Methods of Biological Sampling
Handnet Sampling of Aquatic Benthic Macroinvertebrates
1978

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Methods for the Examination of Waters and Associated Materials

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Contents

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Warning to users

The analytical procedures given in this booklet should only be carried out by competent trained persons, with adequate supervision when necessary. Local Safety Regulations must be observed. Laboratory procedures should be carried out only in a properly equipped laboratory. Field operations should be conducted with due regard to possible local hazards, and portable safety equipment should be carried. Care should be taken against creating hazards for others. Lone working, whether in the laboratory or field, should be discouraged. Reagents of adequate purity must be used, along with properly maintained apparatus and equipment of correct specification. Specification for reagents, apparatus and equipment are given in manufacturers' catalogues and various published standards. If contamination is suspected, reagent purity should be checked before use.

There are numerous handbooks on first aid and laboratory safety. One such publication is 'Code of Practice for Chemical Laboratories' issued by the Royal Institute of Chemistry, London. Another such publication, which includes biological hazards, is 'Safety in Biological Laboratories' (editors E Hartree and V Booth), Biochemical Society Special Publication No 5, The Biochemical Society, London.

Where the committee have considered that a special unusual hazard exists, attention has been drawn to this in the text so that additional care might be taken beyond that which should be exercised at all times when carrying out analytical procedures. It cannot be too strongly emphasized that prompt first aid, decontamination, or administration of the correct antidote can save life, but that incorrect treatment can make matters worse. It is suggested that both supervisors and operators be familiar with emergency procedures before starting even a slightly hazardous operation, and that doctors consulted after any accident involving chemical contamination, ingestion, or inhalation, be made familiar with the chemical nature of the injury, as some chemical injuries require specialist treatment not normally encountered by most doctors. Similar warning should be given if a biological or radiochemical injury is suspected. Some very unusual parasites, viruses and other micro-organisms are occasionally encountered in samples and when sampling in the field. In the latter case, all equipment including footwear should be disinfected by appropriate methods if contamination is suspected.

The best safeguard is a thorough consideration of hazards and the consequent safety precautions and remedies well in advance. Without intending to give a complete checklist, points that experience has shown are often forgotten include: laboratory tidiness, stray radiation leaks (including ultra violet), use of the correct protective clothing and goggles, removal of toxic fumes and wastes, containment in the event of breakage, access to taps, escape routes, and the accessibility of the correct and properly maintained first aid, fire-fighting, and rescue equipment. If in doubt it is safer to assume that a hazard may exist and take reasonable precautions rather, than to assume that no hazards exists until proved otherwise.

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About this series

This booklet is one of a series intended to provide recommended methods for the determination of water quality. In the past, the Department of the Environment and its predecessors, in collaboration with various learned societies, has issued volumes of methods for the analysis of water and sewage culminating in 'Analysis of Raw, Potable and Waste Waters'. These volumes inevitably took some years to prepare, so that they were often partially out of date before they appeared in print. The present series will be published as individual methods, thus allowing for the replacement or addition of methods as quickly as possible without need of waiting for the next edition. The rate of publication will also be related to the urgency of requirement for that particular method, tentative methods being issued when necessary. The aim is to provide as complete and up to date a collection of methods and reviews as is practicable, which will, as far as possible, take into account the analytical facilities available in different parts of the Kingdom, and the quality criteria of interest to those responsible for the various aspects of the water cycle. Because both needs and equipment vary widely, where necessary, a selection of methods may be recommended for a single determinand. It will be the responsibility of the users – the senior analytical chemist, biologist, bacteriologist etc, to decide which of these methods to use for the determination in hand. Whilst attention of the user is drawn to any special known hazards which may occur with the use of any particular method, responsibility for proper supervision and the provision of safe working conditions must remain with the user.

The preparation of this series and its continuous revision is the responsibility of the Standing Committee of Analysts (to review Standard Methods for Quality Control of the Water Cycle). The Standing Committee of Analysts is one of the joint technical committees of the Department of the Environment and the National Water Council. It has nine Working Groups, each responsible for one section or aspect of water cycle quality analysis. They are as follows:

1.0 General principles of sampling and accuracy of results
2.0 Instrumentation and on-line analysis
3.0 Empirical and physical methods
4.0 Metals and metalloids
5.0 General non-metallic substances
6.0 Organic impurities
7.0 Biological methods
8.0 Sludge and other solids analysis
9.0 Radiochemical methods

The actual methods etc are produced by smaller panels of experts in the appropriate field, under the overall supervision of the appropriate working group and the main committee. The names of those associated with this method are listed inside the back cover.

Publication of new or revised methods will be notified to the technical press, whilst a list of Methods in Print is given in the current HMSO Sectional Publication List No 5, and the current status of publication and revision will be given in the biennial reports of the Standing Committee of Analysts.

TA DICK
Chairman

LR PITTWELL
Secretary

20 July 1977

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1 Summarized Description of the Method

1.1	Biota sampled	Benthic macroinvertebrates
1.2	Habitats sampled	All accessible aquatic habitats of rivers, streams, ponds, estuaries and lake shores
1.3	Type of sampler	Handnet
1.4	Basis of operation	Manual sampling
1.5	Form of data	Qualitative and/or relative abundance
1.6	Limitations of method	i. Water depth – method is restricted to shallow water (up to c. 1·5m); ii. mesh size of net, which influences the size of organisms taken; iii. operator safety, eg bed and bank stability, current velocity.
1.7	Efficiency of method	Closely dependent on sampling effort
1.8	Logistics of sampling	Lightweight sampler used by one person

2 Introduction

A handnet is probably the most versatile sampler for benthic macroinvertebrates and can be used in shallow riffles, in waters which are of wadeable depth, or in depths up to about 1.5 metres, from the bank or a boat. The methods of sampling with a handnet described below are appropriate when qualitative results are required. A handnet will not give quantitative results (ie numbers of individuals of different species per unit area of river bed) unless it is converted to a Surber-type sampler (see another publication in this series). However, it is sometimes possible to give an indication of the relative abundance of taxa but such results should be interpreted with caution.

3 Equipment

3.1 A handnet consists of a handle and a frame holding a net in which the organisms are collected. Handles are usually made of metal or wood, the choice depending upon personal preference, and may have provision for extension in length. Frames, usually constructed in metal, have been made in various shapes, eg round, triangular, or essentially rectangular. Of these alternatives the essentially rectangular shape (see Fig 1) is preferred since the flat edge can be placed in close contact with the bed during use and the vertical sides permit a better cross-sectional area of water to enter the net than does a triangular shape. The frame should be large enough to allow a reasonable sample to be taken but not so large that the complete handnet offers too much resistance to the flow of water which could make sampling difficult in fast flows. Suitable rectangular handnets currently in use have evolved in the light of experience and have frame dimensions in the following ranges (eg Fig 1):

Width	(W)	200 – 250 mm
Height	(H)	190 – 220 mm
Shoulder	(S)	100 – 120 mm

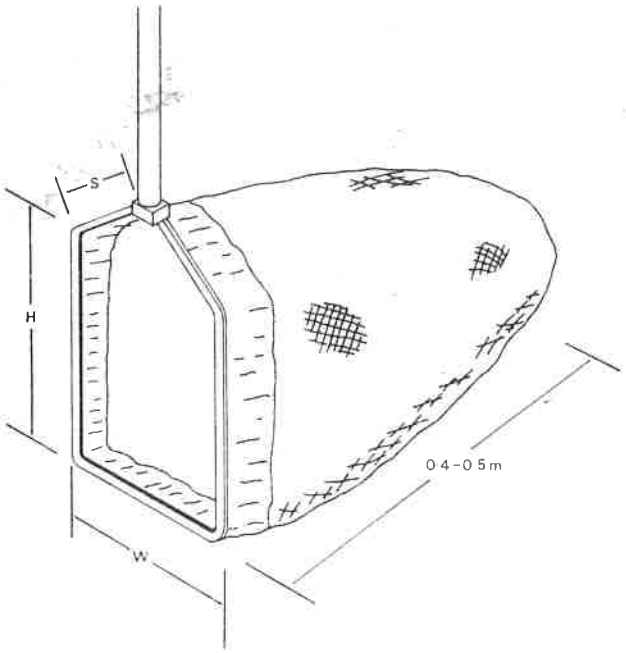

Figure 1 Basic handnet

3.2 In choosing an appropriate net two interrelated factors have to be considered:

(a) The dimensions and shape of the net;
(b) the mesh size of the net material.

Finer mesh sizes increase the risk of clogging with organisms and debris which reduces net efficiency by increasing the tendency of water and organisms to flow around rather than into the net. This effect can be minimized by increasing the depth of the net. On the other hand, an unnecessarily deep net can be inconvenient in use. An approximate guide to the depth of a net best suited to mesh size is included in the Table.

Table: Recommended handnet mesh sizes

Survey Objective	Mesh Threads per cm	Maximum Aperture Size	Recommended Minimum Depth	Comments
General/Routine Biological Surveillance: Data for Surveys using Trent/Biotic Index	8	950μm	400 mm	May not capture first instar stages of some insects
For Routine Surveillance with more complete records	12	610μm	450 mm	More likely to capture first instar stages
For special surveys requiring data in complete detail	24	265μm	550 mm	Ensures capture of first instar stages and very small organisms which may prove of value in water quality determination.

3.3 The shape of the net is not particularly important from a sampling point of view and it may be determined by practical considerations in manufacture. Fig 2a shows how two conical nets can be cut from material 1 metre wide and Fig 2b shows the pattern for one of the more usual bag-shaped nets. The net material is normally sewn to strong canvas which is attached to an inner frame thereby reducing abrasion. Methods of joining the inner and main frames which facilitate replacement of the net in the field are clearly advantageous. Net material may be of either a monofilament weave or knitted but the latter, being stronger, is preferred. Synthetic fibre is preferable since it is stronger and less liable to decompose, but must be selected to ensure flexibility. The mesh size

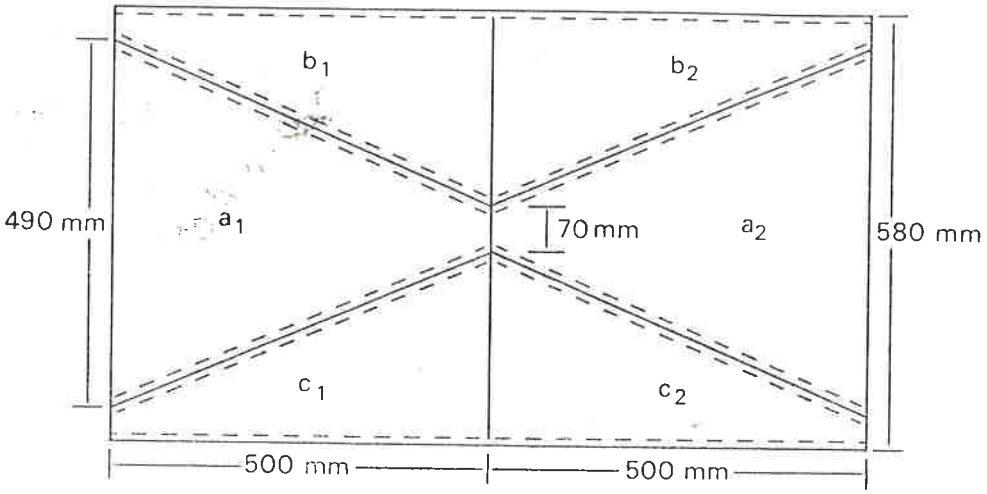

Figure 2 a Suggested pattern for two conical nets from material 1 metre wide. Parts a, b and c make one net, b and c being stitched together to form a shape like a. The chisel ends are joined together and the two halves (a and b+c) stitched together to complete the net

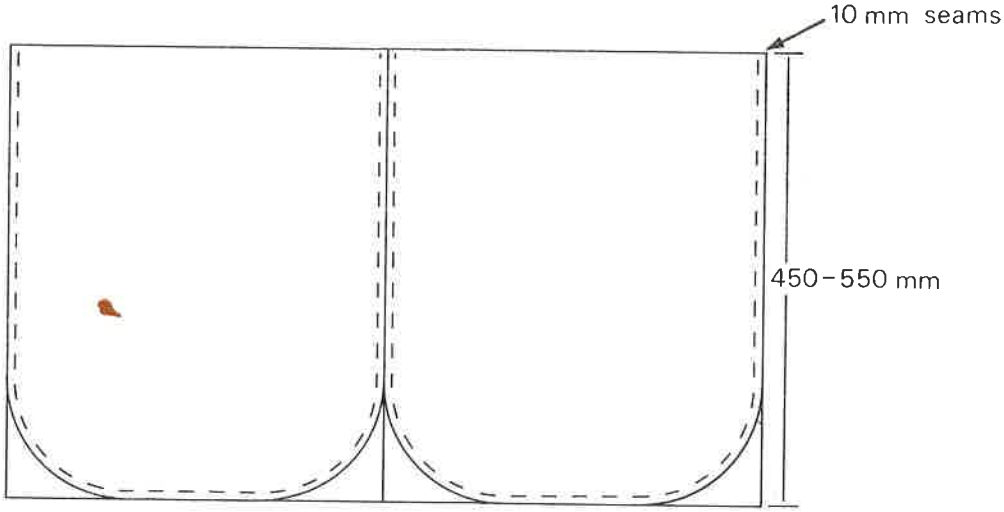

Figure 2 b Suggested pattern for a bag-shaped net from material 1 metre wide

should be appropriate for the objectives of the study; the maximum recommended aperture sizes are given in the Table.

3.4 Suitable handnets may be obtained from the suppliers listed below.* The names of these suppliers are given for the convenience of users of this method and do not imply official recommendation of their products. Handnets of similar specifications by other manufacturers would be equally effective.

4 Methods of use

No one sampling procedure is appropriate to all types of water and it is therefore necessary to describe a number of procedures to meet differing requirements. Furthermore, standardized sampling procedures are desirable in order to facilitate the maximum comparability of results.

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* Antox (UK) Ltd,
Swadlincote.
Derbyshire.
S M Davis,
25 Quest Hills Road,
MALVERN, Worcs.
T Gerrard and Co,
(Division of Griffin Biological Laboratories)
Gerrard House,
Worthing Road,
E PRESTON,
W Sussex BN16 1AS.

4.1 **Factors which may influence the procedure** adopted in given circumstances include:

(a) The sampling objective – which may be a comprehensive species list for the site, and/or the relative abundance of taxa within the selected biotope.

(b) The characteristics of the site – including depth of water, current velocity, type and stability of the bed, and the amount of vegetation present.

When it is intended to collect as many species as possible a sample should be taken by a combination of the methods described below. (Sections 4.2, 4.3 and 4.4). It is customary to explore thoroughly all the types of substratum by this combination of methods, including sweeps through patches of weed and between the roots of overhanging trees.

Except in deep or static water or when sweeping the net through weeds or in the surface of mud or silt deposits, a handnet should be placed on the bed and the sampling carried out in such a way that the animals drift into it. In order to avoid excessive wear and tear on the net it should not be used like a shovel, unless absolutely necessary.

4.2 Hand-sampling in flowing shallow water

4.2.1 Hold the straight lower edge of the handnet against the stream bed, and, by hand, turn over the stones immediately upstream of the net in the flowing water. The dislodged animals will be carried into the net by the current. Examine the stones and remove any attached or clinging species and add these to the sample. The finer, lower deposits should also be disturbed to dislodge further attached organisms. Repeat this procedure at several places across the river in order to include different microhabitats within the riffles.

4.2.2 The removal of the catch may be facilitated by washing it into a corner of the net using the flowing water and gently shaking the net whilst withdrawing it from the water. Turn the net inside out to aid the transfer of the sample to a container of water. Remove by hand any animals clinging to the net and add them to the sample. It is recommended that the net be thoroughly washed between samples.

4.2.3 Further sample treatment, such as decanting surplus water, reducing sample bulk by removing sticks, stones, leaves and other debris or the addition of preservatives, depends upon operator preference and the objective of the sampling programme.

4.3 Foot-sampling in polluted or deeper water

4.3.1 Where there may be a risk of pollutants affecting the hands, or where the fauna is suspected of being sparse or where the water is too deep for hand sampling, foot sampling may be used. Hold the net vertically on the river bed downstream of the foot, and with the toe or heel of the boot disturb the substratum to release material which will be caught in the net. Different habitats should be sampled by working across the river.

4.3.2 This method is somewhat selective in that fewer of the attached animals will be taken. Where practicable therefore some stones should be lifted and examined for such animals. These should then be added to the contents of the net and transferred to a container using the procedure described in 4.2.2.

4.4 Sampling in slow-flowing and static water

4.4.1 In slow-flowing or static water the handnet may not be the most appropriate method for sampling. Consideration should be given to the use of grabs, dredges, corers or air-lift samplers.

4.4.2 Some habitats, such as stony shores of lakes, may be sampled by the hand-picking method (4.2.1) although the efficiency of collection may be lower. The best procedure is to remove stones carefully, agitate them vigorously in the net, and finally pick off by hand any animals which remain attached.

4.4.3 When sampling other slow-flowing or static water habitats the reduction or absence of water movement necessitates a different procedure from that used in flowing water where the current is employed to assist in sweeping dislodged animals into the net. In static water the relative motion between the fauna and the net must be supplied by the operator. The substratum may be disturbed with the feet and the dislodged fauna caught by repeated sweeps of the net through the water immediately above the disturbed area. In deeper static water where the substratum consists of weed or silt, the handnet may be carefully drawn or pushed through the surface layer of the substratum.

4.5 Methods for assessing relative abundance

4.5.1 An indication of relative abundance of taxa in a clearly defined biotope may be obtained by any of the qualitative methods described above. By sampling over a fixed distance for a limited period of time, the relative abundance within samples may be compared at different sites for water quality monitoring purposes provided that the sites have similar biotopes. With hand-sampling a sampling period of up to ten minutes may be required but with foot-sampling a shorter period, up to two minutes, is usually sufficient. Additional time should be allowed for picking off attached and clinging organisms.

4.5.2 If comparable results are sought, the sampling effort over the time period should be similar, and for this reason it is best if the same operator is involved. Even so, differing conditions such as current velocity, depth, temperature (especially with hand-sampling) and the nature of the substratum may affect the sampling efficiency.

4.5.3 Long periods of foot-sampling in a river with a rich benthic fauna can result in excessive catches to process, and if carried out frequently at the same sampling station the community may be adversely affected.

Address for Correspondence

However thoroughly a method may be tested, there is always the possibility of a user discovering a hitherto unknown problem. Users with information on this method are requested to write to:

The Secretary
The Standing Committee of Analysts
The Department of the Environment
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LONDON SW1P 3EB
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