CHAPTER 3

DEMONSTRATION OF VARIABILITY - THE METHODS

Having discovered not only that oyster shells vary in many ways but that these variations might be useful for site interpretation, it was essential to devise ways of quantifying the variations. The techniques adopted had to fulfil a number of requirements. The methods had to be simple to use so that they could be carried out by personnel of all levels and backgrounds with a minimum of training. The equipment had to be inexpensive because not only was this project unfunded but cost is very much a primary consideration in any archaeological unit or department. Elaborate facilities had to be unnecessary so that the basic work could be carried out almost anywhere. The speed with which the shells could be processed was also an important consideration, bearing in mind the large numbers of oyster shells that might need to be processed.

CONSERVATION AND STORAGE

The condition of oyster shells from archaeological excavations can differ within a site or from site to site. Sometimes the condition of the shells can be related to factors such as primary, secondary or tertiary deposition; direct disposal in pits or ditches and immediate burial will tend to preserve while dispersal over large internal floor or external yard surfaces, and later burial, will lead to wear and breakage. Chemical degradation can occur in certain soil conditions or burial circumstances; acid soils, for example, may destroy the organic matrix of the shell and may etch into the calcium component as well, but large numbers of shells may actually create a micro-environment with a low pH that preserves shells (except those on the periphery of the deposit) and also other environmental material both within and beneath the deposit. Additionally, mechanical damage can be caused during excavation when heavy implements are used to remove large deposits or immediately after excavation when shells (considered of low priority and importance heretofore) are stored in the open air subject to frosts and other adverse conditions. For the moment, the specific effects of different factors on the survival condition of oyster shells is improperly understood. However, it is possible to make basic recommendations for the conservation of oyster shells and the preservation of any environmental evidence on or in them.

When the shells are removed from the soil, they should be handled with at least as much care as other faunal remains like bones. On no account should the shells be cleaned. Any mud or other accretions should be allowed to dry naturally on the shells. Once dry, the shells should be packed in paper or polythene bags, or directly into storage boxes but using common sense and discretion about the quantities that can be packed together. The more friable the shells, the fewer that can be placed on top of each other without causing more damage. Care should be taken that smaller or more fragile marine mollusc species are not crushed by the heavier oyster shells. If possible they should be put in a separate bag or container (plastic box or vial) on top of the oyster shells. It is not necessary to mark each individual shell or shell fragment with indian ink. One or more clearly and indelibly written waterproof labels within, and the same information on the outside of, each bag or other container should suffice.

Oyster shells (and other marine molluscs) should be only washed with the supervision of the specialist. When shells are washed in the customary way with a tooth or nail brush, vital evidence is lost by two means. First of all, useful environmental evidence can be scrubbed off with the mud. Often it is only the mud that holds barnacles and calcareous seaweeds in place on the shell. Some encrusting worm tubes are actually constructed of mud or sand grains. It is important that the finds assistant understands what these things look like, and how to remove the mud while retaining the evidence. Secondly, scrubbing can etch into the soft shell removing such features as the growth lines by which the shells can be aged. Ideally, if the shells need washing, they should be held under a gentle stream of cold water over a 1mm sieve while dirt is removed carefully with a soft-bristled paintbrush. The shells are then air dried. The condition of the shells will dictate the speed and amount of care needed for washing. It is not considered necessary to produce a perfectly clean shell. Only enough dirt needs to be removed to facilitate handling, to record measurements and other characters, and to examine the growth lines.

EQUIPMENT

The following items are needed for processing oyster shells:

A good quality (e.g. Veteran) transparent plastic ruler marked with millimetres; this is easier and quicker than calipers for taking measurements of oyster shells.

Sheet of white paper used in the estimation of measurements for broken shells.

Supply of old clean newspapers on which to place the shells so that dust and debris can easily be tipped straight into a dustpan or bin after each sample is recorded.

Pencils or pens.

Notebook of 5mm squared paper ruled up appropriately or ready made recording sheet (see details below)

Hand lens particularly useful for examining Bryozoa on shells.

Anglepoise-type desk lamp especially useful for examining growth lines.

Scientific calculator

Millimetre graph paper

NB It is possible to enter data directly onto computer spreadsheet for analysis and graphics but this facility is not assumed. A lap-top type computer for portability, sealed but operable within a plastic cover to prevent damage to the system by the inevitable generation of dust while handling shells, would be ideal.

TECHNIQUES

Initial recording: the record sheet

The requirements of simplicity, speed and cost-effectiveness for processing the shells resulted in the decision to record characters that are visible to the naked eye, i.e. macroscopic, albeit with occasional help of a hand lens and well-angled light source. The record sheet, a copy of which can be seen in Figure 3.1, sets out a grid on which to record upto 26 items of information about each shell either by entering an appropriate figure or comment or by marking with an oblique line the presence of a characteristic. It is possible to record whether the shell is a right or left valve, its maximum width and maximum length, the age (from the right valve), the eight types of evidence for infesting or encrusting organisms (details of which are given separately below), twelve descriptive categories (details are given below) and a space for comments.

Sorting

Shells should be carefully tipped onto a sheet of newspaper on a large table top or other flat surface. The shells should be sorted into species and identified. Several useful books for identification are listed in the bibliography. Specimens need to be counted. Fragments of gastropods like winkles are counted if the apex is present. Pieces without apices are not counted. Fragments of bivalves such as cockles are only counted if they include the hinge or umbone on the valve. Although it is possible to distinguish the right from the left valves in most species, this was only done for oysters in this project. The number of individuals for bivalves other than oysters was considered to be the total number of valves divided by two. In oysters, whichever of the right or left valve totals was the greatest was considered to be the minimum number of individuals.

Recording size

Oysters should then be divided into shells that can be measured and those that are too broken to measure accurately. The criteria of suitability for measurement are the possession of the umbo/ligament scar, the adductor muscle scar on the internal surface and at least two thirds of the shell intact. Shells are measured by placing them with the internal surface downwards onto the ruler which lies across a piece of plain paper. For the maximum width measurement the hinge or umbonal end is placed on the zero mark and the shell aligned on the ruler so that maximum distance between the hinge and the opposite edge/periphery of the shell along the axis of growth can be measured. The maximum length of the shell is measured along the greatest distance between the margins of the shell at right angles to the maximum width measurement (see Figure 3.2). Where part of the edge of the shell is missing, it is often possible to estimate its position by following the natural curve of the periphery between the two ends of the break. This can either be done by eye or by drawing in the line with a pencil on the piece of plain paper on which the ruler rests. Any measurements taken like this should be marked with a > sign denoting that the measurement is at least that. Measurements should be taken to the nearest millimetre and efforts made to ensure consistency by reading the measurements always with the ruler in the same position both on the table top and in relation to the body. This means that the angle at which the eye observes the gradations of the ruler is always the same.

Recording age

This is not an exact science and tends to involve a subjective judgement in some cases (Winder, 1980). Attempts have been made to define the way in which the concentric growth rings evident on bivalve shells relate to age in many species. Some of the work has been in tremendous detail on both a macroscopic and microscopic level (for example, Pannella and MacClintock, 1968; Barker, 1964; Deith, 1983). However, there would appear to be only two papers dealing with the problems of aging oysters macroscopically. Massey (1914) tried to relate growth rings on the left or cupped valve to the known age of oysters without great success. She quotes a Danish worker, who had tried to do the same thing (Petersen, 1908), as saying "certainly the zones of growth on the shells have something to do with growth periods, but it is often not easy to determine them with certainty". Probably the greater degree of ornamentation in the form of growth shoot "frills" on the left valve is a complicating factor in age assessment. Therefore, only the right flat valves of oysters were used for aging in the Hamwic material.

The shell can be seen to be covered in broad concentric bands. These are made up of a series of relatively widely-spaced lines representing the growth in the warmer months (approximately March to late October or November), and closely arranged lines representing growth in the colder winter months. The first growth band, closest to the hinge, represents the growth attained by the spat (young) oyster between setting in July or August and the onset of cold weather, that is only half a year. A great problem exists in exactly pin-pointing the limits of each growth band, partly because of the variations in the widths separating the lines (being primarily due to change in weather conditions at the time the shell was laid down) and the fact that growth does not actually stop in cold weather. Added to this is the complication of wear in archaeological specimens.

Measurements in width of growth bands would be inaccurate or impossible. Overall measurement was possible. Since, as previously mentioned, addition in linear dimensions decreases with age, the growth bands become progressively narrower at the margins of older shells so that they may be almost vertical in arrangement. This must be borne in mind when aging the shell. In 'stunters' the rapid fall-off in growth occurs prematurely. Small oysters, particularly thick ones, may therefore be stunted oysters of some age.

Where it is difficult to visually discriminate between the yearly growth bands, there are some simple techniques that may improve the accuracy with which oyster shells are allocated to year groups. There is a tendency for each growth band to follow a slight curve upwards from the surface of the shell when rapid growth has been in progress, and inwards towards the surface during slower growth. These "ridges" can sometimes be felt by passing the pad of the thumb gently over the surface of the shell. An oblique light source will cause the ridges to cast shadows so that they can be seen in relief. If the shell is held so that the lateral margins are viewed instead of the surface, a series of "steps" may be seen with relatively prominent horizontal lamellae (plates) marking the end of each year's rapid growth.

Despite the fact that these methods may be criticised as subjective, results seem to indicate that they are not so very inaccurate especially when using large samples of 100 or more shells. For example, growth curves derived from these data approximate closely to the sigmoid curve typical in modern bivalves.

Recording infestation

Eight types of evidence for infesting or encrusting organisms can be recorded on a presence or absence basis by an oblique stroke in columns i - viii on the record sheet. The epibiont organisms associated with oysters are an important indicator of both local and regional environment. There are eight types of infesting or encrusting organism which commonly leave traces on oyster shells. In dead oyster shells the only remaining evidence is from those animals which alter the shell or attach hard parts to it. Marine polychaete worms are responsible for most of the visible signs of infestation. Polydora ciliata (i) is a worm up to 25mm in length, but usually smaller, which burrows into the general outer surface of the shell. Plate 3.1 illustrates a the typical appearance of an oyster shell attacked by Polydora ciliata. Plate 3.2 shows these small burrows in close up. The burrows are normally very small and have little effect on the health of the oyster. However, in cases of severe infestation the shell may be riddled with the burrows right through to the inner layer. The oyster reacts by sealing off such intrusions with patches of greeny-black conchyolin. Diverting shell growth resources in such defence mechanisms can seriously weaken the oyster. The organic conchyolin patches have usually disappeared in archaeological specimens but a badly affected shell will break readily.

A much larger related marine polychaete, Polydora hoplura (ii), which grows to 50mm in length, makes clearly distinguishable U-shaped burrows on the inner surface of the margins of the shell. Plate 3.3 shows a burrow of this type. This organism can have a more immediately deleterious effect on the well-being of the oyster because its presence affects the ability of the bivalve to close its shell. This may result in inefficient respiration and possible dehydration in intertidal beds. The oyster responds to this pest by secreting a layer of shell around the worm with its mud and mucous tube. The resulting mud-filled blisters are easily recognisable in both modern and archaeological shells. Plate 3.4 shows a blister caused by this worm. When the fragile blisters are accidentally broken, the U-shaped burrows created by Polydora hoplura become visible.

Cliona celata (iii) is a sponge which initially finds shelter, like the two Polydora worms, among the frilly growth shoots and crevices of the oyster shell. Damage typical of sponge boring is shown in Plate 3.5. Like the Polydora worms, it is thought that the metabolic waste products of the organism gradually dissolve the shell. In Cliona neat round holes perforate the shell. As the sponge increases its hold on the shell, the holes link up to form an internal network that resembles honeycomb. In a live oyster the sponge is visible as small yellow pustules over the surface of the shell.

Some marine worms live in calcareous tubes (iv) that they secrete and attach to the outer surface of oyster shells. The two most commonly occurring are made by Pomatoceros triqueter, an example of which is shown in Plate 3.6, and Hydroides norvegica - illustrated in Plate 3.7. Pomatoceros tubes are often referred to as "German writing" because of their supposed resemblance to Gothic script. The tube has an approximately triangular cross-section and a longitudinal keel. Hydroides tubes are slightly larger with a circular cross-section and no keel. Neither of these organisms can be considered as pests.

Barnacles (v), usually acorn barnacles of the Balanus type, can be found as whole shells attached to the surface, or inverted and embedded in oysters that have settled on a substrate covered with barnacles. A barnacle in situ on an oyster shell is shown in Plate 3.8. The shells are composed of six loosely-associated plates which are easily broken and frequently become detached during post-excavation handling. However, the place of attachment is still often visible as a round scar-like basal plate. Entire oyster shells can be covered by barnacles but oysters are only minimally affected by their presence. The greatest problem is that areas heavily colonised by barnacles prevent the settlement of young spat oysters.

Polyzoa (vi) or Bryozoa are minute invertebrates occupying individual box-like cells that are joined together in large colonies. To the naked eye the colonies look like moss or lace on the shell. An example is shown in Plate 3.9. The microscopic physical remains of the colonies are diagnostic in shape but the animals have not been identified to species in this instance.

Several species of gastropod mollusc are active predators on oysters, especially young, thin-shelled ones. The sting-winkle Ocenebra erinacea and the dog-whelk Nucella lapillus use the tooth-bearing radula (tongue) to bore neat, round holes through the shell. An example of a borehole (vii) can be seen in Plate 3.10 where it clearly perforates the shell. Once the shell has been penetrated, the predator sucks out the meat within. This action in a young specimen would probably result in death. Since larger oyster shells sometimes have boreholes that do not penetrate the shell, it is obvious that predatory gastropods may become detached before completing the attack, or older oysters can fend off attack by rapidly laying down new shell layers to seal the holes.

Tubes of sand (viii) are created by worms of the Sabellid type and cemented to oyster shells. These can be individual tubes or massive colonies of them commonly called "ross". These tubes are shown on Plate 3.11.

Recording descriptive characters

Twelve qualitative characteristics can be recorded in columns A - L on the record sheet. These refer to the following: relative thickness and weight; chambering and chalky deposits (formed during rapid salinity changes and possibly indicating estuarine conditions); degree of wear; natural colour or post-burial staining; attachment of adult or spat oysters; irregularity of shape; man-made notches or cuts; and the presence of a ligament.

Rate of processing

The speed with which the basic information can be recorded in oyster shells depends on many factors. With some experience, and large samples to handle, perhaps a hundred shells an hour can be recorded. Numerous, small, individually wrapped samples or samples characterised by heavily infested shells will take a lot longer to process.

In this chapter the methods for recording macroscopic characteristics in archaeological oyster shells have been outlined. The next chapter describes how these methods were actually put into practice using materials from the Six Dials site of Saxon Southampton. A preliminary study established that there was intrasite variation in the average size of shells in samples from different contexts and phases. Further study of the same material showed that other features also differed in a significant way. Current knowledge of the Southampton environment, both in the present and the past, was used to explain the observed differences in the archaeological material

CONTEXT DETAILS:

L	R	MW	ML	AGE	i Polydora ciliata	ii Polydora hoplura	iii Cliona celata	iv Calcareous tubes	v Barnacles	vi Polyzoa	vii Bore holes	viii Sand tubes	A Thin	B Thick	C Heavy	D Chambered	E Chalky deposit	F Worn	G Flakey	H Colour/stain	I Oysters attached	J Irregular shape	K Notches/cuts	L Ligament	

Figure 3.1 The record sheet for details of oyster shells.

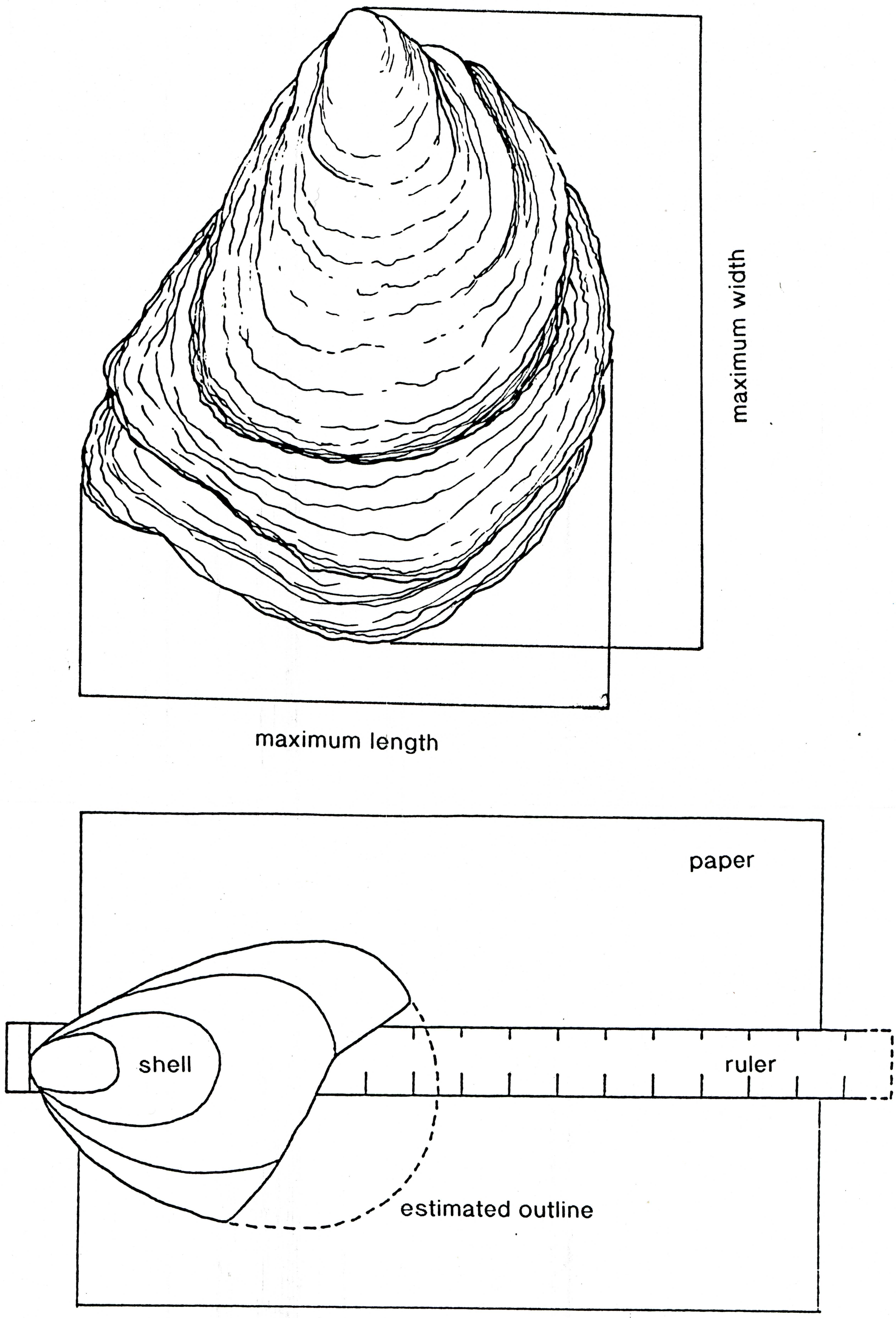

Figure 3.2 Method of measuring oyster shells.