

Procedural Guideline No. 3-6

Quantitative sampling of intertidal sediment species using cores

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Background

Core sampling of sediments is a well-established technique for obtaining quantitative data on infauna for analysis. The technique has been well used in the past, particularly on estuarine intertidal sediments, and a large amount of historical data is available for many of these areas in the UK. The advantages of using cores are that they provide quantitative results of a given precision and may provide a common standard for comparison between a number of data sets. The major disadvantage to the technique is that the collection and subsequent analysis of the samples can be very time-consuming and therefore costly.

This protocol has been adapted from those outlined in an Environment Agency internal report (Barnett 1993) and the MNCR Rationale and Methods (Hiscock 1996) in addition to the texts of Baker and Wolff (1987) and Holme and McIntyre (1984).

Purpose

Applicable to the following attributes

Core sampling will be appropriate for attributes concerning quality in terms of species richness and the abundance of species. Generic attributes are:

- Maintain or increase the species richness in the biotope and/or abundance of key species in biotopes.
- Maintain or increase the quantity of particular species of conservation importance.

Applicable to the following survey objectives

- Establish/re-establish the species which are present in biotopes at a site including their abundance/biomass to within quantified limits of precision.
- Establish/re-establish the abundance/biomass of a particular species to within quantified limits of precision.

Logistics

Equipment

Site location

Maps and charts to an appropriate scale (1:10,000 or better) and a Geographical Positioning System/differential Geographical Positioning System (dGPS). On a large site it may be advisable to use rapid transport such as an All Terrain Vehicle (ATV) or hovercraft.

1 Scottish Natural Heritage, 2 Anderson Place, Edinburgh EH6 5NP, UK.

2 Environment Agency, Waterside House, Waterside North, Lincoln LN2 5AH, UK.

Sampling

0.01m² cylindrical corer, 0.1m² box corer, 5cm diameter corer, plungers, spade/trowel/fork, 0.5mm mesh sieve, 1mm mesh sieve, buckets/strong plastic bags, specimen jars, wash bottles, weatherproof camera (with flash), waterproof notepad and pencils, waterproof marker, plastic/waterproof labels, folding quadrat 1m x 1m. Also appropriate protective clothing and health and safety equipment.

Storage and preservation

10% buffered saline formalin solution (4% formaldehyde), 70% IMS, suitable buckets/containers. Also appropriate health and safety equipment for handling chemicals.

Personnel

Minimum two field workers with knowledge of marine invertebrate taxonomy. Three field workers are optimum; two for wet work and one for dry (recording and photography).

Time of year

There is no clearly identifiable time of year to survey littoral sediment communities. Summer months, which provide long periods of daylight and amenable weather conditions, involve the inclusion of large ephemeral populations of invertebrates and the recruitment of juveniles into adult populations. These factors must be accounted for in any data interpretation. More established winter populations are still prone to large fluctuations in structure through events such as heavy rainfall and freezing conditions. During winter, there are the logistical disadvantages of short daylight hours and potentially disruptive weather conditions.

Of primary importance is that any survey, if the results are to be compared over time, must take place at the same time of year to previous studies. Even then, major weather events between survey dates should be taken note of and included in any interpretation.

Method

Locate site and collect specified number of core samples and supporting information.

Survey objectives

To collect data on the abundance of a named species to a specified level of precision requires prior information on the density and aggregation of the species at the site. In general, the more abundant and less aggregated the species the less replicates will be needed. The procedure for establishing these criteria is described in Holme and McIntyre (1984). When the number of replicates required has been established the sampling procedure can be followed.

To collect standard information which will be applicable across the nature conservation agencies and the Environment Agency and Scottish Environment Protection Agency, the following CORE (Common Operation Required Element) and SSR (Supplementary Sampling Requirement) methods have been adapted from Barnett (1993).

Field

Common Operation Required Element (CORE) methods

The CORE methods are the minimum to be applied at each site.

- (1) Five replicate samples should be taken to a depth of 15cm using a 0.01m² cylindrical corer. The samples may be collected from up to a maximum of 5m either side of the site centre but not up or down the shore.
- (2) Each replicate sample (1 core) should be placed in a suitable container (resealable plastic bucket or strong plastic bag) and returned to the laboratory for processing. The outer surface of the container (not the lid) should be labelled with a waterproof marker and a waterproof label should be added to the sample to stay with it through processing. The label will show survey name, site number, survey station and date (for instance: 'Taw 15.2 on 12.9.98').

- (3) The replicate samples are to be washed over a 0.5mm mesh sieve not more than 24 hours after collection (up to 2 days if refrigerated) and then fixed in 10% buffered saline formalin solution. (The reliability of field sieving is regarded as unproven and, therefore, only laboratory sieving can be confidently recommended.) Samples must not be fixed (or frozen) prior to sieving.

The samples will then be ready for processing in the laboratory.

Additional sampling

In addition to the Environment Agency CORE methods the following is taken from the MNCR Rationale and Methods (Hiscock 1996) and deemed to be a minimum which must be applied at each site.

- (1) A 1m² area is marked out using a quadrat within an undisturbed section of the site and a record taken of the abundance of obvious mounds and casts and any algal cover. The area is then excavated to a depth of approximately 20–30cm and examined in the field for larger macrofaunal species which may not be recorded in the core samples. Sample inspection can be aided by the use of a riddle (c. 5mm mesh) if practical.
- (2) A sample for particle size analysis should be taken to a depth of 15cm using the 5cm diameter corer, with the sample frozen (within 24 hours) prior to analysis if information is required on organic components.
- (3) Photographs should be taken of the site to show main features and also, where necessary, specific details.
- (4) For the site as a whole the following site features must be recorded:

Score 1–5:

- surface relief (even–uneven)
- firmness (firm–soft)
- stability (stable–mobile)
- sorting (well–poor)
- black layer (1 = not visib., 2 = >20cm, 3 = 5–20cm, 4 = 1–5cm, 5 = <1cm)

Note if present:

- mounds/casts
- burrows/holes
- tubes
- algal mat
- waves/dunes (>10cm high)
- ripples (<10cm high)
- drainage channels/creeks
- standing water
- subsurface coarse layer
- subsurface clay/mud
- surface silt/flocculent

Supplementary Sampling Requirement (SSR) methods

The SSR methods are to be applied at sites (in addition to CORE methods) where coarser sediments prevail. Coarser sediments are defined as <50% material passing through 0.5mm mesh sieve. Wherever possible it should be determined before the survey if SSR methods will be required, to economise on time and effort. SSR methods comprise two additional protocols dependent upon sediment type:

- (1) Coarse sediment with silt/clay (substantial amount of <63µm diameter material). An additional 5 x 0.01m² cores, supplementary to the CORE method, are taken and processed through a 0.5mm mesh sieve.
- (2) Coarse sediment and others (sands and gravels, etc.). An additional 3 x 0.1m² box cores, supplementary to the CORE method, are taken and processed through a 1.0mm mesh sieve.

Subsequent fixing and laboratory processing is then standard as for the CORE methods.

Data analysis

Information collected on identification and enumeration of species present within samples (in addition to biomass/age where appropriate) plus ancillary information will require a computer with suitable database or spreadsheet software.

Accuracy testing

The technique will produce quantitative results with precision and accuracy dependent upon the heterogeneity of the environment and the number of samples taken. Multiple sampling by different field workers can be used to test the accuracy of the field procedures. The guidelines of the NMBAQC³ should be followed for all laboratory work.

QA/QC

- Samples must not be taken any appreciable vertical distance up or down the shore from the site.
- Samples should not be taken from previously disturbed sediment (footprints, etc.).
- Care should be taken that the corers are inserted to the correct depth of 15cm and removed intact from the sediment, with excess material removed from the outside of the corer before placement into its container.
- Samples should be labelled correctly, on the outside of the container and with a waterproof label inserted into the sample to track it through processing.
- Any deviation to the CORE or SSR sampling methods should be clearly reported.
- Samples should be washed over a 0.5mm sieve not more than 24 hours after collection (up to 2 days if refrigerated) and then fixed in formalin solution. (The reliability of field sieving is regarded as unproven, and therefore only laboratory sieving can be confidently recommended.)
- Samples should not be fixed or frozen prior to sieving.
- Samples should be fixed in 10% buffered saline formalin solution (4% formaldehyde). The volume of residual sediment in a container should not exceed one-third to one-half the volume of formalin solution. For samples containing a high volume of clay/water a higher concentration of formalin may be required.
- The guidelines of the NMBAQC should be followed.

Data products

Data products from core sampling traditionally take the form of species abundance per sample matrices or spreadsheets. Care must be taken when storing or exchanging information that all ancillary data is kept with the species records. Information on the physical habitat, juvenile counts, etc. will prove invaluable during analysis.

Cost and time

Costs

Costs involved with core sampling are as for other intertidal-based field work in terms of day rates for contractors, travel and subsistence. Day rates for contractors at the time of writing are in the order of £200–300 per person per day plus expenses. The added cost associated with core sampling is the laboratory analysis of the samples obtained. Contractors can charge either by volume or by sample basis with

³ National Marine Biological Analytical Quality Control programme – see http://www.sepa.org.uk/research/NMBAQC/aq_main.html

charges varying from £50–150 per 0.01m² core depending upon sediment characteristics and species richness – species-rich samples or those with a large proportion of clay and organic detritus can be very time-consuming to process. Particle size analysis is in the order of £40–80 per sample.

Time

Field

Two to three people will be capable of recording and taking five core samples and one quadrat dig within 30-40 minutes, longer if box cores are to be taken. Overall time will largely be dependent upon the spacing of sites and the number of replicates required. With large areas to be covered the possibility of using rapid transport such as quadbikes, other ATVs and hovercraft should be considered. Working two low tides a day will cut down on the time and hence the cost of field work.

Laboratory

A long time is usually required to process samples, though this depends upon a number of variables. It can vary between <1 hour to >1 working day for each core depending upon sediment type and richness of the sample.

Health and safety

Particular care is to be taken to avoid being cut off by the incoming tide. Very soft shores should not be accessed on foot. Lone working should not be undertaken. Risk assessments must be addressed for specific locations where field work is being undertaken. Laboratory safety codes of practice (COSHH approved methods) must be followed.

References

- Baker, J M and Wolff, W J (eds) (1987) *Biological surveys of estuaries and coasts*. Estuarine and Brackish-Water Sciences Association Handbook, No.3. Cambridge, Cambridge University Press.
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- Holme, N A and McIntyre, A D (eds) (1984) *Methods for the study of marine benthos*, 2nd ed. IBP Handbook, No.16. Oxford, Blackwell Scientific Publications for International Biological Programme.