Excavations in Poole 1973 - 1983

† Ian P. Horsey

Edited by Keith S. Jarvis

with contributions by

† F.W. Anderson, H.M. Appleyard, H. Astbury, K.J. Barton, D.F.Beamish, D.H. Brown, R.J. Charleston, J. Coy, E. Crowfoot, F.Green, P. Hairsine, J.M. Harvey, D.A. Hinton, J.G.Hurst, K.S. Jarvis, L.J. Keen, J. Kerr, D.J. Markell, N. Shiel, R.G. Thomson, † J.H. Thornton, I West, D.F. Williams and J.M. Winder.

Principal Illustrator Lesley Cartwright

1992

Dorset Natural History and Archaeological Society
Monograph Series: Number 10
Series Editor Jo Draper

THE OYSTERS

by J. M. Winder

Summary

Oyster fishing in Poole harbour has been a staple industry from late Saxon times and oysters were exploited in the Roman period. Even today, shipping has to avoid the oyster bank off Poole Quay (Fig. 2) - the legacy of the post-medieval industry (Hutchins 1796,16). Other middens of earlier date may similarly have influenced the reclamation and expansion of medieval Poole.

The oyster studies have established:

1. A substantial industry, as indicated by large middens, developed at Hamworthy and Poole in the Saxon and early Conquest period. This industry could well have affected the choice of the site of Poole itself.

2. Studies of the shells can prove that deposits represent an industry rather than casual exploitation of natural resources.

3. Poole oysters are distinctive and can be distinguished from oysters from other localities. Ultimately it may be possible to establish the marketing area of these oysters.

4. Statistical analyses can establish the original environment from which the oysters were obtained. In the case of Poole, comparisons of modern and archaeological samples can distinguish between oysters from within the muddier environment of Poole harbour and the more sandy conditions in Poole Bay.

Introduction

The recovery of substantial samples of oyster shells by the archaeological unit of Poole Museums Service, and their subsequent examination, has played a key role in the elucidation of techniques for the macroscopic study of oyster shells from the urban archaeological context. The discovery of large numbers of shells in a midden at Thames Street (Site PM9) in 1975, when exploratory studies were just beginning into the potential of oyster shells (Winder 1980), led to the retrieval of bulk samples of shell from this and later excavations in the town. These samples have enabled a detailed analysis of size, shape and infestation characteristics to be carried out. The results provide information about the way this resource was exploited.

Over the period from 1973 to 1983, oyster shells were recovered from six archaeological contexts in Poole. These were Thames Street (PM9), Town Cellars (PM11), Newports (PM13), Paradise Street (PM21), the Prison (PM22) and Pex Marine (PM24). Oysters were also examined from a borehole at the Shipwright's Arms, Hamworthy (PM32:Fig.3). Information about the types of shell deposits is given in the site archive. The reports on sites PM3,9,10 and 13 also refer to medieval and post-medieval oyster deposits other than the substantial 11th-/12th-century oyster layer beneath part of Poole. For comparative purposes, samples of modern live oysters were also examined and their details recorded. Some samples were dredged from natural beds in Poole Bay while others were obtained from beds of oysters which had been relaid within Poole Harbour in South Deep and Wych Channel.

Forty-seven samples of archaeological oyster shell and four samples of modern oysters were taken. A total of 3,492 shells were examined. These represented a minimum number of 1,816 individual oysters. Nine and a half per cent of the shells were too badly damaged to be measured. Although details of the characteristics of all the measurable shells were recorded, only twenty-three of the archaeological samples, grouped into seven appropriate categories, were used for the analysis because of the larger number of shells they contained. Together with the modern samples, this provided eleven groups of shell for analysis. All of these archaeological samples discussed are from deposits at Poole and Hamworthy dated by radiocarbon to the late-Saxon and early post-Conquest period. The Poole oysters are mainly from a large midden beneath the Town Cellars radiocarbon dated to the 11th/12th century and containing many millions of oyster shells (Horsey and Winder *supra*).

Aims

There were three main aims to the study of the oyster shells. First, since many of the shell deposits were on the former waters' edge, it would be necessary to determine whether the shells were natural shore-line deposits or deliberate dumps of shells. Secondly, an attempt was to be made to find out the extent to which the oysters were cultivated, if at all. Thirdly, it was hoped that the location of the beds being fished might be indicated by a comparison of the archaeological samples with modern oysters of known provenance allowing for morphological changes in Poole harbour over the last millenium.

Research Background

Oyster shells are probably the most variable of all the British bivalved molluscs. There are references, both ancient and modern, to the idea that an experienced person can tell where an oyster was from by examination of its various features. The details to support this theory have always been rather scarce and it is not certain that the distinguishing features would survive in the archaeological record. However, even when excavated after centuries of burial, oyster shells can still be seen to vary in fundamental ways involving size, shape, age and infestation, as well as other features such as relative thickness and weight, structural anomalies such as chambers and chalky deposits, colour or staining, degree of wear and preservation, and man-made marks. The examination of the Poole oysters was one of the first attempts to quantify these variations in the appearance of oyster shells and to see whether they could be explained in terms of both their biology and ecology, which could be used to indicate the place of origin, and the level of exploitation by man.

Size

In any sample there is likely to be a wide range of sizes. The size of oyster shells depends on many factors. The most obvious is the age or developmental stage. Growth is rapid to begin with, reaches a peak of linear extension, then slows down with the energy of the oyster being diverted to other activities on maturity. Growth continues as a thickening of the shell and possibly as internal changes in shape. The overall effect of temperature through its influence on metabolic processes, the availability of food, and the salinity of the seawater can be responsible for size differences; so can the depth of water in which oysters grow. Since oysters cannot produce shell when they are out of water, shell growth in intertidal oysters will be slower than that in sublittoral specimens. Inheritance also plays a part in the achievement of shell size in an oyster population, while environmental factors, such as high levels of water-borne silt and sand, heavy infestation or adverse handling methods, are also capable of affecting size.

Initially the Poole shells were sorted into left valves, which tend to be saucer-shaped with external frilly growth shoots, and right valves which are typically flat and much smoother on the outer surface. Linear measurements were taken by placing a shell in the correct alignment on a ruler and recording maximum length and width in millimetres. The width of the shell is measured from the hinge, where the two valves are joined by the ligament, to the margin immediately opposite - following the orientation of the animal originally protected by the shell valves.

In the first instance, the size analysis of the Poole samples (and others from Wessex and London) made use of the maximum width measurement of the right valves because right valves survive in larger numbers and are generally better preserved so that measurements can be more accurate. However, the right valve in live oysters is often inset within the left one - making it feasible only to measure the left valve. As it is desirable to compare the archaeological specimens with modern oysters, the sizes of Poole oysters have therefore been analysed again using the maximum diameter of the left valve.

The basic information about the sizes of shells in the different samples is given in Table 24. This shows that the mean sizes and standard variations differ from sample to sample. These are large oysters.

Table 24. Basic data for left valve maximum diameter of Poole oysters.

Sample	N	MEAN	ST.DEV
Modern Oysters			
Poole Bay 11.11.87	183	81.49	10.76
Poole Bay 17.11.87	182	81.63	11.16
South Deep 17.11.87	102	96.68	9.38
Wych Channel 11.11.87	139	99.63	10.09
Archaeological Oysters			
Thames Street			
PM9 F50 0.5 cubic metre	228	93.11	8.49
Paradise Street			
PM21 L53-57	74	78.61	14.38
PM21 L58 random + block	71	83.41	12.09
PM21 L58 502.206	90	78.62	13.82
PM21 L58 all samples	231	81.54	12.79
Shipwrights' Arms			
PM32 samples 1-5	93	89.46	12.60
PM32 samples 6-10	76	91.07	13.78

Note. Measurements in millimetres

To determine whether the differences were significant in statistical terms, each sample was compared with all the others using two sample t-tests. Where a t-value of 2 or more (i.e. ninety-five per cent confidence level) was obtained in the test, it was considered that there was a significant difference in shell sizes.

First of all the samples of modern oysters were tested for similarity in size. Table 25 shows the two sample t-test results for the comparisons of the two samples of oysters from natural beds in Poole Bay and the relaid oysters from South Deep and Wych Channel in Poole Harbour. There was no significant difference in size between the two Poole Bay samples but there was a large significant difference between these and the ones from within the harbour. The t-value obtained for the comparison of the South Deep and Wych Channel samples was an unexpected 2.34 - which indicated that they were significantly different but by a narrow margin.

Table 25. Two sample t-test results for modern Poole oysters

	2 Poole 17	3 South 17	4 Wych 11
Natural Beds			
1 Poole Bay 11.11.87	0.12	12.45	15.50
2 Poole Bay 17.11.87		12.14	15.13
Relaid Beds			
3 South Deep 17.11.87			2.34
4 Wych Channel 11.11.87			

Note. t values less than 2 indicate no significant difference (at the ninety-five per cent confidence level) in size between the Left Valve maximum diameter (LVDM) measurements of samples.

However, t-tests utilise only the mean, standard deviation and the number of specimens in the sample and therefore the results may not truly reflect the similarity or difference between two samples. The histograms of size frequencies for the samples illustrate aspects of variation in size distribution that are not covered by simple t-tests. The Kolmogorov-Smirnov test examines the similarity between the size - frequency distributions of the samples and this was also applied to the data from the samples.

Table 26 presents the results of the additional Kolmogorov-Smirnov tests. Here the situation is clarified since no significant difference in size distribution has been found between the two harbour samples. It is possible that the Poole Bay samples were alike; the Poole Harbour samples were similar; but the Bay oysters were significantly different in size and size distribution from the harbour oysters.

Table 26. Results of Kolmogorov-Smirnov tests on modern Poole oysters.

	2 Poole 17	3 South 17	4 Wych 11
Natural Beds			
1 Poole Bay 11.11.87	-	+	+
2 Poole Bay 17.11.87		+	+
Relaid Beds			
3 South Deep 17.11.87			-
4 Wych Channel 11.11.87			

Note.
+ signifies a significant difference in distribution of sizes
- signifies no significant difference in distribution of sizes

Following this, all the archaeological and modern oyster samples were compared for size. The results of the two sample t-tests are given in Table 27.

Table 27. Two sample t-test results - Modern and archaeological oysters.

		5	6	7	8	9	10	11
1	Poole Bay 11	12.0	1.6	1.2	1.7	0.0	5.2	5.4
2	Poole Bay 17	11.5	1.6	1.1	1.8	0.1	5.1	5.3
3	South Deep 17	3.3	9.5	7.8	10.4	12.1	4.5	3.1
4	Wych Channel 11	6.3	11.2	9.7	12.4	15.1	6.5	4.8
5	PM9 F50		8.2	6.3	9.3	11.3	2.6	2.0
6	PM21 L53-57			2.2	0.0	1.6	5.1	5.4
7	PM21 L58 r+b				2.3	1.1	3.1	3.6
8	PM21 L58 502.206					1.7	5.5	5.8
9	PM21 L58 all						5.1	5.3
10	PM32 1-5							0.8
11	PM32 6-10							

Note. t values less than 2 indicate no significant difference in size between Left Valve Maximum Diameter measurements of samples

The t-values in Table 27 show that the Poole Bay samples were not significantly different in shell size from most of the Paradise Street (PM21) samples. The sizes of the shells from the two sets of samples obtained from the core beneath the Shipwrights' Arms (PM32) were alike. There was also a similarity in size between

Table 28. Results of Kolmogorov-Smirnov tests on Poole oysters

		5	6	7	8	9	10	11
1	Poole Bay 11	+	-	-	-	-	+	+
2	Poole Bay 17	+	-	-	-	-	+	+
3	South Deep 17	-	+	+	+	+	+	+
4	Wych Channel 11	+	+	+	+	+	+	+
5	PM9 F50		+	+	+	+	-	-
6	PM21 L53-57			-	-	-	+	+
7	PM21 L58 r+b				-	-	+	+
8	PM21 L58 502.206					-	+	+
9	PM21 L58 all						+	+
10	PM32 1-5							-
11	PM32 6-10							

Note.
+ indicates a significant difference in distribution of sizes
- indicates no significant difference in distribution of sizes

the Thames Street (PM9) sample and one group from the Shipwrights' Arms. The modern harbour oysters were significantly different in size from all the other samples.

Reference to Table 28, showing the conclusions from the Kolmogorov-Smirnov tests on the same set of samples, substantiates and clarifies the results from the t-tests given in Table 27.

Table 28 shows that in fact all of the Paradise Street samples are probably similar in size distribution to the natural Poole Bay oysters; and both the Shipwrights' Arms samples are like the Thames Street ones in size. Additionally, a similarity is now demonstrated between the South Deep sample of relaid oysters and the Thames Street sample. A summary of the size relationships, demonstrated for the modern and archaeological oyster shell samples from Poole, can be seen in Table 29.

Table 29. Relationships between modern and archaeological oyster shells from Poole (based on size).

Modern Samples

- Poole Bay Natural Oyster Beds
  - Poole Bay 11 = Poole Bay 17
- Poole Harbour Relaid Oyster Beds
  - Wych Channel 11 = South Deep 17

Archaeological Samples

- Paradise Street PM21 L53-57
  - PM21 L58 random block
    - PM21 L58 502.206
      - PM21 L58 all
- Thames Street PM9 F50
  - Shipwrights' Arms PM32 L1-5
    - PM32 L6-10

Shape

When the shells were measured, differences in shape were observed between the samples. One simple way of considering shape variations in oyster shells is the degree of roundness or elongation of outline. There is believed to be a link between the outline shape of an oyster and the type of substrate on which it lies. In the Portuguese and American species of oyster - which normally exhibit a more oval shape than our native oyster - an elongate form is induced in oysters on very soft mud while a rounder type occurs on firmer sea beds in deeper water. Our native European flat oyster may also be influenced by substrate but in a unique way determined by its own original template for shell growth.

Some oyster shells have an irregular general shape. This tends to occur when the spat oyster settles from its free-swimming stage onto an object from which it acquires its shape. It can also happen when many young oysters settle on the same object and compete for growing space. Irregularities like these, accompanied by groups of oysters adhering together, are more typical of natural breeding populations than relaid populations where young oysters would be separated from each other and from disfiguring attachments. However, the absence of irregularities and clumping cannot necessarily be taken to imply the reverse. Regular dredging on natural beds can separate and disperse oysters over a wider area, thus enabling individuals to attain a regular shape. Indeed, this seems to be the case with the present-day oysters from Poole Bay and their equivalent in the archaeological record.

One readily quantifiable aspect of shape in oyster shells is the relationship between width and length. Linear regressions were calculated for width over length measurements for left valves in each sample. If width equalled length in the majority of specimens, then the regression line best fitting the scatter of points on the graph would be at an angle of forty-five degrees. The shells could be considered to be almost round. The correlation co-efficient shows how closely the points are grouped around the line, so that a figure of one would indicate that all the points representing the width and length of shells in the sample were on the regression line. As the figure decreases, so does the degree of correlation.

The results of the linear regressions are presented in Table 30 which gives the slope (as the tan of the angle), the y intercept and the correlation co-efficient. The samples are arranged as in previous tables.

Table 30. Shape of Poole Oysters based on a linear regression of width over length in left valves.

SAMPLE	SLOPE (tan of angle)	Y INTERCEPT	CORR. COEFF.
Poole Bay 11	0.69	22.18	0.76
Poole Bay 17	0.70	21.03	0.81
South Deep 17	0.38	53.15	0.47
Wych Channel 11	0.49	41.55	0.56
PM9 F50	0.65	35.90	0.68
PM21 L53-57	0.62	29.47	0.67
PM21 L58 r+b	0.59	31.17	0.58
PM21 L58 502.206	0.67	24.10	0.67
PM21 L58 all	0.59	31.87	0.62
PM32 L1-5	0.72	26.44	0.78
PM32 L6-10	0.69	28.99	0.75

In Table 31 the angles of slope for the regression lines obtained for width over length are shown in descending order of magnitude. This table shows that whilst none of the samples can be said to have perfectly rounded shells, some are definitely more rounded than others. The modern natural oysters from Poole Bay and the archaeological shells from the Shipwrights' Arms site (PM32) are fairly closely grouped at the top end of the scale of roundness. The shells from Thames (PM9) and Paradise Street (PM21) sites are intermediate on the scale and separated by a substantial margin from the modern relaid oysters of the harbour which are at the bottom of the scale.

The correlation coefficients show that the roundest shells are also the most closely grouped around the regression line with, for example, sixty-one to sixty-six per cent of the shells in the Poole Bay samples being accounted for by the line. In contrast, the shells in the samples with the least rounded shells from the modern Poole Harbour beds were only explained in terms of the line in twenty-two and thirty-two per cent of cases.

Another way of looking at the shape characteristics of the oyster shells is to divide the width measurement by the length. If

Table 31. Shape of Poole oyster shells on a scale of roundness

Order of Roundness	Angle of Slope in degrees	Sample
Most rounded		
1	35.7	PM32 L1-5
2	34.8	Poole Bay 17
3	34.6	Poole Bay 11
4	34.5	PM32 L6-10
5	34.0	PM21 L58 502.206
6	33.2	PM9 F50
7	31.7	PM21 L53-5
8	30.7	PM21 L58 r+b
9	30.4	PM21 L58 all
10	26.0	Wych Channel 11
11	21.0	South Deep 17
Least rounded		

Note. An angle of slope of 45 degrees would indicate a shell with equal width and length, ie rounded. Less than 45 degrees indicates progressively broader or longer shells, ie less rounded.

Table 32. Percentages of different shaped oyster shells in Poole samples. (based on width divided by length in left valves)

Sample	Long Shells (less than 1)	Broad Shells (more than 1)	Ratio (approx)
Poole Bay 11	62	38	2:1
Poole Bay 17	68	32	2:1
South Deep 17	76	24	3:1
Wych Channel 11	85	16	5:1
PM9 F50	16	84	1:5
PM21 L53-57	42	58	1:1
PM21 L58 r+b	52	48	1:1
PM21 L58 502.206	52	48	1:1
PM21 L58 all	50	50	1:1
PM32 L1-5	33	67	1:2
PM32 L6-10	33	67	1:2

the shells are round, i.e. width equals length, the result of this sum is one. When the shells are broad, i.e. width is greater than length, the result is more than one. Where the shells are long, i.e. length is greater than width, the result is less than one. The proportions of shells in a sample tending to be longer or wider can therefore be calculated.

The relationships demonstrated between modern and ancient samples of oyster shells in Poole for sizes and size distribution are well defined. Similar tests of comparison between the Poole samples and sixty other samples derived from archaeological sites and modern oyster beds in Wessex and London indicate that the size characteristics of Poole oysters are distinct and confined to this region.

Analyses of shell shape have not been so extensive. It is only possible to attempt an interpretation on a local level. We know that there is a contrast in size between the shells from Poole Bay and Poole Harbour. We also know that the shells from Poole Bay show a two-to-one ratio of elongate and broad shells. The shells from South Deep show a change in proportions of three elongate to every broad shell; and in Wych Channel the ratio is five elongate to one broad shell. So there is a demonstrable difference in shape as well as size for the oysters from these locations.

However, using t and Smirnov tests, a correspondence in size and size structure has been shown between the archaeological and modern oyster samples such that it seems reasonable to assume that the oysters from the Paradise Street site (PM21) were probably collected from Poole Bay while the oysters from Thames Street (PM9) and the Shipwrights' Arms (PM32) were derived from beds within the Harbour in places like South Deep or Wych Channel. Are the different shape characteristics seen in the modern samples also reflected in the archaeological oyster shells?

The Paradise Street oysters showed a one-to-one ratio of elongate to broad shells. The Shipwrights' Arms oysters were in the ratio of one elongate to two broad. The Thames Street shells were in the proportions of one elongate to five broad. So changes in shape can be seen in the archaeological shells in the same way

Table 33. Differences in shape in Poole Oyster Samples

Modern Samples		Archaeological Samples	
Bay type Oysters			
Poole Bay 11 and 17		Paradise Street	
2:1		1:1	
long		'round'	
Harbour type Oysters			
South Deep	Wych Channel	Shipwrights' Arms	Thames Street
3:1	5:1	1:2	1:5
longer	longest	broader	broadest

as they can be shown in modern oyster samples but there is a major difference between the old and modern shells. Today it is the proportions of elongate shells in the samples that varies. In the past it was the number of broad shells that showed the greatest variation.

It was stated earlier that outline shape in other species of oyster is thought to be related to the type of substrate on which the oyster lies. Longer shells are found on soft mud and rounder shells on firm ground. (Elongate in this context being the layman's way of describing an increase in the distance from hinge to margin. It must be pointed out that, in biological terms, this dimension is the width of the animal).

The Portuguese and American oysters typically have a shell that is greater in size from hinge to margin than at right angles to this. These species are also capable of surviving partial burial in soft sediments. The English flat oyster normally has a rounded shell and is incapable of living in very soft muds. It can be postulated that shell-growth response of the flat oyster to different types of substrate would be different. In order to prevent the oyster from sinking and suffocating in soft muds, shell growth would be directed towards an increase in surface area to maintain its position on top of the substrate and would not be concerned with maintaining access for a respiratory current of water as the oyster gradually sank by the heavier hinged end.

It is known that the Poole Bay sea bed today is firmer, sandier and cleaner than the bed of Poole Harbour which is characterised by fine silty mud intermixed in areas with gravel or shell debris and patches of clay. The shapes of the Poole oysters probably reflect the two main categories of substrate. For the reason outlined above, adaptation to life on softer sediments may have led to an increase of surface area leading to higher proportions of either longer or broader shells (defined by internal anatomy).

The predominance of longer shells in both Bay and Harbour modern samples, when compared with the archaeological shells, may be due to physical changes which have been taking place within the Harbour, possibly resulting in higher levels of silt both on the bed and in the water column. The area of water at high-tide level in Poole Harbour has been gradually decreasing over the past 6,000 years, this process accelerating in the last century or so due to the colonisation of mud flats by Spartina and reclamation by man for land use. This must mean that whilst the silt load of river systems entering the Harbour remains constant, it is delivered to an area of harbour which is estimated to have decreased by about 2,500 acres from 6,000 b.p. to 1966. An area of 511 acres of harbour is thought to have disappeared between 1807 and 1966. At an average loss of 0.4 acres of water a year, 417 acres would have vanished since the oysters found on the Paradise Street site were dredged. It is possible that these processes have affected the nature of the sea-bed sediments and thus the shapes of the oyster shells.

Infestation

The small marine invertebrates that attack oysters, or attach themselves to the shell, have specific ecological requirements and sometimes distinct distributions in nature. Evidence of infestation of oyster shells may indicate the location of the oyster beds being fished. Animal encrustations on the inner surface show that the shell has been lying on the sea bed after the death of the oyster which is therefore probably the result of natural causes rather than dredging.

Freshly-dredged live oysters are frequently covered by all manner of organisms including soft-bodied animals, like sea squirts and sponges, and seaweeds. In oyster shells from archaeological excavations the only evidence to survive comes from those creatures that have left characteristic marks such as bore-holes in the shell or have left hard parts attached to it. The occurrence of this type of evidence was recorded for each measurable shell in the selected samples on a presence or absence basis only, as it was not thought practicable to ascertain the frequency of, for example, the individual bore-holes in each shell.

The frequency with which each of eight major categories of evidence for infesting or encrusting organisms occurred in each sample was calculated and the rate of infestation plotted in histogram form.

The pattern of infestation in the shells helps to substantiate the idea that variability in appearance can be used to determine the location of the beds from which they were fished and can reflect changes in the substrates of the Harbour and Bay. There were eight main types of evidence for infesting or encrusting organisms. These were burrows of the worms *Polydora ciliata* and *Polydora hoplura*; the honey-comb borings of the sponge *Cliona celata*; bore-holes of gastropod molluscs such as *Ocenebra erinacea*; sea-mats or Polyzoa; acorn barnacles of the Balanoides group; calcareous tubes of worms like *Pomatoceros triqueter*; and sand tubes made by Sabellid worms.

The percentage frequency with which these organisms were recorded in the oyster shells is shown for selected samples in Fig. 106. It is important to note that only presence or absence of evidence of infesting organisms was used to calculate percentage frequency for use in comparisons and not the intensity. The modern Harbour specimens were, however, noted as being massively encrusted by the various organisms, including soft-bodied forms, whilst the bay shells were only minimally affected.

The graphs (Fig. 106) show that overall infestation is much slighter in the archaeological specimens. Encrusting forms are virtually absent from all samples except the Thames Street one. High levels of infestation in the modern specimens could be partly due to greater levels of nutrients accompanying an increase in silt deposits during recent times.

Polydora ciliata and *Polydora hoplura* are two marine polychaete worms that are responsible for distinctive burrows in the oyster shell, the former creating small burrows over the general outer shell surface and the latter usually causing larger U-shaped burrows and mud-filled blisters on the inner edges of the shells. The two species have different geographical distributions and habitat preferences. *P. hoplura* is found mostly in the southwest of England where it thrives in oysters on soft ground in still warm conditions such as the head waters of creeks or inlets. *P. ciliata* has a wider distribution and is found predominantly on hard sandy or clay grounds, particularly in warm shallow water.

The graphs (Fig. 106) also show the burrows of *Polydora ciliata* type occurring most frequently in the modern samples and all but one (PM9) of the archaeological ones, but the numbers of shells affected by *Polydora hoplura* are under-representative in the modern samples because the damage is internal and not readily observable in live specimens. It is known, from talks with local oyster fishermen and from examination of empty modern oyster shells, that internal mud blisters and discolouration on shells is not only very common but a great nuisance to the production of quality oysters for the restaurant trade. In archaeological samples *P. hoplura* is always less common than *P. ciliata*. Since *P. hoplura* is an indicator of softer muddy ground in shallow warm water it is possible to suggest that in the 10th, 11th and 15th centuries from which the archaeological specimens were drawn, the low levels of *P. hoplura* may indicate an environment that was less muddy. This was the case on the Poole Foundry site (PM46).

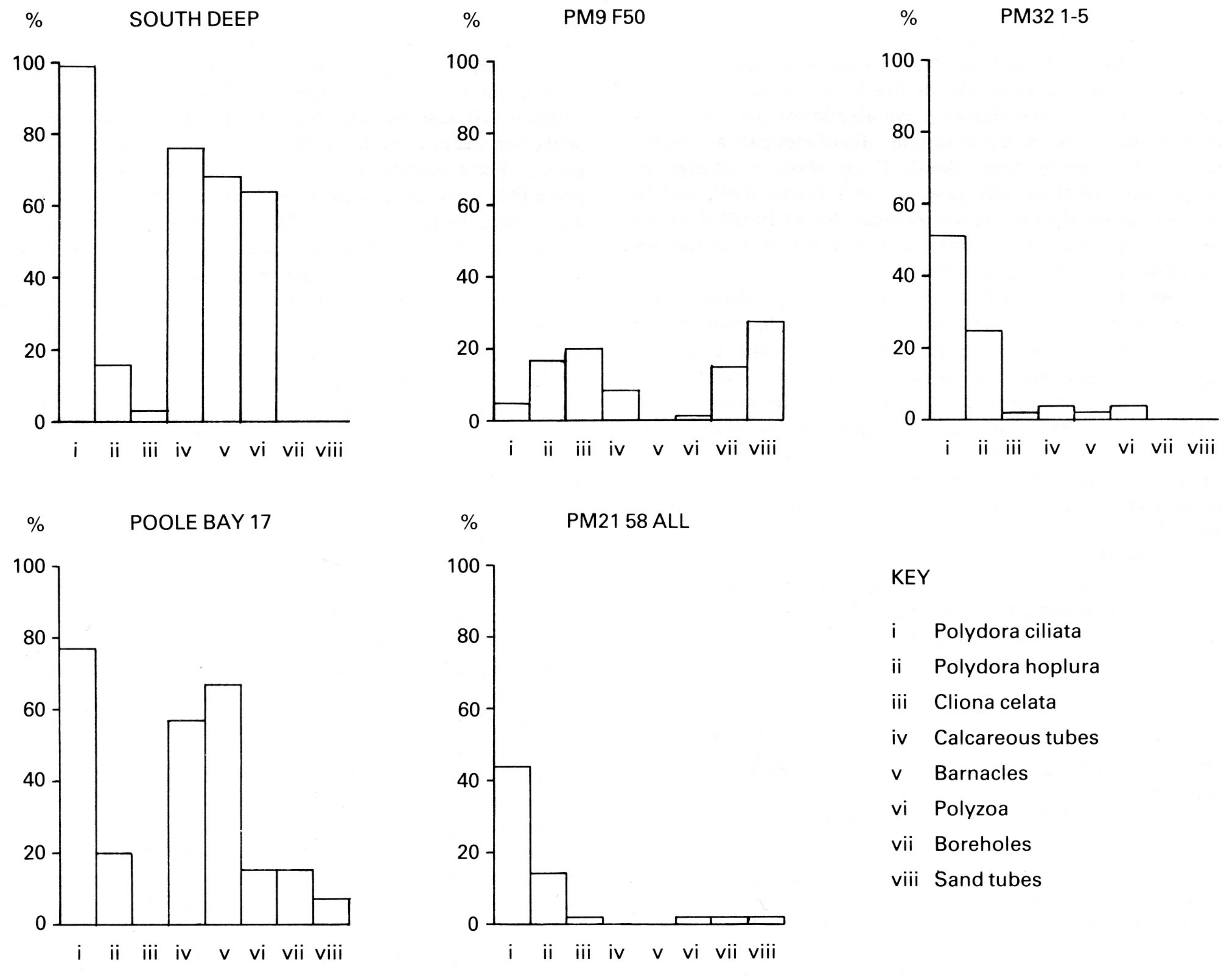

Figure 106. The oysters. Degree of infestation in selected samples.

Cliona celata is marginally more frequent in the harbour specimens. Calcareous tubes from *Pomatoceros triqueter*, Balanoides type barnacles and Polyzoan encrustations are all more frequent in the harbour shells especially the Polyzoa. Bore holes caused by predatory gastropods and Sabellid sand tubes are absent from the Harbour shells but present in the bay shells.

Discussion

There are similarities in size between the modern and archaeological oyster shells. In the same way that there is a statistically significant difference in size between oyster shells from natural beds in Poole Bay and those from relaid oysters in Poole Harbour, a distinction can be made between the various archaeological samples. The distinctive size of the oysters seems to be a regional characteristic. Oysters which show no significant difference in size from these have been recorded from the Greyhound Yard and Alington Avenue sites in Dorchester, from the Six Dials site in Southampton and at Newport Roman Villa on the Isle of Wight. No comparable oyster shells have been found among the other sixty samples examined from sites in Wessex and London. The Poole oysters are different because they are larger than elsewhere. Daniel Defoe in 1724 wrote that 'this place is famous for the best, and biggest Oysters in all this Part of England,......Tis observed more Pearl are found in Pool Oysters, and larger than in any other Oysters about England.' The large size of the oysters produced in Poole is borne out by this research project but the pearls that Defoe mentions are just a product of his imagination. Commercially viable pearls are not found in the flat oyster (*Ostrea edulis* L.). In Great Britain only the freshwater pearl mussel (*Margaritifera margaritifera* L.) creates valuable pearls.

The archaeological deposits in Poole must be considered as deliberate dumps of shell rather than natural shore-line accumulations. In the first instance, all the shells are full grown and no immature specimens are present. This is a firm indication that the shells are derived from oysters that had been collected rather than dead specimens washed ashore. The shells show no sign of wear or internal encrustation. On the contrary, the shells are mostly clean and fresh-looking with sharp edges. The exception is the bottom layer of the core sample from Shipwrights' Arms. Here some shells were discoloured and had Polyzoa, barnacles and oyster spat inside but, since possible knife marks were also recorded, the shell deposits were probably man-made. Elsewhere, evidence of opening, such as cuts on the smooth inner surface, and V- or W-shaped notches were frequently noticed on shell margins. In many instances it was interesting to note that the two valves of the oyster were still in position; this was particularly noticeable in samples from Thames Street and the Shipwrights' Arms. Various documentary sources (Hutchins 1796,16; Philpots 1890,375) refer to an incident in 1747 when 'in digging a dock for a ship on a tongue of land opposite the harbour called Hamworthy, a large bed of oyster shells was found six-feet-and-a-half thick, regularly piled one upon another. The ligatures of most were visible. The whole bed was covered with about a foot of black mould. But this was not a natural bed of oysters; for they had all been opened, the fishermen having a knack of taking them out without breaking the ligatures'. So recent archaeological excavations have provided evidence to support this account.

The fact that such large quantities of shell were thrown on the shore, over a relatively short time-span, at a period and in a location for which there is no known documentary or archaeological evidence for habitation, indicates the oysters were not being fished for domestic purposes but on a commercial scale with subsequent processing of the meat since live oysters would normally be transported in the shell. There are written accounts by writers such as Hutchins, Defoe, Britton and Bayley, for the processing of Poole oysters in the 17th century - 'In the reigns of James I and Charles I, great quantities of oysters, taken in or near the harbour, were pickled, barrelled, and sent hence to London, Holland, the West Indies, Spain and Italy'. The actual pickling process is not described but would probably have involved brine.

The enormous numbers of shells generated by the processing of oysters for export constituted a threat to shipping by blocking the channels where they were thrown overboard. 'They were formerly opened at Hamworthy and the shells left on the shore; but, about 1640 or 1670, they were forbidden by the corporation, who imagined such encumbrance might injure the channel; on which they opened them in boats on the mud, near the strand, and threw the shells there, by which that hill of shells was raised, which at high water at least, is surrounded by the sea, and called the "Oyster Bank" '. That bank is still marked on navigation maps of Poole Harbour today. The extensive middens found beneath the Town Cellars and the Shipwrights' Arms could have accumulated in the same way.

However, the corrected radiocarbon dates for oyster shells from the excavated middens show that they were deposited between the 9th and 12th century. Therefore, the examination of the oyster shells from recent excavations in Poole has provided very strong evidence to support the view that the kinds of oyster fishing and processing activities recorded in documents for the 17th and later centuries were based on a long-standing tradition that stretched back at least six centuries earlier - before the town of Poole had come into existence. Further evidence could come to light in future excavations in Poole and Hamworthy. Kelly's Directory for 1903 has an entry concerning the Poole oyster industry and includes an interesting item of information, which one must assume to have been local knowledge, that 'Warehouses on either side of the water are built on oyster shells'.

Places where oysters breed well are not necessarily the best places for producing well-developed meat. For this reason young oysters have traditionally been collected from their natural place of settlement and transferred to places where conditions are favourable for fattening the oysters. Nobody knows for certain when this practice was first introduced although it has often been suggested that the Romans introduced oyster culture to Britain. It is known that in the early 19th century many Poole boats took brood oysters from the natural beds in Poole Bay to the creeks of the Thames estuary to fatten for the London market. The last day's catch of the season was always thrown into the channel in Poole Harbour to provide for the local demand. Young oysters from Poole Bay and places further afield, like the Solent, continue to be relaid in channels of the harbour for fattening.

The analysis of the modern oyster samples has proved that there is a difference in size, shape and infestation between the natural oysters from Poole Bay and the relaid ones in Poole Harbour. These differences are also demonstrated in the archaeological samples. It has been deduced, therefore, that some of the excavated samples were derived from Poole Bay and others from Poole Harbour. Fishermen from Poole Harbour may have been relaying oysters as early as the 9th century. It is even possible that the practice was first introduced in the Roman period when Hamworthy was a Roman settlement.

A note on other marine molluscs and fauna.

Reference is made in the bone report to small quantities of whelk, cockles and winkle shells from medieval contexts on sites PM2 and PM3. Cockles, winkle and carpet shell (*Venerupis decussata*) were also recorded from medieval contexts on site PM7.

Whelk, winkle and common mussel are also present in a 16th-century context on site PM10 and whelk and cockle are present in a late post-medieval context on PM9. These results suggest small-scale foraging on the harbour foreshore for a minor element of the diet. However, if the meat was removed from the shell elsewhere the consumption of such items would not be visible in the archaeological record.

Crab, conger eel, common eel and various fish and sea birds are recorded in the bone report and also indicate the exploitation of the harbour resources.

Acknowledgement: The author wishes to thank Mr D. Davies of Sea Harvest of Poole for his valuable help.

THE PREHISTORIC AND ROMAN FINDS

by Keith S. Jarvis

Prehistoric and Roman evidence from the medieval town is extremely sparse and is limited to one sherd of briquetage and two colour-coated sherds from site PM3 (Church Street) and ten sherds of briquetage from site PM10 (West Street). Worked flint is also rare although this may be partly due to the recovery policy.

On the Foundry site a ditch containing briquetage was excavated. The evidence suggests peripheral salt working to the Romano-British settlement opposite Poole at Hamworthy (Smith 1930).

THE SITE ARCHIVE

The site archive is deposited in the Waterfront Museum, The Quay, Poole, Dorset. The level 1 and 2 archive consists of 11 files.

Site Record

1. General and Introduction
2. Site text records
3. Site graphic records
4. Site photographic records

Finds Record

5. Finds/Stratigraphic unit card index
6. Small Finds card index
7. X radiograph index
8. Finds files
    - 8.1 Pottery
    - 8.2 Tile
    - 8.3 Glass
    - 8.4 Other finds Iron, Bronze etc.
    - 8.5 Leather
    - 8.6 Coins & Jettons
    - 8.7 Stone and mortars
    - 8.8 Pipes
    - 8.9 Textiles
    - 8.10 Palaeobotanical
    - 8.11 Animal Bone
    - 8.12 Marine Molluscs
    - 8.13 Other finds
9. Historical and general information
10. Watching briefs
11. The Finds

ABBREVIATIONS

LMMC	*London Museum Medieval Catalogue* 1940
PBA	Poole Borough Archives
R.C.H.M.	Royal Commission on Historical Monuments (England)
SF	Small Find
UBD	*Universal British Directory* Volume 4
VCH	*Victoria History of the County of Dorset* : Vol.2. (1908), Vol.3. (1968)
b.p.	before present
pers. comm.	personal communication
fl.	floruit