Marine Archaeological Surveys: mapping the underwater cultural heritage.

by Mark Redknap and Les Emptage.

SUMMARY.

This contribution describes the work of M.A.S. (Marine Archaeological Surveys), and briefly reviews some computer applications within the field of marine archaeology.

Introduction and Background.

The Ancient Monuments and Archaeological Areas Act 1979 makes provisions to schedule monuments in, on or under the sea bed within the seaward limits of U.K. territorial waters. This extends the possibility of ancient monument status and protection to wrecks and structures in the water of national importance, though rescue provisions of Part 2 of the Act do not unfortunately apply to the sea-bed (Croome 1982, 5-6). The guide to the compilation of DOE record forms for Scheduled Ancient Monuments (AM 107) includes in its site type list SHIP FIND, and land classification (on and around site) includes marine and intertidal sites (DOE 1983).

At the time of writing most archives on marine sites in the U.K. have been compiled on an irregular basis, and few local authorities around the coast have marine sites on their SMR. One will soon be set up for the Isle of Wight (D.Tomalin pers.comm.) and the new advisory archaeological diving Unit recently established at St.Andrew's University to supply technical services to the Dept.of Transport will in the long term be considering centralised registers, though no plans exist for immediate implementation. The specialised nature of the field, cost and administrative limitations have slowed progress towards a national archive for our underwater heritage. The lack of an adequate database for the allocation of priorities and resources for marine archaeology, and for planners and researchers and those concerned with education in its widest sense seriously affects the field's development.

The great potential of sandbanks around our coast for preserving wrecks, and at the same time the meagre resources available for rescue situations below water were highlighted seven years ago by the dramatic exposure and discovery of several well preserved ships-of-the-line wrecked on the Goodwins Sands in 1703. In response to the lack of any clear organisation for dealing with such sites in Britain, or for collecting data on finds from such areas, the Goodwins Archaeological Survey was formed in 1982 to run a pilot study for future work. The group comprised professionals from many disciplines working in their spare time, supported by sponsorship and personal contributions. Now re-named M.A.S. (Marine Archaeological Surveys), it continues to monitor and survey the Thames Estuary and Goodwins areas (as a registered charity), and will be assisting other archaeological projects in aspects of marine geophysical surveying.

The historical sources for wrecks in the Thames Estuary and Goodwins areas have been outlined elsewhere (Redknap and Fleming 1985: Larn 1977). Apart from recording documented sinkings and stray finds trawled up by fishermen (such as those recorded from the Thames Estuary: Fig. 1) there are two additional approaches to plotting our underwater heritage. 'Net-fastenings' merit inspection and evaluation. Drops in catch size have forced many fishermen to new hunting grounds, taking with them their local knowledge. M.A.S. initially compiled a net-fastening register for the Dover-N.Foreland area, and have recently extended the list to the N.Kent coast . While useful for exposed, relocatable sites, problems arise if they have subsequently been reburied. Poor visibility, bad weather, and strong tides may retrict diving time, and conventional swim-line techniques have limited success. Recent developments within the fields of marine geophysical surveying and deep water surveillance have made available a range of instruments and techniques designed to remove such restrictions.

Method.

The triple system of sidescan sonar, sub-bottom profiler and proton magnetometer is well tested as an archaeological tool, and has been described elsewhere (see Redknap and Fleming 1985 for review). Generally speaking, the raw accoustic geophysical data from this shallow water survey technique is not computer logged. An enourmous quantity of data is presented, and were it to be digitised, in excess of 20 megabytes storage per hour would be required. The raw data is usually presented in real time on a facsimile recorder. If it is required to be reprocessed the standard technique is to data log in analogue form on magnetic tape.

This is not to say that computers are not used during the processing of this data. Many of the commercial sidescan sonars incorporate microprocessors into their gain control circuits in order to relieve the operator the tedious task of constantly adjusting the signal level and threshold controls during surveys (note though at the present time the sub-bottom profilers used do not have this facility available).

Proton-magnetometers, on the other hand, produce relatively little data, and this is easily logged with positional data on the navigational computer.

Navigational accuracy is a prerequisite if the surveying systems are to be used to any effect. Decca 'Main Chain' provides one navigational system suitable for wide searches but its accuracy is rarely better than c.20 m. Alternative lightweight, portable short-range microwave distance measuring systems are now available with an accuracy of + 0.5 m (3 m. in a rolling boat). For their measurement of distance they rely on the nearly constant velocity of radio waves, and the time lapse between an aerial transmitter mounted on the mast of the survey vessel and reception at three remote beacons set up along the coast and surveyed into O.S. co-ordinates (distance travelled is equal to the product of the time lapse and the velocity of travel). At regular intervals a number of coded microwave pulses (C band) are transmitted from the system to the land beacons, which return unique signals. The distance codes are presented to a local control and display unit, and are also made available in either serial or parallel format for computer interfacing.

The navigation computer then translates the distance codes into co-ordinates which are then output to an x-y plotter and also stored on magnetic media.

As a computer is available, most surveying software packages incorporate a facility to display the required ship's route on a screen together with the actual track steered. This information made available to the helmsman enables an accurate course to be maintained (Fig. 2, top).

The area to be surveyed is normally sliced into a grid and the survey tracks fed into a computer enabling the helmsman to compare actual with desired position on the plotter. Horizontal survey control has been provided for M.A.S. by a Motorola Mini-Ranger III or trisponder electronic position-fixing system, interfaced to Hewlett Packard HP 85 microcomputer with HP 9872 plotter (Fig.2, bottom).

A total of 27 computer plotted sheets from the 1983 survey were collated onto 3 charts at a scale of 1:2500. This incorporated 70 lines of continuous information for each technique (sidescan, magnetometer, sub-bottom profiler). These trackplots were used as underlays for subsequent analysis. A total of 103 targets were interpreted and plotted in this way, in an area where only half a dozen sites were previously known. The availability of such systems makes it practical to survey areas offshore for archaeological sites with a fair degree of precision, and as part of the general trend towards archaeology within more scientific parameters, sites become to some degree quantifiable without diving. However visual inspection remains essential as a follow-up if the contact data is to be fully evaluated.

Discussion.

Computers find many applications within the related fields of Oceanography and Palaeogeodesy. For example, NASA WOLFPLOT, a FORTRAN subroutine using Versatec electrostatic plotter has been used for reconstructions of sea-levels over the past 13,000 years important for the study of glacial eustacy and modelling for hominid migration routes (Marcus and Newman 1983). Computer-based indices of ancient shipwrecks have been compiled for the Mediterranean and Roman Provinces using a COBOL programme on ICL 4/75 adapted for use with the University of Bristol Honywell Series 60 Level 68 system (Parker and Painter 1979). A similar computerised register for submerged occupation sites in the Mediterranean has recently been compiled (N.C.Flemming, pers.comm). The Maritime Artifact Project currently being organised by the Nautical Archaeology Society in Britain, aims to compile a modest register of maritime material held in museums and collections, using a form facilitating data transference to the mainframe computer at the University College of North Wales, Bangor (organised by J.Illsley, Dept.of History). An International survey of underwater cultural heritage organised by C.M.A.S. in association with U.N.E.S.C.O. intends to apply SPSS statistical analysis to the data (Gifford, Redknap and Flemming 1985).

However as yet no standard checklist for marine site classification exists, and few data-bases have yet been computerised. Data-bases exist for log-boats (McGrail 1976), and the National Maritime Museum intends to use GOS combined with microcomputer to store data on collections, archives, and excavation data (Booth 1981, 23-5; see also Graham 1977). The Swedish National Maritime Museum has compiled a register of wrecks, containing amongst other things more than 1000 wrecks, most belonging to the post-medieval period (as yet uncomputerised). An extensive national adminstrative framework in Australia is involved with legislation, wreck registers, conservation facilities, amateur sport diver groups etc., and a wreck inspection programme has been classifying sites into 1) steam vessels, 2) sailing vessels c.1780+, 3) European wrecks pre 1780, 4) S.E.Asian, indigenous and other sites (McCarthy 1983, 349). At a more detailed level, the various classifications of ship contents exist illustrating the variety of material from individual wreck sites that require recording (ship equipment, working equipment, military equipment, documents and stationary, navigational equipment, tools, domestic effects, galley utensils, eating and drinking gear, victuals, personal belongings: for recent review, Reinders 1985).

Most research has been directed towards single site recording systems such as the programs and graphics techniques developed to interpret the remote sensing readings from the survey of the C.S.S.Georgia wreck site (Smith 1985, 8) and the computerised archive for the Mary Rose.. In due course M.A.S. hope to collect information on all aspects of the man-affected marine environment (including studies of sediment formation). While work began with the survey of a particularly well-documented area, the group is now collecting data from private collections and local sources, and it is intended to use dBase II on a small business microcomputer (as dBase II is readily available). Data will include target area, site location, fix accuracy , type of observation, depth, simple classification of sea bed, type of find, status, material, construction, finds location, conservation etc. (Fig.3 shows idealisation of input). This modest start is experimental, and it remains to see whether more elaborate systems are justifiable.

The following observations may be made:

1) Marine site prediction and discovery depend on position, sediment cover, and sequence of events leading up to burial and exposure. Detection is influenced by sediment cover, visibility, sea-state, availability of high technology, depth and the presence of large recognisable features.

2) It follows that the identification of early shipping in U.K.waters will often rely on geophysical techniques or chance.

3) Marine sites exist in remarkable states of preservation, and are subjected to sudden drastic environmental changes that jeopardise their survival.

4) Intensive geophysical surveying on pre-selected areas has demonstrated a high incidence of cultural material on the sea-bed.

5) There is an urgent need for systematic data collection and monitoring in off-shore areas.

6) The technology available to archaeologists is more frequently operated by salvors insensitive to the value of our underwater cultural heritage.

7) Computer aided position-fixing systems have an important role to play within marine archaeology.

8) Computer applications for marine site registers and regional monitoring need development.

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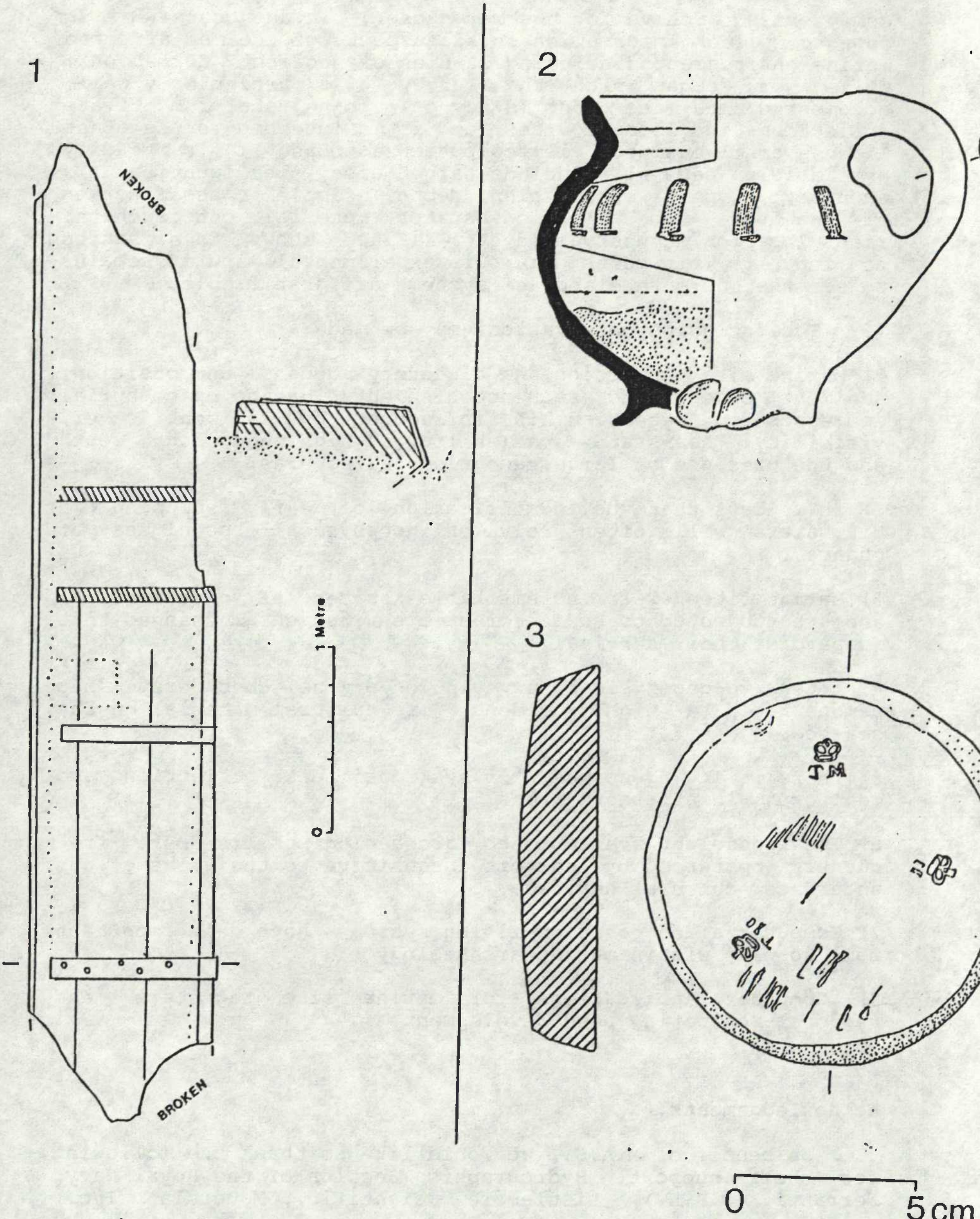

Fig.1. Data from the Thames Estuary: 1= 18th/19th century sailing ship rudder, located by swim-line search; 2= 15th century glazed redware trawled up by fishermen; 3= lead weight recovered during salvage operations on the East-Indiaman 'Hindostan' (wrecked 1803).

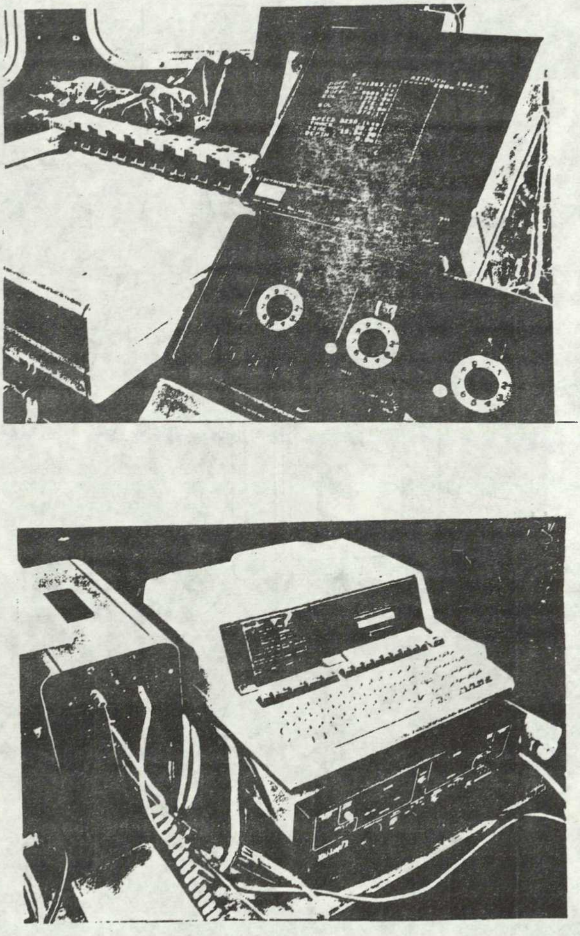

Fig 2. Helman's display and HP 9872 plotter (top), Motorola Mini-Ranger III and Hewlett Packard HP 85 (below).

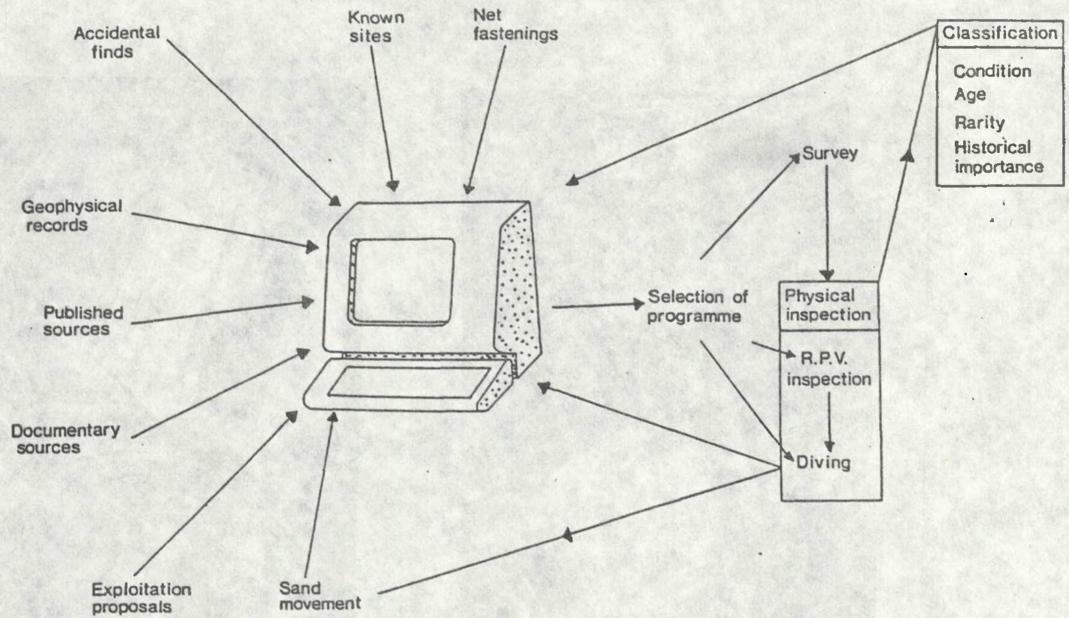

Fig.3 Idealisation of data collection.

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