International Council for
the Exploration of the Sea

C.M. 1963
Shellfish Committee
No. 214

Some observations on mussel settlement at Conway

by

N. REYNOLDS

Ministry of Agriculture, Fisheries and Food,
Fisheries Experiment Station, Conway, Caernarvonshire

The mussel beds at Conway have been worked commercially for a great many years. The mussels were fished for pearls from Roman times up to the early part of the nineteenth century. During the second half of that century a trade in mussels for food developed and has continued ever since. During this century the output has fluctuated from about 300 to 900 tons a year. The normal output is in the region of 400-500 tons. The major variations in output usually take place over several years. The most recent "low" was in the season of 1957/58 when only 300 tons were produced. Since then the tendency has been for the output to rise, 470 tons in 1961/62 and 540 tons in 1962/63. The methods of fishing and of management of the fishery have changed very little in the last half century. The fishery may be considered as one in a state of equilibrium, which is at present in a phase of increasing productivity.

The main object of the investigations described in this report was to study the annual recruitment to the fishery. The observations were confined to those areas which dry out at low water. After some preliminary trials four sites were selected for regular sampling. These are indicated on the sketch map.

"Site I" lies on the north side of the Conway channel, opposite No. 7 buoy, at the level of low water of a moderate spring tide. The ground slopes steeply to the channel and is composed of pebbles and gravel with some sand. The ebb tide runs very strongly in that area.

"Site II" is on the opposite side of the channel, near No. 7 Buoy. The level is a little above spring tide low water. The ground is fairly level, mainly gravel and sand, and has less tidal scour than Site I.

"Site III" is on the west bank of the channel near the Perch at about the low-water mark of neap tides. The ground here is mainly sandy, formed into large ridges covered with mussels.

"Site IV" is quite different from the others as it is at about the half tide level. The ground is flat, composed of sand and gravel, and was carpeted with mussels which were practically all less than 15 mm long when the observations were started.

After some experimenting it was decided to take five sub-samples, each covering 1/50 sq. metre, for each sample. These were not taken as truly random samples because on some of the sites only about a quarter of the ground

actually carried mussels. For this reason the sub-samples were taken as randomly as possible on patches of mussels. A suitably sized square of wood was placed on the ground and the mussel carpet was cut round it with a stout knife. The square of mussels was then lifted and placed in a bag. Starting in February 1962 each site was sampled at monthly intervals. Prior to this some observations had been made at Site IV in December 1961 and at Site I from July 1961 onwards. Each sample was brought back to the laboratory and carefully washed over a series of four sieves of which the finest had a 1 mm mesh. The mussels were then carefully separated from each other and from debris in a white enamel dish. A good light was essential for this work as the very small mussels were often hard to see, due to variations in shade from almost colourless to black. After separation they were placed in size groups of 3 mm up to 9 mm in length, and of 5 mm from 10 mm upwards. This sampling programme was continued through the summer and autumn of 1962 until November. The results are given in Tables 1 to 4.

Of the four sampling points Site IV (Table 1) gives the clearest picture, perhaps because this site was clothed in an even carpet of mussels and lent itself to this type of sampling programme. In February 1962 the most numerous size group was undoubtedly the 0-3 mm group, and there were very few mussels over 14 mm in length. From February to July there was a general decrease in the numbers of mussels in all size groups. This decline was most marked in the 0-3 mm group which fell from 1,782 to 82 per 1/10 sq. metre. By July the population had a well-marked mode from 7-19 mm. This mode, which resembles that of a year class, persisted quite clearly through to November. The number of mussels in the group decreased fairly steadily, but their average size increased from about 13 mm in July to 20 mm in November.

Recruitment in the 0-3 mm group started in August and continued to November by which time there were over 10,000 per 1/10 sq. metre. There was also some growth in these small mussels which resulted in a rise in the count in the 4-6 mm group in October, and in the 7-9 mm group in November. The growth of the larger mussels in this population is also shown by the fact that while there were only 3 per 1/10 sq. metre in the 20-24 mm group in February, there were 206 in November. These results are much what one would expect from the inter-action of recruitment, predation and growth.

The other three sites (Site I, Site II, Site III) are all virtually low water sites which allow the mussels to grow to about 70 mm in length. In all cases the distribution of mussels is patchy which makes sampling more difficult. These sites are fished regularly during the winter months; during the period in question fishing stopped in March and was resumed in September. One might expect that during the summer months the absence of fishing and the higher summer growth rate would result in an increase in numbers of mussels in the larger size groups and that there would be, in effect, a restocking of the fishery with mussels of market size (i.e. over 55 mm in length). None of the three low water sites showed this. It seems probably that the samples taken were too small to yield significant results.

Turning to the smaller size groups (where the numbers of mussels are much greater), we find that the picture obtained is broadly similar to that from Site IV. Settlement of mussels of the 0-3 mm group started in July and continued throughout the summer and autumn (Tables 2, 3, 4). It is interesting to compare these results with those which were obtained at Site I between July and November 1961, before the start of the main investigation. At that time some samples of about 1/50 sq. metre were examined. In mid-July a count of 79 0-3 mm group mussels was obtained; this increased to 1,420 in late August and fell to 435 by mid-September. There was a further fall to 183 by November. The two years were similar in that settlement started in July and was heavy in August, but quite different from September onwards. This may be connected with the fact that the autumn of 1961 was relatively windy with frequent gales, whereas the autumn of 1962 was notable for long spells of quiet weather. This difference in the weather may have affected either the settlement of young mussels or their survival. It will be seen from Table 2 that few of the 1961 settlement survived to February 1962. From this one might expect that there would be few survivors of the 1962 settlement in the spring of 1963. This was far from being the case. In late March small mussels were seen among the adults and on stones in large numbers. A general survey of the beds in early April showed that the greater part of the fishery was covered with a settlement of mussels which were mainly 4-7 mm long. These were obvious on quite casual inspection in contrast to the large numbers of 0-3 mm group mussels the previous autumn, which were invisible except on careful examination. It is of interest to note that the heavy spatfall of mussels this year is not confined to Conway. Extensive settlements have been reported from many places on the east coast, and also from some places on the west coast.

By mid-June 1963 those mussels which had settled in sheltered niches were growing nicely but the great majority of those on exposed surfaces such as boulders had disappeared. While they could shelter between the barnacles they were safe, but when they grew too big for that they became very vulnerable to birds such as gulls and oystercatchers. It is now clear that we have witnessed a substantial and widespread spatfall on the Conway beds. It is interesting that this appears to have come after the coldest winter for well over a century. Savage (1956) suggested that there was a connection between the occurrence of heavy spatfalls and unusually cold winters. The present case is of particular interest because, although the spatfall became apparent in March, there is little doubt that the settlement of mussels about a millimetre long took place the previous autumn. It is also relevant that the adult mussels on the Conway beds were in excellent condition right through to the end of April. Some individuals may have spawned in the spring, but there was certainly no mass spawning such as one might associate with a heavy settlement of young mussels. It seems probable that the growth rate of these young mussels is very slow, and that the population which was 4-7 mm long in March was the same one which was 0-3 mm long in the previous autumn, and that they were, in fact, spawned the

previous spring. If this is so it is difficult at first sight to understand the connection which Savage postulated between cold winters and heavy spatfalls. Perhaps the link is the indirect one that a cold winter allows of better survival of the tiny mussels.

There is no doubt that predation by crabs plays an important part in the life of young mussels. At one stage it was thought that the mussels at Site IV would make a useful stock for relaying and a quantity (perhaps $\frac{1}{2}$ cwt) were relaid at about mean low-water level. Within four days every one had disappeared, although much of the shells and associated debris remained. A subsequent lot protected by perforated plastic grew very well. A pair of prawn pots left on this site for 24 hours caught 204 crabs (Carcinus maenas), mainly in the 30-60 mm size group, of which 184 were female. Such crabs are voracious eaters of mussels of the sizes we are now considering, i.e. up to about 20 mm long. It is well known that during very cold weather crabs tend to leave the shores and seek deeper water. It is therefore possible that a very long cold spell could result in better survival of the young mussels during the winter months. This does not, however, seem to be a very likely explanation, as by the time the warm weather returns the mussels are still very small and are presumably still vulnerable to crabs.

There are indeed some considerable and, until recently, unsuspected problems involved here. Savage (1956) in discussing the connection between cold winters and heavy settlement worked on the assumption that the appearance of spat on the beds occurred within a few weeks of the parents spawning. Evidence is now accumulating that mussels may normally be little more than a millimetre in length many months after they are spawned. So far it appears that settlement at Conway occurs mainly in the late summer and autumn and that these mussels do not grow big enough to be seen on casual inspection until the following spring. Although it is commonly said that a spatfall occurs only occasionally, it is probable that quite a considerable replenishment of the stock occurs each year. In the long run this annual replenishment may be of greater value than the occasional mass settlement.

SUMMARY

Observations of the size distribution of mussel populations at four sites in the Conway estuary were made at monthly intervals during 1962. It was found that settlement of young mussels in the 0-3 mm size group started in July and continued through the autumn. There was evidence of great mortality among them. These mussels appeared to grow very slowly and were only 4-6 mm long by the following spring. By April 1963 the heavy settlement was clearly visible on the mussel beds. Since the adult mussels were at this time in excellent condition, and had been all through the winter and spring, it seems unlikely that the spatfall resulted from a 1963 spawning. The available evidence suggests that it was the result of the 1962 spawning and that the rate of growth in the very early stages is lower than had previously been thought.

Evidence was found that the shore crab, Carcinus maenas, can be a serious predator of small mussels.

BIBLIOGRAPHY

SAVAGE, R. E. 1956. The great spatfall of mussels (Mytilus edulis L.) in the River Conway estuary in spring 1940. Fish. Invest. Lond., Ser. II, 20, (7).

TABLE 1

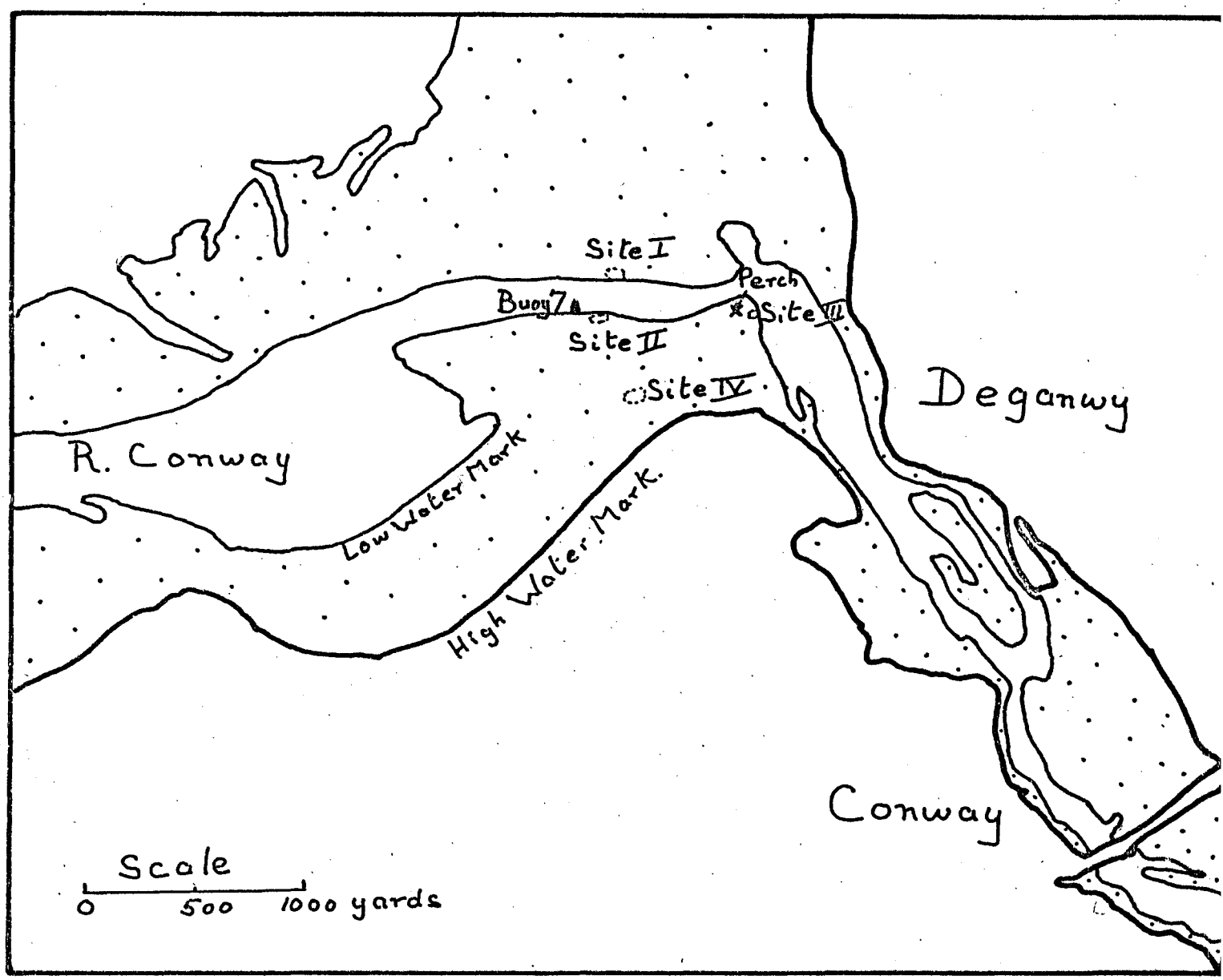
Numbers of mussels of various sizes per 1/10 sq. metre at Site IV - 1962

Size (mm)	February	March	April	May	June	July	August	September	October	November
0-3	1,782	1,644	1,351	878	237	82	483	4,711	3,727	10,440
4-6	558	333	556	497	382	80	45	36	70	470
7-9	352	233	330	351	261	174	85	54	35	60
10-14	298	393	386	482	497	284	215	176	110	93
15-19	64	171	152	153	218	248	253	278	183	185
20-24	3	21	26	5	40	68	93	112	136	206
25-29			4		2	5	33	10	30	34
30-34					0			1	1	0
35-39					1				1	1

TABLE 2

Numbers of mussels of various sizes per 1/10 sq. metre at Site I - 1962

Size (mm)	February	March	April	May	June	July	August	September	October
0-3	127	117	107	33	24	138	1,079	2,625	1,646
4-6	27	27	22	41	44	14	20	172	118
7-9	21	12	8	4	32	7	4	16	20
10-14	6	14	7	8	26	14	11	3	4
15-19	9	8	14	4	9	1	6	11	6
20-24	8	10	12	9	12	2	8	4	7
25-29	8	16	12	9	9	3	4	4	6
30-34	7	11	8	6	9	9	7	3	5
35-39	8	9	3	15	6	9	17	7	9
40-44	13	9	9	7	4	6	9	6	16
45-49	15	20	19	15	7	14	11	11	10
50-54	16	13	15	13	24	19	11	14	12
55-59	5	9	11	16	17	9	14	8	9
60-64	8	5	6	6	8	11	8	10	15
65-69	2	3	2	4	4	4	2	0	2
70-74	1	0	0	0	0	0	0	0	-
75-79	0	0	1	0	0	0	0	0	1
Total over 55 mm	16	17	20	26	29	24	24	18	27



Sketch map of the Conway Estuary, showing Sampling Sites.

X633228