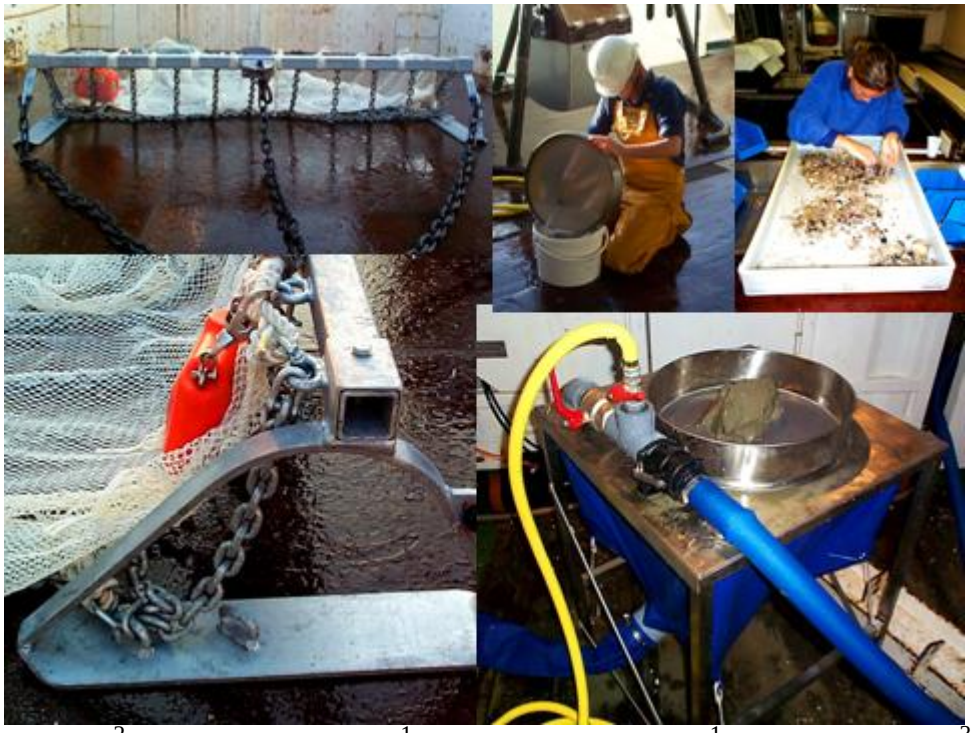
Methodology for the Combined Sampling of Marine Groundfish and Benthic Invertebrate Communities



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METHODOLOGY FOR THE COMBINED SAMPLING OF MARINE GROUNDFISH AND BENTHIC INVERTEBRATE COMMUNITIES

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SUMMARY

A detailed methodology manual is presented. The samplers used to sample benthic invertebrates are described, along with procedures for deploying each sampler. The procedures required to process each type of sample on board the vessel are described, as are the preservation and storage methods necessary for material that has to be processed back at the laboratory. For each step of the procedure, the data required to be recorded are listed and examples of suggested data recording forms are provided. The samplers used to sample the fish assemblage are described. Generally fish sampling was carried out as part of the co-ordinated ICES quarter 3 International Bottom Trawl Surveys (IBTS), and so the sampling procedures and general data recording process was dictated by the needs of this survey. This was generally sufficient for the purposes of this project, though care was taken to ensure that benthic sampling was carried out only at IBTS stations where the entire catch was sampled (i.e. no sub-sampling of the unsorted catch was done). Again examples of suitable fish sample data recording forms are provided. The main database holding the fish and benthic survey data are described.

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1. INTRODUCTION

This manual was produced following initial work undertaken by FRS in 2001 and 2002 when considerable "pilot" work was undertaken, and after considerable consultation between the partners involved in the EU funded MAFCONS (Managing Fisheries to Conserve Groundfish and Benthic Invertebrate Species diversity) project. This consultation process, which included one dedicated workshop, took place prior to any coordinated survey sampling work in 2003 and 2004. The manual acted as a strict guide to all the sampling and subsequent analysis undertaken during the course of the project. As problems arose, partners in the MAFCONS project were consulted and consensus reached as to how these should be addressed. Following each decision the manual was revised accordingly. This manual therefore provides full details regarding the methods used for the survey, sampling, and data processing work conducted to support the objectives of the SEERAD funded MF0753 and EU funded MAFCONS projects. In particular it outlines: sampling procedures for epibenthic invertebrates and infauna during the national groundfish surveys; sample processing onboard and in the laboratory; the recording of data and the requests for fish data from the actual groundfish surveys; database construction and guidelines for use of the various survey databases.

It is intended that this manual could provide a guide for all future combined fish and benthic invertebrate surveys required for undertaking holistic ecosystem assessments. For the EU MAFCONS project, the purpose of the manual was to ensure that, as far as it was possible to do so, all the methodology employed by the different partners involved was consistent. To make any future data collection as compatible with the data collected during the course of this project, it is to be hoped that future researchers will adhere as closely as possible to the methods presented here.

2. LOCATION OF SAMPLING STATIONS

Benthos sampling took place during the 3rd and 4th quarter International Bottom Trawl Surveys (IBTS) over the period 2001 to 2004 in the North Sea and in waters west of Scotland. Benthos samples were taken at the locations of groundfish survey fish trawl stations in order to link information on the fish and benthic communities at each station. In the North Sea areas of priority were designated for benthic sampling. These covered the three main epibenthic assemblages (Figure 2.1, Callaway *et al*. 2002) and included ICES rectangles with variable levels of fishing effort (Callaway *et al*. 2002), allowing the effects of different fishing regimes on the different benthic assemblages to be examined.

A station could only be included in the data analyses if the entire suite of samples was taken: one beam trawl sample for epifauna and benthic fish, five grab samples for infauna and five sediment samples (box-corer samples and meiofauna samples are optional). Data on the demersal fish fauna were obtained from the IBTS for the relevant trawl samples. At every station, relevant abiotic, hydrographic and station specific information was also recorded (Sheet 1 and/or EXCEL worksheet ENV– see Sections 10 & 14.5{Appendix 5}). Appendix 1 (section 14.1) lists the criteria required to fill in each field of the forms.

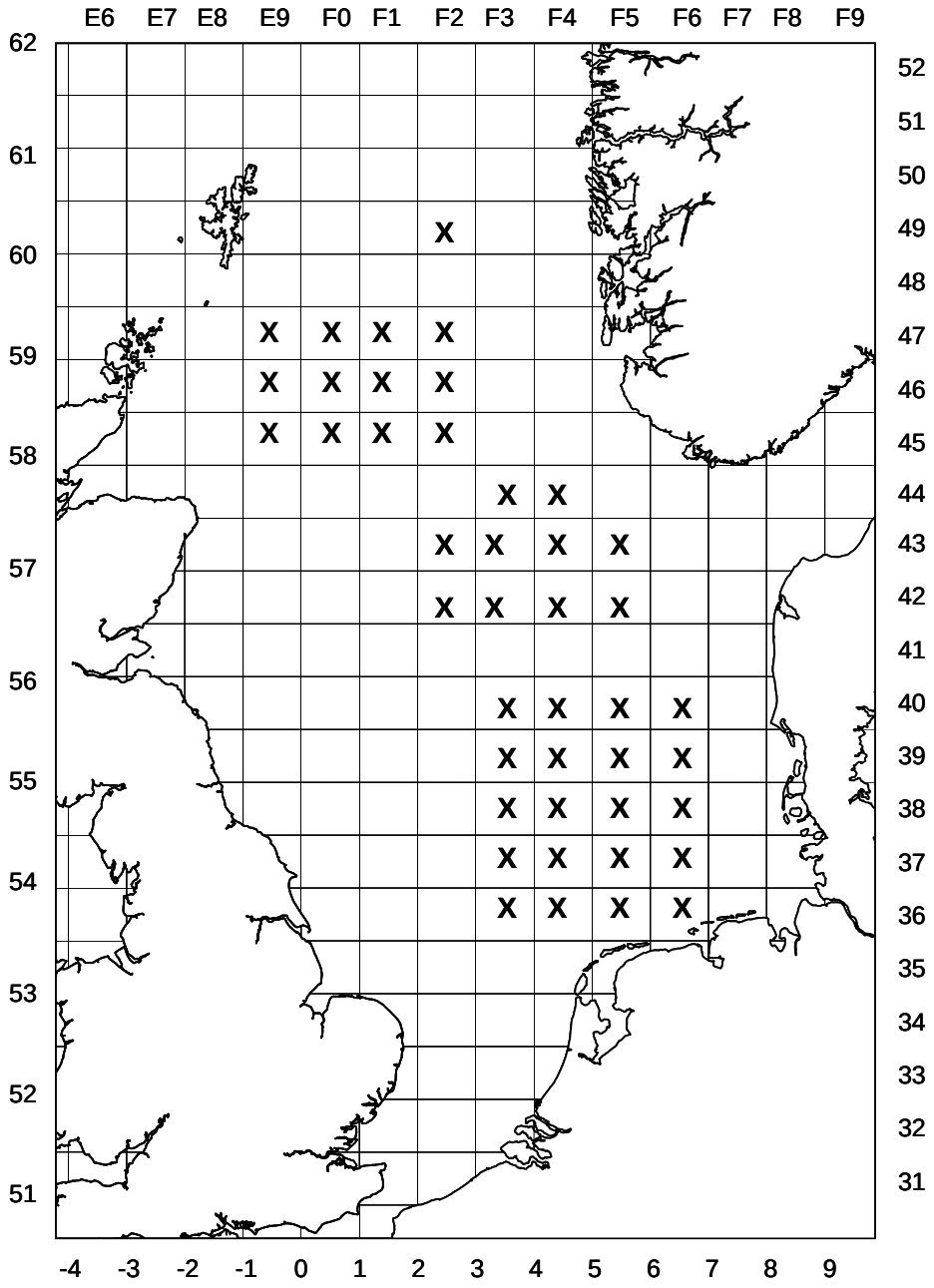

Figure 2.1. Areas of sampling priority. The areas cover three of the main epibenthic community types in the North Sea with both high and low fishing effort within the same area (Callaway *et al.* 2002).

3. EPIFAUNA

Epifauna consists of a large range of different sized sessile and motile species that were sampled using a 2m-beam trawl. This performed reliably on soft and coarse grounds, although whether or not quantities of individuals were sampled reliably with this equipment remains a topic of debate (Greenstreet et al 2007a). Generally 2m-beam trawl samples are described as semi-quantitative ('Guidelines for the conduct of benthic studies at aggregate dredging sites', DTLR 2002). For the purpose of the this study, epifauna was defined as "all animals caught in the 2m-beam trawl and

retained in the 5mm sieve". Animals were also retained from a 2mm-sieve to examine whether only retaining animals in the 5mm sieve might miss an important component of the epibenthic faunal production. The 2mm fraction of the epibenthos sample still underestimates the smaller epibenthic fauna because the mesh of the beam trawl is 4mm stretched, potentially allowing animals <4mm to escape capture in the first place. However, animals retained in the 2mm sieve also provide an indication the identity and relative abundance of the hyper-benthos, even if it is not a representative sample.

3.1. EQUIPMENT

3.1.1. 2m-beam trawl (galvanised steel)

Dimensions of the shoes, the net and the chain mat are specified in Jennings *et al.* (1999) (Figures 3.1.1.1 and 3.1.1.2). Additional information about the individual beam trawls used in each of the surveys is recorded in the 2m-beam trawl-haul information sheet (Section 14.5 Sheet 2 and/or 2BTHI); a video camera or a stills camera may be attached to the trawl. Increasing the weight of the trawl by attaching extra weights should be avoided, unless absolutely necessary in order to keep it on the seabed. If extra weight is added, the weight attached should be recorded in the 2m-beam trawl-haul information sheet (Section 14.5 Sheet 2 and/or 2BTHI). The net should consist of 20 mm mesh (10 mm knot to knot) with a 4 mm knotless mesh liner (2 mm 'knot to knot'). A linked-chain chain-mat connects the footrope of the net to the beam bar. This chain serves to lift fish and benthic organisms off the seabed and into the net, yet allows the net to pass over larger boulders on the seabed. Ideally the "standardised" towing warp should be to 14 mm, 6/19 construction. However, some vessels use 12mm or 16 mm warp. Since this potentially affects the performance of the beam trawl on the seabed, it is important to note the warp diameter in the 2m-beam trawl-haul information sheet (Section 14.5 Sheet 2 and/or 2BTHI). All the material collected in the beam trawl is passed through a sieve tower consisting of 5mm and 2mm (woven mesh) sieves. This procedure is greatly facilitated by using a Gardline Autosiever. Material from the 5mm-sieve fraction requiring to be analysed on return to the laboratory following each cruise should be stored in buffered 4% formaldehyde solution (see Section 14.2 {Appendix 2}). All material retained in the 2mm sieve fractions should be similarly stored for later analysis in the laboratory. All samples should be stored in containers labeled internally and externally, requiring appropriately sized storage bottles and waterproof labels.

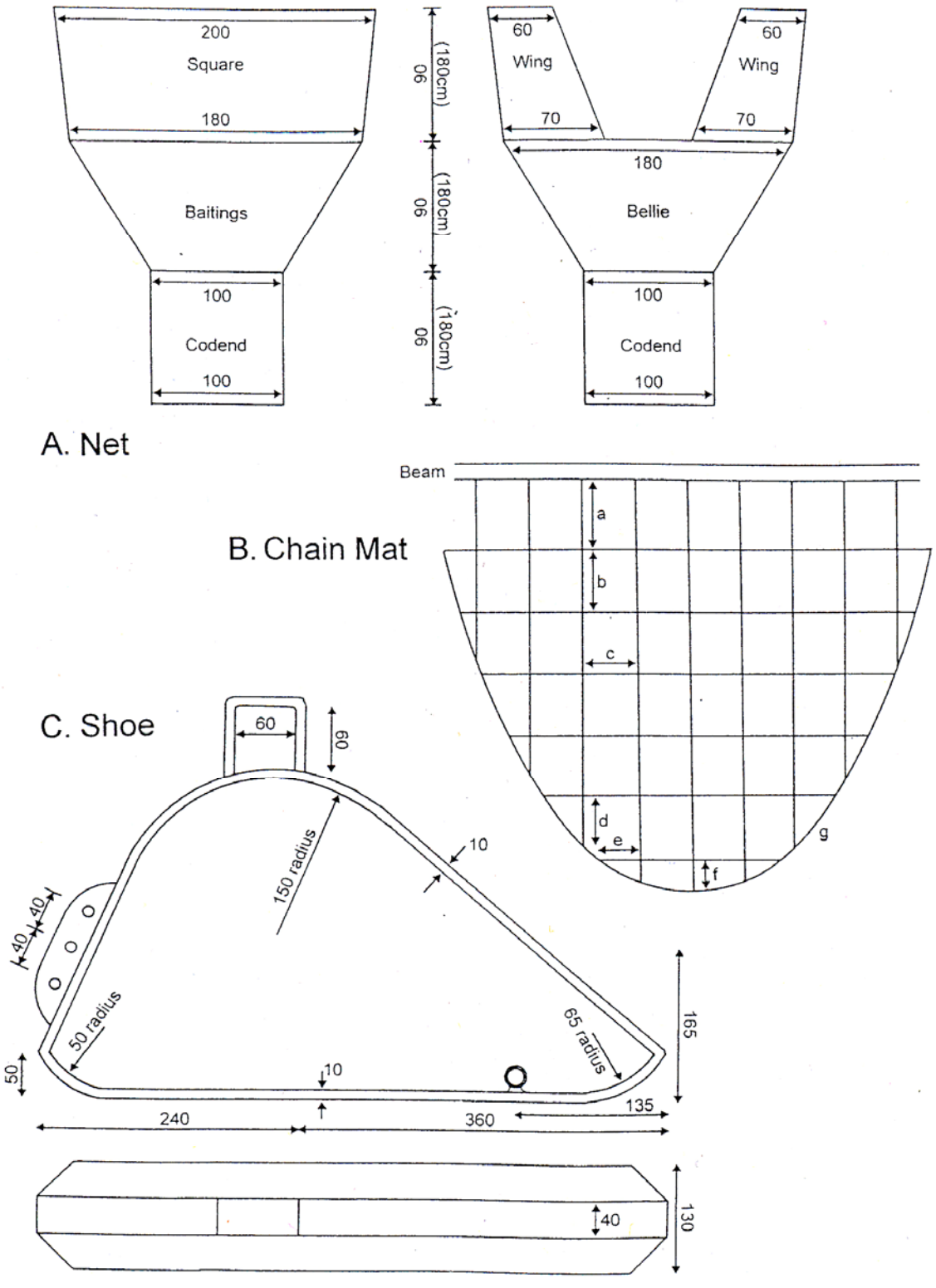

Figure 3.1.1.1. Dimensions and construction guide for Epibenthic 2m Beam Trawl (After Jennings et al 1999).

Figure 3.1.1.2. 2m beam trawl being deployed.

3.2. SAMPLING PROCEDURE

Every time a beam trawl is taken at a station, the EXCEL worksheet '2m-beam trawl-haul information' (Section 14.5 {Appendix 5} Sheet 2 and/or EXCEL worksheet 2BTHI,) must be filled in. This worksheet is applicable to each of the 2m-beam trawl samples taken, but some of the fields will be constant throughout the survey (e.g. country, ship, warp diameter). Appendix 1 (section 14.1) lists the criteria required to fill in each field of the sheet. Explanation of some of the fields is given below. As a general rule the warp length/depth ratio should be 3:1, never more than 3.5:1 and in shallower water no less than 2.5: 1. The speed of the vessel and warp pay-out speed

should be almost synchronised, maintaining a slight forward motion to keep the beam trawl stable in the water. A 1.5-knot vessel speed and warp pay-out of 50m/min should achieve this. When initially deploying the beam trawl over the side or stern of the vessel, two ropes, one either side, should be used to steady it, keeping the beam trawl stable and reducing the risk of it turning upside down. For each tow, an average towing speed of 1.5 knots (average speed over ground – see section 14.5 Appendix 5 Sheet 2) should be maintained for a tow duration of 5 minutes. As some vessels will have little control at such slow speeds, tow speeds between 1-2 knots will be deemed acceptable.

During the period that the beam trawl is towing on the seafloor, towing direction, ground speed, depth and position of the beam trawl are entered into the haul information sheet (see section 14.5 Appendix 5 Sheet 2 and/or EXCEL worksheet 2BTHI). Where possible these data are recorded at 1-minute intervals throughout the tow. This will allow for a more accurate calculation of area covered by the beam trawl. If this is not possible, the data must, as a minimum, be recorded at the Start and Stop fishing times (see section 14.5 Appendix 5 Sheet 2). The first readings are taken after the trawl has landed on the bottom (as indicated by Scanmar©), and starts to be towed (Start) – i.e. at the point when the winches are blocked up (end of warp payout). Stop (fishing end) should be recorded as the time that the trawl leaves the bottom, as indicated by Scanmar©. For those partners operating without Scanmar©, 'Stop' is taken to be at 5 minutes and thus the readings for 5 minutes and 'Stop' in EXCEL worksheet 2BTHI (Time Stop Fishing) and Sheet 2 (section 14.5 Appendix 5) are the same. A conversion factor, based on trawls where Scanmar© was used, can then be applied to such samples to account for the underestimate of actual area covered by the 2m beam trawl (between starting to recover at 5mins and the trawl actually leaving the seabed).

On recovering the beam trawl, half the warp should be recovered as fast as possible to ensure the beam trawl lifts off the seabed quickly and cleanly. Thereafter a recovery rate of 70-100m /sec^{-1} should ensure minimal damage to the animals in the codend. The codend should be washed out after each tow. If the net needs more thorough washing, it should be towed behind the vessel with an open codend.

Wherever possible Scanmar© should be attached to the beam trawl showing whether the beam trawl has been in close vicinity to the seabed. Alternatively, on retrieving the trawl, shiny beam trawl shoes have been shown to indicate evidence that the trawl has maintained bottom contact. Another method may be to apply spray paint or pen marks before launching the beam trawl and to then examine for their presence after the haul. This will indicate whether the trawl has been on the bottom and whether it has been the right way up (see section 14.5 Appendix 5 Sheet 2 and/or EXCEL worksheet 2BTHI). This latter method is strongly recommended, whether Scanmar© is used or not.

3.3. SAMPLE PROCESSING

For the animals retained in the 5mm sieve fraction, data are required for analyses of species diversity and also for the estimation of production of the community based on the method described by Brey (1990, 1999, 2001) and modified by Jennings *et al.* (2001). This method of estimating community production requires individual weights of the fauna and so all animals from the beam trawl 5mm-sieve fraction should be identified to species, measured and weighed. However, for the 2mm fraction, production will be calculated from mean individual weights and the fauna will be identified to a lower taxonomic level (see section 3.3.2). For each beam trawl taken, all of the material (organic and non-organic) is removed from the codend and washed through the 5mm and 2mm woven mesh sieves. All invertebrate fauna and fish in the sieved fractions are then retained for processing.

3.3.1. 5mm sieve fraction

The vast majority of species from the beam trawl occur in low abundance and for the 5mm-sieve fraction they will have to be identified to species level, measured and weighed individually. However, higher abundance species will be processed in slightly different ways than low abundance species. Therefore, this section first gives some general rules for processing the 5mm-sieve fraction and then specifies procedures for low, moderately abundant and highly abundant species. For a worked example of how the processing of the entire beam trawl sample can be done see Appendix 6 (section 14.6).

All animals are identified to species level. Many larger species can be identified from photographs taken during previous cruises and the species identification database (SID). However, this method bears the risk of misidentification and the majority of species will have to be identified from published identification keys (see Appendix 3, Section 14.3). Any specimens that cannot be identified at sea, or are too small to be weighed at sea (< 0.3g), must be preserved and stored in well-labeled containers to be returned to the laboratory for further examination. The majority of animals will have to be measured and weighed. As a general rule, measurements should be recorded in millimeters (mm) and weights in grams (g). All weights should be taken as the blotted wet weight, where the excess water is removed by placing the animals on absorbent paper, such as filter paper, before taking the weight (following the method described in Rumohr 1999). Size measurements should be recorded to the nearest mm below, weight measurements to the nearest 0.1g below. If a different level of precision is applied, this must be noted in the relevant forms (Sheet 4 and/or EXCEL worksheet 2BTLW and Sheet 5 and/or 2BTLFD, see section 14.5 Appendix 5). Most calipers, for example, measure to a precision of at least 0.1mm; hence size measurements could be made to the nearest 0.1mm below, which would have to be noted in the field 'Precision-L' in the worksheet 2BTLW (see Appendix 1, section 14.1). Animals weighing <0.3g should be preserved and retained to be measured to a higher resolution in the laboratory (0.01-0.0001g). In the 5mm fraction several species such as the hermit crab *Anapagurus laevis*, amphipods and polychaetes fall into this category and have to be dealt with in the laboratory. The size and weight of these animals will have to be measured to a greater precision, e.g. the nearest 0.001g below, which has to be recorded in the relevant forms.

3.3.1.1. *Low Abundance species*

For each species, total number of individuals and total weight are recorded in the 2m-beam trawl haul summary sheet (Sheet 3 and/or EXCEL worksheet 2BTHS, see Appendix 5, section 14.5). This process is started at sea and completed back in the laboratory for animals that cannot be dealt with onboard (e.g. cannot be identified or are too small to be weighed). Each individual animal of each species is then measured and weighed according to specifications in the species list (see Appendix 4, section 14.4). These specifications were agreed on as practice has shown that different institutes carry out the size-weight measurements in different ways, depending on numbers of staff, availability of technical equipment, or habit. Measurements may be entered into Sheet 4 see (Appendix 5, section 14.5), directly into the EXCEL worksheet 2BTLW (see Appendix 5, section 14.5), into a self-prepared computer worksheet, or into a database that is automatically produced by the measuring equipment. All methods are allowed, but eventually the measurements must be transferred into the EXCEL worksheet 2BTLW for data transfer to the project coordinator. No size frequency sheets need to be filled in here, as all individuals of the low abundance species are recorded in the length-weight sheet (Sheet 4 and/or EXCEL worksheet 2BTLW, see Appendix 5, section 14.5). Size frequency data can thus be extracted for them from this sheet.

3.3.1.2. *Moderately abundant species*

For these species it will not be possible to weigh and measure every individual. Past surveys showed that only about 2-5 species per cruise fall into this category. Total number and weight is recorded in the 2m-beam trawl haul summary sheet (Sheet 3 and/or EXCEL worksheet 2BTHS). A number of different methods may then be used to establish and record the size frequency distribution. Appendix 6 (section 14.6) outlines the procedure used by FRS MLA and this may be followed as a guide. Sheet 5 (see Appendix 5, section 14.5) can then be used when following the procedure. If other project participants determine their size frequency distributions differently, they must ensure that the appropriate data is still recorded in order to complete EXCEL worksheet 2BTLFD. Size classes should be in 1mm steps. If different size classes are used, this has to be noted in the worksheet 2BTLFD. For each species, the number of individuals per size category is then entered directly into the data entry worksheet 5 (2BTLFD). For size-weight relationships, 5 individuals should be weighed per size class and entered in the 2m-beam trawl-length-weight relationships sheet (Sheet 4 and or EXCEL worksheet 2BTLW, see Appendix 5, section 14.5). When the size frequency distribution has been completed for a species, it is important to make sure that 'I' is entered into the 'LFDComp' column on 2BTLW (Sheet 4) (see Appendix 1, section 14.1).

3.3.1.3. *Very high abundance species - Sub-sampling*

At a few stations several thousand individuals of one species will be caught in a single haul, e.g. *Ophiura albida* in the southern North Sea or *Echinus* spp. in the north. In those cases sub-sampling may be necessary. Once the haul has been sieved and sorted, the abundant species to be sub-sampled are separated from the other fauna. For each species the total weight of the individuals is then recorded in the 2m-beam trawl haul summary sheet (Sheet 3 and/or EXCEL worksheet 2BTHS). A representative sub-sample of the species is then taken and the fraction sampled by weight recorded on sheet 5 (size frequency data) (there is no field for this in EXCEL worksheet 2BTLFD). Total weight and weight of the sub-sample must be recorded, as these are necessary to calculate the raising factor, which has to be entered in EXCEL worksheet 2BTLFD. All animals of the sub-sample are measured individually and a size frequency distribution is thus built up (example in Appendix 6, section 14.6). Total numbers per size class will then be calculated automatically in the EXCEL worksheet 2BTLFD, by entering the numbers of individuals per size class of the sub-sample and the raising factor for that size class. Summing up the raised numbers of all size classes gives the total number of the sub-sampled species, which is then entered into EXCEL worksheet 2BTHS. For size-weight relationships, 5 individuals should be weighed per size class and entered in the 2m-beam trawl-size-weight relationships sheet (Sheet 4 and/or EXCEL worksheet 2BTLW, see Appendix 5, section 14.5).

3.3.2. 2mm sieve fraction

As mentioned before, the 2mm sieve fraction of the beam trawl sample will only be used as an indication of the hyperbenthos present at each station. All processing of the 2mm-sieve fraction will be done in the laboratory, and so each sample must be bottled, fixed, preserved (4% formaldehyde solution), and labeled clearly at sea to be returned to the laboratory. The methodology that will be used to estimate production from this sieve fraction uses allometric relationships based on the relationship between production and mean individual weight at a given temperature (Edgar 1990a; 1990b). Mean individual weights are calculated per size class (based on sieve size denominations) at the Taxon Group level (see 'List of taxonomic groups', section 5.1.2.3). Each sample is split into taxon groups and the total number of individuals and total weight are recorded in the epibenthos production sheet (Sheet 3 and/or EXCEL worksheet 2BTHS, see Appendix 5, section 14.5). From this data mean weight per taxon group can be calculated per sample.

No further analysis of this fraction will be necessary at this time. Project participants are however requested to retain the preserved 2mm-sieve fraction from each of the stations sampled. If required, this will allow for identification to a finer taxonomic resolution and calculation of individual sizes and weights. This may be necessary to explore the use of different methods for calculating productivity. At present there is no commitment to processing these samples, just to preserving and storing them.

Appendix 6 (section 14.6) gives a detailed example of how to work up an entire epifaunal sample (both sieve fractions). This is only an example, and project participants do not have to follow the procedure exactly, so long as the data required for the EXCEL worksheets 2BTHS, 2BTLW, 2BTLFD and for the 2mm sieve fraction 2BTHS (see Appendix 5, section 14.5) are collected.

4. HYPERBENTHOS

It would be advantageous if project participants with access to a hyperbenthos sledge could take samples with this equipment in addition to those taken by the 2m-beam trawl. The 2m-beam trawl is likely to miss the majority of the hyperbenthos and estimates of hyperbenthos from the sledge samples would allow for the evaluation of the catchability of hyperbenthos in the 2m-beam trawl.

5. INFAUNA (MACROBENTHOS)

At every station infauna samples are taken with a Van Veen grab, and if available and time allows, with a Box corer. The Van Veen grab is one of the most common tools for collecting quantitative infauna samples in the North Sea. Using this type of grab will allow comparisons of this survey with previous studies. However, the downwardly directed jaws of the grab are vulnerable to incomplete closure due to the presence of stones. In areas with coarse ground it may be difficult and time consuming to gain the desired number of valid samples. As a guideline, when on grounds that are difficult to sample, sampling should only continue if 3 samples in the first 5 grab attempts are successful. Sampling should then be abandoned if following the first 5 grabs there are 3 void attempts in a row. Box-corers penetrate further into the sediment than grabs and hence sample deeper dwelling benthic infauna. Although the majority of infaunal species live in the upper centimeters of the seabed, deeper dwelling animals are often relatively large and contribute considerably to the standing biomass.

5.1. VAN VEEN GRAB SAMPLES

5.1.1. Equipment

Use a 0.1m^2 Van Veen grab (Figure 5.1.1.1) Actual dimensions may vary slightly so measure and record the individual grab dimensions in Sheet 6 and/or InFHI spreadsheet. A container may be required to measure the volume of grab sample in case the penetration depth can not be measured using a ruler in the centre of the grab. The sampled material will be passed through a sieve stack consisting of sieves with mesh sizes of 4mm, 2mm, 1mm, and 0.5mm. This process is greatly facilitated by the use of a Gardline Autosiever (Figure 5.1.1.2), and this is recommended. Material retained in each sieve will be stored in buffered 4% formaldehyde solution, so storage bottles and waterproof labels for all sieve fractions will be required. All samples should be stored in containers labeled internally and externally. Finally a corer for collecting sediment samples (25-mm diameter cores to 10cm depth) will be required.

Figure 5.1.1.1. Van Veen grab of the Senckenberg Institute, Germany

Figure 5.1.1.2. Gardline Autosiever

5.1.2. Sampling procedure

At every station an 'Infaunal sampler information sheet' (Sheet 6 and/ or EXCEL worksheet InFHI) is filled in. All fields must be completed for each time that a grab is deployed, which is why there is a deployment number (DEP NO on Sheet 6 and InFHI). Appendix 1 (section 14.1) lists the criteria required to fill in each field of the Sheet. Each individual grab used on the survey must have a

specific ID, which is recorded in the Infaunal sampler information sheet every time a sample is taken. The specific dimensions of each grab ID (to calculate individual grab areas) must be recorded and supplied to the project coordinator after the cruise. If the same grab is used throughout the survey the sampler ID will always be the same (e.g. VVG1).

At each station five Van Veen grab samples are taken. During retrieval of the gear from the seabed, the first 5m of warp should be hauled slowly to maximise sampling efficiency. The grab can then be hauled to the surface at a faster rate. Each individual grab is checked to see that it is a valid sample. Validity is based on criteria outlined by Rumohr (1999), which consider non-valid samples to have the following characteristics:

- contain a sample volume of less than 5 litres in soft sediments and less than 2.5 litres in hard-packed sand;
- incomplete closure of the grab;
- obvious uneven bite;
- spillage during transfer of samples onboard.

On gaining a valid grab, penetration depth is measured in the grab (deepest point of the sediment) before sediment samples are taken. If the design of the grab does not allow for a measurement of penetration depth, the volume of the sampled material has to be recorded. This can be achieved by emptying the sediment of the grab into a container with litre markings. The penetration depth can later be calculated from the volume measures. Penetration depth is recorded in the Infaunal sampler information sheet (Sheet 6 and/or EXCEL worksheet InFHI, see Appendix 5, section 14.5).

Sediment samples should be taken from each of the five grabs. A record of when sediment samples have been taken is made in the Infaunal sampler information sheet (Sheet 6 and/or EXCEL worksheet InFHI, see Appendix 5, section 14.5, for further details see section 10 on abiotic parameters).

5.1.2.1. *Sample processing at sea*

Once onboard individual grab samples are washed through a series of sieves (4mm, 2mm, 1mm and 0.5mm) using the Gardline Autosiever (Figure 5.1.1.2). It is advisable to undertake all of the sieving at sea, but if samples cannot be sieved through the entire set of sieves onboard, e.g. due to weather conditions or time constraints, the samples may be sieved through the 1mm and 0.5mm sieves or even only through the 0.5mm sieve. Sieving through the other sieves may then be carried out later in the laboratory. If the sample cannot be sieved at all at sea, the whole sample must be preserved in at least 4% buffered formaldehyde solution and sieved and processed later in the laboratory. It is important to note in the Infaunal sampler information sheet (Sheet 6 and/or EXCEL worksheet InFHI), whether the sample was preserved rather than fresh when sieved. This will help to establish whether the number of animals retained in the sieve is affected by the preservation procedure.

Each of the sieved fractions are individually preserved in buffered 4% formaldehyde solution and stored in well-labeled (internally and externally) containers. Labels should include the station number, haul number, date, country and sieve size. Samples are then returned to the laboratory for sorting and identification, enumeration and analysis.

5.1.2.2. *Sample processing in the laboratory*

For the animals retained in the 4, 2 and 1mm sieve fractions, data are required for the analysis of species diversity and also for the estimation of production of the community based on the method described by Edgar (1990a; 1990b). Only production data are required from the 0.5mm sieve fraction. Edgar's method for estimating production avoids the need to weigh individuals but retains an element of size structuring in the calculation of production, by using the structuring of size classes based on sieve sizes. Ultimately, estimation of secondary production for the entire benthic community will be based on separate estimates for the three benthic components: epifauna (all fauna retained in the 5mm sieve fraction of the beam trawl); infaunal macro-fauna (all fauna retained in the 1, 2 & 4mm sieve fractions) and the infaunal meiofauna (meiofaunal cores from Box Corers, using methods to be developed).

Samples can be sorted directly from being preserved in formalin, or they can be transferred to ethanol before further processing. If they remain in formalin the samples are immersed in water and are sorted under a fume-absorbing hose. Samples preserved in ethanol should also be rinsed in water and can then be sorted with or without a fume-absorbing hose. However, the different procedures may result in different weight loss of animals. Hence, procedures should be documented in order to be taken into account during data analysis. The length of time that samples stay in formalin and ethanol should also be documented.

For each sieve fraction of each sample, the preserved material needs to be sorted and the fauna removed. It is important to note that all organic matter should be picked out for processing, as the estimation of production is based on a method that size structures animals by the sieving procedure (Edgar, 1990a; 1990b). Even if groups such as Nematodes may have previously been disregarded in other macrofaunal studies, they must be included in the production estimates. To facilitate sorting it is recommended that the sample be stained with Rose Bengal. Samples may be stained at the time of fixation by adding 4g Rose Bengal per dm^{-3} 40% formaldehyde, before dilution and buffering of the formaldehyde. There is a risk here however of over-staining. If over-staining does occur Rumohr (1999) suggests the addition of alkaline fluids (pH 9) for de-staining. Rumohr (1999) also describes a more successful staining method. Just before the sorting procedure is about to take place, the sample is washed free of the preservation fluid over a sieve with a smaller mesh size than the fraction being processed. The sieve is then allowed to stand in Rose Bengal stain (1g per dm^{-3} of tap water plus 5g of phenol for adjustment to pH 4-5) for 20 minutes with the sample well covered. The sample is then washed in the sieve until the tap water is no longer coloured. Animals such as bivalves or amphipods may float on the surface and do not stain well. During the sorting process attention should be paid to these unstained animals. A record should be made as whether or not staining has been used in the sorting process.

During the sorting procedure it is recommended that a magnification aid be used (e.g. magnification lamp or stereomicroscope). Magnification has to be used for the 1mm and the 0.5mm fraction. If there is a lot of sediment in the 4mm and 2mm fractions, magnification should also be used for these fractions, at least a table magnification lens. Larger animals can be sorted without magnification.

For quality control assessment, some of the sample material should be sorted twice, preferably by two different people, to determine the extent to which organisms are missed by the first sort.

5.1.2.3. *Taxon Groups*

The method to be used for estimation of production does not require the measurement of individual weights. Instead the community is size structured by the sieving process and mean individual weights of taxon groups are then used to estimate production of a particular sieve size category of that taxon group, at a given temperature. In the original work by Edgar (1990a) fauna were mainly split at the Phyla level when producing mean individual weights, but on splitting the Crustacea into 2 taxon groups, Edgar found a significant difference in the relationships with mean individual weight. For the purpose of this study it was decided that some Phyla would be split into a number of taxon groups to represent those that share more similar body shape and thus mean weights. Also this method should more appropriately group taxa within Phyla that are likely to behave similarly in the sieving process.

The criteria used to determine the groups were; (1) The ease to separate out animals into these groups during the sorting process (i.e. no requirement for use of keys; obvious at first sight); (2) the likelihood of the groups within Phyla having different morphologies and different behaviour in the sieving process. An initial list of 38 Taxon Groups is given below as a guideline. Partners should work as far as possible to separate the fauna into these 38 groups. It is recognised that many of these groups will only appear rarely, if at all, in the sieve fraction samples.

The following is the recommended list of Taxon Groups:

- Annelids into three groups: Oligochaetes, Polychaetes –Errantia, Polychaetes – Sedentaria.
- Crustacea into eight groups: Amphipods, Isopods, Decapods – Natantia, Decapods – Reptantia, Mysids, Cumaceans, Euphausids, Cirripids.
- Echinoderms into six groups: Asteroids, Echinoids – regular, Echinoids – irregular, Ophiuroids, Holothuroids, Crinoids.
- Molluscs into five groups: Bivalves, Gastropods, Nudibranchs, Chitons, Cephalopods
- Then a further thirteen miscellaneous groups: Actinarians, Ascidians, Bryozoans, Chaetognaths, Ehiurans, Nemerteans, Nematodes, Porifera, Platyhelminths, Priapulids, Pycnogonids, Sipunculids, Ostracods.
- Finally, one group for fish, one group for ‘Other organic matter’, and one group for ‘Eggs’

As this is an adaptation of the Edgar method and it is therefore a method under development, it is recognised that these guidelines for use of Taxon Groups may need to be modified as experience is gained. It is likely that animals will be found that do not easily fit into any of these groups. When this happens, Three steps should be followed in assigning the material to a group: (1) If the animal is from an easily distinguishable group, a new group should be added to the list; (2) If the animal is from one of the Phyla listed, but does do not fit into an obvious taxon group, a group for ‘Others’ for that Phylum should be added, e.g. ‘Other Molluscs’; (3) If the material is indistinguishable as any particular Taxon group it should be added to the group ‘Other organic matter’.

It is also likely that the ability to separate animals into taxon groups will decrease as their size decreases. Thus, it will be much harder to separate animals in the smallest sieve sizes. In this case it may prove necessary to combine groups for practical purposes. For example, errant and

sedentary Polychaetes may be easy to separate in sieve sizes greater than 1mm, but below this they may need to be grouped as 'Polychaetes-All'. Another example is the Sipunculids, Echiurans and Priapulids. In this case in the smaller sieve fractions these may all need to be grouped as 'Unsegmented worms'. Where it proves necessary to combine particular taxon groups, it is important that a record is supplied of what is included in the amalgamated group.

5.1.2.4. *4, 2 & 1mm sieve fractions*

For the 4, 2 and 1mm sieve fractions, data are required for species diversity and community structure analyses (total number of individuals and total weight per species), and for estimation of community production based on mean individual weights at the taxon group level (derived from total number of individuals and total weight per taxon group). Sieved fractions should be sorted following the procedures outlined above and all fauna are split into the relevant taxon groups. At this stage one of two different procedures can then be followed. The first procedure involves the animals being weighed twice, once for total weight per taxon group and once for total weight per species. Using the second procedure, animals are identified to species straight away and taxon group level data is extracted from the species diversity database by summing the total weights and total numbers of all species in a taxon group. Either procedure can be used so long as the instructions outlined below are followed. Ideally the first procedure is preferable.

For procedure one, once the fraction has been sorted into taxon groups, production data is extracted at the taxon group level. The number of individuals and total weight per taxon group are recorded in the Infaunal Production data collection sheet (Sheet 7 and/or EXCEL worksheet InFProd, see Appendix 5, section 14.5). Again, total weight should be recorded as blotted wet weight. Precision of the weight measurement should always be recorded in the data entry (see Appendix 1, field 98, section 14.1). For the 4mm sieve fractions only, any large individual animals (i.e. diameter/length greater than 1cm) are weighed separately to account for the bias that large animals give to the mean individual weight (Edgar 1990 a & b). These are not included in the total weight for their taxon group. A separate total weight and total number of individuals should be recorded for these large individuals of a given taxon group (e.g. 'Bivalves-large'). This is carried out for all three sieve fractions, of each grab, at each station sampled. Once the production data has been extracted from a sample, animals are stored in preservative in suitably labeled containers (e.g. vials or small jars) until species diversity data can be extracted. All data required to estimate production from these size fractions will then be available in EXCEL worksheet InFProd (see Appendix 5, section 14.5). On completion of sample processing for the production data, the individuals from each taxon group are re-examined and identified to species level using the appropriate published identification guides (see Appendix 3, section 14.3)). Total number of individuals and total weight per species is then entered into Sheet 8 and/or EXCEL worksheet InFSpDiv. The taxon group of each species should also be entered so that the data can be cross-referenced with the production data from EXCEL worksheet InFProd. It is important at this stage to fill in the column 'ProdDataExtra' with Y for 'yes' as this shows that Procedure One has been followed and that the production data are available separately in the InFProd EXCEL worksheet (see Appendix 5, section 14.5).

For procedure two, once the fraction has been sorted into taxon groups, all animals that can be, are immediately identified to species level. Using this procedure all data are entered into Sheet 8 and/or EXCEL worksheet InFSpDiv and data that are required for the taxon group level production estimates, can then be extracted later using a database link list. Total numbers of individuals and total weight per species are entered into Sheet 8 (and/or EXCEL worksheet InFSpDiv, see Appendix 5, section 14.5). Again, total weight should be recorded as blotted wet weight. Precision of the weight measurement should always be recorded in the data entry (see Appendix 1, field 98, section 14.1). For any animals or organic matter that cannot be identified to species level, total

number of individuals and total weight is recorded at the taxon group level in Sheet 8 (and/or EXCEL worksheet InFSpDiv, see Appendix 5, section 14.5) (e.g. 'Other organic matter' for unidentifiable organic matter, or 'Other-Polychaetes' for unidentifiable bits of polychaete worms). These data will be required for the production estimates. For samples from the 4mm sieve fractions, all large animals (>1cm in diameter/length) of a species must be given separate totals. For example, hypothetically, you may need total number of individuals and total weights for both '*Abra alba*-large' and '*Abra alba*-small'. This is for extraction of data for the production estimates. For species diversity analyses data for large and small components of a species will be added together. It is important at this stage to fill in the column 'ProdDataExtra' with N for 'no' as this shows that Procedure Two has been followed and that the production data must be extracted from this worksheet (InFSpDiv), as there will be no data for these sieve fractions in worksheet InFProd (see Appendix 5, section 14.5).

5.1.2.5. *0.5mm sieve fraction*

Animals from the 0.5mm sieve fraction will only be used for the productivity calculations and thus animals are only identified to taxon group level. Only one replicate of the 0.5mm fraction need be processed per station, preferably the 0.5mm fraction of the first replicate. In the 0.5mm fraction there is a higher probability of single individuals representing taxonomic groups which may be lighter than 0.001g. This may cause weighing problems and, hence, animals should be grouped into phyla, rather than taxonomic groups in order to have more individuals in the group to be weighed. For each phyla, total number of individuals and total weight are recorded in the Infaunal production sheet (Sheet 7 and/or EXCEL worksheet InFProd, see Appendix 5, section 14.5). Again, total weight should be recorded as blotted wet weight. No further analysis of these fractions will be necessary at this time. However, the preserved 0.5mm fraction from each of the stations sampled should be retained. If required, this will allow for identification to a finer taxonomic resolution and calculation of individual sizes and weights. This may be necessary to explore the use of different methods for calculating productivity.

5.1.2.6. *Sub-sampling*

Sub-sampling of grab samples may be necessary in areas with coarse sediment where almost the entire sample is retained in the 0.5mm sieve. The 4, 2 & 1mm sieve fractions should all be possible to process and analyse entirely. However, in the case of the 0.5mm sieve fraction, sub-sampling may be required.

5.2. BOX-CORER SAMPLES

5.2.1. Equipment

Use a 0.25m^2 or a 0.1m^2 box corer (Figure 5.2.1.1) Actual dimensions may vary slightly so measure and record the individual box corer dimensions in Sheet 6 and/or InFHI (see Appendix 5, section 14.5). Penetration depth must be measured using a ruler in the centre of the box. This needs to be of sufficient length to be capable of measuring penetration depth when the box core has fully penetrated the sediment. The sampled material will be passed through a sieve stack consisting of sieves with mesh sizes of 4mm, and 1mm. Because of the quantity of material involve, particularly if a 0.25m^2 box core is used, this process is impractical without using a Gardline Autosiever (Figure 5.1.1.2). Material retained in each sieve will be stored in buffered 4% formaldehyde solution, so storage bottles/containers and waterproof labels for all sieve fractions will be required. All samples should be stored in containers labeled internally and externally. Finally a corer for collecting

sediment samples (25-mm diameter cores to 10cm depth) from the material in the box core will be required.

Figure 6.5.21.1. Box corer of FRS Marine Laboratory

5.2.2. Sampling procedure

Every time a Box Core is taken at a station, the 'Infaunal sampler information sheet' (Sheet 6 and/or EXCEL worksheet InFHI) must be filled in (one sheet per station includes records for both replicates). The sheets are applicable to each of the cores taken, but some of the fields will be constant throughout the survey (e.g. Gear, Year). Appendix 1 (section 14.1) lists the criteria required to fill in each field of the Sheet. Some further explanation of the sampling procedure is now given. At each station where the Box Core is deployed, two samples are taken. Penetration depth of the deepest point of the sediment within the sampler is recorded in the Infaunal sampler information sheet (Sheet 6 and/or EXCEL worksheet InFHI, see Appendix 5, section 14.5). Any meiofauna or sediment samples are taken from the undisturbed sediment surface, preserved, and stored in well-labeled containers.

5.2.2.1. *Sample processing at sea*

Samples are washed through a 4mm and 1mm sieve using the Gardline Autosiever. The sieved fractions are then preserved separately in buffered 4% formaldehyde solution and stored in well-labeled containers. Samples are returned to the laboratory for sorting, identification, enumeration and analysis.

5.2.2.2. *Sample processing in the laboratory*

The 4mm-sieve fraction will be used for comparison with the 4mm fraction of the Van Veen grabs and so should be processed in exactly the same way as that of a 4mm-sieve fraction taken with a grab. Again, either Procedure One or Two can be used as long as all of the data for species diversity and estimation of production is provided (see Section 6.5.1.2.4). 'Gear type' should be recorded as BCO for Box Core samples. The 1mm sieve fraction can be stored and processed later if time allows. This may be necessary when comparing results with the 1mm and above fractions of the Van Veen samples. Due to the difficulty of handling the box core, sub-sampling would only be possible from the sieved material. Sub-sampling sieved, unprocessed material is invalid because the sieving process may start sorting the animals or stratifies the material.

6. VOUCHER SPECIMEN COLLECTION

Each project participant should keep individual specimens of each identified species preserved in a voucher specimen collection. This allows comparisons of species between institutes and will help to solve potential identification problems. Additionally, individuals of species should be preserved for a collection of all species found during the project. It is suggested that this collection be established at the University of Wales Swansea, where the voucher specimen collection of previous North Sea benthos surveys is also kept. For the collection, 5-10 carefully preserved intact individuals with the location and date of sampling should be provided. Name of the captor, as well as information of water depth and substratum type at the location of capture would also be useful. Provision of photographs of the live specimens would also be helpful and allow for the species inclusion in the SID. It is thus important to have extra sample containers for the collection of voucher specimens from the 5mm-sieve beam trawl samples at sea.

7. RELAXING, FIXATION AND PRESERVATION

All infauna samples and parts of the epifauna samples will be preserved at sea for storage and later processing in the laboratory. Formaldehyde and alcohol will be the main preservatives used. Samples to be stored and processed after collection will always be fixed and preserved, but in some cases it may also be advisable to relax specimens first. Relaxation helps to maintain the features important for its subsequent identification. It is however unlikely that partners will have enough time to apply this to every potential specimen, but where possible relaxation of difficult groups such as Actinians is encouraged. It may also be possible to minimise numbers by selecting voucher specimens for specific species. A list of possible substances to be used for the relaxation, fixation and preservation of specimens is given in Appendix 2 (section 14.2).

8. MEIOFAUNA

Meiofauna samples have to be taken from Box Core samples. The meiofauna samples are taken with a 25 mm diameter corer from the intact sediment surface of the Box Corer to about 10-20 cm depth. The depth of the meiofauna samples should be recorded. Meiofauna samples cannot be

taken from Van Veen Grab samples, because grabs do not close entirely allowing interstitial water to escape and thereby washing out a considerable fraction of the meiofauna. Samples should be preserved immediately in 4% formaldehyde-seawater solution or neutralised 4% formaldehyde-water solution. Samples are then stored in well-labeled containers with the haul and grab number indicated, as well as date and country. The University of Ghent, Belgium may advise on sample processing.

9. GROUNDFISH SURVEYS (GOV OR 8M-BEAMTRAWL SAMPLE)

Groundfish surveys (GFS) of the countries involved in the MAFCONS project are either undertaken with a GOV otter trawl or an 8m beam trawl. Quantification of the numbers at length of each species of fish caught in each trawl sample is routinely undertaken. These data can be supplied by the Scientist in Charge of each of the Groundfish Surveys involved in the project, or later requested from ICES.

9.1. VALIDITY OF A GFS HAUL

Although the groundfish surveys are standardised in the framework of the IBTS, there are national differences in terms of sub-sampling. This has implications for the species richness and diversity estimates. At stations chosen for benthos sampling it is important to check whether the entire catch has been sorted for different species or whether sub-samples of the catch were taken prior to sorting ("Other remarks" section on the GOV/8m beam trawl information sheets (Sheets 10 & 11), see Appendix 5, section 14.5). If possible, at stations where the entire groundfish catch has not been checked for rare species, or there is no clear record of the sub-sampling method, benthic sampling should be avoided and the groundfish haul will be discounted as invalid for estimation of groundfish species richness and diversity (Sheets 10 & 11 – GOV/8m-beamtrawl information sheets, see Appendix 5, section 14.5).

9.2. SAMPLING PROCEDURE

Every time a groundfish trawl is taken at a station to be sampled for benthos, the GOV/8m-beamtrawl information sheets (Sheets 10 & 11 and/or EXCEL worksheets GOVHI & 8BTHI, see Appendix 5, section 14.5) must be filled in. These sheets are applicable to each of the groundfish samples taken at stations where the full complement of benthic samples will also be taken. Some of the fields will be constant throughout the survey (e.g. country, ship, warp diameter). Appendix 1, (section 14.1) lists the criteria required to be filled in each field of the sheets. Where possible, during the groundfish tow further information is entered into the GOV/8m beam trawl information sheet. This includes the towing direction, ground speed, depth and position of the gear. If it is possible these data should be recorded at 5-minute intervals throughout the tow and at the very least at the 'Start' and 'Stop' fishing times. This will allow for a more accurate calculation of the area covered by the gear. Access to these data will depend on the co-operation of the GFS Scientist in Charge.

9.2.1. Sample processing

Processing of the groundfish samples is unlikely to be undertaken by the benthic ecologists on board so the potential to influence how the original data is collected is limited. However, to meet the purposes of this project, it is important to ensure that the "standard data" recorded at each station for the IBTS include:

- GFS Haul summary (Sheet 12 and/or EXCEL worksheet GFSHS, see Appendix 5, section 14.5). For each species, total number of individuals and total weight are recorded in the GFS haul summary sheet.

- GFS Size-weight relationships (Sheet 13 and/or EXCEL worksheet GFSLW, see Appendix 5, section 14.5). For each species, individual size-weight data are entered into the GFS Size-weight relationships sheet. It is possible that only a number of species will be examined for this.

- GFS Size frequency data (Sheet 14 and/or EXCEL worksheet GFSLFD, see Appendix 5, section 14.5). For each species, the number of fish per size category is recorded in the GFS Size Frequency sheet. It is important that raising factors are recorded where sub-samples are taken.

Sheets 12 and 13/14 (where available, see Appendix 5, section 14.5) should be completed for each valid haul taken with the GOV or 8m beam trawl. If additional data, such as size-at-age are recorded, these can also be collected separately (there are no provided data collection sheets for these however).

10. ABIOTIC PARAMETERS

In order to explain spatial and temporal diversity patterns and changes in community structure, as many abiotic parameters as possible should be measured. Both surface and bottom temperature and salinity will be measured during the GFS and are entered at each station on the Environmental sheet (Sheet 1 and/or EXCEL worksheet ENV, see Appendix 5, section 14.5). Depth is recorded separately for each sampling type (e.g. groundfish, epifauna and infauna) on the relevant sampler information sheets. Depth should be recorded as actual depth rather than depth below keel (DBK). Settings on the ship's sounder should therefore be checked to verify whether DBK is the default. Depth of the keel can then be added as a correction factor.

Many other abiotic factors influence changes in benthic community structure and so, where possible, additional data should be supplied for the relevant areas sampled. This may, for example, include winter bottom temperature, or the difference between winter and summer bottom temperatures. Data on sediment composition can be partly extracted from literature and maps of the BGS, but also from sediment sampling undertaken at each station (see below). Remote bottom sensing data (e.g. RoxAnn, QT.), may also be accessed if collected.

10.1. SEDIMENT

Sediment samples are taken from intact Van Veen grab samples. They are taken with a 25mm diameter corer, one from each of the five grabs, to a depth of 10cm, or to the deepest penetration depth if <10cm. All samples are labeled with the station, haul and grab number, and date and country, and immediately frozen or fixed in ethanol. In the laboratory all samples should preferentially be gently dried in the air or in an oven (60°C or less), or freeze-dried in order not to cake the sediment.

In terms of sediment analyses the grain size distribution will be determined. The remains of the sediment samples after grain-size analyses will be stored in order to potentially carry out other analyses, e.g. organic matter or carbon content.

11. DATA EXCHANGE

The project coordinator will provide the original data collection sheets (Appendix 5, section 14.5) and data entry EXCEL files to all project participants before they go to sea. The data collection sheets (see Sheets 1-14 in Appendix 5, section 6.14.5) do not have to be used if it is easier to just update systems currently used by each institute. However, the data must be supplied to the project coordinator in the EXCEL data entry files, and therefore project participants are responsible for ensuring the data required by the EXCEL worksheets are recorded at each station. It will be possible to enter some of the data into the data worksheets at sea (e.g. Environmental information for each station), but some of the data will not be entered until after the samples have been processed in the laboratory. Once the individual EXCEL databases have been completed, copies are sent to the project coordinator who will then enter them into the master Microsoft ACCESS databases (backed up in standard ASCII format). Backed up versions of individual EXCEL survey data worksheets should also be maintained by each participating institute throughout the project.

11.1. DATA COLLECTION SHEETS

The individual data collection sheets (Sheets 1-14) are collated in Appendix 5 (section 14.5). As explained above, these do not have to be used, but they show all the data that is required to be collected for the diversity and productivity analyses. Appendix 1 (section 14.1) lists the criteria for completing each of the boxes (fields) on each sheet.

11.2. DATA ENTRY SPREADSHEETS

Electronic data entry worksheets can also provided by FRS to any participating institute. This allows for straightforward entry of data from data collection sheets (or alternative data collection methods) into an EXCEL database format. Table 11.2.1 lists each data collection sheet and corresponding data entry worksheet. For each of the worksheets, databases are only provided initially with room for 33 records. This was to minimise the size of the file for exchange. When partners receive the workbook they should then follow the instruction given on each worksheet to extend the number of available records where necessary. Please ensure that all instructions provided on each Excel worksheet are adhered to during data entry.

Data collection Sheet (Appendix 5)	Data entry worksheet (EXCEL file)	Summary
Environmental sheet	1. ENV	Abiotic, hydrographic and station-specific info. for each valid MAFCONS station.
2M Beamtrawl haul information	2. 2BTHI	All info. Specific to the sampling procedure. Completed for each haul.
2M Beamtrawl haul summary	3. 2BTHS	Catch composition data for each sample taken, with total numbers and weights for each species caught.
2M Beamtrawl size-weight relationships	4. 2BTLW	Individual size-weight measurements for each species.
2M Beamtrawl size-frequency data	5. 2BTLFD	Size frequency data for abundant species. Recorded for each species on data collection sheet 5. Individual species-specific data, by size class, then entered into a size frequency data worksheet (2BTLFD) for all species of a haul.
Infaunal sampler haul information	6. InFHI	All info. specific to the sampling procedure. Completed for each sample.
Infaunal production data	7. InFProd	Total numbers and total weight per taxon group.
Infaunal species diversity data	8. InFSpDiv	Total numbers and total weight per species.

10. GOV haul information	10. GOVHI	All info. specific to the sampling procedure. Completed for each sample.
11. 8M Beamtrawl haul information	11. 8BTHI	All info. specific to the sampling procedure. Completed for each sample.
12. GFS haul summary	12. GFSHS	Catch composition data for each groundfish trawl, with total numbers and weights for each species caught.
13. GFS size-weight relationships	13. GFSLW	Individual size-weight measurements for each species recorded.
14. GFS size frequency data	14. GFSLFD	Size frequency data for each species by size category.

Table 11.2.1: Corresponding data collection (Appendix 5) and data entry (EXCEL workbook) sheets, with a summary of their content.

12. MAFCONS SURVEY DATABASE

12.1. INTRODUCTION

The master databases provides the raw data for any diversity and productivity analyses of the fish and benthic invertebrate survey data collected as part of the SEERAD MF0753 and EC MAFCONS projects. It contains all checked raw data provided by the individual institutes involved in the project as supplied on the original data entry forms (see section 11) and subsequently modified to remove inconsistencies and errors. The databases are available on the MAFCONS website as individual tables in comma delimited ASCI text files. Access to these databases is currently password protected for use by MAFCONS project partners only. Once all primary papers have been published the data will be made more freely available for use by other scientists. The entire data set is also stored on FRS MLA ROAME MF0753 shared drive for use by MLA scientists.

12.2. GENERAL RULES OF USE

1. All files will be protected as read-only files so no alterations can be made to them.

2. Any tables required for analyses must be exported to a new database or analysis program.

3. The associated meta-data files must be read and followed when attempting to undertake analyses with any of the tables.

4. The MAFCONS project scientific co-ordinator, Dr Simon Greenstreet, should be contacted in relation to any queries regarding database use (greenstreet@marlab.ac.uk).

12.3. TABLES HELD IN THE DATABASE

The following is a list of the tables held in the MAFCONS database.

ENVIRONMENT TABLE (ENV)
INFAUNA HAUL INFORMATION (InFHI)
INFAUNA PRODUCTION DATA (InFProd)
INFAUNA SPECIES HAUL SUMMARY DATA (InFSpDIV)
INFAUNA SPECIES LIST (InFSpLt)
2BT EPIFAUNA HAUL INFORMATION (2BTHI)

2BT EPIFAUNA HAUL SUMMARY (2BTHS)
2BT EPIFAUNA SPECIES LIST (2BTSpLt)
2BT EPIFAUNA SPECIES L/W DATA (2BTLW)
2BT EPIFAUNA LENGTH FREQUENCY TABLE (2BTLFD)
SEDIMENT DATA (SED)

Each table has an associated Meta Data table (e.g. ENV_MetaData) with gives a description for each field. The Meta Data table must be consulted before using the data tables.

13. REFERENCES

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14. APPENDICES

14.1. APPENDIX 1. CRITERIA FOR COMPLETING FIELDS IN DATA COLLECTION SHEETS (SHEETS 1-13).

Table 14.1.1. lists the criteria for completing each field in the data collection sheets. Numbers refer to the field numbers found in each box of each sheet.

1	COUNTRY	ICES alpha code for countries (GFR, ENG, SCO, NOR) and new one added for Netherlands & Belgium (NAB).
2	SHIP	Walter Herwig (WAH, Walter Herwig III (WAH3), Tridens old (TRI), Tridens new (TRI2), Michael Sars (SAR), ?(HMOS), Endevour (END), Scotia old (SCO), Scotia new (SCO2)
3	GEAR	GOV (Grand Ouverture Verticale), HOB (High Opening Bottom Trawl), 2m Beam Trawl (2BT), 8m Beam trawl (8BT), Van Veen Grab (VVG), Box Core (BCO)
4	GROUND GEAR	Type of ground gear on the GOV (A-D)
5	KITE	Is a kite used on the GOV? Y = Yes, N = No
6	WARP DIAMETER	Diameter of trawl warps (mm)
7	DEPLOYMENT NUMBER (DepNo)	Van Veen or Box Core deployment (replicate) number. This may be the same as Haul number for some partners.
8	STATION NUMBER	The station number identifies the geographic locations at which all sampling is done. The station number should be the same as the haul number of the GOV or 8BT
9	HAUL NUMBER	The Haul Number identifies the particular samples at each station
10	YEAR	2003, 2004
11	MONTH	1 – 12
12	DAY	1 – 28/29/30/31
14	TIME START FISHING	The time when the gear is on the bottom and has started fishing; 0000 – 2400 (GMT).
15	TIME STOP FISHING	The time when the gear has lifted off the bottom; 0000 – 2400 (GMT). For the 2m Beamtrawl, simply add recorded Haul Duration (16) to Time Start Fishing (14) (in Hours, minutes and seconds). For GOV/8m Beamtrawl record time hauled (Hour & minutes).
16	HAUL DURATION	Duration of time that the gear was on the bottom and fishing. Time should be recorded in minutes and seconds for the 2m Beamtrawl, and minutes only for the GOV/8m Beamtrawl.
22	E/W	East (E) or West (W)
29	ICES RECTANGLE	ICES statistical rectangle code
30	HAUL VALIDITY	Is the particular haul (GOV, 8BT, 2BT, VVG, BCO) valid? V = Valid, I = Invalid
31	WARP LENGTH	Length of warp out (m)
32	SCANMAR USED	Has a Scanmar unit been used on the gear; Y = Yes, N = No
33	PAY OUT SPEED	Speed at which the warp was deployed (metres per minute)
34	TOWING DIRECTION	1-360 (north), (ships heading)
35	GROUND SPEED	Average speed in knots (2 decimal places where available)
36	SPEED THROUGH WATER	Boat speed through the water in knots
39	SEDIMENT SAMPLE	Was a sediment sample taken from the grab? Y = Yes, N = No. If Y, enter depth of sediment core taken (e.g. 10cm) instead of Y.
40	MEIOFAUNA SAMPLE	Was a meiofaunal sample taken from the grab? Y = Yes, N = No. If Y, enter depth of meiofaunal core taken instead of Y.
41	DEPTH	Actual depth in meters, rather than depth below the keel (m)
42	SURFACE CURRENT DIRECTION	1 – 360 (north) 0 = slack water
43	SURFACE CURRENT SPEED	Meters per second
44	BOTTOM CURRENT DIRECTION	1 – 360 (north) 0 = slack water
45	WIND DIRECTION	0 – 360
46	WIND SPEED	Meters per second
47	SWELL DIRECTION	0 – 360
48	SWELL HEIGHT	Swell height in meters
49	SURFACE TEMPERATURE (°C)	Surface water temperature (°C) from CTD measurements. NB. This data may not be available at sea.

50	BOTTOM TEMPERATURE (°C)	Bottom water temperature (°C) from CTD measurements. NB. This data may not be available at sea.
51	SURFACE SALINITY	Surface salinity from CTD measurements. NB. This data may not be available at sea.
52	BOTTOM SALINITY	Bottom salinity from CTD measurements. NB. This data may not be available at sea.
53	MARKS ON SHOES	Was spray paint used to mark the Beam Trawl shoes to check the Beam trawl had been fishing on the bottom? Y = if spray paint rubbed off, N = if spray paint was not rubbed of and N/A if spray paint was not used.
54	OTHER REMARKS	Any other remarks about the station or sample
55	RECORD TYPE	Fixed values. ST = station data, 2BTHS = 2m Beam Trawl Haul Summary etc.
56	TIME	Times during the haul when information needs to be recorded.
57	LAT (DEG)	Haul position. Degrees latitude
58	LAT (MIN)	Haul position. Minutes latitude
59	LONG (DEG)	Haul position. Degrees longitude
60	LONG (MIN0	Haul position. Minutes longitude
61	SIEVE	Sieve size in mm.
62	SPECIES NAME	Scientific name with genus and species name or name of other taxonomic level. Scientific name with genus and species name for the 4, 2 and 1mm sieve, family or genus for the 0.5mm sieves for the infauna.
63	SPECIES CODE	Species code as in Howson and Picton. Where countries use their own laboratory codes, they must provide a translation Sheet when data are exchanged. In the case of groundfish the official NODC code should be used.
64	TOTAL NO COUNTED	Number of animals counted in the sample. In the case of the groundfish this will be the number of fish caught per 30 minutes.
65	TOTAL WEIGHT	Total weight (g) of all the animals of a particular species caught in a sample to one decimal place
69	PRECISION –L	5, 1, 0.1 indicates whether measurements were taken to the nearest 5, 1 or 0.1mm below. In the case of infauna this may go down to the nearest 0.01 or even 0.001.
70	LENGTH	Size of an animal in mm
71	WEIGHT	Weight of animal in g
72	WEIGHT ADDED TO BEAM TRAWL	How much extra weight has been added to the beam trawl in Kg. 0 if no weight has been added.
73	GPS DATUM	What geographic referencing system (eg WGS84) does the vessel use?
74	HEIGHT	Height of the trawl opening (m)
75	WING	Width of the trawl wings (m)
76	DOORS	Width of the trawl doors (m)
77	NO	Number of animals
78	SEDIMENT TYPE	Brief description of the sediment type in each of the grabs (e.g. mud, sand, gravel etc.)
79	CONTAINER (Con Type)	Indicate here whether there is a separate record of the containers used for that station. This is just to help with storage and identification of samples at the laboratory. R = recorded in separate inventory
80	HAUL VALID	Is the Box Core/Van Veen a valid sample? V = Valid, I = Invalid
81	PROP. CATCH SORT	Proportion of the catch that was sorted. If there is no record of this for the GFS data, the haul should be discounted as Invalid for MAFCONS. This will also indicate whether the total number counted and total weight for the GFS data are raised or 'real' totals.
82	LENGTH CAT	Size of animal (cm)
83	START	When the gear is on the bottom and has just started fishing
84	STOP	When the gear has just come off the bottom and stopped fishing
85	BEAM TRAWL ID	Beam trawl ID. If partners have multiple beam trawls they should all be given an individual ID number (e.g. SCOTIA-1, SCOTIA-2) and the heights and width for the individual beam trawls recorded.
86	BEAM HEIGHT	Height of the beam trawl opening (m)
87	BEAM WIDTH	Width of the beam trawl opening (m)

88	INFAUNAL SAMPLER ID	Infaunal sampler ID. If partners have multiple Van Veen's/Box Corers, they should all be given an individual ID number.
89	INFAUNAL SAMPLER AREA	Area sampled by the infaunal sampler, this can be calculated from the sampler dimensions (Different Van Veen's/Box core's may have slightly different dimensions)
90	PENETRATION DEPTH	The depth of the deepest sediment in the sampler (mm)
91	PRESERVEDED BEFORE SIEVING	Was the sample preserved before it was sieved? Y = Yes, N = No
92	STATION VALIDITY	Is the station valid for the MAFCONS project? To be a valid sample it must have fish, epifauna and infauna. V = Valid, I = Invalid
93	INFAUNAL SAMPLER VALIDITY	There must be 5 valid grabs to make the infaunal sampling valid. V = Valid, I = Invalid
94	LFDComp	Are all individuals of the species recorded in the Length-Weight Sheet? If they are not the species will also have a length frequency distribution sheet (Sheet 5). Complete = C, Incomplete =I
95	NO MES.	Total number of individuals measured in that size category.
96	R TOT	Raised total number of individuals in that size category for the whole sample of that species.
97	BOTTOM CURRENT SPEED	Meters per second
98	PRECISION–W	1, 0.1 & 0.01indicates whether weights were taken to the nearest 1, 0.1 or 0.01grams. At sea this will almost always be 0.1, but in the case of infauna this may go down to the nearest 0.01 or even 0.001.
99	TAXON GROUP	The taxonomic group that an animal is assigned to for estimation of production data (see list and details in Section 1.5.4)
100	PROD DATA EXTRA	This field identifies whether a break down of production data has been supplied with the species diversity data. InFProd worksheet supplied = Y, Only InFSpDiv supplied = N.
101	SKIPPER'S DISTANCE TRAWLED	This field is optional. It is to be used as a reference to check against the database-calculated distance trawled.

Table 14.1.1. Criteria for completing fields in data collection sheets.

14.2. APPENDIX 2. FIXATIVES, PRESERVATIVES AND RELAXANTS

These chemicals should be used if species need to be fixed and preserved, if species need special treatment before they can be identified and if specimens are kept for the voucher specimen collection.

14.2.1. Fixatives, narcotics and preservatives

14.2.1.1. *Formaldehyde (Fixative and preservative)*

Formaldehyde is the best fixative and preservative available. However, it is a toxin, a carcinogen and irritant and it therefore has to be handled with extreme caution. The concentration should be 4-5% in samples for effective fixation. Since formaldehyde tends to become acidic during storage, a buffering agent should be added as this will help to prevent the dissolution of any calcareous material. A commonly used buffer is Borax (Sodium tetraborate).

14.2.1.2. *Alcohol (Fixative and preservative)*

Alcohol (70% ethanol/ IMS) is often used for later preservation of samples. It may be an adequate fixative for small animals, but tends to become diluted by body fluids of larger animals. However, if long-term preservation of samples is anticipated, specimens can be transferred to alcohol after fixation with formaldehyde. Disadvantages associated with alcohol as a preservative are its tendency to evaporate from most sealed jars. It also dissolves colour pigments and dehydrates body tissue making it hard and inflexible. Furthermore it is flammable and expensive.

14.2.1.3. *Propylene phenoxetol (Narcotic and preservative)*

Propylene phenoxetol cannot be used as a fixative, but it is a good preservative at 1.5%. It can also be used as an anaesthetic/relaxant at 0.15%. It is difficult to dissolve and it is advised to make up a 1.5% stock solution, which will keep. It can be used directly as a preservative and can be diluted in 10 parts seawater as a narcotic. It is the best preservative for worker and specimen as it is unlikely to evaporate, has better colour retention and is less harmful to the operative.

14.2.1.4. *Magnesium Chloride, $MgCl_2$ (Narcotic only)*

For most marine groups animals can be immersed slowly into an 8% solution. Alternatively the seawater that the animal is in can slowly be replaced with an 8% solution. Relaxation can take from several minutes to several hours.

14.2.1.5. *Magnesium Sulphate, $MgSO_4$ (Narcotic only)*

This is used in the same way as Magnesium Chloride, but using a 15 to 30% solution in seawater. Additionally the tip of a muslin bag containing $MgSO_4$ crystals can be immersed into the water containing the animal.

14.2.1.6. *Carbon Dioxide as soda water (Narcotic only)*

The animal is allowed to relax in seawater, before adding soda water until it is at 30 to 50% by volume.

14.2.1.7. *Menthol crystals (Narcotic only)*

The animal is allowed to relax in seawater, before a few menthol crystals are scattered (number dependent on size of animal) onto the surface of the water containing the animal.

14.2.1.8. *Alternative narcotics*

A range of alternative narcotics can be used, which include:

- Chloral hydrate, 0.2% solution in seawater
- Chloretone, add a few crystals to water containing animal
- Clove oil, add a few drops to water containing animal
- Ethane disulphonate, 0.25% solution in seawater
- Ethanol, add drop by drop to water containing animal
- Ethyl Carbamate (urethane) as 10% solution in seawater
- Formaldehyde, add drop by drop to water containing animal
- Temperature change, either slow chilling or warming
- Tobacco smoke, bubbled through water containing animal

14.2.2. Relaxants

An 8% solution of Magnesium Chloride, a tub of Menthol Crystals and some bottles of soda water should cover most eventualities and avoid toxic or otherwise harmful chemicals. These are recommended for use as relaxants on the groundfish survey.

14.2.3. Recommended treatments for main marine groups:

Please note: it is important to relax specimens in the groups marked with * before fixation if the need to identified later.

14.2.3.1. *Sponges*

Fix and preserve in 5% formaldehyde. Calcareous sponges should be preserved in 75% ethanol as formaldehyde can decalcify the specimens.

14.2.3.2. *Hydroids*

Relax in 8% $MgCl_2$ (or 15% $MgSO_4$ or Menthol crystals). Fix in 5% formaldehyde for at least 24 hours; transfer to 75% ethanol for preservation.

14.2.3.3. *Actinians**

Allow to relax in seawater then narcotise by replacing slowly with either 8% MgCl2 or Soda water to 50% (or 10% MgSO4 plus 1 or 2 drops of formaldehyde every 15 minutes)

14.2.3.4. *Nemerteans*

Relax in 8% MgCl2 or add Menthol crystals to water

14.2.3.5. *Polychaetes**

Relax in 8% MgCl2 (or gradual addition of 70% ethanol, or 20% MgSO4, or 0.15% propylene phenoxetol to water). Fix in 5% formaldehyde for 24 hours then transfer to 1.5% propylene phenoxetol (this preserves colour, but if unavailable 75% ethanol will do). Ideally, don't fix in ethanol and don't leave in formaldehyde.

14.2.3.6. *Priapulids*, Sipunculans*, Echiurans**

Relax using menthol crystals with a few drops of alcohol added after an hour (or put straight into 8% MgCl2)

14.2.3.7. *Small Crustaceans*

Relax in soda water (or add a few drops of 70% ethanol to water or use 0.15% propylene phenoxetol).

14.2.3.8. *Opisthobranchs**

Relax in 8% MgCl2, fix and preserve in 5% formaldehyde or transfer to propylene phenoxetol after fixation.

14.2.3.9. *Bryozoans*

Calcified bryozoans fix and preserve in 75% ethanol, fleshy or membranous ctenostomes fix in 5% formaldehyde for 24 hours then transfer to propylene phenoxetol for preservation

14.2.3.10. *Echinoderms*

Fix in excess 75% alcohol, replace after a few days due to dilution from body fluids. Do not preserve long term in formaldehyde as the acid can dissolve the calcareous ossicles and plates, which are essential for identification, particularly of holothurians.

14.2.3.11. *Ascidians**

Relax using Menthol crystals (or immerse in 8% $MgCl_2$). Fix in 5% formaldehyde. They can be preserved in propylene phenoxetol, or left in formaldehyde.

14.3. APPENDIX 3. IDENTIFICATION LITERATURE

14.3.1. General

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14.4. APPENDIX 4. WEIGHING AND MEASURING TECHNIQUES FOR FREQUENTLY SAMPLED SPECIES

14.4.1. Sessile organisms

	counting	measuring	weighing
Porifera Porifera should be counted and the total weight taken. If counting is impossible presence must be recorded. Specimens should be water logged when weighed.			
Axinella dissimilis	Count	-	Total weight
Axinella infundibuliformis	Count	-	Total weight
Dysidea fragilis	present	-	Total weight
Halichondria bowerbanki	present	-	Total weight
Halichondria panicea	present	-	Total weight
Phakellia ventilabrum	Count	-	Total weight
Scypha ciliata	count	-	Total weight
Stelligera stuposa	Count	-	Total weight
Suberites ficus	Count	-	Total weight
Suberites pagurorum	Count	-	Individual weight
Tetilla cranium	count	-	Total weight
Cnidaria Branching hydroids should be recorded as present and total weight recorded; Encrusting hydrozoans should be recorded as present only.			
Abietinaria abietina	Present	-	Total weight
Abietinaria filicula	Present	-	Total weight
Actinauge richardi	Count	-	Total weight
Adamsia carciniopados	Count	-	Total weight (remove crab and shell)
Aglaophenia acacia	Present	-	Total weight
Alcyonium digitatum	Present	-	Total weight
Bolocera tuediae	Count	-	Total weight
Bougainvillia britannica	Present	-	Total weight
Bougainvillia ramosa	Present	-	Total weight
Calliactis parasitica	Count	-	Total weight
Campanularia volubilis	Present	-	Total weight
Caryophyllia smithii	Count	-	Total weight
Clytia hemisphaerica	Present	-	-
Cyanea capillata	Count	-	Total weight
Cyanea lamarckii	Count	-	Total weight
Dicoryne conferta	Present	-	-
Diphasia alata	Present	-	Total weight
Diphasia attenuata	Present	-	Total weight
Diphasia pinaster	Present	-	Total weight
Epizoanthus incrustatus (=E. papillosus)	Count	-	Total weight (take out Pagurus sp.)
Eudendrium rameum	Present	-	Total weight
Eudendrium ramosum	Present	-	Total weight
Filellum serpens	Present	-	-
Flabellum macandrewi	Present	-	-
Gonothyraea loveni	Present	-	Total weight
Grammaria abietina	Present	-	-
Halecium beanii	Present	-	Total weight

Halecium halecinum	Present	-	Total weight
Halecium muricatum	Present	-	Total weight
Halecium sessile	Present	-	Total weight
Halopteris catharina	Present	-	Total weight
Hormathia digitata	Count	-	Total weight (remove from substratum)
Hydractinia echinata	Present	-	-
Hydrallmania falcata	Present	-	Total weight
Lafoea dumosa	Present	-	Total weight
Lafoea fruticosa	Present	-	Total weight
Laomedea flexuosa	Present	-	Total weight
Lytocarpia myriophyllum	Present	-	Total weight
Metridium senile	Count	-	Total weight
Nemertesia antennina	Present	-	Total weight
Nemertesia ramosa	Present	-	Total weight
Obelia bidentata	Present	-	Total weight
Obelia dichotoma	Present	-	Total weight
Obelia geniculata	Present	-	Total weight
Obelia longissima	Present	-	Total weight
Pennatula phosphorea	Count	Length	Individual weight
Plumularia setacea	Present	-	Total weight
Polyplumaria frutescens	Present	-	Total weight
Rhizocaulus verticillatus	Present	-	Total weight
Sagartia elegans	Count	-	Total weight
Sagartia troglodytes	Count	-	Total weight
Selaginopsis fusca	Present	-	-
Sertularella gayi	Present	-	Total weight
Sertularella polyzonias	Present	-	Total weight
Sertularella rugosa	Present	-	Total weight
Sertularella tenella	Present	-	Total weight
Sertularia argentea	Present	-	Total weight
Sertularia cupressina	Present	-	Total weight
Stomphia coccinea	Count	-	Total weight
Tamarisca tamarisca	Present	-	Total weight
Thuiaria articulata	Present	-	Total weight
Thuiaria thuja	Count	-	Total weight
Tubularia indivisa	Present	-	Total weight
Urticina eques	Count	-	Total weight
Urticina felina	Count	-	Total weight
Ventromma halecioides	Present	-	Total weight
Virgularia mirabilis	Count	Length	Individual weight
Sipuncula & Echiura			
Echiurus echiurus	Count	-	Individual weight
Phascolion strombus	Count	-	-
Annelida Generally they should be counted, the thorax width should be measured to the 0.1mm below and animals weighed individually. Tubeworms should be left in the tube if the tube was produced by themselves, but removed if other material such as sand was used.			
Ampharete grubei	Count	Thorax width	Individual weight
Amphictene auricoma	Count	Thorax width	Individual weight - in tube
Ditrupa arietina	Count	Tube length	Individual weight with tube

Filograna implexa	Present	-	-
Hydroides norvegica	Present	-	-
Lagis koreni	Count	Thorax width	Individual weight, take out of tube
Lanice conchilega	Count tube fringe	Thorax width	Individual weight
Lygdamis muratus	Count	Thorax width	Individual weight, take out of tube
Neoamphitrite figulus	Count	Thorax width	Individual weight – in tube
Owenia fusiformis	Count	Thorax width	Individual weight – in tube
Polyphysia crassa	Count	-	Individual weight
Pomatoceros lamarcki	Present	-	-
Pomatoceros triqueter	Present	-	-
Sabellaria alveolata	present	-	-
Serpula vermicularis	Present	-	-
Terebellides stroemi	Count	Thorax width	Individual weight – in tube
Thelepus cincinnatus	Count	Thorax width	Individual weight
Crustacea			
Balanus balanus	Count	-	Remove some and take total weight
Balanus crenatus	Count	-	Remove some and take total weight
Scalpellum scalpellum	Count	Length of individual capitulum	Total weight
Verruca stroemia	Count	-	-
Mollusca			
Crepidula fornicata	Count	-	Total weight
Anomia ephippium	Count	-	-
Hiatella arctica	Count	Measure longest axis	Individual weight
Pododesmus patelliformis	Count	-	-
Brachiopoda			
Macandrevia cranium	Count	Longest axis	Individual weight
Bryozoa General rule: take total weight of branching bryozoans; record encrusting ones as present.			
Alcyonidium diaphanum	Present	-	Total weight
Alcyonidium gelatinosum	Present	-	-
Alcyonidium parasiticum	Present	-	-
Alderina imbellis	Present	-	-
Amphiblestrum auritum	Present	-	-
Amphiblestrum flemingii	Present	-	-
Aspidelectra melolontha	Present	-	-
Bicellariella ciliata	Present	-	-
Bicellarina alderi	Present	-	-
Bowerbankia gracilis	Present	-	Total weight
Bugula flabellata	Present	-	Total weight
Bugula plumosa	Present	-	Total weight
Buskea dichotoma	Present	-	-
Callopora craticula	Present	-	-
Callopora dumerilii	Present	-	-
Cellaria fistulosa	Present	-	-
Cellepora pumicosa	Present	-	-
Conopeum reticulum	Present	-	-
Crisia aculeata	Present	-	-

Crisia eburnea	Present	-	-
Dendrobeania fruticosa	Present	-	Total weight
Dendrobeania murrayana	Present	-	Total weight
Electra pilosa	Present	-	-
Escharella immersa	Present	-	Total weight
Escharoides coccinea	Present	-	-
Escharoides mamillata	Present	-	-
Eucratea loricata	Present	-	Total weight
Flustra foliacea	Present	-	Total weight
Hornera lichenoides	Present	-	-
Lichenoporidae	Present	-	-
Membranipora membranacea	Present	-	-
Omalosecosa ramulosa	Present	-	-
Palmiskenea skenei	Present	-	-
Parasmittina trispinosa	Present	-	-
Porella compressa	Present	-	-
Porella laevis	Present	-	-
Pyripora catenularia	Present	-	-
Reptadeonella violacea	Present	-	-
Reteporella beaniana	Present	-	-
Reteporella septentrionalis	Present	-	-
Schizomavella linearis	Present	-	-
Schizoporella patula	Present	-	-
Scrupocellaria reptans	Present	-	-
Scrupocellaria scrupea	Present	-	-
Scrupocellaria scruposa	Present	-	-
Securiflustra securifrons	Present	-	Total weight
Tegella unicornis	Present	-	-
Tricellaria peachii	Present	-	Total weight
Tricellaria ternata	Present	-	-
Triticella pedicellata	Present	-	-
Tubulipora liliacea	Present	-	Total weight
Tubulipora phalangea	Present	-	Total weight
Turbicellepora avicularis	Present	-	-
Turbicellepora boreale	Present	-	-
Vesicularia spinosa	Present	-	Total weight
Tunicata Solitary ascidians should be counted, measured along the longest axis and weighed individually. Make sure that they are water logged. Colonial ascidians should be recorded as present and the total weight taken, if possible.			
Aplidium pallidum	Present	-	Total weight
Ascidia conchilega	Count	Longest axis	Individual weight
Ascidia mentula	Count	Longest axis	Individual weight
Ascidia virginea	Count	Longest axis	Individual weight
Ascidiella aspersa	Count	Longest axis	Individual weight
Ascidiella scabra	Count	Longest axis	Individual weight
Botrylloides leachi	Present	-	-
Ciona intestinalis	Count	Longest axis	Individual weight
Corella parallelogramma	Count	Longest axis	Individual weight
Molgula citrina	Count	Longest axis	Individual weight
Molgula occulta	Count	Longest axis	Individual weight

Polycarpa pomaria	Count	Longest axis	Individual weight
Styela clava	Count	Longest axis	Individual weight

14.4.2. Motile organisms

	Counting	Measuring	Weighing
Nemertea	Present	-	-
Polychaeta			
Anaitides maculata	Count	Thorax width	Individual weight
Aphrodita aculeata	Count	Length to the closest 1mm below	Individual weight
Eumida bahusiensis	Count	Thorax width	Individual weight
Eunice harassii	Count	Thorax width	Individual weight
Eunice norvegica	Count	Thorax width	Individual weight
Eunoe nodosa	Count	Thorax width	Individual weight
Gattyana cirrosa	Count	Thorax width	Individual weight
Glycera alba	Count	Thorax width	Individual weight
Harmothoe extenuata	Count	Thorax width	Individual weight
Harmothoe glabra	Count	Thorax width	Individual weight
Harmothoe lunulata	Count	Thorax width	Individual weight
Hyalinoecia tubicola	Count	Thorax width ; if whole worm is available, measure length	Total weight in tube; individual weight without tube
Laetmonice filicornis	Count	Length to the closest 1mm below	Individual weight
Lepidonotus clava	Count	Thorax width	Individual weight
Lepidonotus squamatus	Count	Thorax width	Individual weight
Maldane	Count	Thorax width	Individual weight
Neanthes fucata	Count	Thorax width	Individual weight
Neanthes virens	Count	Thorax width	Individual weight
Nephtys	Count	Thorax width	Individual weight
Nephtys assimilis	Count	Thorax width	Individual weight
Nephtys caeca	Count	Thorax width	Individual weight
Nephtys cirrosa	Count	Thorax width	Individual weight
Nephtys hombergii	Count	Thorax width	Individual weight
Nephtys incisa	Count	Thorax width	Individual weight
Nephtys longosetosa	Count	Thorax width	Individual weight
Nereis pelagica	Count	Thorax width	Individual weight
Nereis zonata	Count	Thorax width	Individual weight
Nothria conchylega	Count	Thorax width	Individual weight
Ophelia limacina	Count	Thorax width	Individual weight
Ophelina	Count	Thorax width	Individual weight
Ophelina acuminata	Count	Thorax width	Individual weight
Ophelina norvegica	Count	Thorax width	Individual weight
Perinereis cultrifera	Count	Thorax width	Individual weight
Polynoidae	Count	Thorax width	Individual weight
Sigalionidae	Count	Thorax width	Individual weight
Pycnogonida			
Nymphon brevirostre	Count	Total length including proboscis	Individual weight

Nymphon gracile	Count	Total length including proboscis	Individual weight
Nymphon stroemi	Count	Total length including proboscis	Individual weight
Pycnogonum littorale	Count	Total length including proboscis	Individual weight
Crustacea If eggs are attached include them in weight measurement; carapace length should be measured down the centre line; if there are spines on the carapace, measure widest point from just anterior to spine for width measurements; eye measurements are from the posterior edge of eye socket.			
Ampelisca brevicornis	Count	Eye to tip of telson	Individual weight
Ampelisca macrocephala	Count	Eye to tip of telson	Individual weight
Anapagurus laevis	Count	Width of chela	Individual weight
Astacilla longicornis	Count	Eye to tip of telson	Individual weight
Atelecyclus rotundatus	Count	Width of carapace	Individual weight
Byblis gaimardii	Count	Eye to tip of telson	Individual weight
Calocaris macandreae	Count	Carapace length	Individual weight
Cancer bellianus	Count	Width of carapace	Individual weight
Cancer pagurus	Count	Width of carapace	Individual weight
Carcinus maenas	Count	Width of carapace	Individual weight
Caridion gordoni	Count	Eye to tip of telson	Individual weight
Cirolana borealis	Count	Eye to tip of telson	Individual weight
Cirolana cranchii	Count	Eye to tip of telson	Individual weight
Corystes cassivelaunus	Count	Width of carapace	Individual weight
Crangon allmanni	Count	Eye to tip of telson	Individual weight
Crangon crangon	Count	Eye to tip of telson	Individual weight
Diastylis rathkei	Count	Eye to tip of telson	Individual weight
Dichelopandalus bonnieri	Count	Eye to tip of telson	Individual weight
Dorhynchus thomsoni	Count	Width of carapace	Individual weight
Ebalia cranchii	Count	Width of carapace	Individual weight
Ebalia granulosa	Count	Width of carapace	Individual weight
Ebalia tuberosa	Count	Width of carapace	Individual weight
Ebalia tumefacta	Count	Width of carapace	Individual weight
Epimeria cornigera	Count	Eye to tip of telson	Individual weight
Eualus gaimardii	Count	Eye to tip of telson	Individual weight
Eurynome aspera	Count	Width of carapace	Individual weight
Eusirus longipes	Count	Eye to tip of telson	Individual weight
Galathea	Count	Carapace length to base of rostrum	Individual weight
Galathea dispersa	Count	Carapace length to base of rostrum	Individual weight
Galathea intermedia	Count	Carapace length to base of rostrum	Individual weight
Galathea nexa	Count	Carapace length to base of rostrum	Individual weight
Galathea squamifera	Count	Carapace length to base of rostrum	Individual weight
Galathea strigosa	Count	Carapace length to base of rostrum	Individual weight
Gammarus locusta	Count	Eye to tip of telson	Individual weight
Geryon trispinosus	Count	Width of carapace (in front of spines)	Individual weight
Goneplax rhomboides	Count	Width of carapace	Individual weight
Hippolyte varians	Count	Eye to tip of telson	Individual weight

Hippomedon denticulatus	Count	Eye to tip of telson	Individual weight
Hyas araneus	Count	Width of carapace	Individual weight
Hyas coarctatus	Count	Width of carapace	Individual weight
Hyperia galba	Count	Eye to tip of telson	Individual weight
Inachus dorsettensis	Count	Width of carapace	Individual weight
Inachus leptochirus	Count	Width of carapace	Individual weight
Inachus phalangium	Count	Width of carapace	Individual weight
Iphimedia obesa	Count	Eye to tip of telson	Individual weight
Iphinoe trispinosa	Count	Eye to tip of telson	Individual weight
Leucothoe spinicarpa	Count	Eye to tip of telson	Individual weight
Liocarcinus arcuatus	Count	Width of carapace	Individual weight
Liocarcinus depurator	Count	Width of carapace	Individual weight
Liocarcinus holsatus	Count	Width of carapace	Individual weight
Liocarcinus marmoreus	Count	Width of carapace	Individual weight
Liocarcinus pusillus	Count	Width of carapace	Individual weight
Lithodes maia	Count	Carapace width	Individual weight
Macropipus tuberculatus	Count	Width of carapace (in front of spines)	Individual weight
Macropodia deflexa	Count	Width of carapace	Individual weight
Macropodia rostrata	Count	Width of carapace	Individual weight
Macropodia tenuirostris	Count	Width of carapace	Individual weight
Maera loveni	Count	Eye to tip of telson	Individual weight
Munida rugosa	Count	Carapace length to base of rostrum	Individual weight
Munida sarsi	Count	Carapace length to base of rostrum	Individual weight
Mysidopsis angusta	Count	Eye to tip of telson	Individual weight
Necora puber	Count	Width of carapace	Individual weight
Nephrops norvegicus	Count	Carapace length	Individual weight
Pagurus alatus	Count	Width of chela	Individual weight
Pagurus bernhardus	Count	Width of chela	Individual weight
Pagurus cuanensis	Count	Width of chela	Individual weight
Pagurus prideaux	Count	Width of chela	Individual weight
Pagurus pubescens	Count	Width of chela	Individual weight
Palaemon elegans	Count	Eye to tip of telson	Individual weight
Pandalina brevirostris	Count	Eye to tip of telson	Individual weight
Pandalus borealis	Count	Eye to tip of telson	Individual weight
Pandalus montagui	Count	Eye to tip of telson	Individual weight
Philoceras echinulatus	Count	Eye to tip of telson	Individual weight
Philoceras trispinosus	Count	Eye to tip of telson	Individual weight
Pilumnus hirtellus	Count	Width of carapace	Individual weight
Pirimela denticulata	Count	Width of carapace	Individual weight
Pisa tetraodon	Count	Width of carapace	Individual weight
Pisidia longicornis	Count	Width of carapace	Individual weight
Pontophilus norvegicus	Count	Eye to tip of telson	Individual weight
Pontophilus spinosus	Count	Eye to tip of telson	Individual weight
Porcellanidae	Count	Width of carapace	Individual weight
Portumnus latipes	Count	Width of carapace	Individual weight
Processa canaliculata	Count	Eye to tip of telson	Individual weight
Processa edulis crassipes	Count	Eye to tip of telson	Individual weight
Processa nouveli	Count	Eye to tip of telson	Individual weight

Processa nouveli holthuisi	Count	Eye to tip of telson	Individual weight
Processa parva	Count	Eye to tip of telson	Individual weight
Sabinea sarsi	Count	Eye to tip of telson	Individual weight
Spirontocaris lilljeborgi	Count	Eye to tip of telson	Individual weight
Spirontocaris spinus	Count	Eye to tip of telson	Individual weight
Thia scutellata	Count	Width of carapace	Individual weight
Thoralus cranchii	Count	Eye to tip of telson	Individual weight
Tmetonyx cicada	Count	Eye to tip of telson	Individual weight
Xantho pilipes	Count	Width of carapace	Individual weight
Mollusca Gastropods: spire tip to bottom of whorl or siphon if present; bivalves: longest axis ignoring ears when present.			
Abra alba	Count	Longest axis	Individual weight
Abra nitida	Count	Longest axis	Individual weight
Abra prismatica	Count	Longest axis	Individual weight
Acanthocardia echinata	Count	Longest axis	Individual weight
Acanthodoris pilosa	Count	Total length	Individual weight
Acteon tornatilis	Count	Shell length	Individual weight
Adalaria proxima	Count	Total length	Individual weight
Aeolidia papillosa	Count	Total length	Individual weight
Aequipecten opercularis	Count	Longest axis	Individual weight
Akera bullata	Count	Total length	Individual weight
Alloteuthis subulata	Count	Mantle length	Individual weight
Antalis entalis	Count	Total length	Individual weight
Antalis vulgaris	Count	Total length	Individual weight
Aporrhais pespelecani	Count	Longest vertical axis	Individual weight
Aporrhais serresianus	Count	Longest vertical axis	Individual weight
Archidoris pseudoargus	Count	Total length, if possible	Individual weight
Arctica islandica	Count	Longest axis	Individual weight
Armina loveni	Count	Total length	Individual weight
Astarte sulcata	Count	Longest axis	Individual weight
Beringius turtoni	Count	Longest vertical axis	Individual weight
Buccinum humphreysianum	Count	Longest vertical axis	Individual weight
Buccinum undatum	Count	Longest vertical axis	Individual weight
Calliostoma formosum	Count	Longest vertical axis	Individual weight
Calliostoma zizyphinum	Count	Longest vertical axis	Individual weight
Capulus ungaricus	Count	Longest vertical axis	Individual weight
Chamelea gallina	Count	Longest axis	Individual weight
Chlamys distorta	Count	Longest axis	Individual weight
Clausinella fasciata	Count	Longest axis	Individual weight
Colus gracilis	Count	Longest vertical axis	Individual weight
Colus islandicus	Count	Longest vertical axis	Individual weight
Colus jeffreysianus	Count	Longest vertical axis	Individual weight
Corbula gibba	Count	Longest axis	Individual weight
Coryphella browni	Count	Total length	Individual weight
Cuspidaria cuspidata	Count	Longest axis	Individual weight
Cuspidaria rostrata	Count	Longest axis	Individual weight
Delectopecten	Count	Longest axis	Individual weight
Dendronotus frondosus	Count	Total length	Individual weight
Diplodonta rotundata	Count	Longest axis	Individual weight
Discodoris millegrana	Count	Total length	Individual weight

Donax variegatus	Count	Longest axis	Individual weight
Donax vittatus	Count	Longest axis	Individual weight
Eledone cirrhosa	Count	Mantle length	Individual weight
Ensis americanus	Count	Longest axis	Individual weight
Ensis arcuatus	Count	Longest axis	Individual weight
Ensis ensis	Count	Longest axis	Individual weight
Ensis siliqua	Count	Longest axis	Individual weight
Epitonium clathratulum	Count	Longest vertical axis	Individual weight
Epitonium clathrus	Count	Longest vertical axis	Individual weight
Euspira catena	Count	Longest vertical axis	Individual weight
Euspira pallida	Count	Longest vertical axis	Individual weight
Facelina bostoniensis	Count	Total length	Individual weight
Flabellina pellucida	Count	Total length	Individual weight
Gari fervensis	Count	Longest axis	Individual weight
Gibbula cineraria	Count	Longest vertical axis	Individual weight
Gibbula tumida	Count	Longest vertical axis	Individual weight
Jujubinus miliaris	Count	Longest vertical axis	Individual weight
Jupiteria minuta	Count	Longest axis	Individual weight
Lacuna crassior	Count	Longest vertical axis	Individual weight
Lepidochitona cinerea	Count	Length	Individual weight
Littorina saxatilis tenebrosa	Count	Longest vertical axis	Individual weight
Loligo forbesii	Count	Mantle length	Individual weight
Lucinoma borealis	Count	Longest axis	Individual weight
Lutraria lutraria	Count	Longest axis	Individual weight
Lyonsia norwegica	Count	Longest axis	Individual weight
Mactra stultorum	Count	Longest axis	Individual weight
Modiolarca tumida	Count	Longest axis	Individual weight
Modiolula phaseolina	Count	Longest axis	Individual weight
Modiolus barbatus	Count	Longest axis	Individual weight
Modiolus modiolus	Count	Longest axis	Individual weight
Musculus discors	Count	Longest axis	Individual weight
Mysia undata	Count	Longest axis	Individual weight
Mytilus galloprovincialis	Count	Longest axis	Individual weight
Neptunea antiqua	Count	Longest vertical axis	Individual weight
Nucula hanleyi	Count	Longest axis	Individual weight
Nucula nitidosa	Count	Longest axis	Individual weight
Nucula nucleus	Count	Longest axis	Individual weight
Okenia elegans	Count	Total length	Individual weight
Onchidoris muricata	Count	Total length	Individual weight
Palliolum tigerinum	Count	Longest axis	Individual weight
Parvicardium ovale	Count	Longest axis	Individual weight
Parvicardium scabrum	Count	Longest axis	Individual weight
Phaxas pellucidus	Count	Longest axis	Individual weight
Plagiocardium papillosum	Count	Longest axis	Individual weight
Polinices fuscus	Count	Longest vertical axis	Individual weight
Polinices montagui	Count	Longest vertical axis	Individual weight
Polinices pulchellus	Count	Longest vertical axis	Individual weight
Propilidium exiguum	Count	Longest vertical axis	Individual weight
Pseudamussium septemradiatum	Count	Longest axis	Individual weight

Puncturella noachina	Count	Length	Individual weight
Raphitoma echinata	Count	Longest vertical axis	Individual weight
Rossia macrosoma	Count	Mantle length	Individual weight
Scaphander lignarius	Count	Shell length	Individual weight
Sepiola atlantica	Count	Mantle length	Individual weight
Spisula elliptica	Count	Longest axis	Individual weight
Spisula solida	Count	Longest axis	Individual weight
Spisula subtruncata	Count	Longest axis	Individual weight
Tectura testudinalis	Count	Longest vertical axis	Individual weight
Tectura virginea	Count	Longest vertical axis	Individual weight
Tellimya ferruginosa	Count	Longest axis	Individual weight
Tergipedidae	Count	Total length	Individual weight
Timoclea ovata	Count	Longest axis	Individual weight
Tridonta elliptica	Count	Longest axis	Individual weight
Tridonta montagui	Count	Longest axis	Individual weight
Tritonia hombergii	Count	Total length	Individual weight
Trivia arctica	Count	Longest vertical axis	Individual weight
Trophon muricatus	Count	Longest vertical axis	Individual weight
Trophon truncatus	Count	Longest vertical axis	Individual weight
Turritella communis	Count	Longest vertical axis	Individual weight
Typhlomangelia nivalis	Count	Longest vertical axis	Individual weight
Velutina velutina	Count	Longest vertical axis	Individual weight
Volutopsius norwegicus	Count	Longest vertical axis	Individual weight
Echinodermata			
Amphiura brachiata	Count	Width of disc	Individual weight
Amphiura chiajei	Count	Width of disc	Individual weight
Amphiura filiformis	Count	Width of disc	Individual weight
Anseropoda placenta	Count	Longest arm to opposite edge of disc	Individual weight
Asterias rubens	Count	Longest arm to opposite edge of disc	Individual weight
Asterina gibbosa	Count	Longest arm to opposite edge of disc	Individual weight
Astropecten irregularis	Count	Longest arm to opposite edge of disc	Individual weight
Brissopsis lyrifera	Count	Longest axis	Individual weight
Cidaris cidaris	Count	Diameter of disc	Individual weight
Crossaster papposus	Count	Longest arm to opposite edge of disc	Individual weight
Cucumaria frondosa	Count	Longest axis	Individual weight
Echinocardium cordatum	Count	Longest axis	Individual weight
Echinocardium flavescens	Count	Longest axis	Individual weight
Echinocyamus pusillus	Count	Longest axis	Individual weight
Echinus	Count	Longest axis	Individual weight
Echinus esculentus	Count	Longest axis	Individual weight
Henricia oculata	Count	Longest arm to opposite edge of disc	Individual weight
Henricia sanguinolenta	Count	Longest arm to opposite edge of disc	Individual weight
Hippasteria phrygiana	Count	Longest arm to opposite edge of disc	Individual weight
Leptasterias muelleri	Count	Longest arm to opposite edge of disc	Individual weight

Leptopentacta elongata	Count	Longest axis	Individual weight
Leptosynapta inhaerens	Count	Longest axis	Individual weight
Luidia ciliaris	Count	Diameter of disc	Individual weight
Luidia sarsi	Count	Diameter of disc	Individual weight
Ocnus lacteus	Count	Longest axis	Individual weight
Ophiomyxa pentagona	Count	Longest arm to opposite edge of disc	Individual weight
Ophiopholis aculeata	Count	Diameter of disc	Individual weight
Ophiothrix fragilis	Count	Diameter of disc	Individual weight
Ophiura affinis	Count	Diameter of disc	Individual weight
Ophiura albida	Count	Diameter of disc	Individual weight
Ophiura ophiura	Count	Diameter of disc	Individual weight
Ophiura sarsi	Count	Diameter of disc	Individual weight
Parastichopus tremulus	Count	Longest axis (weigh immediately!)	Individual weight
Plutonaster bifrons	Count	Longest arm to opposite edge of disc	Individual weight
Pontaster tenuispinus	Count	Longest arm to opposite edge of disc	Individual weight
Porania pulvillus	Count	Longest arm to opposite edge of disc	Individual weight
Poraniomorpha hispida	Count	Longest arm to opposite edge of disc	Individual weight
Psammechinus miliaris	Count	Longest axis	Individual weight
Pseudarchaster parelii	Count	Longest arm to opposite edge of disc	Individual weight
Pseudothyone raphanus	Count	Longest axis	Individual weight
Psolus phantapus	Count	Longest axis	Individual weight
Psolus squamatus	Count	Longest axis	Individual weight
Pteraster militaris	Count	Longest arm to opposite edge of disc	Individual weight
Spatangus purpureus	Count	Longest axis	Individual weight
Stichastrella rosea	Count	Longest arm to opposite edge of disc	Individual weight
Strongylocentrotus droebachiensis	Count	Longest axis	Individual weight
Thyone roscovita	Count	Longest axis	Individual weight

14.4.3. Fish

Fish should be counted, measured head to tail to the nearest 0.5cm below and weighed individually to the nearest gram.

14.5. APPENDIX 5. DATA COLLECTION SHEETS

Thirteen individual data collection sheets were designed to cover all major data gathering activities associated with MAFCONS work being carried out on the groundfish surveys. These are listed below, and copies of each sheet are provided in subsequent pages.

Sheet 1	Environmental data
Sheet 2	2m Beamtrawl haul information
Sheet 3	2m Beamtrawl haul summary
Sheet 4	2m Beamtrawl size-weight relationships
Sheet 5	2m Beamtrawl size frequency data
Sheet 6	Infaunal sampler information
Sheet 7	Infaunal production data
Sheet 8	Infaunal species diversity data
Sheet 10	GOV haul information
Sheet 11	8m Beamtrawl haul information
Sheet 12	GFS haul summary
Sheet 13	GFS size-weight relationships
Sheet 14	GFS size frequency data

1. ENVIRONMENTAL SHEET (ENV)

STATION VALIDITY (92)	COUNTRY (1)			STATION NUMBER (8)
RECORD TYPE (55) **ST**	SHIP (2)			ICES RECTANGLE (29)
	DAY (12)	MONTH (11)	YEAR (10)	GPS DATUM (73)
SURFACE CURRENT DIRECTION (42)	SURFACE TEMPERATURE (°C) (49)			WIND DIRECTION (45)
SURFACE CURRENT SPEED (43)	BOTTOM TEMPERATURE (°C) (50)			WIND SPEED (46)
BOTTOM CURRENT DIRECTION (44)	SURFACE SALINITY (51)			SWELL DIRECTION (47)
BOTTOM CURRENT SPEED (97)	BOTTOM SALINITY (52)			SWELL HEIGHT (48)
OTHER REMARKS (54)				

2. 2M BEAM TRAWL HAUL INFORMATION (2BTHI)

GEAR [3]	WARP PAY OUT SPEED [33]	TIME START FISHING [14]	SHIP [2]			HAUL VALIDITY [30]
2BT						
WARP DIAMETER [6]	WEIGHT ADDED TO BEAM TRAWL [72]	TIME STOP FISHING [15]	COUNTRY [1]			STATION NUMBER [8]
WARP LENGTH [31]	MARKS ON SHOES [53]	HAUL DURATION [16]	DAY [12]	MONTH [11]	YEAR [10]	HAUL NUMBER [9]
POSITION at each time interval		SCANMAR USED [32]	BEAM TRAWL ID [85]	BEAM HEIGHT [86]		BEAM WIDTH [87]

TIME [56]	LATITUDE (DEG) [57]	LATITUDE (MIN) [58]	LONGITUDE (DEG) [59]	LONGITUDE (MIN) [60]	E/W [22]	DEPTH [41]	TOW DIR [34]	GROUND SPEED [35]
START [83]								
1								
2								
3								
4								
5								
STOP [84]								

OTHER REMARKS [54]	SKIPPER'S DISTANCE TRAWLED [101]

3. 2M BEAM TRAWL HAUL SUMMARY (2BTHS)

RECORD TYPE (55)	COUNTRY (1)	STATION (8)	HAUL (9)	SIEVE (61)	SPECIES NAME (62)	SPECIES CODE (63)	TOTAL NO COUNTED (64)	TOTAL WEIGHT (65)
2BTHS								
2BTHS								
2BTHS								
2BTHS								
2BTHS								
2BTHS								
2BTHS								
2BTHS								
2BTHS								
2BTHS								
2BTHS								
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2BTHS								
2BTHS								
2BTHS								
2BTHS								
2BTHS								
2BTHS								

4. 2M BEAM TRAWL LENGTH/WEIGHT RELATIONSHIPS (2BTLW)

RECORD TYPE (55)	COUNTRY (1)	HAUL NO (9)	STATION NO (8)	SIEVE (61)	SPECIES NAME (62)	SPECIES CODE (63)	LFDComp (94)	PRECISION -L(69)	LENGTH (70)	PRECISION -W(98)	WEIGHT (71)
2BTLW											
2BTLW											
2BTLW											
2BTLW											
2BTLW											
2BTLW											
2BTLW											
2BTLW											
2BTLW											
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2BTLW											
2BTLW											
2BTLW											
2BTLW											
2BTLW											

5. 2M BEAM TRAWL LENGTH FREQUENCY - BY SPECIES (2BTLFD)

COUNTRY (1)	SHIP (2)	HAUL VALIDITY (30)	HAUL NUMBER (9)	STATION NUMBER (8)

GEAR (3)	DAY (12)	MONTH (11)	YEAR (10)	SPECIES NAME (62)	SPECIES CODE (63)

SIZE	LW					NO MES. (95)	R TOT (96)	SIZE	LW					NO MES. (95)	R TOT (96)
0								0							
1								1							
2								2							
3								3							
4								4							
5								5							
6								6							
7								7							
8								8							
9								9							
0								0							
1								1							
2								2							
3								3							
4								4							
5								5							
6								6							
7								7							
8								8							
9								9							
0								0							
1								1							
2								2							
3								3							
4								4							
5								5							
6								6							
7								7							
8								8							
9								9							
0								0							
1								1							
2								2							
3								3							
4								4							
5								5							
6								6							
7								7							
8								8							
9								9							
					TOTAL								TOTAL		

	1ST SAMPLE	2ND SAMPLE	3RD SAMPLE
COUNTED (NOT MEASURED)			
SIZE RANGE			
FRACTION SAMPLED			
RAISING FACTOR			

6. INFAUNAL SAMPLER INFORMATION (InFHI)

N.B. 1 page per station	GEAR (3)	SHIP (2)			INFAUNAL SAMPLING VALIDITY (93)
	INFAUNAL SAMPLER ID (88)	COUNTRY (1)			STATION NUMBER (8)
	INFAUNAL SAMPLER AREA (89)	DAY (12)	MONTH (11)	YEAR (10)	

RECORD OF GRABS AT EACH STATION

DEP NO (7)	HAUL NO (9)	LATDEG (57)	LATMIN (58)	LONGDEG (59)	LONGMIN (60)	E/W (22)	DEPTH (41)	HAUL VALID (80)	PEN DEP (90)	SED (39)	MEIO (40)	SED TYPE (78)	PRES (91)	CON TYPE (79)
1														
2														
3														
4														
5														
6														
7														
8														
9														
10														
11														
12														
13														
14														
15														
16														

7. INFAUNAL PRODUCTION DATA (InFProd)

RECORD TYPE (55)	COUNTRY (1)	STATION NO (8)	HAUL NO (9)	GEAR (3)	DEP NO (7)	SIEVE (61)	TAXON GROUP (99)	TOTAL NO COUNTED (64)	TOTAL WEIGHT (65)	PRECISION-W (98)
InFProd										
InFProd										
InFProd										
InFProd										
InFProd										
InFProd										
InFProd										
InFProd										
InFProd										
InFProd										
InFProd										
InFProd										
InFProd										
InFProd										
InFProd										
InFProd										
InFProd										
InFProd										
InFProd										
InFProd										
InFProd										
InFProd										
InFProd										
InFProd										
InFProd										
InFProd										
InFProd										
InFProd										

8. INFAUNAL SPECIES DIVERSITY DATA (InFSpDiv)

RECORD TYPE (55)	COUNTRY (1)	STATION NO(8)	HAUL NO(9)	GEAR (3)	DEP NO (7)	SIEVE (61)	TAXON GROUP (99)	SPECIES NAME (62)	SP CODE (63)	TOT NO(64)	TOTWGHT (65)	PRECISION-W (98)
InFSpDiv												
InFSpDiv												
InFSpDiv												
InFSpDiv												
InFSpDiv												
InFSpDiv												
InFSpDiv												
InFSpDiv												
InFSpDiv												
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InFSpDiv												
InFSpDiv												
InFSpDiv												

10. GOV TRAWL INFORMATION (GOVHI)

GEAR (3)	WARP DIAMETER (6)	TIME START FISHING (14)	SHIP (2)			HAUL VALIDITY (30)
GOV						
GROUNDGEAR (4)	WARP LENGTH (31)	TIME STOP FISHING (15)	COUNTRY (1)			STATION NUMBER (8)
KITE (5)	WARP PAY OUT SPEED (33)	HAUL DURATION (16)	DAY (12)	MONTH (11)	YEAR (10)	HAUL NUMBER (9)

POSITION AND NET GEOMETRY at each time interval										SCANMAR USED (32)	
TIME (56)	LATDEG (57)	LATMIN (58)	LONGDEG (59)	LONGMIN (60)	E/W (22)	DEPTH (41)	HEIGHT (74)	WING (75)	DOORS (76)	TOW DIR (34)	SPEED (35)
START (83)											
5											
10											
15											
20											
25											
STOP (84)											

OTHER REMARKS (54)

SKIPPER'S DISTANCE TRAWLED (101)

11. 8M BEAM TRAWL INFORMATION (8BTHI)

GEAR (3)	WARP PAY OUT SPEED (33)	TIME START FISHING (14)	SHIP (2)			HAUL VALIDITY (30)
8BT						
WARP DIAMETER (6)	WEIGHT ADDED TO BEAM TRAWL (72)	TIME STOP FISHING (15)	COUNTRY (1)			STATION NUMBER (8)
			NED			
WARP LENGTH (31)	MARKS ON SHOES (53)	HAUL DURATION (16)	DAY (12)	MONTH (11)	YEAR (10)	HAUL NUMBER (9)
POSITION at each time interval		SCANMAR USED (32)	BEAM HEIGHT (86)			BEAM WIDTH (87)

TIME (56)	LATITUDE (DEG) (57)	LATITUDE (MIN) (58)	LONGITUDE (DEG) (59)	LONGITUDE (MIN) (60)	E/W (22)	DEPTH (41)	TOW DIR (34)	GROUND SPEED (35)
START (83)								
5								
10								
15								
20								
25								
STOP (84)								

OTHER REMARKS (54)	SKIPPER'S DISTANCE TRAWLED (101)

12. GFS HAUL SUMMARY (GFSHS)

RECORD TYPE (55)	COUNTRY (1)	HAUL NO(9)	STATION NO(8)	GEAR (3)	SPECIES NAME (62)	SPECIES CODE (63)	TOT NO COUNTED (64)	TOTAL WEIGHT (65)	PROP. CATCH SORT (81)
GFSHS									
GFSHS									
GFSHS									
GFSHS									
GFSHS									
GFSHS									
GFSHS									
GFSHS									
GFSHS									
GFSHS									
GFSHS									
GFSHS									
GFSHS									
GFSHS									
GFSHS									
GFSHS									
GFSHS									
GFSHS									
GFSHS									
GFSHS									
GFSHS									
GFSHS									
GFSHS									
GFSHS									
GFSHS									
GFSHS									
GFSHS									
GFSHS									

13. GFS LENGTH/WEIGHT RELATIONSHIPS (GFSLW)

RECORD TYPE (55)	COUNTRY (1)	HAUL NO (9)	STATION NO (8)	SIEVE (61)	SPECIES NAME (62)	SPECIES CODE (63)	PRECISION (69)	LFDComp (94)	LENGTH (70)	WEIGHT (71)
GFSLW										
GFSLW										
GFSLW										
GFSLW										
GFSLW										
GFSLW										
GFSLW										
GFSLW										
GFSLW										
GFSLW										
GFSLW										
GFSLW										
GFSLW										
GFSLW										
GFSLW										
GFSLW										
GFSLW										
GFSLW										
GFSLW										
GFSLW										
GFSLW										
GFSLW										
GFSLW										
GFSLW										
GFSLW										
GFSLW										
GFSLW										
GFSLW										

14. GFS LENGTH FREQUENCY DATA (GFSLFD)

RECORD TYPE [55]	COUNTRY [1]	GEAR [3]	HAUL NO [9]	STATION NO[8]	SPECIES NAME [62]	SPECIES CODE [63]	LEN CAT [82]	NO FISH [64]	RF [66]	RT [67]
GFSLFD										
GFSLFD										
GFSLFD										
GFSLFD										
GFSLFD										
GFSLFD										
GFSLFD										
GFSLFD										
GFSLFD										
GFSLFD										
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GFSLFD										
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GFSLFD										
GFSLFD										

14.6. APPENDIX 6. 2M EPIBENTHIC BEAM TRAWL CATCH: WORKED EXAMPLE

Figure 14.6.1 shows schematically how each 2m epibenthic beam trawl catch could be worked up. The catch is initially washed through a sieve tower consisting of a 5mm sieve on top of a 2mm sieve. All the material retained in the 2mm sieve is immediately put into preservative for analysis in the laboratory. The material retained in the 5mm sieve is partially processed on board the vessel. Biological material is separated from the inorganic seabed debris and sorted into species. Organisms too small to weigh at sea (eg. <0.3g), or which cannot be adequately identified, are preserved for analysis on return to the laboratory. This leaves the material, grouped into species A to N in Figure 14.6.1, to be worked up on board the vessel.

For species of low abundance (A to G in Figure 14.6.1), all individuals will be both measured and weighed. A total count and total weight of each species is first obtained. These data are recorded on Form 3, the 2m Epibenthic Beam Trawl Haul Summary Form, and entered into Worksheet 3 of the same name (2BTHS). Each individual of each species is then measured and weighed and the data recorded on Form 4, the 2m Epibenthic Beam Trawl Size-Weight Relationships Form, and entered into Worksheet 4 of the same name (2BTLW). This is all that needs be done for these species. The database developed from worksheet 4 can be queried to determine the required size frequency distribution information at a later date, thus this table contains “complete” size frequency distribution information for these species in the sample. It is therefore not necessary to enter the data for these species in Form 5 or Worksheet 5. For this to be the case, however, it is critical that field “LFDComp” in Form/Worksheet 4 (2BTLW) is therefore filled correctly; C (for complete LFD information) for scarce species where all individuals have been measured and weighed, and I (for incomplete LFD information) for abundant species. For abundant species, this LFD information will be recorded on Form 5 and entered on Worksheet 5 (2BTLFD) (see below).

The more abundant species, H to N in Figure 16.6.1, will be too numerous to measure and weigh every individual in the catch. For species of intermediate abundance, H to L in Figure 16.6.1, weigh the entire catch of each species, record the values on Form 3 and enter the data into worksheet 3 (2BTHS). Start measuring individuals of each species and record the data on the Size Frequency form. The first five individuals of each size (preferably in reasonable condition) are recorded in the LW column and kept aside in their size-category groups for later weighing. Continue measuring until satisfied that the recorded size frequency distribution is representative of the sample (may require 200 or more individuals if 10 or more size categories are present). Figure 16.6.2 shows an example of the form at the point at which we decide that we have an adequate size frequency distribution. At this point a total of 107 individuals have been measured. We see that for size classes 7 to 14 we have the required 5 individuals kept aside for weighing, so we set this size range as our 2nd sample. Our 1st sample therefore comprises animals of less than 7mm, while our third sample consists of animals greater than 14mm. Of the 107 animals so far measured, 102 of these fall into our 2nd sample. This is therefore the number measured for the 2nd sample.

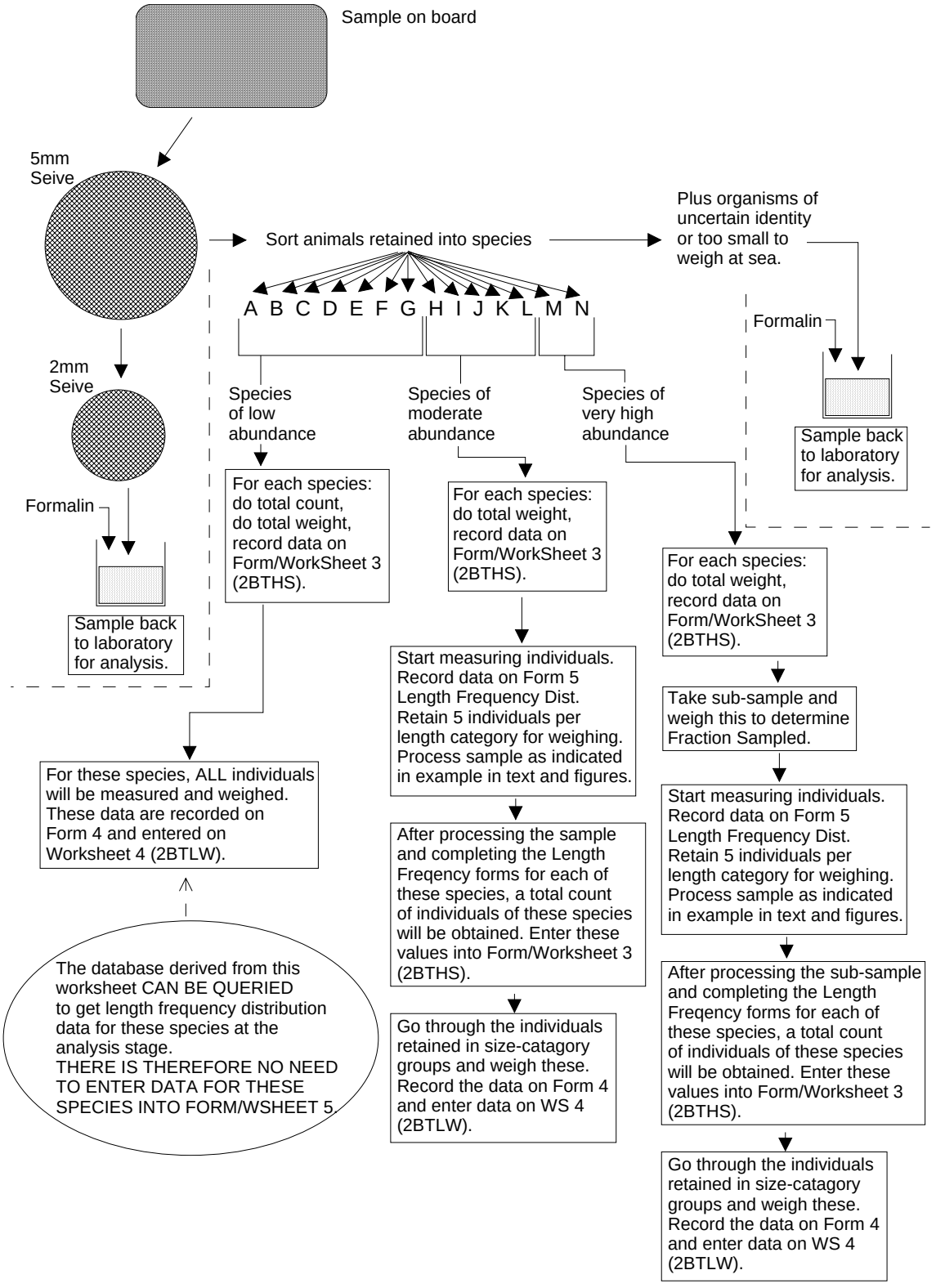

Figure 14.6.1: Schematic for processing 2m Epi-benthic beam trawl catches

5. 2M BEAM TRAWL LENGTH FREQUENCY – BY SPECIES (2BTLFD)

COUNTRY (1)	SHIP (2)	HAUL VALIDITY (30)	HAUL NUMBER (9)
SCO	**SCO2**	**V**	**S03/001**

GEAR (3)	DAY (12)	MONTH (11)	YEAR (10)	SPECIES NAME (62)
2BT	**1**	**1**	**2003**	*Echinus* **sp**

SIZE	LW					TOTAL	RT	SIZE	LW					TOTAL	RT
0								0							
1								1							
2								2							
3								3							
4								4							
5								5							
6	I			*1*				6							
7	IIIII	II			*7*			7							
8	IIIII	IIIII	II		*12*			8							
9	IIIII	IIIII	IIIII	I	*16*			9							
10	IIIII	IIIII	IIIII	IIIII	*20*			0							
1	IIIII	IIIII	IIIII	I	*16*			1							
2	IIIII	IIIII	IIII		*14*			2							
3	IIIII	IIIII	I		*11*			3							
4	IIIII	I			*6*			4							
5	II			*2*				5							
6	I			*1*				6							
7	I			*1*				7							
8								8							
9								9							
20								0							
1				*5*	*102*			1							
2								2							
3								3							
4								4							
5								5							
6								6							
7								7							
8								8							
9								9							
30								0							
1								1							
2								2							
3								3							
4								4							
5								5							
6								6							
7								7							
8								8							
9								9							
					TOTAL	0							TOTAL		

	1ST SAMPLE	2ND SAMPLE	3RD SAMPLE
COUNTED (NOT MEASURED)			
SIZE RANGE OF ANIMALS COUNTED			
FRACTION SAMPLED			
RAISING FACTOR			

Figure 14.6.2. Size frequency form at point where the size frequency distribution is deemed to be adequately established.

We then go through the remainder of the sample, counting all the animals belonging to the 2nd sample size range, and continuing to measure animals less than 7mm and greater than 14mm in size and recording these on the sheet. Having gone through the remainder of the catch (of eg species H), we have a count of 375 individuals belonging to the 2nd sample size range of 7 to 14mm. A further 4 individuals have turned up in the 1st sample size range of less than 7mm and these have been measured and recorded on the form (Figure 14.6.3). In this instance, all these animals have also been retained for weighing since we still have not exceeded the requirement of 5 individuals for any of these size categories. A further 20 animals have turned up in the 3rd sample size range of greater than 14mm. Again all these animals have been measured and recorded on the sheet (Figure 14.6.3), and where required, animals have been put aside in their size category groups, until 5 of each size category are available for weighing.

The Size Frequency form can now be completed. The number of each size category actually measured is tallied up in the "NoMeas" column. For our 1st and 3rd samples we can now fully establish their size ranges; 4 to 6mm for the 1st sample and 15 to 21mm for the 3rd sample. For these two samples we have no count – all the individuals in these size ranges were actually measured. The fraction sampled is "ALL" because we have gone through the entire catch, and the Raising Factor is 1, the number measured is what was present in the entire catch. For the 2nd sample 102 individuals were actually measured and a further 375 individuals of the same size range were counted. The Fraction sampled is again "ALL" because we went through the entire catch to get these values. The raising factor for the size categories in this size range is calculated by $\frac{NoMeas + NoCount}{NoMeas}$. In this example, $\frac{102 + 375}{102} = 4.67647$. This working is shown on the form for later data assurance checking purposes. The Raised Total column (RtotNo) is then completed by multiplying the number measured in each size category by the appropriate raising factor. The completed working for this example is shown in Figure 14.6.3. (although partners may wish to complete the raised totals on Sheet 5, this does not have to be done, as when the total number per size class and raising factors are supplied to 2BTLFD, the worksheet will automatically calculate raised totals.)

The final steps are then to weigh the (up to) five individuals of each size category, recording these data onto Form 4 and entering them into worksheet 4. The one difference here is that since Form 3 does not hold complete LFD information for these more abundant species, I (for incomplete LFD information) is entered into field "LFDComp". The total number of individual animals in the catch, 506 in this example, is then recorded in the Total Number field of Form 3, the 2m beam trawl haul summary form, and in the appropriate field in the corresponding worksheet 3 (2BTHS).

5. 2M BEAM TRAWL LENGTH FREQUENCY – BY SPECIES (2BTLFD)

COUNTRY (1)	SHIP (2)		HAUL VALIDITY (30)	HAUL NUMBER (9)
SCO	**SCO2**		**V**	**S03/001**
GEAR (3)	DAY (12)	MONTH (11)	YEAR (10)	SPECIES NAME (62)
2BT	**1**	**1**	**2003**	*Echinus* **sp**

SIZE	LW					TOTAL	RT	SIZE	LW					TOTAL	RT
0								0							
1								1							
2								2							
3								3							
4	I				*1*	1	1	4							
5	I				*1*	1	1	5							
6	III				*3*	3	3	6							
7	IIIII	II			*7*	7	33	7							
8	IIIII	IIIII	II		*12*	12	56	8							
9	IIIII	IIIII	IIIII	I	*16*	16	75	9							
10	IIIII	IIIII	IIIII	IIIII	*20*	20	94	0							
1	IIIII	IIIII	IIIII	I	*16*	16	75	1							
2	IIIII	IIIII	IIII		*14*	14	65	2							
3	IIIII	IIIII	I		*11*	11	51	3							
4	IIIII	I			*6*	6	28	4							
5	IIIII	IIIII			*10*	10	10	5							
6	IIIII	I			*6*	6	6	6							
7	III				*3*	3	3	7							
8	II				*2*	2	2	8							
9	I				*1*	1	1	9							
20	I				*1*	1	1	0							
1	I				*1*	1	1	1							
2								2							
3					*131*	131		3							
4								4							
5								5							
6								6							
7								7							
8								8							
9								9							
30								0							
1								1							
2								2							
3								3							
4								4							
5								5							
6								6							
7								7							
8								8							
9								9							
					TOTAL		506						TOTAL		

	1ST SAMPLE	2ND SAMPLE	3RD SAMPLE
COUNTED (NOT MEASURED)	0	375	0
SIZE RANGE OF ANIMALS COUNTED	4 TO 6	7 TO 14	15 TO 21
FRACTION SAMPLED	ALL	ALL	ALL
RAISING FACTOR	1	4.67647	1
		(102+375)/102	

Figure 14.6.3. Final size frequency form, completed after the whole sample has been processed.

Finally, for highly abundant species (eg M and N in Figure 14.6.1), where it is simply not practical to go through the entire catch in the way described above, a weighed sub-sample is taken and processed. First the entire catch is weighed and this data is recorded on form 3 and entered into Worksheet 3 (2BTHS). The sub-sample is then taken and this is also weighed. The Fraction Sampled is then simply calculated as $\frac{Weight\_of\_sub-sample}{Weight\_of\_entire\_catch}$. Thus if the entire catch weighs 25.3Kg and the sub sample weighs 3.5Kg, the fraction sampled is 3.5/25.3 (=0.13834). The sub-sample is then treated in exactly the same manner as if it was the entire catch of a moderately abundant species, with the size frequency data recorded onto Form 5, and the size-weight relationship data for the (up to) 5 individuals of each size category entered into form 4. The data on these forms then being entered into worksheets 5 (2BTLFD) and 4 (2BTLW) respectively. The only difference now is that the Fraction Sampled values differ at the bottom of the LFD form, affecting the calculations of the three raising factors. Figure 14.6.4 shows the same data as Figure 14.6.3, but now assumes that these data had been obtained by processing the sub-sample of 3.5Kg obtained from the total catch of 25.3Kg described above. When the sub sample is fully processed, and the Size Frequency Data form completed, the tally of all the raised numbers at size, 3657 in this example, is then entered into the Total Number fields of the haul summary form and worksheet (No 3, 2BTHS). The groups of 5 individuals at each size category are then weighed and the data recorded on the Size-Weight Relationship Form (No 4) and entered into the corresponding worksheet (2BTLW). Again this sheet does not contain full LFD information so “I” (for incomplete) is entered into the “LFDComp field.

5. 2M BEAM TRAWL LENGTH FREQUENCY – BY SPECIES (2BTLFD)

COUNTRY (1)	SHIP (2)		HAUL VALIDITY (30)	HAUL NUMBER (9)
SCO	**SCO2**		**V**	**S03/001**
GEAR (3)	DAY (12)	MONTH (11)	YEAR (10)	SPECIES NAME (62)
2BT	**1**	**1**	**2003**	*Echinus* **sp**

SIZE	LW				TOTAL	RT	SIZE	LW				TOTAL	RT
0							0						
1							1						
2							2						
3							3						
4	I				*1*	1	7	4					
5	I				*1*	1	7	5					
6	III				*3*	3	22	6					
7	IIIII	II			*7*	7	237	7					
8	IIIII	IIIII	II		*12*	12	406	8					
9	IIIII	IIIII	IIIII	I	*16*	16	541	9					
10	IIIII	IIIII	IIIII	IIIII	*20*	20	676	0					
1	IIIII	IIIII	IIIII	I	*16*	16	541	1					
2	IIIII	IIIII	IIII		*14*	14	473	2					
3	IIIII	IIIII	I		*11*	11	372	3					
4	IIIII	I			*6*	6	203	4					
5	IIIII	IIIII			*10*	10	72	5					
6	IIIII	I			*6*	6	43	6					
7	III				*3*	3	22	7					
8	II				*2*	2	14	8					
9	I				*1*	1	7	9					
20	I				*1*	1	7	0					
1	I				*1*	1	7	1					
2								2					
3					*131*	131		3					
4								4					
5								5					
6								6					
7								7					
8								8					
9								9					
30								0					
1								1					
2								2					
3								3					
4								4					
5								5					
6								6					
7								7					
8								8					
9								9					
					TOTAL		3657					TOTAL	

	1ST SAMPLE	2ND SAMPLE	3RD SAMPLE
COUNTED (NOT MEASURED)	0	375	0
SIZE RANGE OF ANIMALS COUNTED	4 TO 6	7 TO 14	15 TO 21
FRACTION SAMPLED	3.5/25.3	3.5/25.3	3.5/25.3
RAISING FACTOR	7.22857	33.80420	7.22857
	25.3/3.5	102+375 / 102 * 25.3 / 3.5	25.3/3.5

Figure 14.6.4. Final size frequency form, completed after the whole sub-sample taken from the catch of a highly abundant species has been processed, and taking account of the effect of such sub-sampling on the calculation of appropriate raising factors.