

Marine Biological Association of the United Kingdom

Creating a Modern Database from Archive Material

The Norman Holme Archive

*Interpretation of marine field research notebooks
in the historical context of the MBA, 1958-83*

Martin K.S. Lilley

August 2006

MIBA



Contents

1. Background to the Norman Holme Archive	4
2. The Holme Archive	4
2.1 Background	4
2.2 The Bottom Fauna of the English Channel Part 1	5
2.3 The Bottom Fauna of the English Channel Part II	7
2.4 Faunal Distributions in the English Channel	8
2.5 Echinoderm and Brittlestar Survey	9
2.6 Database contents	10
3. Marine Recorder	10
4. Methodological Issues	11
4.1 Survey codes	12
4.2 Marine Recorder limitations	12
4.3 Equipment	13
4.4 Locations	13
4.5 Brittle-star Station Repeats	13
4.6 Areas	14
4.7 Depths	15
4.8 Tow lengths	15
4.9 Sample Volume	15
4.10 Sediment Classification	16
4.11 Sample Sorting	16
4.12 Species Records	17
4.13 Species Names	17
4.14 Species Identification	18
4.15 Species Quantification	18
4.16 Species Distribution	19
4.17 Dead Shells	19
4.18 Incidental Comments	20
5. Acknowledgements	20
5.1 Author contact	20
6. References	21
7. Appendices	
A: The Bottom Fauna of the English Channel Part 1	23
A1 Reference	23
A2 Survey Dates	23
A3 Station Record Information	23
A4 Species Information	23
A5 Benthic Survey Part One specific sample comments	23

A6 Dead Shells Comments	25
B: Regions of the English Channel	26
C: The Bottom Fauna of the English Channel Part II	27
C1 Reference	27
C2 Survey Dates	27
C3 Station Records	27
C4 Species Records	28
C5 Benthic Survey Part Two specific sample comments	28
C6 Dead Shell Comments for Benthic Survey Part 2	30
D: Norman Holme's Species listing order – Benthic Dredge (DS) station sampling	31
E: Species Names changed since 1959 - Benthic Surveys Parts 1 & 2	32
E1 Background	32
E2 Species Name Changes 1959 to Present (2005).	32
E3 Species Name Changes 2005 – 1959	36
F: Index of Common Names or Species Descriptions used during the Benthic Surveys Parts 1 & 2	40
G: Thoughts on Anchor Dredges and their net sizes	45
H: Echinoderm and Brittlestar Survey notes	48
H1 Reference	48
H2 Background	48
H3 Survey Dates	48
H4 Library References for station records	48
H5 Sample Sorting	49
H6 Sample Volumes	49
J: Vessels used for measuring sample size and their volumes	51
J1 Background	51
J2 Tubs	51
J3 Buckets and Small Buckets	52
J4 Jars	53
K: Brittle-star Survey Equipment usage	54
L: Species Notes on identification during Brittlestar cruises of May-July 1971 (quoted from NMBL ref PHM3, notebook 22). Author: Dr Norman Holme	56
M: Brittlestar Survey Species name changes and descriptions	57

1. Background to the Norman Holme Archive

In 2005 the Marine Aggregate Levy Sustainability Fund (ALSF) provided funds to the Marine Biological Association of the United Kingdom (MBA) under Grant No: MAL0022 to reanalyse Dr Norman Holme's scientific data. The grant enabled the creation of a modern database from Dr. Norman Holme's data to allow subsequent reanalysis of these data using modern multivariate statistical methods. Further work in 2006 included a resurvey of a subset of sites in and around areas of modern aggregate extraction using Dr Holme's original data as a baseline.

This document provides details of the transfer of the Norman Holme archive data held in the National Marine Biological Library (NMBL) onto a modern database, specifically Marine Recorder. A key part in the creation of the database was the retrieval of a large amount of information recorded in field notebooks and on loosely-bound sheets of paper. As this work involved amending, interpreting and updating the available information, it was felt that an accurate record of this process should exist to allow scientists of the future to be able to clearly link the modern database to the archive material. This document also provides details of external information sources that were used to enhance and qualify the historical interpretation, such as estimating volumes and species abundances.

2. The Holme Archive



Figure 1: Dr Norman Holme, pictured at sea, June 1975.
©Photographer: R.L.Barrett

2.1 Background

Dr. Norman Holme (Figure 1) was an eminent zoologist based at the Marine Biological Association in Plymouth from 1949 to 1987. During his time working at the MBA he conducted numerous surveys, the legacy of which is now being rediscovered.

Dr Holme sampled the benthic invertebrate fauna of the English Channel extensively between 1959 and 1985, during a series of cruises on board the laboratory's research vessels. After his death in 1989 all his scientific material was catalogued and archived within the NMBL library. A report for the Ministry for Agriculture Fisheries & Food (MAFF) was conducted during 2000 and 2001 to into the datasets available at the MBA (MBA, 2001). The report assessed the possibilities for further research or resurveying based around the scientific data. In relation to benthic records, the report concluded that Dr Holme's records formed a unique baseline resource with which to compare present day studies in the English Channel and reflect the faunal effects of fishing or climate change. Three main

datasets in the Norman Holme archive were identified by the MAFF report for potential resurvey. These were a study of the Echinoderms and Molluscs for 324 stations distributed throughout the English Channel using an Anchor dredge (benthic Dredge Survey Parts 1 and 2); a Brittlestar survey from 329 stations in the Western Channel using a mini-Aggasiz trawl (Brittlestar Survey); and thirdly a full record of death assemblages collected during the Anchor dredge surveys (benthic Dredge Survey Parts 1 & 2).

The findings of the MAFF report (MBA, 2001) specified the variable nature of the archived material. During the Dredge Surveys (1958-62), the echinoderms and molluscs were recorded quantitatively, while the other taxa were only recorded in a more sporadic qualitative way. The report also described how a full record of all dead-shell material from the Dredge samples existed. The Brittlestar Survey recorded all the echinoderms recovered from the mini-Aggasiz trawl samples with a predominantly quantitative approach. Further record was made in the report of the archive of videotapes, video cassettes and photographic transparencies from Dr Holme's archive material. A selection of the photographs have been subsequently analysed as part of the Mapping European Seabed Habitats (MESH) project by Oakley & Hiscock (2005) and Hiscock & Oakley (2005). A few video tows were studied, but footage was too poor to identify species (Oakley *pers comm.*, 2006).

Norman Holme's species samples were all donated to the Natural History Museum and are still present (November 2005) in the Darwin Centre. Access to the centre can be arranged through the curator. These samples comprise of sample jars, labelled with the station number, containing unlabelled species preserved in alcohol. The samples have been surveyed, but not identified to species. The preserved samples represent a fraction of the species recorded by Dr. Holme during his surveys. Classes represented include Asteroidea, Annelida, Alcyonacea, Scleractinia, Actinidae, Hydrozoa, Cirripedia, Holothuria, Echinoidea, Ophiuroidea, and Crustacea. These are all grouped together in sections in the museum with a written record of their locations. Mollusca is represented by approximately 1500-2000 samples spread widely throughout the mollusc section by species, with no record of the location of each Holme Collection sample.

2.2 The Bottom Fauna of the English Channel Part 1:

Holme, N.A., 1961. The Bottom Fauna of the English Channel. *J. Mar. Biol. Ass. U.K.* Vol. 41, pp397-461.

A survey of the bottom fauna of the English Channel, along the whole length of the south coast of the United Kingdom, was undertaken by Dr. Norman Holme between 1958-9. A modified Forster anchor dredge was used to collect samples using a systematic methodology.

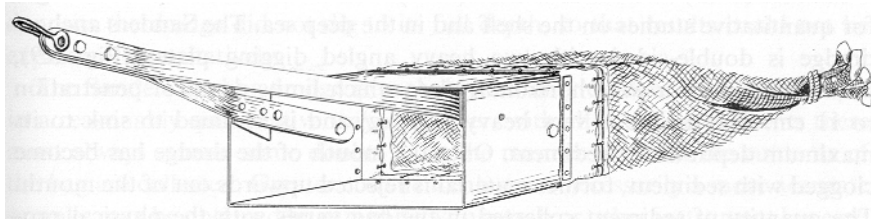


Figure 2: Dr. Holme's modified Forster Anchor dredge. Drawn by Mr G. A. Battin (Holme, 1961)

One hundred and sixty seven sites were sampled all along the South Coast. The scientific paper detailed sediment types, samples sizes and sieve treatment for each sample. Abundances and location of living organisms were also recorded. Figure 3 shows the distribution of the sampling sites close to the south coast with selected regions receiving repeated sampling.

The survey revealed a number of different faunistic communities existing along the South Coast of the United Kingdom with fairly abrupt boundaries. Details of these faunal communities (summarised in section 2.4) and distribution maps can be found in Holme (1961).

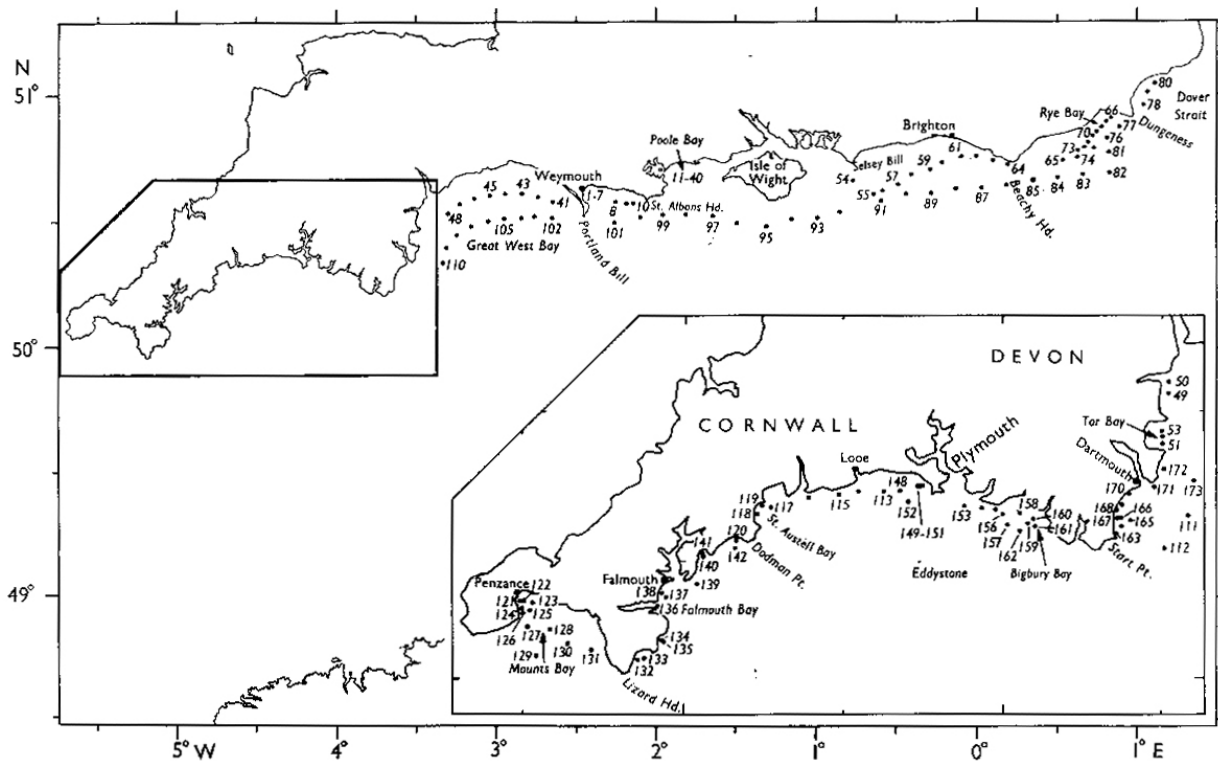


Figure 3: Sampling locations for Dr. Holme's Benthic Survey of the English Channel Part 1 (Holme, 1961).

Full details of this survey and references for the notebooks can be found in Appendix A. Norman Holme split the channel into regions to simplify analysis of all the data. A map of these regions is included in Appendix B.

2.3 The Bottom Fauna of the English Channel Part II:

Holme, N.A., 1966. The Bottom Fauna of the English Channel. Part II; *J. Mar. Biol. Ass. U.K.*, Vol. 46, pp. 401-93.

The Bottom Fauna of the English Channel Part II was a continuation of the work started by Dr. Norman Holme in 1958-9 to survey the benthos along the South Coast of England (Holme, 1961). This survey was conducted between 1959 and 1962. The continuation added to the South Coast data by employing the same techniques and methodology. A further 144 sample sites sampled including nine transects across the English Channel to the French Coast, a survey along the French coast and around the Channel Islands (Figure 4).

Dr Holme published this survey in a similar format to Bottom Fauna Part I, but also including English Channel distribution maps for most species rather than tables of figures.

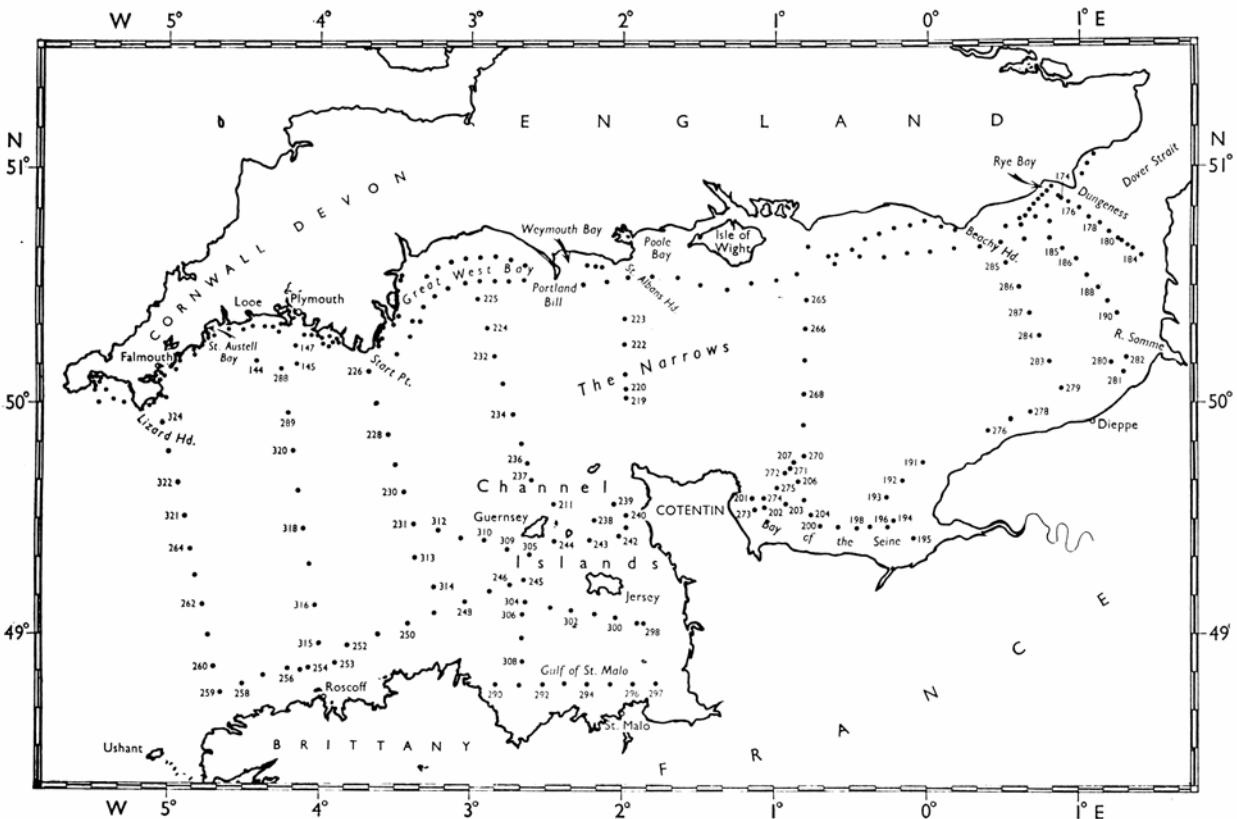


Figure 4: Sampling locations of part II of the Benthic survey of the English Channel. Un-numbered dots represent sample locations for Part I (Holme, 1966).

Full details of this survey can be found in Appendix C.

2.4 Faunal Distributions in the English Channel

Norman Holme used his benthic dredge surveys (Holme, 1961; 1966) to create a picture of the distribution of species within the English Channel. Species along the English coast were classified and described in Holme (1961). These distributions were subsequently added to and reanalysed in Holme (1966). The MAFF report (MBA, 2001) provided a summary of the biogeographical trends described by Dr Holme with which to base long-term change against. For distributions maps for individual species see the relevant papers. Species are as they were named by Dr. Holme. Many species names have now changed (see Appendix E for current, 2005, scientific names).

Group 1 – General distribution: Widely distributed and often preferring areas of substantial water movement e.g. *Ophiothrix fragilis*, *Chlamys opercularis*, *Glycymeris glycymeris*, *Natica alderi* and *Echinocardium cordatum*. In addition there is a suite of species that are restricted to soft sediments that occur off England, but not France. Similarly, there are species found only on the French side.

Group 2 – Western distribution: Species that extend as far as Plymouth and Start Point on the northern shore to Guernsey on the south. Some may extend further in deep water. E.g. *Arca tetragona*, *Chlamys tigrina*, *Astarte sulcata*, *Gari costulata*, *Hyalinoecia tubicola* and *Ophiocomina nigra*.

Group 3 – Western Channel: Species that extend as far up-Channel as Weymouth Bay and the tip of the Cotentin Peninsula. The limits to their distribution may relate more to the distribution of sandy substrata than to other factors. E.g. *Cyprina islandica*, *Dosinia lupinus*, *Chamelea gallina*, *Callianassa subterranea*, *Upogebia stellata*, *Amphiura filliformis* and *Labidoplax digitata*.

Group 4 – Cornubian: Warm water species with limited penetration of the Channel. Most occur in shallow water e.g. *Tellina squalida*, *Sipunculus nudus* and *Marthasterias glacialis*.

Group 5 – Sarnian: Distribution centred around the Channel Islands but extending, in some cases to Portland and the Isle of Wight or even into Cornish estuaries. E.g. *Nucula nucleus*, *Chlamys varia*, *Venus verrucosa*, *Venerupis rhomboides*, *Calyptrea chinensis* and *Gari depressa*.

Group 6 – Eastern: Cold water forms commonest in the eastern parts of the Channel e.g. *Spisula elliptica*, *Buccinum undatum* and *Mya truncata*. (MBA, 2001, summarised from Holme, 1961; 1966)

An index of the common names used during the Benthic Surveys can be found in Appendix F.

2.5 Echinoderm and Brittlestar Survey:

Holme, N.A., 1984. Fluctuations of *Ophiothrix fragilis* in the Western English Channel; *J. Mar. Biol. Ass. U.K.*, Vol. 64, pp. 351-78.

Historically *Ophiothrix sp.* have been widely distributed throughout the English Channel, with *Ophiocomina sp.* more restricted to the western half. Where these species are found they tend to occur in large aggregations. Regular sampling off Plymouth revealed a decline in numbers by the early 1970s (Holme, 1984). Dr. Holme analysed the historical populations by looking at records in scientific journal articles throughout the 1900s up to the 1970s. A series of surveys in the Western English Channel conducted between 1965 and 1983 were an attempt to gain a more complete and up to date picture of *Ophiothrix sp.* populations. Holme (1984) detailed the data collected to get a clear picture of the populations as coming from several distinct sources. These were: 1) 349 trawls with a 1m wide Aggasiz trawl, mainly made during 1970-74 (Figure 5); 2) Towed Sledge



Figure 5: A 3ft mini-Aggasiz trawl. Dr. Holme is pictured back left. ©Photograph R.L. Barrett, June 1975

video and photograph studies (Holme & Barrett, 1977), subsequent analysis of photographs (Oakley & Hiscock, 2005; Hiscock & Oakley, 2005); 3) Observations from a submersible including field notes, videos and photographs (Wilson et al., 1977; Wilson, 1977); and 4) incidental observations (by Dr. Holme) during sea trips with field classes between 1961 & 1973.

The scientific publication resulting from the Brittlestar Survey (Holme, 1984) is a partial analysis of the information obtained from the 349 mini-Aggasiz trawls. The map (Figure 6) shows the distribution of these samples over the western English Channel. Research on the other echinoderm species obtained from this survey does not appear to have been published. All the information from this survey has been included in the database. For further details and NMBL archive references see Appendix H.

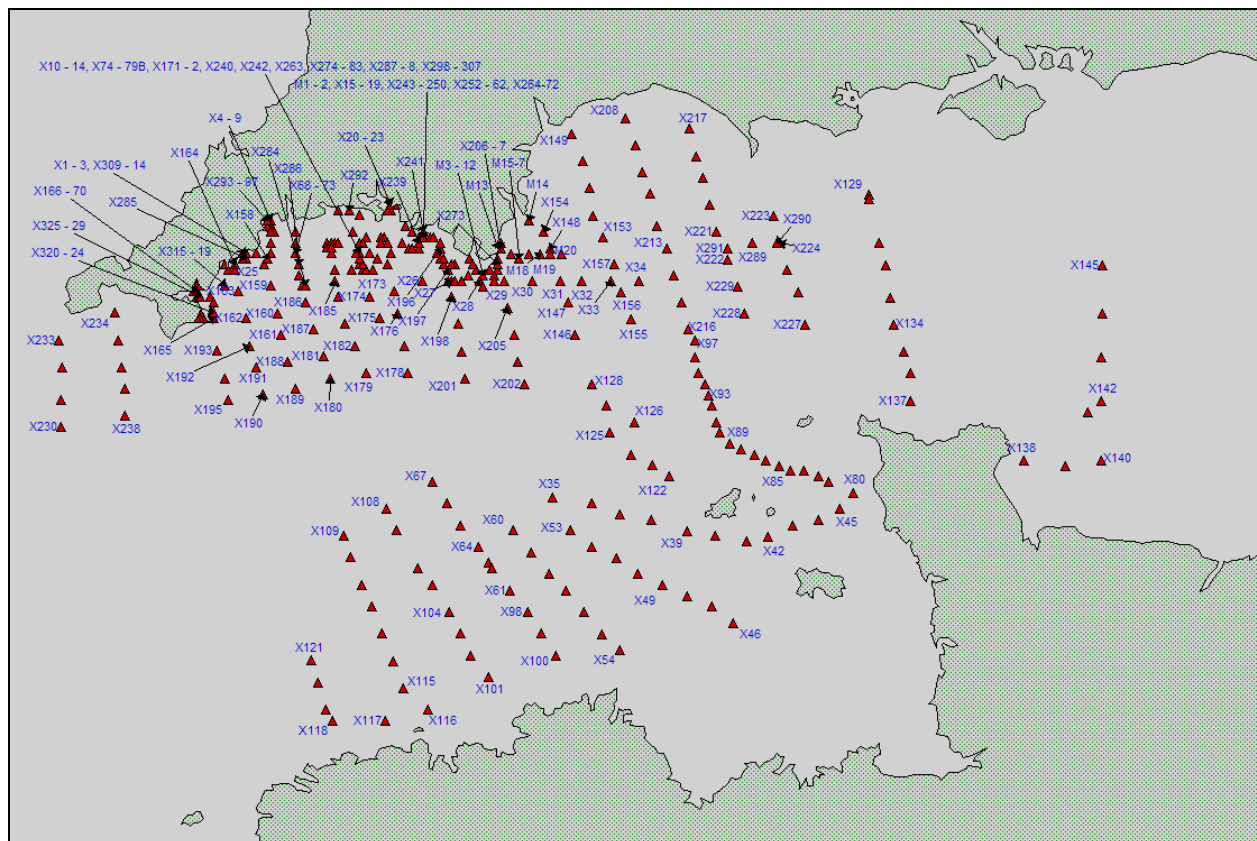


Figure 6: Brittlestar Survey sample locations. © M.K.S. Lilley.

2.6 Database contents

A database was created from the archived notebook material for Norman Holme’s ‘Bottom Fauna of the English Channel’ survey (Holme, 1961), ‘Bottom Fauna of the English Channel Part II’ (Holme, 1966) and Brittlestar Survey (partially published in Holme, 1984). The survey material was entered into Microsoft Excel spreadsheets for statistical analysis and into Marine Recorder for subsequent uploading to the National Biodiversity Network (NBN).

3. Marine Recorder

Marine Recorder has been developed out of the Joint Nature Conservancy Council (JNCC)’s Marine Nature Conservation Review (MNCR). The program is a front for a Microsoft Access database. The program ensures consistency in the input of data and compatibility between datasets for subsequent analysis by any interested parties. The information is also compatible with the National Biodiversity Network, an effective way of disseminating natural history knowledge and providing data access to the public. Marine Recorder species lists require that only current species names can be entered.

Marine Recorder has three main levels – Surveys, Events and Samples. Surveys have a list of all Events that took place within that survey. Samples have to have an Event registered for them.

- Survey – This is where the main details of a survey are specified. A typical survey would have a title, organisation conducting the survey, the start and end dates, any references associated with the survey and co-ordinates of the region including a description or outline summary of the survey as a whole.
- Events – These include specific locations within the survey including latitude and longitude, a date when the sampling took place, the co-ordinates of the location, the recorders and the type of survey taking place, such as a line transect or a point survey. A description may also be included.
- Samples – Samples are replicates at each event location. There may be only one replicate. Sample information includes the type of sampling and equipment used, time, species records, biotopes, sediment type and depth or height on the shore and specific references. This section is where all information collected on the day of the sampling is located. The section also includes a description for adding information that is not compatible with the rest of Marine Recorder.

Once data has been entered into Marine Recorder, validated and verified it can be uploaded to the National Biodiversity Network to give access to the public and other organisations.

4. Methodological Issues

During the course of creating the database a large number of issues were encountered. A solution has been found for many of these issues, while for others compromises have had to be made. A number of these issues are highlighted below. These seek to explain the methodological approaches taken and to allow scientists of the future to clearly establish the links between the archive notebooks and modern database. Hopefully, these issues will also enable others to replicate the steps taken, using other data sets, and not make the same errors of judgement.

Dr. Norman Holme's data was partially included in an MBA database, created during the 1980s, archived in the National Marine Biological Library, Plymouth (Archive reference MM1). The database fell out of use, leading to outdated materials, and the whereabouts of the database were not well known to most staff at the MBA. A modern comprehensive database using the original materials was deemed the best way forward.

4.1 Survey codes

Dr Norman Holme applied a prefix in front of each sample he took on his cruises. The codes applying to these particular surveys were DS (probably standing for Dredge Survey) for the benthic Anchor dredge samples, eg. Station DS187, and X (for Ophiothrix?) for the Brittlestar survey Aggasiz trawls. These codes allowed easy comparison between notebooks, species lists, scientific papers and simple record keeping on spreadsheets.

4.2 Marine Recorder limitations

Marine Recorder is based on database boxes that require an entry (coloured yellow), others that prefer an entry (green), and those that have space to add information if the user requires (white). This later category includes the Description sections. The compulsory boxes are the most constraining. A number of pieces of information are required to enter the survey, including latitude and longitude or OS grid reference for both the survey as a whole and for each event, the organisation or individual running the survey, a start date for the survey, at least one recorder, event date, site name and an overall survey name. These compulsory pieces of information require a good knowledge of the survey before entering any data into Marine Recorder.

Marine Recorder uses a limited number of equipment categories to group equipment and allow comparisons. This means for example that all sizes of Aggasiz trawl used are consolidated into the category of “Aggasiz trawl”. A listing of all the equipment used during the Brittlestar survey is included in Appendix K.

In order to import a spreadsheet with species information on it the Events must have already been created within Marine Recorder. This is to ensure the species information can identify which Event it is associated with. Most important is not to add ANY Sample information to the Events before importing the species information from Microsoft Excel. Samples are all required to be unique and each import creates a new reference. Biotope, depth and habitat information can be added after the species information has been imported. (If species information is being added directly into Marine Recorder rather than being imported from Microsoft Excel this does not apply).

Many pieces of information provided in Dr Holme’s notebooks do not have appropriate sections for entering them within Marine Recorder. This is likely to be the case with many surveys unless they were designed originally with Marine Recorder in mind for data archiving. Rather than omitting and possibly losing these pieces of information, such as Decca co-ordinates, they have been copied into the Description section of the relevant section.

4.3 Equipment:

During the Benthic dredge surveys, a double-sided Large Anchor Dredge was used for all samples, unless stated otherwise in the sample descriptions. A drawing of this dredge is shown in figure 2. The net was lined with Stramlin (burlap) inside the Courlene from sample DS174 onwards to reduce the amount sediment washing out of samples. The size of the Anchor dredge frame was quoted by Holme (1961), but he fails to record the net size or volume at any point. For a discussion on possible net sizes and other dredges used occasionally during the surveys see Appendix G.

In the Brittlestar Survey the main equipment Dr. Holme used was a mini-Aggasiz trawl. An Aggasiz trawl is primarily a double-sided beam trawl or “light dredge fitted with runners, having a mouth 1 m wide” (Holme, 1984). The trawl is designed to be able to work either way up on the seabed. Many of the Brittlestar trawls were conducted in water greater than 50m and the advantages of double sided equipment can be imagined. Holme’s trawl is pictured in figure 6.7 Eleftheriou & Holme (1984) and the picture was reprinted as figure 5.5 in Eleftheriou & McIntyre (2005). The dredge was used with Courlene netting of approximately 1/2" diameter mesh unless specified in the Sample Description of Marine Recorder. The prolonged timescale of the 350 Brittlestar stations inevitably leads to some variability in the sampling techniques. A number of different trawl types were used between 1965 and 1983. For a detailed listing of equipment by stations, and analysis of why certain unconventional trawls were used occasionally, see Appendix K.

4.4 Locations:

Locations for each station were originally recorded from DECCA co-ordinates on board the research vessels. Norman Holme converted these to Latitude and Longitude for his Holme (1961) paper, quoted both in the second Benthic survey paper (Holme, 1966) and used both in his notebooks for all three surveys. These Latitude and Longitude values were used for the locations of the samples in Marine Recorder and the spreadsheet. In many places Dr. Holme recorded the location of the sample in his field notebooks, for instance “E of Teignmouth Pier”. These locations have been used within the Event name of Marine Recorder where they were given to simplify finding of stations. Where Holme had not recorded a location, Admiralty charts were used to give an approximate position.

4.5 Brittlestar Station Repeats:

In order to compare changes in populations of Brittlestars many of the locations are repeats of earlier samples by other Plymouth scientists. Some stations are repeats of the Benthic Channel Survey (1958-62) – Holme (1961, 1966) - but using the 3 ft rectangular mini-Aggasiz trawl (1m double-sided beam trawl). The Aggasiz trawl does not dig into the sediment as much as the Anchor dredge and samples the surface-living fauna far more efficiently, but the infauna less efficiently, than the anchor dredge. These repeats

were specified by Holme in the paper and have been specified in the Event Location Name within Marine Recorder. The remaining samples of the Brittle-star survey were all planned to coincide with 1/10th by 1/10th subdivisions of the ICES fishery statistical rectangles (Holme, 1984). ICES Grid references have been given (where present) with Decca co-ordinates and Chart number in Event/Location description of Marine Recorder. Grid references are read Northings then Eastings. e.g Eddystone is 293E57. Northing numbers are based on one number per 3 minutes of longitude. Eastings are based on one number per 1 minute East latitude.

4.6 Areas:

The Joint Nature Conservancy Council (JNCC) started the MNCR in 1987. In order to aid analysis of biotope and species records, a series of sectors were set up to map the coast of the United Kingdom. These sectors had their coastal limits carefully designated, but no consideration was given to the outer limits of the regions. The two sectors applying to Norman Holme's datasets are MNCR Sector 7 – Eastern English Channel and MNCR Sector 8 – Western English Channel. The eastern boundary of Sector 7 extends due East from eastern Kent and the western boundary of Sector 8 South-West from Lands End. The boundary between Sectors 7 and 8 is known to run approximately South-South-East from Durlston Head near Swanage (Hiscock, 1998). The sectors did not have their outer boundaries defined. For the purposes of this database and data analysis a shallow easterly curving line has been assumed to run from Durlston Head to Cap de la Hague near Cherbourg in northern France. Stations DS 219-23 are within the Western Channel sector. Marine Recorder uses the MNCR sectors to index Events. Dr. Norman Holme split the channel into smaller sectors to simplify analysis of his data. The English Channel was split into fourteen regions (Figure 7), Areas 1-8 in what is now JNCC MNCR Sector 8 and 9-14 in Sector 7.

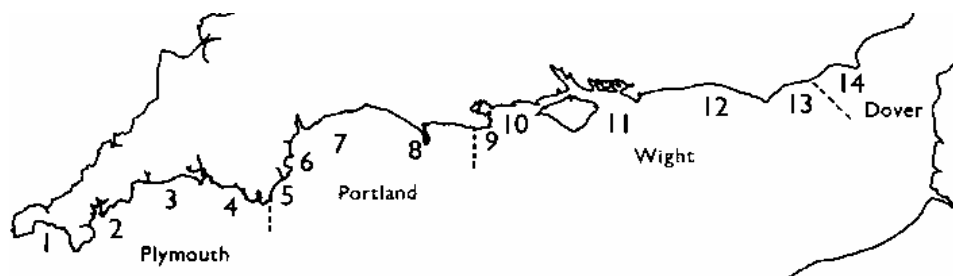


Figure 7: The locations of Norman Holme's fourteen regions along the South Coast of the United Kingdom. These regions allow grouping of local stations (Holme, 1961).

Norman Holme used a different set of twelve sectors to split the sites up initially in his notebooks. Details of these are included in Appendix B.

For the Brittle-star survey, where the sectors above were not used, MNCR Sectors were assumed to

correspond to W of 1 deg 50'W - Sector 8; E of 1 deg 50'W - Sector 7

4.7 Depths:

Holme recorded depths from the ship-board Echo-sounder in fathoms (BSL - Below Sea Level), subsequently corrected for tidal height and then converted to metres (BCD - Below Chart Datum) during the first Benthic survey (Holme, 1961). These original and converted values were both included within the Sample description in Marine Recorder. The second Benthic survey and Brittlestar survey followed the practise of only recording BSL.

The Habitat category within the Samples required classification of depths into categories, e.g 10-20m. Where the value fell on the boundary between two categories (e.g 20m being in both the 10-20m and 20-30m categories) both are chosen. The time of a sample was also included in each Sample where given. During the Brittlestar survey Dr. Holme was observing and recording the bottom topography profile at each site from the Echosounder. Holme normally noted a single comment such as "Smooth". Evidence to clarify this assumption came from the notebook for Station X59 where Dr. Holme commented "switched on too late to see contours".

4.8 Tow lengths

Tow lengths (time on the bottom) varied at each station and were usually recorded in the Duration box of the 'Sample' in Marine Recorder. However it is not possible to enter fractions of minutes into this cell. Where no figure is present a time will be in the Sample Description, if one was recorded by Holme, for the length of the tow e.g. 3.5 minutes.

4.9 Sample Volume

Dr. Holme's datasets have limitations to their application in the modern environment. One of the main limitations with the dataset is its inaccuracy with respect to measured volumes of the samples. Dr. Holme measured samples with whatever vessel he had to hand. These appear to have included baths, tubs, buckets and jars. Dredge sample volumes were usually measured in 'baths'. Dr. Holme describes one bath as having a volume of approximately twenty litres (Holme, 1961, 1966). Brittlestar samples were more frequently measured using 'tubs'. The volume of a tub is not known for certain. Tubs used in 2005 have a volume of approximately eighty litres (Appendix J2). On the whole no definitive record has been found as to the volumes of these containers, but estimations have been made in Appendix J based on circumstantial evidence. The volume of each sample is given in the Sample Description of Marine Recorder.

4.10 Sediment Classification:

Dr. Holme wrote a brief description for the main sediment from each anchor dredge he obtained. These sediment deposits were used as the Sample name in Marine Recorder. During the first Benthic Survey (Holme, 1961), the sediment deposits were all abbreviated in his Journal of the Marine Biological Association of the UK (JMBA) paper. The abbreviations were also used extensively in the field notebooks. These abbreviations were lengthened into prose for the Sample titles.

Sand - Medium/Muddy. In his key to the deposits, Holme (1961) used the same symbol (m.) for both medium and mud. Where 'm.' was used on its own it obviously referred to Mud, however it most commonly occurred as 'ms.' for M___ Sand. As mentioned earlier, Holme used the abbreviations to categorise the sediment in his notebooks too and consequentially, without any further evidence, it was not possible to differentiate between Muddy Sand and Medium Sand. As a result, Muddy Sand was used in all cases. During the Second Benthic Survey, Dr. Holme (1966) solved the problem through the use of med. for Medium and the introduction of Clay and Silt into the deposit key.

Many samples in the Echinoderm & Brittlestar Survey do not have sediment types attributed to them and were classified as Unknown Sample or Unknown Sediment. The mini-Aggasiz trawl, used predominantly, was designed to resuspend the sediment and collect the epifauna. Sediment samples were rare in Aggasiz trawls.

4.11 Sample Sorting

Sediment samples were sorted using sieves. Fine samples were passed through a square mesh 2.2mm sieve. Coarser samples were passed through 2.5, 5, or 11.5mm square mesh sieves. Often, with large samples, Holme passed a portion through sieves. Sometimes these portions were a measured volume, such as one bath, but more usually a "small unmeasured portion" was sieved. In almost all cases the remainder of the sediment was hosed through on deck with the larger material being picked out. The process described above inevitably adds a degree of qualitative sampling into the samples.

Holme designed a hopper for use when sieving samples. The hopper contained water jets to resuspend the sediment prior to sieving. Figure 10.1 in Holme & McIntyre (1971) shows a diagram of 'Holme's hopper' (described in Holme, 1959).

Occasionally two samples were taken at stations where the first sample was washed through the mesh of the net or contained "a number of stones with no fine soil". Dr. Holme (1961) recommended a Stramlin lining for use in deeper water to prevent washing out, but did not use one during this survey.

From Station DS219 Dr. Holme tried out rough sorting with an experimental metal screen (Holme, 1966). As each sample came on deck it was sieved through the screen in its entirety. Holme (1966) described the screen as having square apertures of 10mm across. By hosing the sediment on the coarse screen

conspicuous shells and dead organisms could be picked out. The screen was said to have a similar effect to an unlined Courlene net and should allow comparison of these samples with those prior to lining the net with Stramlin from station DS174 onwards. For convenience this method has been referred to as 'Rough Sort' in the descriptions of samples within Marine Recorder. From the pile of sediment underneath the screen a portion was taken to sieve through the finer 2.2mm mesh. Holme (1966) describes how residue from the 2.2mm sievings was preserved up to a volume of approximately two litres. Dr. Holme (1966) suggested that the 2.2mm sieve might lead to losses through the sieve of smaller organisms, but that the labour advantages associated with the collecting and subsequent sorting would have been considerably higher if a smaller mesh was used. The larger animal counts were thought to be reasonably accurate (Holme, 1966).

4.12 Species Records:

For the Benthic dredge surveys Dr Holme appeared never to have written up the species information. Two folders, held in the NMBL archive, contain a foolscap-sized sheet for each station with living species on the front and a list of dead shells on the rear. The species records were carefully transcribed into a Microsoft Excel spreadsheet and imported into Marine Recorder. Differentiation between living and dead organisms was included in the spreadsheets. Dr. Holme frequently specified whether organisms were adult or juvenile, living or dead. Marine Recorder allows species qualifiers to highlight differences within species. Future statistical analysis may recombine this information, but for the present time it was important not to lose any of the raw detailed information.

4.13 Species Names:

Dr. Holme conducted his surveys between 1958 and 1983, with the Benthic surveys between 1958 and 1962. Inevitably between the original surveys and the present period there have been numerous changes of species Latin names. One of the rules of Marine Recorder is that the species lists are required to use the currently accepted name for a species. A database of current names certifies the validity of each species name. Species names were checked against the database in the Natural History Museum (NHM). The database is called the Natural Biodiversity Network (NBN) Species Directory <http://nbn.nhm.ac.uk/nhm/>. A copy of Howson & Picton (1997) was also used to check species names. The third source used to identify names was the Flanders Marine Institute taxon search. This can be found at <http://www.vliz.be/vmcdcddata/aphia/search.htm> and was very comprehensive at listing old Latin names for a species and then giving a link to the currently accepted name. This list was more up to date than the NHM, but cross-referencing is recommended because Marine Recorder's database was developed around the NBN Species Directory.

The spreadsheets and Marine Recorder used the currently accepted names in 2005. Included in the

Appendix are species lists of the original name used by Dr. Holme and the currently acceptable name. To enable cross referencing there are two versions of the list - Holme usage to present, and present to Holme's names (Appendix E).

There were a large number of names used by Dr. Holme that were either a common name or were not specific enough to attribute a species to. Marine Recorder is unable to use any name higher up the hierarchical classification than Genus. For instance every mention of Hydroid or Hydroidea has had to be included only in the Sample Description. An index of these quotes with a sample reference is also included within the appendix (Benthic Surveys - Appendix F; Brittlestar Survey – Appendix M).

4.14 Species Identification

Dr. Holme frequently failed to leave any record about volumes of measuring vessels or what his abundance words meant, but he certainly left a comprehensive note about the limitations of the Echinoderm and Brittle-star Survey. The back pages of one of his field notebooks (NMBL ref PHM3, notebook 22) contained “Species Notes on identification during cruises of May-July 1971”. The period these notes apply to contained sample stations x26-145. During this period Dr. Holme recorded all the Echinoderms with a few Genus' not identified to species. For the remaining phyla sporadic records appear to have been kept. Holme details a number of species and the frequency with which they were recorded. The notes are quoted in their entirety in Appendix L.

4.15 Species Quantification:

Species have usually been recorded quantitatively, for example “52 *Ophiothrix fragilis*”, but at intervals Holme used qualitative expressions such as “common”, “frequent” or “occasional” to describe abundances. There was no indication that these descriptions tallied with the current SACFORN (Superabundant, Abundant, Common, Frequent, Occasional, Rare, Not Present) scale. The only assumption that could be made was that the descriptions were comparable within samples. Occasionally figures were given in brackets next to abundance descriptions, in this case the figures were used in the spreadsheet. In order to conform with the guidelines for using Marine Recorder a record of Presence was filed for each species given a descriptive abundance by Dr. Holme. For example, where *Abra abra* was Common, a P was recorded on the spreadsheet. In order not to lose the description, the abundance word was recorded within the Sample Description in Marine Recorder.

Subsequent findings showed that for the first Benthic survey (Holme, 1961) a frequency code was adopted by Holme as follows:

- A (abundant) – several hundred
- C (common) – >32
- F (frequent) – 17-32

- (occasional) – 9-16
- R (rare) – 1-8

However distribution maps employed during the second Benthic Survey (Holme, 1966) classify abundances per sample into “1-2”, “3-9”, “10-99”, and “100 or more living” categories. This also does not tally with the scale used to analyse the historical Brittlestar data (Holme, 1984):

Common (>100 / dredge haul; >10 m⁻²)

Occasional (11-100 / dredge haul; 1-10m⁻²)

Rare (10 or less / dredge haul; <1m⁻²)

Likewise, the graphical representation of *Ophiothrix fragilis* abundances uses <10³, 10³-10⁴, and >10⁴ per dredge haul (Holme, 1984).

Generally the raw data lacks the qualification of keys needed to successfully analyse the information in detail. Unfortunately, for much of this data, the record of Presence or Absence is as accurate as analysis can be.

4.16 Species Distribution

Dr. Holme (1966) highlighted that the sample sizes (in the Anchor dredge) were too small for adequate sampling of the sparse benthos of the English Channel. While living species lists were not comprehensive enough to specify presence or absence of a species within a region, density of the occurring species could be suggested. The inclusion of dead shells listings, Holme argued, enhanced the dataset by giving a sizable species list for each station. The combined dataset then gave a clear picture of species absent from geographical regions, particularly the molluscs.

4.17 Dead Shells:

During the Benthic Surveys Norman Holme picked out many empty shells and dead species. Dr. Holme (1961) specified that these records were taken on a “semi-quantitative basis, and such records are of value in confirming the absence of certain species in particular areas”. The number picked out appeared to have been governed by the amount of time available and to have been biased towards certain species. For example a notable quote was from Station DS19 reads as follows:

“A selection from the large number in the sievings - N.B These estimates are obviously biased in favour of the more rarer species in each haul”

Despite the obvious bias Dr. Holme listed the dead organisms in the same order each time. This would suggest that there was a checklist to species that he was working from (Appendix D). Counts of the dead shells appeared to have been conducted on the number of shells rather than pairs. While for gastropods this made sense, for bivalves the numbers are likely to inflate the actual abundances of these species.

Dead Shells were highlighted as such in the species qualifier column of Marine Recorder using the phrase

‘dead’ or ‘shell’. This again allows subsequent analysis to combine the values or to regard them as separate specimens.

4.18 Incidental Comments

Norman Holme, scattered through the notebooks and species lists, included a number of comments. These were usually to do with a sample washing out of the net or the trawl towing roughly over the bottom. Others were obviously incidental thoughts that occurred on board or on analysis, usually relating to species abundances or a difference to normal in that region. These comments have been included in the Appendix A5 (Benthic Survey Pt 1) & C5 (Benthic Survey Pt 2) to ensure they were not lost.

5. Acknowledgements

I would like to acknowledge the Marine Aggregate Levy Sustainability Fund for funding the analysis of Dr. Norman Holme’s scientific data under Grant No. MAL0022. Thank you to Drs Stuart Jenkins, Matthew Frost and Hilmar Hinz at the Marine Biological Association for providing me the opportunity to work on the project; to staff of the National Marine Biological Library for their help, support and free reign over the archive material. In addition Mr Pete Rendle, MBA, provided historical confirmation of working practises on the MBA vessels in Dr. Holme’s time.

5.1 Author contact:

Address – The Marine Biological Association of the United Kingdom, The Laboratory, Citadel Hill,
Plymouth, PL1 2PB

Email – martin.lilley@univ.bangor.ac.uk

6. References

- ELEFThERIOU, A. & HOLME, N.A., 1984. Macrofaunal Techniques. In *Methods for the Study of Marine Benthos* (ed. N.A. Holme and A.D. McIntyre), pp.140-216, 2nd edition, Blackwell Scientific Publications, Oxford. [IBP Handbook No. 16.]
- ELEFThERIOU, A. & MCINTYRE, A., eds 2005. *Methods for the Study of Marine Benthos*, 3rd edition, Blackwell Scientific Publications, Oxford.
- FORSTER, G.R., 1953. A new dredge for collecting burrowed animals. *J. Mar. Biol. Ass. U.K.*, Vol. 32, pp. 193-8.
- HISCOCK, K. ed. 1998. *Marine Nature Conservation Review. Benthic marine ecosystems of Great Britain and the north-east Atlantic*. Peterborough, Joint Nature Conservancy Committee. (Coasts and seas of the United Kingdom. MNCR series.)
- HISCOCK, K. & OAKLEY, J., 2005. English Channel towed sledge seabed images. Phase 2: Analysis of selected tow images. *Report to the Joint Nature Conservation Committee from the Marine Biological Association*. Plymouth: Marine Biological Association. JNCC. Contract F90-01-784.
- HOLME, N.A., 1959. A hopper for use when sieving bottom samples at sea. *J. Mar. Biol. Ass. U.K.* Vol. 38, pp.525-29.
- HOLME, N.A., 1961. The Bottom Fauna of the English Channel. *J. Mar. Biol. Ass. U.K.* Vol. 41, pp397-461.
- HOLME, N.A., 1966. The Bottom Fauna of the English Channel. Part II; *J. Mar. Biol. Ass. U.K.*, Vol. 46, pp. 401-93.
- HOLME, N.A., 1984. Fluctuations of *Ophiothrix fragilis* in the Western English Channel; *J. Mar. Biol. Ass. U.K.*, Vol. 64, pp. 351-78.
- HOLME, N.A. & MCINTYRE, A.D., eds, 1971. *Methods of the Study of Marine Benthos*, 1st Edition, Blackwell Scientific Publications, Oxford. [IBP handbook No. 16.]
- HOLME, N.A. & BARRETT, R.L., 1977. A sledge with television and photographic cameras for quantitative investigation of the epifauna on the continental shelf. *J. Mar. Biol. Ass. U.K.*, Vol 57, pp391-403.
- HOWSON, C.M. & PICTON, B.E., ed., 1997. *The species directory of the marine fauna and flora of the British Isles and surrounding seas*. Ulster Museum and The Marine Conservation Society, Belfast and Ross-on-Wye. Belfast: Ulster Museum. [Ulster Museum publication, no. 276.]
- MARINE BIOLOGICAL ASSOCIATION, 2001. Archiving and analysis of the MBA bottom trawl and benthic survey data: unravelling fishing efforts from climate change. *CSG15 Report to MAFF* (Contract MF0727). Plymouth, Marine Biological Association of the United Kingdom.
- OAKLEY, J. & HISCOCK, K., 2005. English Channel towed sledge seabed images. Phase 1: scoping study and example analysis. *Report to the Joint Nature Conservation Committee from the Marine Biological Association*. Plymouth: Marine Biological Association. JNCC Contract F90-01-784. 39

pp.

WILSON, J.B., 1977. The role of manned submersibles in sedimentological and faunal investigations on the United Kingdom continental shelf. In *Submersibles and their Use in Oceanography and Ocean Engineering* (ed. R.A. Geyer), pp. 151-167. Elsevier. [Elsevier Oceanography Series, 17.]

WILSON, J.B., HOLME, N.A. & BARRETT, R.L., 1977. Population dispersal in the brittle-star *Ophiocomina nigra* (Abildgaard)(Echinodermata:Ophiuroidea). *J. Mar. Biol. Ass. U.K.*, Vol 57, pp. 405-439.

Appendix A: The Bottom Fauna of the English Channel Part 1

A1 Reference

Holme, N.A., 1961. The Bottom Fauna of the English Channel. *J. Mar. Biol. Ass. U.K.* Vol. 41, pp397-461.

A2 Survey Dates

The survey dates for this survey are shown below:

Station 1-25: 11-13 Nov 1958

Station 26-53: 28-29 Jan 1959

Station 54-112: 20-27 May 1959

Station 113-142: 15-17 July 1959

Station 148-173: 15-16 December 1959

A3 Station Record Information

Times, Locations using DECCA co-ordinates and Depths in fathoms have been obtained from reading through field notebooks in the NMBL archive. Latitude and Longitude position, Depth in metres, Sediment type, Sample size, and sample treatment were all sourced from the scientific paper (Holme, 1961) with cross referencing to check the accuracy of the information. The notebooks listed below appear to have been written up from the original field notes. Random stations were cross-referenced to check the data matched between the notebooks. In order to differentiate between his different surveys Norman Holme used a prefix to the station number to specify the survey. All stations in Benthic Survey 1 have the prefix DS, probably standing for Dredge Survey.

Stations DS1-DS16 – NMBL archive reference PHM2, book 16;

Stations DS17-DS151 - PHM4, book 8;

Stations DS152-DS173 - PHM2, book 17

A4 Species Information

Species information for both Benthic Surveys (Holme 1961, 1966) can be found in the species information sheets, PHM4 in the NMBL archive, entitled “English Channel Fauna, Station Faunal Records, Stations 1-173” & “Bottom Sampling Station Records DS174-324, Also DS144-147 & M1-M20”.

A5 Benthic Survey Part One specific sample comments:

At intervals through his notes Dr. Holme noted anything that came to mind. These were often to do with species abundances, differences between the previous station and present or differences with the other end of the English Channel in the general makeup of the benthic community. These are included with slight additions of words to aid understanding or with the new species name added. Any further study of the species information would benefit from comparisons between adjacent stations guided by the quotes

below.

Each quote is preceded by a sample reference.

- Sample DS48: “Note: Increase in numbers and of species at this station. (but dead shells are a selection)”
- DS60: “Note: Many *Abra* were broken & numbers are approximate. Both *Abra prismatica* & *A. alba* definitely identified, but some doubt about certain specimens. *Abra nitida* probably not present.”
- DS61: “A quicker than usual sort of 5 breffits of sievings.”
- DS62: “Quick sort or 4 breffits of sievings, with v. little living material.”
- DS63: “Quick sort of 5 breffits of sievings”
- DS84: “no molluscs (living)”
- DS85: “Fauna includes many attached hydroids, polyzoa etc which would repay closer examination for small crustacea etc.”
- DS104: “Dead shells (selection) NB. Dead shells of *Spisula* (are) a fairly complete collection, showing the ratio between 2 species.”
- DS105: “NB fairly large number of juv & spat lamellibranches”
- DS110: “First station with *M. spinifera* shells” (*Myrtea spinifera*)
- DS117 (off Fowey): "Comparison of dead shells with up-channel collections. Data not emphasised sufficiently by counts includes: *Nucula* sp, *Diplodonta*, *Mysia* - scarce or rare; *Tellina donacina* (now *Moerella donacina*) & *Venerupis rhomboides* (now *Tapes rhomboides*) - not common; *Spisula* (all spp) -scarce; *Chlamys varia* - absent; *Tellina crassa* (now *Arcopagia crassa*) & *Gari tellinella* absent, but ground prob(ably) too muddy."
- It is assumed that the abundances referred to are for the W or SW channel e.g. few *Nucula* in W channel, but plenty in the Eastern Channel.
- DS120: “Large sample - 4 large jars of shells & 2 of sievings. Dead shell records scaled down somewhat to offset large size of sample (e.g 15-20 shells might be recorded as SCARCE at this station) Some species may seen larger than usual e.g *Dosinia* & *Callista*”
- DS126: “NB: many of the shells were rather small”
- DS127: “NB: This station is rather further offshore & in deeper water than previous stations in Mounts Bay. Fauna fairly rich in species, & *Cultellus* (now *Phaxus*) are noticeably larger than up channel. First records of living *Dentalium entalis* (now *Antalis entails*) & *Sipunculus nudus* so far in this survey.”
- DS129: “NB: *Dosinia* at this station rather difficult – prob(ably) large *D. lupinus*, but might include 'albino' *exoleta*.”
- DS134: “A quantity of Lithothamnion (dead) in sievings. Some species (e.g *Lima* (now *Limaria*))

probably associated with *Chaetopterus*”

- DS138: “NB Large size of some adult bivalves”
- DS157: “Large numbers of shells, many intact therefore numbers in list higher than usual”
- DS163: “6 breffits and two 1/2 breffits kept for examination. Dead shell list is therefore as complete as it can be”
- DS166: “NB: Apparent absence of *Spisula solida* although might have been overlooked among large numbers of *Macra* & *S. subtruncata*.”
- DS172: “Large quantity of shells, mainly small. Not all examined closely.”
- DS173: “Quite a number of small shells. These not worked very quantitatively.”

A6 Dead Shells Comments

Below is a comprehensive list of all the comments associated with the dead shells in Benthic Survey Part One. References to the appropriate samples are precede the comments:

- DS1 also highlighted “Single, whole, unjoined, valves, unless otherwise stated. Not all of the commoner shells were picked out. Not many shells were drilled by predatory gastropods”
- DS4: “selected list of shells not recorded, or only in small numbers, in previous hauls”
- DS5: “A selection picked out from the haul”
- DS32: “A few picked out from a large sample”
- DS41,75,106,125,128,133,149-50,156,158,167: “complete count” or “all”
- DS84,87,97,100-1,111,148,159: “All dead shells in a jar”
- DS44,48-52,62-3,65(1),66,68-70,74(1)(2),76-9,81,83,88,91,102,104-5,113,116,119-20,123-4,126-7, 129,134,136-7,139,141,153-5,157,161,166,170: “Dead Shells (selection)”
- DS60: “Selection - Numbers are of shells picked out and give only an approx idea of abundance”.
- DS110: “Selection from 4 - 1/2 breffits of sievings”
- DS112,152,164-5,169: “most of the sample.”
- DS135: “Selection from large quantity”
- DS138: “most of sieved samples”
- DS172: “Large quantity of shells, mainly small. Not all examined closely.”
- DS173: “Quite a number of small shells. These not worked very quantitatively.”

Appendix B: Regions of the English Channel

Holme's 'Dredge Notes' Notebook (NMBL ref PHM4, book 8) delimited the English Channel into twelve separate areas with different limits to these areas as follows:

Area number; Name of Area; Eastern limit; Longitude of Eastern limit.

1. Mounts Bay; Lizard Pt; 5.12'W	8. Poole Bay; St Catherine's Pt; 1.17.5'W
2. Falmouth; Dodman Pt; 4.48'W	9. Nab (Isle of Wight?); Selsey Bill; 0.47'W
3. St Austell; Looe Island; 4.27'W	10. Brighton; Beachy Head; 0.15'E
4. Plymouth; Prawle Pt; 3.43'W	11. Rye Bay; Dungeness; 0.58.5'E
5. GWB (Gt Western Bay?) West; Beer Head; 3.06'W	12. Dover
6. Lyme Bay; Portland; 2.27'W	
7. Weymouth Bay; Durlston Head, Swanage; 1.57.5'W	

Using this set of guidelines Areas 1-7 are in the JNCC MNCR Sector 8 - Western Channel, with Areas 8-12 in Sector 7 - Eastern Channel.

However, in Dr. Holme's (1961) paper for the first Benthic Survey along the South Coast of England the English Channel was split into fourteen regions, Areas 1-8 in what is now JNCC MNCR Sector 8 and 9-14 in Sector 7.

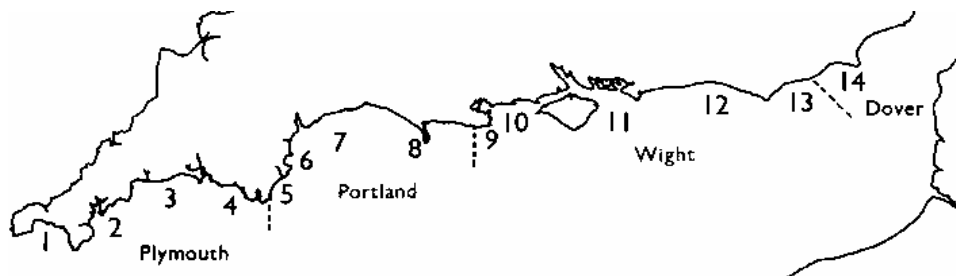


Figure 8: The locations of Norman Holme's fourteen coastal regions (Holme, 1961).

The area numbers used in entering data into Marine Recorder are the 14 regions of the Holme 1961 JMBA paper.

Appendix C: The Bottom Fauna of the English Channel Part II

C1 Reference

Holme, N.A., 1966. The Bottom Fauna of the English Channel. Part II; *J. Mar. Biol. Ass. U.K.*, Vol. 46, pp. 401-93.

C2 Survey Dates

The Survey dates for Part 2 of the Survey were:

Station 144(2)-147: 17 July 1959	Station 226-264: 20-24 July 1961
Station 174-207: 30 Jan – 2 Feb 1960	Station 265-287: 8-10 Nov 1961
Station 211: 4 Feb 1960	Station 288-304: 29-31 Jan 1962
Station 219-225: 11 July 1961	Station 305-324: 2-5 Feb 1962.

C3 Station Records

Stations DS143-7, in the region of the Eddystone Lighthouse, were sampled as part of the original English Channel Benthic Survey along the English coast. They were not included in the first paper (Holme, 1961). No reason was given for their initial exclusion, but their distance from the shore or deep locations appear to be likely reasons. Stations DS144 (Haul 2 & 3), DS145 and DS147 were included in Dr. Holme's second paper (Holme, 1966). In all 10 hauls appear to have taken place within stations DS143-7 as follows: 143 (1), 144 (4), 145 (2), 146 (2), 147 (1). NMBL reference PHM4, book 8 has station positions, dates and depths for all these hauls. The second paper (Holme, 1966) suggests, but for the hauls highlighted, that they may all have suffered from washing out of the sediment from the net. Only the stations included on the paper this survey relates to (Holme, 1966) are included as records.

Sites DS 208-10 are recorded in Dr. Holme's notes as having taken Suction samples only. Details were not included in the Holme (1966) paper or PHM2, book 17 notebook. Stations DS212-8 are also excluded from both the paper and notebooks. There is no record of what samples were taken at these sites. They will have been samples from between North-East Guernsey and North of Cap de la Hague.

Station locations were originally positioned using DECCA co-ordinates. Holme published both Latitude and Longitude and his DECCA co-ordinates (Holme, 1966). Marine Recorder requires Lat/Long positions for all stations, but for completeness the DECCA co-ordinates were added to the Event Location description. DECCA co-ordinates were always written in the order Red, Green, Purple with hyphens replacing any omitted numbers.

The positions of the sample sites were obtained from Holme's Part 2 paper (1966) and field notebook PHM 2, book 17 from the NMBL archive. An approximate description of each location was either taken from the notebooks or worked out using Admiralty charts. The descriptions, for instance 10km S of Start

Point, for each survey record are in the Location tab within Marine Recorder.

Treatment and Sample composition data was obtained from Holme (1966) and the following notebooks in the NMBL archive:

Stations DS144-7 (NMBL ref PHM4, Notebook 8);

Stations DS152-264 (PHM2, book 17; written up from by Holme/duplicated in PHM4, book 3);

Stations DS265-324 (PHM4, book 3).

All depths are recorded from the Echosounder readings. These were not corrected for tidal height “to conform with common practise”. The depths in fathoms were subsequently converted by Holme to metres for inclusion on the Holme (1966) paper and rounded to the nearest metre.

From station DS219, Holme also stopped recording in his notebooks the fathom readings from the Echosounder. Depth values are taken from the Holme (1966) paper and are only in metres. Start times were also omitted. A space appears to have been left in the notebook (NMBL ref PHM 2, book 17) for depth readings, start times, DECCA and Lat/Long co-ordinates, but it appears they were never written in.

There is a note (before DS226 in notebook PHM2,17) saying that the Echosounder was set to 0, rather than 2 fathoms, for stations DS226-264. There is no record as to whether this was taken into account for the depth readings in Holme (1966).

C4 Species Records

Species lists were taken from sheets of notes held in the NMBL archive. Living species were recorded on the front of each sheet with dead shell records on the reverse. The records are stored under NMBL reference PHM4, in an A4 folder entitled “Bottom Sampling Station Records DS174-324, Also DS144-147 & M1-M20”

C5 Benthic Survey Part Two specific sample comments:

The comments below are all quotes taken from the sampling notes, see above for NMBL references.

Station codes are given for all comments to allow subsequent cross-referencing.

- DS145: “Very large sample, occupying 6 jars.”
- DS180: “Sievings very clean. Broken shells more common than whole ones.”
- DS184 (off Boulogne): “Note absence of Western (channel) species with possible exception of *Gari depressa*”
- “Absence of *Lithothamnion* from all stations between DS186 & DS198.”
- DS187: “Among the large numbers of *Spisula* shells, of a number that were picked out for identification, only 2 were *S. solida*.”
 - “Some of the *Tellina* (now *Moerella*) *pygmaea* shells had eggs (or an encrusting

ascidian?) attached to the inside of the shell, suggesting that they were lying on the surface.”

- DS190: “Some dead shells rather large e.g some *Dosinia*, *Arcopagia* (was *Tellina crassa*)”
- DS201: “NB this station shows Sarnian (Channel Island?) influence - e.g *Verrucosa*, *Calyptreaea* & abundance of *Venerupis* (now *Tapes*) *rhomboides*. Also come *Chlamys varia*. Conversely certain species are less common - e.g *Diplodonta* absent, *Spisula elliptica* rare, *Gari tellinella* absent: Weak Western influence here. Is *Galeomma* a western sp?”
- DS204: “NB. *Diplodonta* specimens in previous hauls across the bay should be checked to see if any *Mysia* present.”
- DS206: “This station should be compared in detail to DS101”
- DS211: “Records mainly appear to be of epifauna. Dragged some distance.”
- DS223: “NB the slight western influence noticeable in 221 & 222 seems to have disappeared here. *Venus* (now *Circomphalus*) *casina* has given way to *Venus verrucosa*; *Gari tellinella* now absent; Also *Chlamys distorta* no longer present.”
- DS232: “cf fauna. Espec dead shells with previous stations 230,231 etc. e.g *Dosinia* reappears, *Gouldia* becoming rare.”
- DS240 (haul 1): “*Lithothamnion calcareum* - about 1/2 a small honey jar full. Appeared to be dead. Flattened branching form. None recorded from previous stations in this cruise.”
- DS245: “Two small hauls count as one haul”
- DS266: “Also 2 clumps of cemented shells comprising *Venerupis* (now *Tapes*) *rhomboides*, *Chlamys varia*, Flint & Chalk”
- DS279: “NB. Some good sized-shells of *Dosinia*, *Laevicardium*, *Glycymeris* & *Arcopagia*. A remarkable haul. Complete count of shells in jars.”
- DS280: “Interesting station cp & cf DS279 Warm water spp absent. But *Tellina* (now *Moerella*) *pygmaea*. Also *Tellina* (now *Angulus*) *tenuis*, *Thracia* (2 spp) etc. *Venerupis* (now *Tapes*) *rhomboides* absent.”
- DS310: “Note - Slowly changing fauna, with *Lima* (now *Limaria*) *loscombi* becoming more commoner than *L. hians*. *Gouldia* & *Ophiocomina nigra* coming in. *Venus* (now *Circomphalus*) *casina* replacing *Venus verrucosa* & so on. *Chlamys varia* replaced by *Chlamys tigrina* (now *Palliolum tigrinum*)”
- DS314: “NB Presence of *Arcopagia*, also *Chlamys varia*. Absence of *Chlamys tigrina* (now *Palliolum tigrinum*). Scarcity of *Venerupis* (now *Tapes*) *rhomboides*.”
- DS317: “1 jar lost. The other, sievings only, sorted.”

- DS318: “Jar containing larger animals broken & some of it lost”
- DS319: “NB. Replacement of *Lima* (now *Limaria*), *Astarte sulcata*, *Venus* (now *Circomphalus*) *casina* by forms such as *Chlamys tigrina* (now *Palliolium tigrinum*), *Goodallia triangularis*, *Parvicardium*, *Dosinia*, *Gari tellinella* & *Thracia villosiuscula*, *Solecurtis scopula*.”
- DS324: “Of 2 jars one had preserved sievings, the other larger shells & animals which were not preserved. Hence doubt as to whether some additional shells were alive.”

C6 Dead Shell Comments for Benthic Survey Part 2:

These comments are also quotes from the species notes left by Dr. Norman Holme. Each comment includes a station reference.

- DS175 : “Not all kept after sorting”
- DS185,273: “Selection from a large number”
- DS186: “Nearly all the entire shells in this small sample (listed?)”
- DS188: “Small amount of sieving.”
- DS200: “NB Large Size of some shells, espec *Arcopagia*”
- DS207: “Note - many species present at previous stations, now absent.”
- DS225: “selection”
- DS229,230: “A fine shell gravel containing many small shells. A small (sample was) selected..., plus a few larger shells.”
- DS237: “Species list becoming more restricted”
- DS244: “Selection from large number of small shells in sievings.”
- DS254,279: “all”
- DS259,265: “no sievings”
- DS294: “Not many small shells in the sievings”
- DS307: “not many in sample”

Appendix D: Norman Holme's Species listing order – Benthic Dredges – DS stations sampling.

Norman Holme was using some sort of check-list for identifying species in the samples. At the present time I have been unable to find an actual list, but the list below accurately portrays Holme's species listings in the Benthic Survey sample.

The following order was followed, with very few exceptions for both the living and dead species records. In some places species were recorded in the wrong order and an arrow has been used to put them in their right place! Species were only listed if they were present. For ease of writing I have only used the Genus of species, Holme kept species in the same order each time – for instance *Abra abra* always came before any *Abra prismatica*. (see Appendix E the for modern latin names)

<i>Nucula sp.</i>	<i>Laevicardium/Parvicardium</i>	<i>Lutraria</i>
<i>Glycymeris glycymeris</i>	<i>Dosinia</i>	<i>Mya</i>
<i>Arca lactea</i>	<i>Anomiid sp.</i>	<i>Buccinum</i>
<i>Modiolus</i>	<i>Thyasira</i>	<i>Gari</i>
<i>Mytilus</i>	<i>Mysella</i>	<i>Crepidula</i>
<i>Ostrea</i>	<i>Mysia</i>	<i>Corbula</i>
<i>Chlamys</i>	<i>Limaria</i>	<i>Thracia</i>
<i>Pecten</i>	<i>Venus</i>	<i>Hinia</i>
<i>Astarte</i>	<i>Venerupis</i>	<i>Natica</i>
<i>Kellia</i>	<i>Tellina</i>	<i>Turritella</i>
<i>Gouldia</i>	<i>Arcopagia</i>	<i>Dentalium</i>
<i>Phacoides</i>	<i>Macoma</i>	<i>Calliostoma</i>
<i>Diplodonta</i>	<i>Abra</i>	<i>Gibbula</i>
<i>Montacuta</i>	<i>Solecurtus</i>	<i>Calyptreaea</i>
<i>Cardium</i>	<i>Ensis</i>	
<i>Lepton</i>	<i>Spisula</i>	

Followed by species generalities – ascidians, worms, crabs etc

Finally details of echinoderms where present, e.g *Asterias*, *Echinus*

There are a few more species that occur less frequently, but were recorded every time they were present, which have not been included. A comprehensive could be generated by recording from each species record.

Appendix E: Species Names changed since 1959 - Benthic Surveys Parts 1 & 2.

E1 Background

The following lists show the species names used by Dr. Norman Holme in the species lists that have changed since 1959 with their new names that have been used in Marine Recorder and the spreadsheets. To enable cross referencing there are two versions of the list. In the first the names Holme used on his species lists are in alphabetical order with the current name following. In the second list the current names are in alphabetical order with Holme's names afterwards. Species information can be found in the species information sheets, PHM4 in the NMBL archive, entitled "English Channel Fauna, Station Faunal Records, Stations 1-173" & "Bottom Sampling Station Records DS174-324, Also DS144-147 & M1-M20".

Species names were checked against the database in the Natural History Museum (NHM). The database is called the Natural Biodiversity Network (NBN) Species Directory <http://nbn.nhm.ac.uk/nhm/>. A copy of Howson & Picton (1997) "The species directory of the marine fauna and flora of the British Isles and surrounding seas" was also used to check species names. The third source used to identify names was the Flanders Marine Institute taxon search. This can be found at <http://www.vliz.be/vmdcdata/aphia/search.htm> and was very comprehensive at listing old Latin names for a species and then giving a link to the currently accepted name. This list was more up to date than the NHM, but cross-referencing is recommended because Marine Recorder's database was developed around the NBN Species Directory.

E2 Species Name Changes 1959 to Present (2005).

The name Dr. Holme used is on the left with the current (2005) name on the right:

- *Acmaea* = *Tectura*
- *Acrocnida brachiata* = *Amphiura brachiata*
- *Aloidis gibba* = *Corbula gibba*
- *Ammotrypane aulogaster* = *Ophelina acuminata*
- *Amphioxus* = *Brachiostoma lanceolatum*
- *Arca lactea* = *Striarca lacteal*
- *Astarte triangularis* = *Goodallia triangularis*
- *Atelecyclus septemdenlatus* actually should be spelt *Atelecycles septemdatus* and is now
Atelecyclus rotundatus
- *Bulla* = *Retusa*
- *Calyptraea sinensis* probably the same as *Calyptraea chinensis*
- *Cardium echinatum* – assumed to be the same as *Acanthocardia echinata*

- *Cardium edule* = *Cerastoderma edule*
- *Cardium exiguum* assumed to be the same as *Parvicardium exiguum*
- *Cardium norvegicum* = *Laevicardium crassum*
- *Chlamys furtiva* = *Palliolum striatum*
- *Chlamys opercularis* = *Aequipecten opercularis* = Queen Scallop/Queens
- *Chlamys similis* = *Similipecten similis* as specified on Marine Recorder, NHM database and MCS Species directory. However the Flanders Marine Institute taxon search <http://www.vliz.be/vmdcdata/aphia/search.htm> specifies, according to de Kluiver et al (2000) Macro-benthos of the North Sea: 1. Keys to Mollusca & Brachiopoda, that the current name is *Hyalopecten similis* and that *Similipecten* is now a synonym. *Similipecten* has been used to be accepted by Marine Recorder.
- *Chlamys tigrina* = *Palliolum tigrinum*
- *Crenella prideauxi* = *Rhomboidella prideaux*
- *Cucumaria elongata* = *Leptopentacta elongata*
- *Cucumaria lactea* = *Ocnus lacteus*
- *Cucumaria normani* = *Aslia lefevrei*
- *Cucumaria saxicola* = *Pawsonia saxicola*
- *Cultellus pellucidus* = *Phaxus pellucidus*
- *Cyprina* – reference found to *Cyprina islandica* online and Icelandic cyprine (*Arctica islandica*); listed under *Arctica islandica*.
- *Dentalium entalis* = *Antalis entalis*
- *Dentalium vulgare* = *Antalis vulgaris*
- *Diodora aperture* = *Diodora graeca*
- *Dromia vulgaris* = *Dromia personata*
- *Emarginula conica* = *Emarginula rosea*
- *Emarginula reticulate* = *Emarginula fissura*
- *Eulima polita* = *Polygireulima polita*
- *Gafrarium minimum* = *Gouldia minima*
- *Goneplax angulata* = *Goneplax rhomboides*
- *Hermione hystrix* = *Hermonia hystrix*
- *Hiatella* (crevice-living form) listed as *Hiatella arctica* (DS144(2))
- *Hippocampus europaeus* = *Hippocampus hippocampus*
- *Ilyanthus* assumed to be *Ilyanthus mitchelli* = *Mesacmaea mitchelli*

- *Lepadogaster bimaculatus* = *Diplecogaster bimaculata*
- *Lepralia* = *Lepraliella*
- *Lepralia foliacea* = *Pentapora fascialis*
- *Lima subauriculata* (Montagu) = *Limatula subauriculata*
- *Lithothamnion calcareum* = *Phymatolithon calcareum*
- *Littorina littoralis* = *Littorina obtusata*
- *Littorina rudis* = *Littorina saxatilis* subsp. *rudis*
- *Mactra corallina* = *Mactra stultorum*
- *Modiolus phaseolinus* = *Modiolula phaseolina*
- *Montacula ferruginosa* = *Tellimya ferruginosa*
- *Musculus marmoratus* = *Modiolarca tumida*
- *Nassarius pygmaeus, reticulatus, incrassatus* = *Hinia pygmaea, reticulata, incrassata*.
- *Natica catena* = *Euspira catena*
- *Natica poliana alderi* – *Natica alderi* and *Lunatia poliana* are both synonyms of *Polinices pulchellus*.
- *Nephtys* = *Nephtys*
- *Nucula nitida* = *Nucula nitidosa*
- *Nucula turgida* = *Nucula nitidosa*
- *Nuculana minuta* = *Jupiteria minuta*
- *Onuphis conchylega* = *Nothria conchylega*
- *Pallasia murata* = *Lygdamis muratus*
- *Palmipes membranaeus* = *Anseropoda placenta*
- *Pandora albida* = *Pandora inaequivalvis*
- *Pandora margaritacea / albida* = *Pandora inaequivalvis*
- *Patina pellucida* = *Helcion pellucidum*
- *Peachia hastate* = *Peachia cylindrica*
- *Pectinaria auricoma* = *Amphictene auricoma*
- *Pectinaria auricoma* = *Amphictene auricoma*
- *Pectinaria koreni* = *Lagis koreni*
- *Phacoides borealis* = *Lucinoma (or Lucina) borealis*
- *Phascolion strombi* assumed to be *Phascolion strombus*
- *Phascolosoma elongatum* = *Golfingia elongata*
- *Phascolosoma vulgare* = *Golfingia vulgaris*

- *Phasianella pulla* = *Tricolia pullus*
- *Porcellana longicornis* = *Pisidia longicornis*
- *Portumnus variegates* = *Portumnus latipes*
- *Portunus arcuatus* = *Liocarcinus arcuatus*
- *Portunus depurator* = *Liocarcinus depurator*
- *Portunus holsatus* = *Liocarcinus holsatus*
- *Portunus pusillus* = *Liocarcinus pusillus*
- *Pseudocucumis mixta* = *Neopentadactyla mixta*
- *Purpura lapillus* = *Nucella lapillus*
- *Pyrgoma* is the barnacle that lives on Devonshire Cup Coral. The current name is *Megatrema anglicum*, but Marine Recorder will only accept an older name of *Boscia anglica*. Therefore *Boscia anglica* is used.
- *Solecortus chamasolen* = *Azorinus chamasolen*
- *Squilla desmaresti* = *Meiosquilla desmaresti*
- *Tealia* = *Urticina*
- *Tellina crassa* = *Arcopagia crassa*
- *Tellina donacina* = *Moerella donacina*
- *Tellina fabula* = *Fabulina fabula*
- *Tellina pygmaea* = *Moerella pygmaea*
- *Tellina squalida* = *Angulus squalidus*
- *Tellina tenuis* = *Angulus tenuis*
- *Thaia polita* - 1 probably *Thia potua* which is now *Thia scutellata* and listed as such.
- *Thalassema lankesteri* = *Maxmuelleria lankesteri*
- *Velutina laegivata* = *Velutina velutina*
- *Venerupis rhomboides* = *Tapes rhomboides*
- *Venerupis pullastra* = *Venerupis senegalensis*
- *Venerupis saxatilis* = *Venerupis senegalensis*
- *Venus casina* = *Circomphalus casina*
- *Venus fasciata* = *Clausinella fasciata*
- *Venus striatula* – now *Chamelia gallina*, listed as common (DS1).
- *Venus ovata* = *Timoclea ovata*

E3 Species Name Changes 2005 – 1959

Current 2005 name on left followed by 1959 name.

- *Acanthocardia echinata* assumed to be the same as *Cardium echinatum*
- *Aequipecten opercularis* = *Chlamys opercularis* = Queen Scallop/Queens
- *Amphictene auricoma* = *Pectinaria auricoma*
- *Amphictene auricoma* = *Pectinaria auricoma*
- *Amphiura brachiata* = *Acrocnida brachiata*
- *Angulus squalidus* = *Tellina squalida*
- *Angulus tenuis* = *Tellina tenuis*
- *Anseropoda placenta* = *Palmipes membranaeus*
- *Antalis entalis* = *Dentalium entalis*
- *Antalis vulgaris* = *Dentalium vulgare*
- *Arcopagia crassa* = *Tellina crassa*
- *Arctica islandica* = *Cyprina* – reference found to *Cyprina islandica* online and Icelandic cyprine (*Arctica islandica*);
- *Aslia lefevrei* = *Cucumaria normani*
- *Atelecyclus rotundatus* = *Atelecyclus septemdenlatus* actually should be spelt *Atelecycles septemdatatus*
- *Azorinus chamasolen* = *Solecurtus chamasolen*
- *Boscia anglica* = *Pyrgoma* is the barnacle that lives on Devonshire Cup Coral. The current name is *Megatrema anglicum*, but Marine Recorder will only accept an older name of *Boscia anglica*.
- *Brachiosstoma lanceolatum* = *Amphioxus*
- *Calyptraea chinensis* probably the same as *Calyptraea sinensis*
- *Cerastoderma edule* = *Cardium edule*
- *Chamelia gallina* = *Venus striatula*
- *Circomphalus casina* = *Venus casina*
- *Clausinella fasciata* = *Venus fasciata*
- *Corbula gibba* = *Aloidis gibba*
- *Diodora graeca* = *Diodora aperture*
- *Dromia personata* = *Dromia vulgaris*
- *Emarginula fissure* = *Emarginula reticulate*
- *Emarginula rosea* = *Emarginula conica*

- *Euspira catena* = *Natica catena*
- *Fabulina fibula* = *Tellina fabula*
- *Golfingia elongate* = *Phascolosoma elongatum*
- *Golfingia vulgaris* = *Phascolosoma vulgare*
- *Goneplax rhomboids* = *Goneplax angulata*
- *Goodallia triangularis* = *Astarte triangularis*
- *Gouldia minima* = *Gafrarium minimum*
- *Helcion pellucidum* = *Patina pellucida*
- *Hermonia hystrix* = *Hermione hystrix*
- *Hiatella arctica* = “*Hiatella* (crevice-living form)” (DS144(2))
- *Hinia incrassata* = *Nassarius incrassatus*
- *Hinia pygmaea* = *Nassarius pygmaeus*,
- *Hinia reticulata* = *Nassarius reticulatus*,
- *Hippocampus hippocampus* = *Hippocampus europaeus*
- *Jupiteria minuta* = *Nuculana minuta*
- *Laevicardium crassum* = *Cardium norvegicum*
- *Lagis koreni* = *Pectinaria koreni*
- *Lepadogaster bimaculatus* = *Diplecogaster bimaculata* =
- *Lepraliella* = *Lepralia*
- *Leptopentacta elongate* = *Cucumaria elongata*
- *Limatula subauriculata* = *Lima subauriculata* (Montagu)
- *Liocarcinus arcuatus* = *Portunus arcuatus*
- *Liocarcinus depurator* = *Portunus depurator*
- *Liocarcinus holsatus* = *Portunus holsatus*
- *Liocarcinus pusillus* = *Portunus pusillus*
- *Littorina obtusata* = *Littorina littoralis*
- *Littorina saxatilis* var. *Rudis* = *Littorina rudis*
- *Lucinoma* (or *Lucina*) *borealis* = *Phacoides borealis*
- *Lygdamis muratus* = *Pallasia murata*
- *Mactra stultorum* = *Mactra corallina*
- *Maxmuelleria lankesteri* = *Thalassema lankesteri*
- *Meiosquilla desmaresti* = *Squilla desmaresti*
- *Mesacmaea mitchelli* = *Ilyanthus* assumed to be *Ilyanthus mitchelli*

- *Modiolarca tumida* = *Musculus marmoratus*
- *Modiolula phaseolina* = *Modiolus phaseolinus*
- *Moerella donacina* = *Tellina donacina*
- *Moerella pygmaea* = *Tellina pygmaea*
- *Neopentadactyla mixta* = *Pseudocucumis mixta*
- *Nephtys* = *Nephtys*
- *Nothria conchylega* = *Onuphis conchylega*
- *Nucella lapillus* = *Purpura lapillus*
- *Nucula nitidosa* = *Nucula nitida*
- *Nucula nitidosa* = *Nucula turgida*
- *Ocnus lacteus* = *Cucumaria lactea*
- *Ophelina acuminata* = *Ammotrypane aulogaster*
- *Palliolum striatum* = *Chlamys furtiva*
- *Palliolum tigrinum* = *Chlamys tigrina*
- *Pandora inaequalvis* = *Pandora albida*
- *Pandora inaequalvis* = *Pandora margaritacea* / *albida*
- *Parvicardium exiguum* assumed to be the same as *Cardium exiguum*
- *Pawsonia saxicola* = *Cucumaria saxicola*
- *Peachia cylindrical* = *Peachia hastate*
- *Pentapora fascialis* = *Lepralia foliacea*
- *Phascolion strombus* assumed to be *Phascolion strombi*
- *Phaxus pellucidus* = *Cultellus pellucidus*
- *Phymatolithon calcareum* = *Lithothamnion calcareum*
- *Pisidia longicornis* = *Porcellana longicornis*
- *Polinices pulchellus* = *Natica poliana alderi* – *Natica alderi* and *Lunatia poliana* are both synonyms.
- *Polygireulima polita* = *Eulima polita*
- *Portumnus latipes* = *Portumnus variegates*
- *Retusa* = *Bulla*
- *Rhomboidella prideaux* = *Crenella prideauxi*
- *Similipecten similis* = *Chlamys similis* as specified on Marine Recorder, NHM database and MCS Species directory. However the Flanders Marine Institute taxon search <http://www.vliz.be/vmdcdata/aphia/search.htm> specifies, according to de Kluiver et al

(2000) Macrobenthos of the North Sea: 1. Keys to Mollusca & Brachiopoda, that the current name is *Hyalopecten similis* and that *Similipecten* is now a synonym. *Similipecten* has been used to be accepted by MRec.

- *Striarca lactea* = *Arca lactea*
- *Tapes rhomboides* = *Venerupis rhomboides*
- *Tectura* = *Acmaea*
- *Tellimya ferruginosa* = *Montacula ferruginosa*
- *Thia scutellata* = *Thaia polita* - probably *Thia potua*.
- *Timoclea ovata* = *Venus ovata*
- *Tricolia pullus* = *Phasianella pulla*
- *Urticina* = *Tealia*
- *Velutina velutina* = *Velutina laegivata*
- *Venerupis senegalensis* = *Venerupis pullastra*
- *Venerupis senegalensis* = *Venerupis saxatilis*

Appendix F: Index of Common Names or Species Descriptions used during the Benthic Surveys

Parts 1 & 2.

This index lists all the common names used by Holme, descriptions higher up the taxonomic hierarchy than Genus, and latin names not accepted by the NBN Species Directory with no more recent name found. All these references were entered into the Sample description section of Marine Recorder. The references, e.g. DS4, refer to the sample where that species was located. References are separated using a bullet point between Benthic Survey Parts 1 & 2. The full abundance or Presence/Absence is included in the sample description where given:

- Amphipods
 - DS4,19,20,22,32,45,48,51-2,60,61,65(1),70,83,95,104,111,113,119-20,123,134,136,140-1,155,157,163-4,168
 - DS145,183,190,195,198,207,211,225-7,232,238,245,248,251-2,255,257-8, 260-1,263,265,269,275-6,279-80,283-4,288,291,294,297,304,307,311-2,322
- Anemones,
 - DS1,2,4,8,11,18-20,22,24,29,32,39,40,42,43,46,49, 51-3,55,57,61,63,68,79,84,85,91,93,101,105-8,110-1,120,141-2,150-1,171,173
 - DS144(2),145,147,175-6,178,184,187,192,194-203,205-7,222-3,226,228,231, 235-6,239,243,247,251,268-9,276,278-80,288-90,292,295-7,299,301-2,305, 311-2,314,319,322-3
- *Anomiid* sp – Comment in DS180 – “Not always distinguished from *Ostrea*”. Anomiidae is a Family within the Ostreoida, but no genus’ or species have been mentioned throughout the surveys.
 - DS1-33,7,11-2,18-20,25,36,40,44-5,55-63,65(1)(2),66-7,69,72-74(1)(2),76-8,82-3,87-92,96-7,99,101-4,110,113,115-7,120,123,127,134-7,139,142,151,153,155, 157-8,161,163-4,167-8,172
 - DS144(2)(3),145,147,174,176,178-9,182,186-9,191,194,196-207,211,223-40(1)(2),243-58,260-1,264-75,277-9,285-91,293-304,306-24
- Ascidians
 - DS2,4,16,48,54,55,57,58,64,85,91,96,98,100,101,120,130,134,136,140,155
 - DS195 (green),196,197,201,205-7,211,222-3,228,231,236,239,247-52,254-5,257, 259-61,265,267,269,276-8,284,286,288,292-4,296-7,299-301,304-8,311,315-7, 322-4
- *Aspidosiphon clavatus* – DS263
- Burrowing anemone – DS40
- *Calopodium* – DS49,79

- *Calopodium album/albidium* – DS32,61
- *Calopodium pinna* – DS42
- Caprellids – DS85,263
- Chiton –
 - DS85,116,118,122,125,133
 - DS177,205,211,226,228,231,237,251-2,256-8,260,265,267,289,294,298,302, 305,310,315,320-1
- Chlamys spat – DS230
- Clumps of cemented shells – DS266
- Crabs/small crabs –
 - DS54,57,60,64,66,136-41,151,157,163-4
 - DS145,178,312,319,324
- Crustacean - DS136
- Cumacean - DS134
- Cucumaria – spp not specified several genus' used to be Cucumaria
 - DS112,113,134,135,301
- Cypraea – DS1
- Dorid – DS46,206,222
- Elver - DS197
- Encrusting polyzoan – DS84
- *Eulima polita* – now known as either *Melanella alba* or *Polygireulima polita* – DS155
- Fissurella – (“*Diodora?*” - DS277)(“*Fissurella apertura*” – DS294,309)
 - DS18,60-1,63,65(1)(2),67,71-2,74(1)(2),77,83-5,89,95-8,100,102,113,123,127,133,135-6,139,157,161,163,168,172
 - DS174,176-83,186-8,192-3,197-9,201-3,205,221-3,225,227,232-9,244-5,247-52, 255-8,260-1,263,266-73,275-7,283-4,286,290-4,297-9,301,303-9,311-2,314-7, 323-4
- Flat worm – DS184
- Fossil Ostreidae – DS90 (some sent to Dr. M.R Cox, B.M), DS91
- Fossil tellinid (*macoma?*) – DS87,88,89
- Fossil Trigonina – DS179
- *Gari vespertina* – DS267,297
- Gastropod –
 - DS45,48,50-1,60-3,67-71,73,74(2),77-9,81-2,89-91,95,96, 103-4,110-1,113,117,119-

- 20,124,126-7,129,133-41,152,155,161,163,166,170-3
- DS145,147,174,179,181-4,190,193,195,197-207,211,222,225-6,228,231,233,237, 248,250-3,255-7,261,266-7,269-70,278,280-1,285,290,293-4,296,299-300,302-5,307-10,312-6,318-9
- Gephyreans indet – DS108
- Granulated Calliost – DS179,190-1,194,197,223,228,231-2,234,236,251,255,258, 261,263-4,267,269,277,283,286,290,293,296,305,313-8,321
- Granulated & Whorled *Calliostoma* – DS256-7
- Goby: DS195
- Hermione (likely to be *Hermonia*, closely related to *Aphrodite*) – DS20,135,324
- Hydroid –
 - DS7-12, 17,19-22,24,42-6,48,49,50,52,53,57,60-4, 66-7, 70-1,73-4(1),78,81-6,88,91-3,95-8,100-6,109,110-2,115-6,121,123,127,130,133-5,142,148,153-8,160-1,163,170-1,173
 - DS144(2)(3),145,147,176-81,183-5,187,191,193-7,199,201-3,205-7,211,221-8, 230-1,233-9,240(2),243-6,248-52,255-61,263-7,269-70,272,274-8,283-90,292-7, 301-5,307-18,320-4
- Isopod –
 - DS4,48,133
 - DS187,238-9,242,252,255,279-80,295,306,308,323
- Lamellibranch – DS82,134,166
- Larval lobster – DS144(3)
- Leach – DS231
- Limpets – DS116,117,120,123,127,135,136,137,244,260
- Maldanid – DS96
- *Marginella laevis* – DS260-1,263,288
- Melinna-like worms – DS1,119,152
- Murex –
 - DS11,120
 - DS174-5
- *Natica* sp –
 - DS42,44,62,63,65(1),66,70,71,72,75-9,83,90,97,105,110, 117,124,126,129,134, 137,139-41,163,166,169,171-2

- DS145,147,179,185,190,195,202,225,228,233-5,237-8,242,279-81,288,318,324
- Nemertine –
 - DS90,137
 - DS176,182,195,269,282,286,290,296,303,322
- Nudibranch – DS52
- Ophiurid – DS45
- Other siphons (short) – DS20
- Other worms – DS1.
- *Owenia*-type tubes – (“*Owenia* tubes” also filed here, subsequent reclassification?)
 - DS5,41,59,90,91,103,104,117,119, 148,153
 - DS187,195,198,203-5,211,271
- *Pandora obtusa* – not found DS140 “*Pandora pinna (obtusa)*”DS157 – listed under *P. pinna* in both samples.
- Pholadidae – DS82,85,91,101
- Pholads – DS10,90
- Pleurotoma – DS14,52,53,323
- Polynoid – DS178,193,205-6,226,235,283-4,303,322
- Polyzoa –
 - DS64,85,120,130,134,160
 - DS177,228,231,237,245,250,287,302,307,314,318,323
- Porcellanid – DS2,8,11,17,64,71,85,91,92
- Post-larval decapod –
- DS32
- DS176
- Prawn –
 - DS14,173
 - DS145,178,184,187,222,235,239,245,254-5,257-8,260,265,273,276-8,280,282, 307,309,312
- Prickly cardium – DS173.
- Pycnogonid – DS144(3),145,266,311
- Red & Yellow sponges on gastropod shells – DS4
- Rockling – DS277
- Sand Eel – DS186,189-90

- *Scalaria* – DS183,289,319 – gastropod?
- Serpulid – DS191
- Shrimp – DS52,53,60,71
- Small crustacean + – DS1.
- Small gastropods – DS19,42
- *Solea variegata* – DS289
- Spawn? – DS57,141
- Sponges –
 - DS57,66,70,84-6,92-3,96-8,100,101,116,123,130,134,142,154
 - DS144(3),175-6,178,184,196,205-7,211,221-2,226-7,231,234-8,245-7,250-2, 254-61,263-5,276-8,289,296,300,304-9,312,314,316,324
- Suckerfish – DS38,178,196,272,276
- Synapta or Synaptid – DS42,51
- Tectibranch – DS179
- Terebellid – DS5,55,83,126,130,140
- *Thaia polita* – DS105,280
- Trochid – DS116,119,120,168,190,299,301-2
- Unidentified lamellibranch – DS77,232
- Unidentified tellinid – DS76
- Worm(s) –
 - DS2-4,8,9,11-9,20,22,25,32,42-46,48-53,56-8,60-4,66-73, 74(1),77-9,81-5,87,90-2,95,97-9,101-13,115-21,123-7,129,134-42,148,151-5,157-61,163-6,168-71,173
 - DS144(2)(3),145,147,174,177-8,181,183-8,190,192,194-7,199,201-3,205-7,211, 221-8,230-9,240(2),242-8,250-61,263-6,268-82,284-91,293-4,296-9,301-2, 305-13,315-6,318-20,322-4

Appendix G: Thoughts on Anchor Dredges and their net sizes

During the Benthic dredge surveys (Holme, 1961, 1966), a modified anchor dredge was used for all samples, unless stated otherwise in the sample descriptions. A drawing of this dredge is shown in figure 9. The dredge was modified to reduce the amount of digging into the sediment compared to the original Forster design (Forster, 1953). The dredge was 61cm wide, 30.5cm high and 40.7cm deep (Holme, 1961). The net was lined with Stramlin (burlap) inside the Courlene from sample DS174 onwards to reduce the amount sediment washing out of samples. Despite describing the frame size, the net size or volume was not recorded at any point.

In shallower water a “small anchor dredge” (possibly the Forster dredge?) was deployed where specified in the Sample Description, usually with Stramlin lining to the net. A note against station DS241 (NMBL ref PHM2, book 17) records that the quantity of sediment was less than half what the larger anchor dredge would have brought up. Dr. Holme also recorded (Station DS246, PHM2, book 17) that the “small dredge (works) ok in shallow water, but does not take the warp out fast enough”. This is a reference to a need for the dredge to take the warp out quickly in order to land the dredge on the required ground.

Stations DS24 and 25 were sampled with a conventional fine-mesh biological dredge resulting from damage to the Anchor dredge. An Amphioxus dredge was carried on board and was deployed occasionally during the survey. Stations DS221-3 and DS242 have recorded usage of this dredge. Although Dr. Holme has not specified why this dredge was deployed, usage appears to have taken place when damage was sustained to the larger anchor dredge, or net, and the Amphioxus dredge was used until the damage was repaired (usually later that day).

During his Benthic Surveys, Dr. Holme frequently specified the sample size in relation to the Anchor dredge net being “half full” or “full”. While it is possible to quantitatively compare one sample that was a “full dredge” with another “half full dredge”, how big was the dredge? Dr. Holme described his Anchor-dredge as a modified Forster Dredge including dimensions of the dredge frame (Holme, 1961), but the size of the net was not quantified in the paper or in any of his notebooks. A personal communication with the firm of Duncan & Associates who sell anchor dredges (www.duncanandassociates.co.uk) suggested that a common net bag length, sold for use with a 2 ft x 1ft x 16 in anchor dredge, would be 1.5 metres with an additional 0.5 m collar (*pers. comm.*, 2005). A bag volume was calculated as 0.2789 m³ or 278.9 litres if it was completely full. Dr. Holme described the volume of his Anchor dredge net with “samples were often very large (100 l. or more)” (Holme, 1961). This comment suggested that a net bag of 1.5m length was unlikely to have represented a “full dredge”.

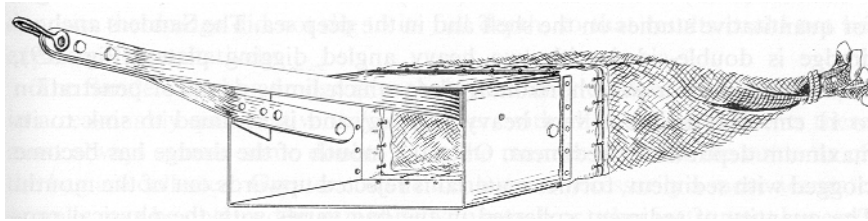


Figure 9: A drawing of Dr. Norman Holme's modified anchor dredge. The bag is only 1.5x the length of the frame.
 Drawn by Mr G.A. Battin (Holme, 1961)

Dr Holme photographed a Forster Anchor dredge (Figure 6.7 in Holme & McIntyre, 1971). The photograph showed an exceedingly short net in relation to the size of the dredge frame. The net appeared to be the same length as the dredge frame itself.

The figure above (figure 9) reproduces a drawing of Dr Holme's modified double-sided anchor dredge. No scale has been included in the drawing. If the drawing was assumed to be to scale then the dredge is 2ft wide by 1ft high by 16" deep (Holme, 1961). This again shows a net no more than 1.5 times the length of the frame or about 32 inches (0.81m). This would give an approximate net volume of 9216 in³ or 151 litres. This diagram is also used to illustrate a semi-quantitative double-sided anchor dredge in both editions of 'Methods for the Study of Marine Benthos' consulted (Holme & McIntyre, 1971; Eleftheriou & McIntyre, 2005).

By contrast, the photograph right (figure 10) was taken of an anchor dredge on a cruise Dr Holme took part in during June 1975. The photographer was R.L. Barratt, regular assistant to Dr Holme throughout his biological surveys. The dredge pictured appears to be approximately 2 foot wide, but the net is closer to four feet or 1.2m in length from the frame to collar at the bottom. This would give a volume of 226 litres for the net, not including the frame volume.

Dr Holme's anchor dredge surveys took place between 1958 and 1962, about 15 years before the photograph (figure 10), and while it is very difficult to be sure of the actual volume of the anchor dredge the assumption that materials may have changed and techniques evolved has to be made. This would also explain the differences in net length



Figure 10: Recovery of a 2 foot wide Anchor dredge, June 1975.
 ©Photographer: R.L. Barrett.

from the original Forster dredge at approximately 0.81m (1961), to 1.2m (1975), and 1.5m (2005) for similar sized dredges. If the drawing above (figure 9) were assumed to be drawn to scale then this net volume also appears to correlate well with “samples were often very large (100 l. or more)” (Holme, 1961).

Dr Holme’s original modified anchor dredge is known to exist within the MBA Ships Store, but the nets are unlikely to have survived the intervening period.

In the resurvey of 2006 the anchor dredge used was a single-sided dredge, known to have existed at the MBA for many years. The dredge was of the same dimensions as Holme’s double sided one, but had a fixed arm. Net volume would obviously vary depending on the location of the knot at the foot of the bag. Consistent knotting on the resurvey meant that full samples recovered were usually in the region of 200 litres from a bag around 1m from the dredge rear edge. However, if knotted higher then smaller samples could have been obtained.

Appendix H: Echinoderm and Brittlestar Survey notes

H1 Reference

Holme, N.A., 1984. Fluctuations of *Ophiothrix fragilis* in the Western English Channel; *J. Mar. Biol. Ass. U.K.*, Vol. 64, pp. 351-78.

H2 Background

The basis of this section comes from a set of five field notebooks held in the National Marine Biological Library (reference PHM3, books 13-17). The notebooks hold field notes and species lists for all approximately 350 trawls in the Western English Channel. The notebooks are entitled “Brittlestar Survey” on the covers and were officially an Echinoderm and Brittlestar Survey. Due to the fragmented and prolonged surveying of the locations there are a large number of survey dates:

H3 Survey Dates:

Stations M1-20: 5 th -6 th January 1965	Station X241: 17 th Sept 1974
Station X25: 10 th Nov 1970	Station X242: 18 th Sept 1974
Stations X1-X14: 14 th -15 th Dec 1970	Stations X243-249: 24 th Oct 1974
Stations X15 & X17-19: 11 th Feb 1971	Stations X250-257: 31 st Oct 1974
Stations X16 & X20-23: 17 th Feb 1971	Stations X258-262: 29 th Nov 1974
Stations X26-67: 17 th -20 th May 1971	Station X263: 14 th Nov 1975
Stations X68-76: 3 rd June 1971	Stations X264-288: 27 th – 29 th Apr 1981
Stations X77-121: 12 th - 16 th July 1971	Station X299 (accidentally numbered): 27 th May 1981
Stations X122-145: 18 th -20 th July 1971	Station X289: 12 th Sept 1981
Stations X146-154: 25 th -26 th Oct 1971	Stations X290-291: 16 th Sept 1981
Stations X155-157: 17 th Nov 1971	Station X292: 30 th Jun 1983
Stations X158-170: 10 th -11 th May 1972	Stations X293-299: 7 th July 1983
Stations X171-216: 15 th -18 th May 1972	Stations X301-2: 13 July 1983
Stations X217-222: 25 th July 1972	Station X303: 18 th July 1983
Stations X223-229: 9 th June 1973	Stations X304-307: 20 th July 1983
Stations X230-238: 13 th June 1973	Stations X308-329: 16 th -17 th Aug 1983
Station X239: 9 th July 1973	
Station X240: 12 th Sept 1974	

H4 Library References for station records

All the information included here is taken from field notebooks held in the National Marine Biological Library Archive.

The following sites are in each of the notebooks:

NMBL ref PHM3, book 23 – Stations X1-X58

PHM3, book 22 – Stations X59-X145

PHM3, book 21 – Stations X146-X236

PHM3, book 20 – Stations X237-X295 + M1-M20 (Jan 1965 survey near Plymouth)

PHM3, book 19 – Stations X296-X329.

These books have the following information for each site: Depth, Bottom topography, Time, Date, Location (Lat/Long, DECCA), ICES Grid Reference, Trawl Type, Tow Time, Sediment Type, Sorting Method, Species Numbers. Descriptive locations were written where they had not been not provided by Dr. Holme. There are no details of the weather or when photographs were taken. This information, but not some of the above, is included in the ship-going? field notebooks (NMBL reference PHM3, books 14-17), also in the library archive.

Stations M1-20. Sampled during January 1965. A note after station X257 in notebook PHM3,20 says "These stations inserted here as they might otherwise get 'lost'"

Stations X1-22 also include the disc diameters of all the Ophiothrix found in those trawls.

H5 Sample Sorting.

The phrase “Rough Sort” was used frequently throughout the notebooks. No evidence was found to indicate whether the Rough Sort was conducted with a hose (Holme, 1961) or over a 10mm mesh screen (Holme, 1966). Trawls x2 and x5 specify “Rough sort for Echinoderms” (NMBL ref PHM3, book 23). The sorting technique was added to the Sample Description where appropriate.

H6 Sample Volumes

The Benthic Surveys used standardised vessels to measure the volume of the sample. Dr. Holme used a Bath of approximately 20 litres to measure the sample (Holme, 1961, 1966). During the Echinoderm and Brittlestar Survey a large variety of vessels appear to have been used to measure the volume of the sample. The prolonged nature of the sampling pattern may be partially responsible for this variation. Records were noted using “Full net”, “Tubs”, “Buckets”, “Small Buckets”, and a “Jar”. Appendix J details these vessels.

Appendix J: Vessels used for measuring sample size and their volumes.

J1 Background

Dredge sample volumes were usually measured in 'baths'. Dr. Holme describes one bath as having a volume of approximately twenty litres (Holme, 1961, 1966). Brittlestar samples were more frequently measured using 'tubs'.

Further analysis of Dr. Norman Holme's data sets would be greatly helped by an approximation of abundances per unit volume. Dr. Holme's notebooks and scientific publications provide very little information on the volumes of the vessels used. One reason for this is the lack of hard data in the *Ophiothrix fragilis* paper (Holme, 1984). Consequentially, a considerable amount of piecing together of information and summations follow in the passage below. Where possible all sources have been referenced.

J2 Tubs

In some stations the sample size, where it was given, is referred to in "Tubs". The only descriptive references found to these "tubs" are at Station x28 (NMBL ref PHM3, book 23) where they are "black polythene tubs" and Station x96 (NMBL ref PHM3, book 22) where a "full net" is referred to as "6 tubs". The equipment in use at x96 was a 3ft Aggasiz trawl. A personal communication (November 2005) from Mr. Pete Rendle, Sea-going Technician at the Marine Biological Association, suggested that the MBA's "black



Figure 12: An MBA style black tub in use. May 1977.
© Photographer: R.L. Barrett



Figure 11: The first photographic record of an MBA style black tub (right centre). May 1977. © Photographer: R.L. Barrett

polythene tubs" will have almost certainly have been the same design in the 1970s as those currently in use on Plymouth Quest in 2005. These tubs are best described as oval in shape (approximately 75cm x 50cm) with outward sloping steep sides about 40-50cm deep. Two large handles are attached to the top rim. The tubs are made of tough plastic with rigid reinforced bases and fairly stiff sides. They are designed to cope

with considerable weights.

Figures 11 & 12 show these tubs in use during a cruise in 1977. The photographs are taken by R.L. Barrett, Dr Holme's regular sea-going assistant. No photographic evidence prior to 1977 has been found to suggest the black tubs were in use during 1965 and 1970. Possible contrary evidence has reveal a photograph, also taken by R.L. Barrett in May 1972 on the MBA's research vessel 'Sarsia' showing a small stack of white tubs. These appear to be a different, rounded shape with fairly straight sides. They would appear to be a similar general size to the black tubs. Which tubs are more likely to have been used between 1970 and 1974?

An opportunity to measure the volume of the current (2005 use) black tubs presented itself. An added complication was that the present tubs in 2005 had holes in them to regulate the levels of seawater. Some tubs had a row of holes halfway up their sides and some with a row three-quarters of the way to the top. Taking a tub with higher holes, the volume was measured at 60 litres to the level of the holes. An extra 20 litres was estimated extra above the hole to the rim. Dr. Norman Holme was taking epifaunal and shelly samples from his Aggasiz trawls. These samples are unlikely to have been affected by any holes within the tubs.

White tubs that look very similar to those in the photograph (figure 13) are stored at the MBA. They measure a volume of 60 litres to the collar (visible above) where a water outlet had been drilled. The collar region would add a minimum of 10 litres extra volume.

The assumed volume of Dr. Holme's "Black Tub" is therefore 80 litres. The "Tubs" referred to are most likely to also be the MBA black polythene tubs. However, either way, a volume of between seventy and eighty litres should be assumed for a full black tub. However a 'six tubs...full sample' would then approximate 400-500 litres, much greater than the possible net volume. This issue remains unresolved.



Figure 13: White tubs on board Sarsia in May 1972.
©Photographer: R.L. Barrett

J3 Buckets and Small Buckets

Bucket and Small Bucket are also used occasionally for smaller samples. There is no record in Dr. Holme's notes as to a volume of either of these 'buckets'. Mr. Pete Rendle suggested that the buckets are likely to be the standard scientific white re-sealable sample containers. Mr. Rendle was certain there was a stack of these on board the MBA research vessel 'Squilla'

for use by biologists (*pers. comm. 2005*). 'Squilla' was a research vessel for the MBA from 1974-2004, while 'Sarsia', the vessel used primarily by Dr. Holme, was employed from 1953-81 (NMBL ref MS1 & 2).

Ms Suzanne Wilson, of the Sir Alister Hardy Foundation for Ocean Science (SAHFOS), currently uses a large Bucket for plankton samples in 2005. These large white sealable sample containers are approximately 18" diameter and 18" deep. A large Bucket has a volume of 16 litres.

J4 Jars

Station x318 records a 'jar' being used to measure the catch size. From the number of species present, including an *Echinocardium*, in the sample the jar must be bigger than a 1lb jam jar. Mr. Pete Rendle was sure that the jar referred to was definitely a Breffit (*Pers. comm. 2005*).

Breffits, can be square or round, square ones in MBA are cubic with a measurement of 16cm per side plus a round collar giving a volume of 4.096 litres plus collar.

Dr. Holme also once used a Honey jar to measure the sample. Sample DS101 read "Flustra - a lot, say two large honey jars full". Is Holme, or an assistant such as his wife, referring to a (round) Breffit in this case too?

Appendix K: Brittlestar Survey Equipment usage

These are Dr. Norman Holme's descriptions, from his field notebooks (NMBL ref PHM3, 19-23), of the equipment he used during the Echinoderm and Brittlestar Survey:

- “3ft mini-Aggasiz trawl, Courlene net”
- “3 ft mini-Aggasiz Fine mesh bag (3/8)”
- “Aggasiz (not Mini-Aggasiz)”
- “3ft Trawl”
- “8ft Aggasiz”
- “Naturalist's Dredge”
- “3ft Rectangular Dredge with 1/2" Courlene netting”
- “Ship's Rectangular dredge with shrimp netting lining” (used after Aggasiz trawl lost in X101; also known after 1st use as “Rect. Dredge” in Sample Descriptions)
- “Beam Trawl? Taken by ship's crew”
- “12ft Beam Trawl”
- “Otter Trawl”
- “?Dredge with Courlene net”
- “Dredge”
- “Ockelmann sledge” also known as an Ockelmann epibenthic sledge and may include a tickler chain.

Primarily the 3ft Aggasiz trawl was used with either a Courlene net or a Fine mesh bag. Usually Holme, in his notebooks, referred to the equipment as “3 ft Aggasiz” without specifying the bag type. The Sample Description for each Station within Marine Recorder specifies the equipment used and the amount of warp let out for the trawl. Occasionally a repeat sample had to be taken because not enough warp had been left out to allow the trawl to collect a sample.

The field notebooks do not carry information on why different equipment was used on occasions. However, an analysis of station samples and dates of sampling reveals which trawls or dredges were used on different occasions. The mini-Aggasiz trawl appears to have been used wherever possible, usually appearing on planned cruises or day trips with multiple samples taken. Aggasiz trawls were only ever used once for a single haul in one day. This was most likely to have been the 8ft Aggasiz trawl, probably with a field class. The Biological dredges (Naturalists dredge, Rectangular dredge etc.) were also used on some cruises. Usage of these dredges tended to be occasional rather than frequent, except for the 1965 Stations M1-20, suggesting that the Biological dredges were carried on board as a spare in case of damage

to the Aggasiz trawl. The remaining dredges and trawls were only ever used on day trips of single or paired hauls. These are likely to have been one-off sampling trips, quite possibly with student classes (Section 3.1 & Holme, 1984)

Marine Recorder uses a limited number of equipment categories to group equipment and allow comparisons. Below are the Marine Recorder equipment categories with Dr. Norman Holme's descriptions of the equipment that have been placed in the same category. Also included are the station numbers applying to each category. See Marine Recorder station Sample Descriptions for precise trawl descriptions.

- Dredge - Biological = "3ft Rectangular Dredge with 1/2" Courelene netting"; "Naturalist's Dredge"; "3ft Dredge"; "Ship's Rectangular dredge with shrimp netting lining" (used after Aggasiz trawl lost in X101; also known after 1st use as "Rect. dredge"). Stations used: x1-2 (cruise), 101-3(cruise), 115-22(cruise), 134-8(cruise), 206-7(day trip), 241(day trip), M1-20(cruise).
- Dredge - unknown = "?Dredge with Courelene net"; "Dredge" Stations used: x16, 20(day trip).
- Trawl - Aggasiz = "3ft mini-Aggasiz trawl, Courelene net"; "Aggasiz (not Mini-Aggasiz)"; "8ft Aggasiz"; "3 ft mini-Aggasiz Fine mesh bag (3/8")" and "3ft Trawl". Stations used: x3-14(cruise), 26-100(cruises), 104-14(cruise), 123-33(cruise), 139-205(cruises + 1 day), 208-38(cruises + 2 days), 242-57 (242 solo, 1 day & cruise), 263-91(cruise + days), 293-299(day for all), 306-29(day + cruise).
- Trawl - Beam = "Beam Trawl? Taken by ship's crew"; "12ft Beam Trawl". Stations used: x15, 17-9(day for all 4), 258-62(day), 301-2(day).
- Trawl - Otter = "Otter Trawl" Stations used: x240(day), 299 (1981)(day), 292(day), 304-5(day).
- Trawl - unspecified = includes use of an "Ockelmann sledge", also known as an Ockelmann epibenthic sledge and may include a tickler chain. Stations used: x21-5(day), 239(solo), 303(solo).

Summary of equipment usage during the Brittlestar Survey:

- "Aggasiz trawl" – Cruises, whole day trips with multiple hauls & one solo trawl.
- "Biological Dredge" used primarily on Cruises with the odd day trip.
- "Dredge with Courelene" & "Dredge" – only used on a day trip.
- "Unspecified Trawl", "Otter" & "Beam Trawls" only used for Day trips or solo hauls.

Appendix L: Species Notes on identification during Brittlestar cruises of May-July 1971 (quoted from NMBL ref PHM3, notebook 22). Author Dr Norman Holme.

“Echinoderms: All listed, and identified with following exceptions:

Ophiura - not to species (to species on later cruises)

Echinus & *Psammechinus* not distinguished with certainty (smaller specimens)

Echinocardium sp. means either *pennatifidum* or *flavescens* (not *cordatum*).

Other Phyla. Recording admittedly sporadic, but following notes may help:

Caryophyllia - often recorded if present

Scallops - rec'd if present.

Queen (*C. operc.*) - often recorded

Buccinum - often recorded

Lima - invariably recorded but not always identified to species

Hyalinoecia - usually recorded

Hermione, *Aphrodite* - usually recorded

Venus casina, *V. fasciata* - usually recorded

Amphioxus - recorded, quantities uncertain

Glycymeris - recorded

Lithothamnion - usually recorded

Flustra - recorded

Modiolus - often recorded to genus

Fusus - recorded

Cliona - often recorded

Atelecyclus - sometimes listed.

Diazonia - large colonies listed.

Alcyonium - sometimes listed.

Chlamys distorta - listed where noticed.

Alpheus - often listed.

Terebratulina - recorded.”

Appendix M: Brittlestar Survey Species name changes and descriptions.

Codes refer to the sample (e.g. M15 or x94). The following sites are in each of the notebooks:

NMBL ref PHM3, book 23 – Stations X1-X58

PHM3, book 22 – Stations X59-X145

PHM3, book 21 – Stations X146-X236

PHM3, book 20 – Stations X237-X295 + M1-M20 (Jan 1965 survey near Plymouth)

PHM3, book 19 – Stations X296-X329.

The notebook codes are those used in the National Marine Biological Library where the books are kept in the archive. This list is not a comprehensive index, not all occurrences of common species were indexed and the list only indicates where a particular species or comment will have been filed. All species accepted by Marine Recorder, but with descriptive comments, are listed as Present within the database and all comments included in the Sample Description.

- “Anemone” - Sample Description
- “*Anomiads*” - Sample Description x193; “*Anomiid*” – Sample Description from x191 & X192, haul2.
- “*Antennularia*” – Sample Description (accepted name on lists but Marine Recorder won’t accept it. Known to be a hydroid); also on X156.
- “*Aphrodite*” – *Aphrodita aculeata* (listed as ‘Synonym: *Aphrodite* of Fauvel’ in the MCS Species Directory)
- “*Astarte elliptica*” – now *Tridonta elliptica*
- “Boring Sponge” – Sample Description
- “Brittle stars ?*Ophiactis*? – listed under *Ophiactis*
- “*Buccinum* eggs hatching” – Sample Description X158.
- “*Buccinum* whelk” – *Buccinum*
- “Burrowing anemone (*Hyamtus*?)” – Sample Description – X75.
- “*Call granulatus*” – *Calliostoma granulatum*
- “*Call. Zizyph*” – *Calliostoma zizyphinum*
- “*Cardium echinatum*” – all listed in Sample Description.
- “*Cardium echinatum*” – Sample Description (accepted on 2005 species list, but not on NHM species directory list.)
- “Cephalopod” – Sample Description – X108.
- “Chiton” – Sample Description, X134.
- “crabs” – Sample Description – x177, PHM3,21.

- “*Cucumaria saxicola*” – now *Pawsonia saxicola*
- “*Cultellus*” – now *Phaxus*
- “Cup coral” – Devonshire Cup coral = *Caryophyllia*
- “*Cyprina*” – reference found to *Cyprina islandica* online and Icelandic cyprine (*Arctica islandica*); listed under *Arctica islandica*.
- “*Diodora apertura*” – now *Diodora graeca*
- ““Dog Whelks” - a few - appear to be *Nucella lapillus var imbricata* - 5 living, dumped without further confirmation” X83; “Dog whelk – several, appear to be *Nucella lapillus var. imbricata*; *Nucella lapillus* (smoother)” X82, PHM3,22. – listed as *Nucella lapillus*
- “*Dromia* + sponge” – X60, under *Dromia* and Sample Description.
- “*Echinus* juv – a few” – Present & in Sample Description. M15 & M18; ditto “several” Present & in Sample Description M16; “at least 1j” – listed as 1 juvenile M13 and many other times. M9 = “frequent”, Present & in Sample Description!
- “*Echinus*” – usually only referred to as *Echinus*. *Echinus esculentus* also grouped under *Echinus*. *Psammechinus* listed separately.
- “Flat anemones – 3” or “common” – Sample Description – X198-9 & 200.
- “*Flustra* – several large clumps” – Present & in Sample Description M15; “several pieces” X223; “a little” – Present X222 & X219.
- “*Fusus*” – listed as *Thyone fusus*
- “*Fusus jeffreysianus*” = *Colus jeffreysianus* X156.
- “*Gobius steveni*” or Steven’s Goby now known as *Gobius gasteveni*
- “Goby” – Sample Description
- “Hermione” – Sample Description – probably a scale worm, not certain. Only listed as an insect on NHM species list. X264; also listed M3; X41; X69, X77; X158, X162, X193 & 221. (see also Hermione in Appendix 5.2)
- “Hermit with Adamsia” – *Pagurus prideaux* (qualified as w/ Adamsia)
- “Hermit with cloak” – *Pagurus bernhardus* (qualified as w/Calliactis)
- “Hermit” – *Pagurus* (qualifier – hermits). Hermits are never referred to as *Pagurus*, but always as ‘Hermit’. Other species could be involved.
- “Hydroids” – Sample Description
- “*Kellia suborb*” – *Kellia subtrigona* now *Thyasira subtrigona*
- “*Lepralia*” – *Lepraliella*
- “*Lima hians*” now *Limaria hians*

- “Maia” – or frequently “spider crab” = *Maja squinado*
- “*Marginella laevis*” X185 Haul2. The only online reference found was <http://www.mba.ac.uk/PMF/Mollusca.pdf> where “ERATO VOLUTA (Montagu) [*Jeffreys*, 1867, IV, p. 400, as *Marginella laevis*]”. Norman Holme used *Marginella*. The species is listed in Marine Recorder under *Erato volute*.
- “*Musculus marmoratus*” – now *Modiolarca tumida*.
- “*O. fragilis* – common (i.e. hundreds)” – all comments listed as Present & in Sample Description – M11; “200-300” M7; “2000-3000” X90; “common, say 500” X49 & X56; “say 3000” X55; “common, about 1000” X48; “common, say 5000” X47; “very common, say over 20,000” X46; “say 10⁴ ie 10,000” X43; “many thousands” X42; “several thousand” X40; “common” X39; “rare” X36; “a few, small (say 10 altogether)” X35; “abundant, say 10⁵” – X29; “abundant” X27; “very common” – X21; “a few” X12.
- “*O. nigra* – mod frequent (several dozen)” – all comments listed as Present & included in Sample Description – M11; “*Oph. nigra* >100” M9; “300-400 estimated” X68; “Over 1000” X65; “few” X42; “a few” X21, X39 & X40; “common, say 2000 or more” X36; “common, say at least 10³” x35; “occasional” X27; “common, several hundred” X12. “*Ophiocomina nigra* – 101-1000” – Present & see Sample Description.. X258, 260, 261 & 262.
- “*O. texturata*” – is now *Ophiura ophiura*
- “*Ophiura* – a number” – Present & in Sample Description. M17; “*Ophiura* – a lot of largish” M14.
- “*Ophiura texturata* – many” x263.
- “*Ovula patula*” – actually *Simnia patula*
- “Pinna shell” X110 PHM3,22. *Pinna* in Species directory is *Atrina fragilis*
- “pipefish” - Sample Description (x250)
- “Prawns” – Sample Description X134; “6 prawns” X136 – Sample Description.
- “Rocklings” – Sample Description – X92, & 108.
- “Sand Eel” – Sample Description. (X169)
- “small spider crabs” – *Maja squinado* (qualifier – spidercrab)
- “Snapping prawn” – Sample Description
- “*Solea lutea*”, listed as *Microchirus boscanion* on 2005 species list, not accepted with Natural History Museum. Old name listed as *Solea variegata*, assumed to be comparable to *Microchirus variegatus* and filed as such X148.
- “Sponge” – Sample Description – x207; x134; x118.
- “*Squilla*” – listed as *Rissoides desmaresti*

- “sucker-fish” – Sample Description (x250)
- “Tectibranch” – Sample Description (X160)
- “Terebellid” – Sample Description – X108.
- “*Thaia polita* - 1 ” probably *Thia potua* which is now *Thia scutellata* and listed as such.
- “Thickback” sole - *Microchirus variegatus*, X152.
- “Topknot” - *Zeugopterus punctatus* – X154.
- “*Tritonia?*” – listed as *Tritonia* X185, haul 1.
- “Trochus sp” – Sample Description x148.
- “Whelk eggs, hatching” X185 Haul2. Listed in Sample Description of site.
- “Whelk” – listed as *Buccinum*