Technical Guideline No. 02– Collection of benthic grab samples

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To be used in conjunction with:

GUIDELINES FOR THE ENVIRONMENTAL MONITORING AND IMPACT ASSESSMENT ASSOCIATED WITH SUBSEA OIL RELEASES AND DISPERSANT USE IN UK WATERS

1 Purpose and Scope

Benthic grab samples can be collected for a number of reasons during an emergency. The most common use of sedimentary grab samples is to acquire a sediment sample for contaminant and particle size analysis and also the collection of an infaunal biological sample. In both of these situations, it is important that the grab used to collect the sedimentary sample is free of contamination prior to being deployed.

This document covers the choice of benthic grab, deployment and retrieval of the grab and removal of the sedimentary sample. It does not include survey design, or provide detail on preservation and storage of samples after collection. It also does not include analysis of samples.

This document supports and should be used in conjunction with environmental monitoring guidelines for subsea oil releases (Law et al., 2014)

2 Health and Safety considerations

While most of the equipment discussed in this document can be deployed via a winch, there is still an element of manual handling in collection of benthic grab samples. Care should be taken to avoid overstretching or awkward twisting. When deploying gear from the deck of a boat, appropriate PPE should be worn. This includes, but is not limited to, toe protected waterproof boots, lifejacket and hard hat. Before the survey starts, the Scientist In Charge (SIC) and ships safety officer should ensure that all scientists and crew have been adequately briefed in relation to the safe operating procedures relating to grab sampling and processing. Staff should be aware that a benthic grab can be extremely hazardous if swinging on the end of a winch wire. They should therefore avoid the immediate area around the operations if not directly involved in deployment and recovery.

3 Collection of benthic grab samples to 200 m depth

Samples of the subtidal seafloor sediments, traditionally acquired using a grab sampling device, are essential for acquiring sedimentary samples for the purpose of particle size, contaminant and infaunal analysis. A number of different types of grabs exist which allow effective acquisition of sediment samples (and associated infaunal communities) across the full range of substrata (i.e., mud, sand, coarse and mixed sediments). This document aims to highlight some key points which need to be considered when selecting which benthic grab to use. To demonstrate this three different grabs and one benthic corer are discussed.

Where samples of coarse or mixed sediments are required for sediment Particle Size Analysis (PSA) and infaunal analysis, a Hamon grab is typically the most effective gear type (Figure 1). Where little is known regarding the sediment types likely to be encountered, the use of a Hamon grab is recommended to reduce the likelihood of failed sampling across the entire range of sediments present within any given site.

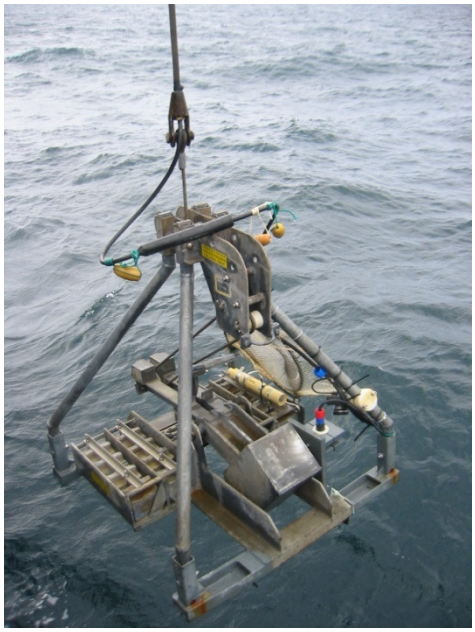


Figure 1. Hamon grab (fitted with video system), the combined gear being known as HamCam

Soft, homogenous sedimentary habitats (e.g., ranging from sands to muds) are most effectively (and typically) sampled using a Day grab (Figure 2). However, such grabs are less reliable when employed to sample coarse or mixed sediments due to the tendency of larger particles to prevent closure of the buckets, thus resulting in partial or total loss of the sample.

Figure 2. 0.1m^2 Day Grab

Whilst the selection of grabbing gear employed is largely driven by the nature of the targeted sediment type, there are a number of implications associated with the use of the different gear types. Firstly, due to the action of the Hamon grab, the whole sample is 'mixed' during the process of collection and retrieval, thereby precluding the examination or sub-sampling of an undisturbed sediment surface. Therefore, sub-samples of sediment obtained from a Hamon grab sample comprise an integrated sediment sample (approximately 0.5 l in volume) which is representative of

the sediments present throughout the entire depth of the sample. Another implication associated with the sub-sampling of Hamon grab samples for PSA is the likely under-representation of the sediment fractions comprising large grain sizes (e.g., due to the sub-samples typically being limited to 0.5 litres).

Conversely, the Day grab does allow access to the undisturbed sediment surface during sub-sampling. Therefore, sediment samples for PSA obtained from Day grab samples comprise a smaller volume of sediment (approximately 300 ml volume) obtained using a small core from the full depth of the grab sample. In this instance, the smaller sediment sub-sample, collected for subsequent PSA, is considered adequate given that this sampling devise should only be employed in areas of relatively uniform, homogenous sediments and, therefore, the potential to compromise the remaining sample (destined for infaunal analyses) is minimised.

If an undisturbed surface sediment layer is required for particle size and /or contaminants analysis (and not an infaunal biological sample) from coarse to mixed sediments then a Shipek grab (Figure 3) is traditionally used. The Shipek grab is very effective at sampling coarse sediments due to its spring loaded firing mechanism. This grab can also be used in combination with the Hamon grab when an infaunal biological sample is also required.

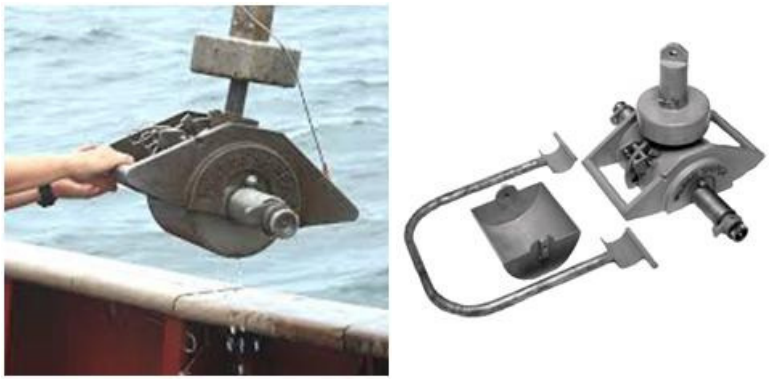


Figure 3 Shipek grab

If an undisturbed sediment core is required then a benthic corer can be used. An example of a benthic corer which is currently employed during benthic surveys is the Nioz corer (Figure 4)

Figure 4. Niox box corer

The retrieval of undisturbed cores permits insitu biogeochemical processes to be investigated. It also allows investigation of the different sediment layers in particular the depth of the REDOX discontinuity layer.

3.1 Camera systems

The inability to examine and describe the surface sediments sampled by benthic grabs such as the Hamon grab can be ameliorated, to some extent, by the use of a camera system positioned on the Hamon grab to enable acquisition of an image of the undisturbed seafloor prior to the sample being taken (Figure 1). These images can then be used, in conjunction with results of the PSA, to more accurately describe the sedimentary habitat present. Alternately, seabed imagery acquired at all (or a subset) of planned sample stations using drop down video and camera sledges (Figure 5) may be used in conjunction with the sediment PSA samples to help inform the wider spatial distribution of sedimentary habitats and potential pollution events.

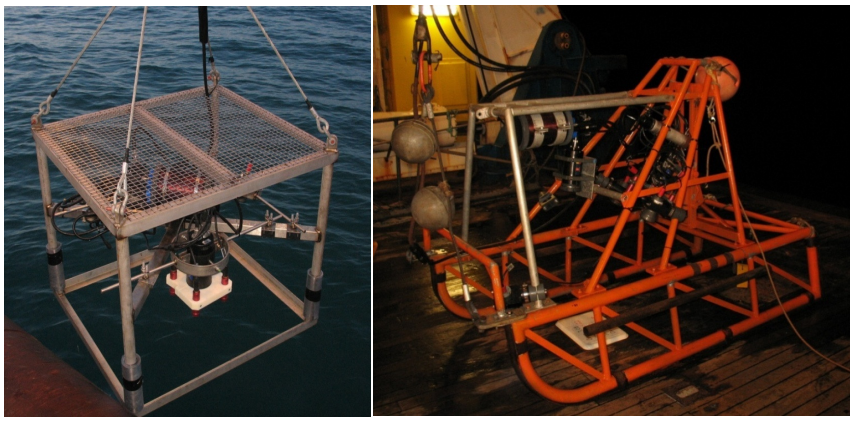


Figure 5. Drop down camera system (deployed over hard/rocky habitats) and camera sledge (deployed over sedimentary habitats)

3.2 Collection of benthic sediment samples up to 2000 m depth

All of the afore mentioned benthic grabs/corers could be successfully deployed in water depths of 2000m, however consideration should be given to the size and robustness (in particular when considering the use of the Day grab and Shipek grab) at these water depths. Construction materials should also be assessed and depth rated before deployment at these depths.

Due to the deployment and recover times associated with working in water depths of 2000m the most reliable and relevant grab/corer in terms of sample type required should be utilised.

4 Procedure

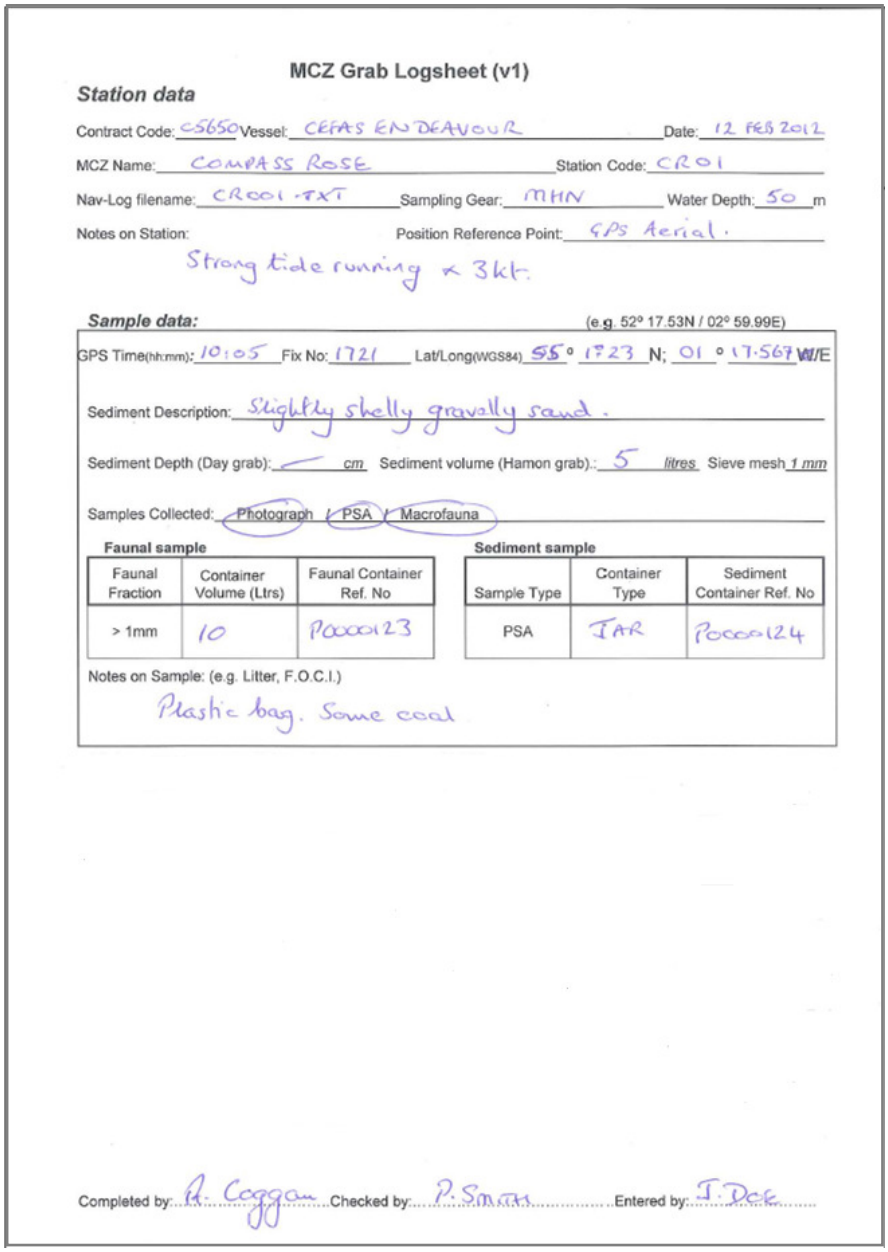
Due to the large range of benthic grabs that could be utilised a general procedure for the acquisition of sediment and infaunal samples is presented here.

4.1 Sample Processing

The main aims of sample processing on board ship are to acquire relevant sediment samples for particle size and contaminants analysis and reduce the volume of the substrate in the sample whilst retaining the biological material.

The basic elements of the ship-based sample processing must be followed in strict order. The following procedure provides some detail relating to the key steps. These will differ depending on the grab used and also the type of subsample required.

I. When the grab hits the seabed all relevant station metadata(position, time, depth etc) should be logged on the sample metadata logsheet (Figure 6)



MCZ Grab Logsheet (v1)

Station data

Contract Code: C5650 Vessel: CEFAS ENDEAVOUR Date: 12 FEB 2012

MCZ Name: COMPASS ROSE Station Code: CR01

Nav-Log filename: CR001.TXT Sampling Gear: MHN Water Depth: 50 m

Notes on Station: Position Reference Point: GPS Aerial.

Strong tide running x 3kt.

Sample data: (e.g. 52° 17.53N / 02° 59.99E)

GPS Time(hh:mm): 10:05 Fix No: 1721 Lat/Long(WGS84) 55 ° 17.23 N; 01 ° 17.567 W/E

Sediment Description: Slightly shelly gravelly sand.

Sediment Depth (Day grab): ~ cm Sediment volume (Hamon grab).: 5 litres Sieve mesh 1 mm

Samples Collected: Photograph / PSA / Macrofauna

Faunal sample

Faunal Fraction	Container Volume (Ltrs)	Faunal Container Ref. No
> 1mm	10	P0000123

Sediment sample

Sample Type	Container Type	Sediment Container Ref. No
PSA	JAR	P0000124

Notes on Sample: (e.g. Litter, F.O.C.I.)

Plastic bag. Some coal

Completed by: A. Coggan Checked by: P. Smith Entered by: I. Dick

Figure 6. Sample metadata logsheet

II. The grab is then retrieved onto deck and sample declared valid

III. Take sediment sub-samples for particle size (core or plastic scoop) and contaminant analysis (stainless steel spoon for contaminants and metals) and place in suitable containers.(Figure 7)

Figure 7. Taking relevant sedimentary subsamples for further contaminants and particle size analysis (a, Hamon grab, b-c, Day grab)

IV. Immediately label and freeze the sediment samples (-18 °C)

V. Pour off or allow excess water to drain from the remaining sample

VI. Photograph the sample with label (Figure 8)

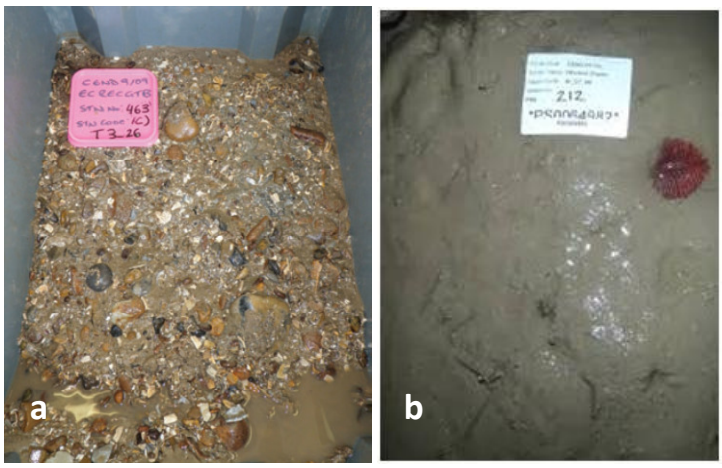


Figure 8. Example photographs of sediment samples (a, Hamon grab, b, Day grab)

VII. Measure the sample volume/or measure the depth of the sample within the grab. If a sediment subsample for contamination is required then the depth of the sample should not be measured as the sediment surface should remain undisturbed and uncontaminated (Figure 9)

Figure 9. Measuring the volume of a Hamon grab sample (a-b) and depth of a Day grab sample (c)

VIII. Release the sample from the grab into a suitable container if not already done so

IX. Wash and sieve the sample on the sieve table (Figure 10)

Figure 10. Washing the sediment sample through a 5 mm top sieve mesh into a 1mm sieve mesh.

X. Photograph the material retained on the sieve table mesh (Figure 11)

Figure 11. An example photograph of sediment retained on the 5mm sieve mesh

XI. Puddle the sediment retained on the final sieve to ensure all fines are removed from the sample (Figure 12)

Figure 12. Puddling the sample to remove the fine sediment fraction

XII. Photograph the material retained on the final sieve mesh (Figure 13)

Figure 13. An example photograph of sediment retained on the 1mm sieve mesh

XIII. Place all the sample (including both sieved fractions)into a suitable container

XIV. Preserve and label (internal and external labels) the infaunal biological sample (Figure 14)

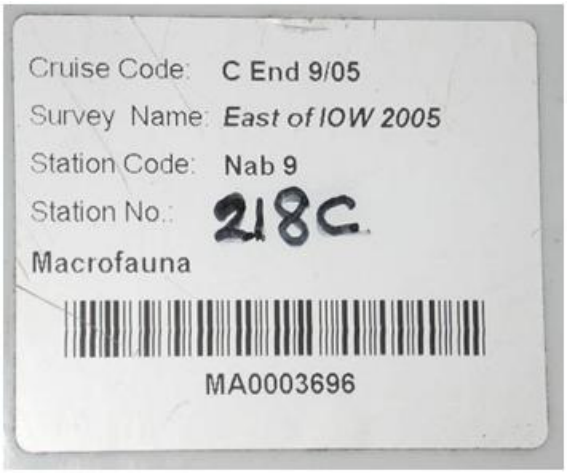


Figure 14. An example sample label

XV. Complete the metadata logsheet entering the remaining sample information (volume/depth of sample, sediment description and container type/size and barcode)(Figure 6)

XVI. All equipment should then be washed using appropriate chemicals before further deployments are carried out.

5 References

Law, R.J., Brant, J.L., Kirby, M.F., Lee, J. Morris, D. and Rees, J. 2014. Guidelines for the environmental monitoring and impact assessment associated with subsea oil releases and dispersant use in UK waters. Science Series Technical Report. Cefas, Lowestoft, 58 pp.

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