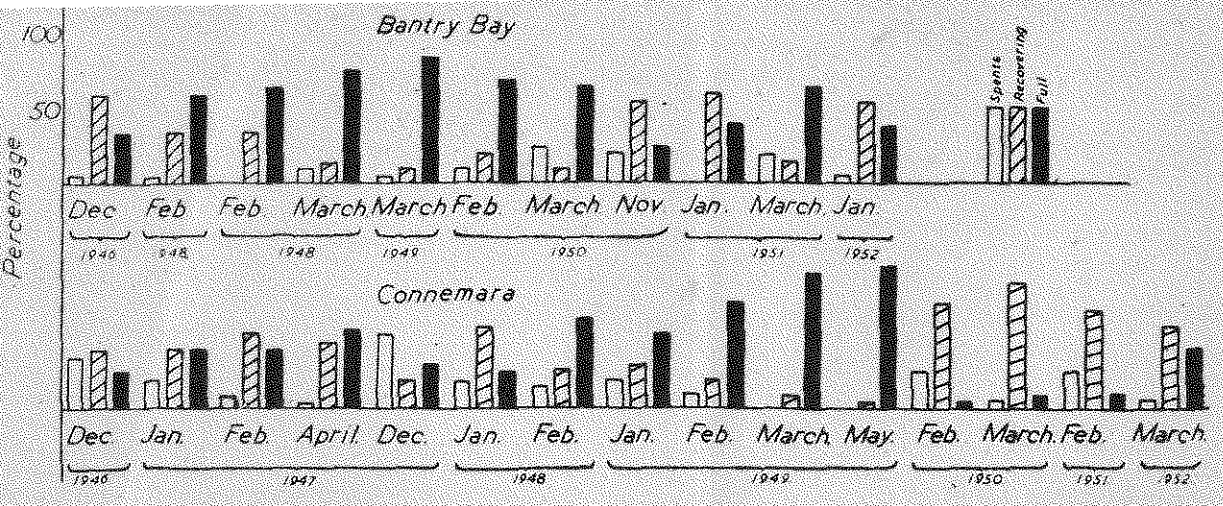


Fig. 2

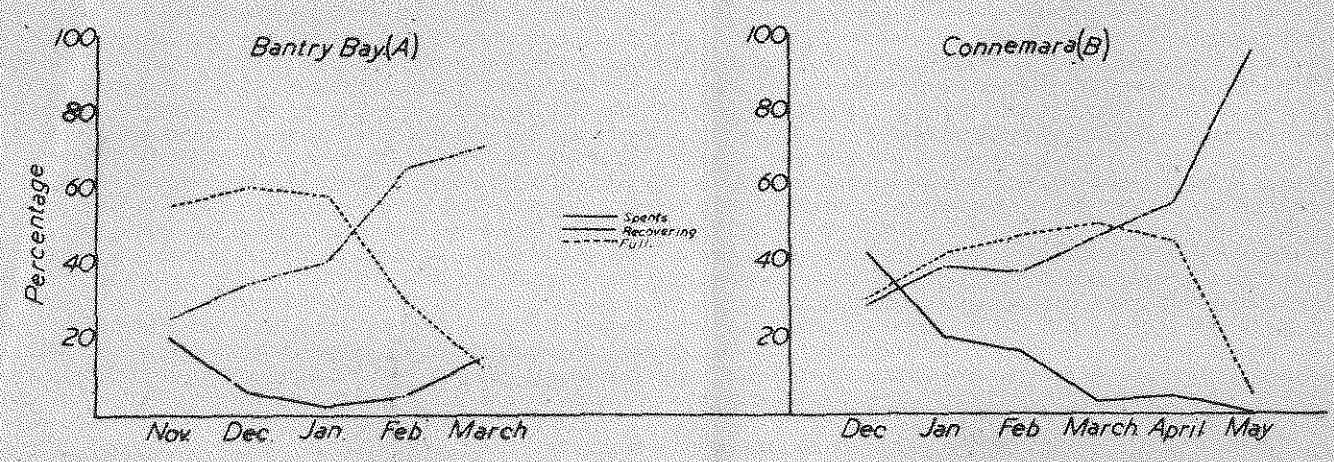


Fig. 3

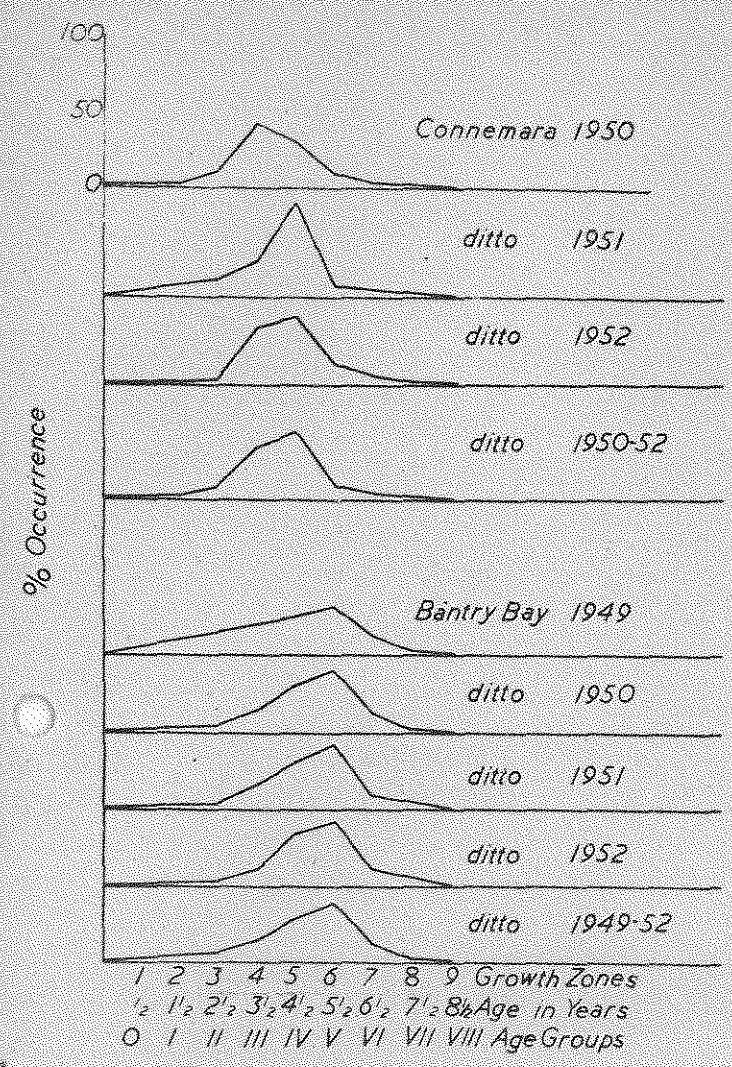
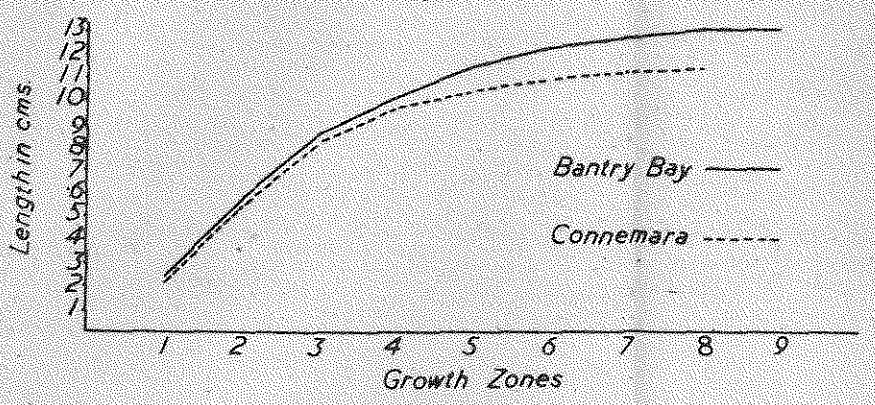


Fig. 5

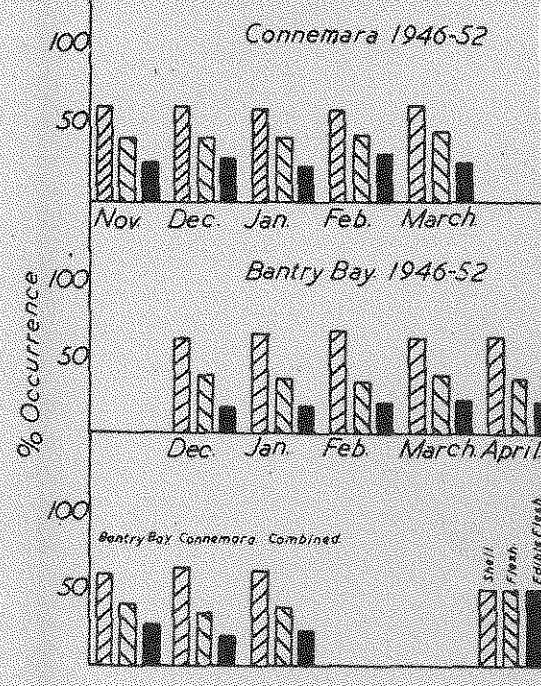


Fig. 6

