# Biological and Biogeochemical data at the British Oceanographic Data Centre

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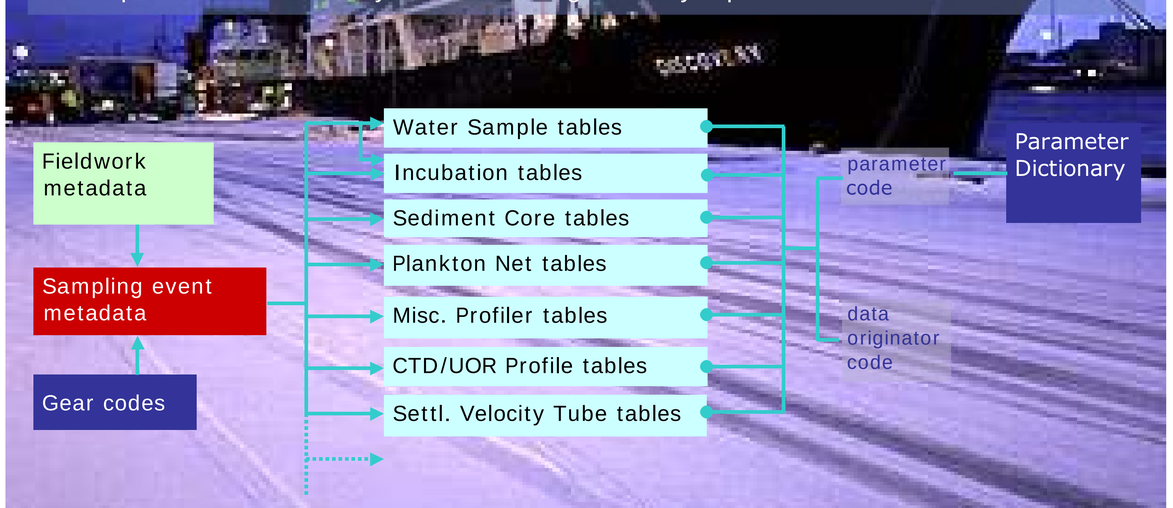
As the UK's National Oceanographic Data Centre, BODC began banking biological and biogeochemical data in the late 1980s. This was in response to the challenges posed by increasingly sophisticated multi-disciplinary programmes such as the UK-NERC North Sea Project (NSP) and the UK-JGOFS Biogeochemical Ocean Flux Study (BOFS). The activity provided a unified approach to data management, delivering an integrated quality controlled data set, including the physics and chemistry of the water column, as the basis for scientists from a range of disciplines to develop understanding of the ecosystem.
The simple relational database structure initially adopted evolved in the 1990s into a fully normalised relational database structure supported by a parameter coding system designed to cover an extensive range of parameters. Since then, a large number of highly diverse data from multi-disciplinary fieldwork programmes in the north-east Atlantic Ocean, Arabian Sea, western and north western European margins and in shelf seas around the UK has been incorporated into the database. The system has demonstrated its ability to integrate the ever growing diversity and complexity of multi-disciplinary oceanographic measurements into a common, easily maintained database structure.

## Structure of the BODC Research Project Database

Biological data, whether originating from discrete water column sampling, continuous profilers, tows or benthic sampling, are all managed within the Research Project Database where they are fully integrated with concomitant oceanographic measurements and associated metadata.

Below is a schematic illustration of the basic structure of the BODC Research Project Database under the Oracle Relational Database Management System. The database is organised around 3 main groups of tables:

- the sampling metadata tables consisting of the sampling activity or event description table with links to the fieldwork description table and to the sampling gear code table.
- the data tables consisting of a series of linkage and data storage tables for each main type of sampling or data collection techniques.
- the parameter dictionary tables defining the 8-byte parameter codes.




All data storage tables have the same field structure consisting of a unique key linking each record to the linkage tables, a data parameter code, a data value, a data quality control flag, a data originator code and a loading date. The data linkage tables invariably control the one-to-many relationship between the events and the data. Their structure has been adapted differently for each main type of sampling or data collection technique in order to incorporate specific metadata information such as for example bottle depth and bottle type for water collection events, plankton net depth range, mesh size, mouth area for plankton net hauls.

The structure of the database is such that it may be easily expanded to include new sampling gear, new methodologies and instrumentation, and new parameters.

## Biological data in the BODC Parameter Dictionary

To date, the BODC parameter dictionary contains 8047 parameter codes, 53% of them biological parameters. Each unique 8-character parameter code is composed of two 4-character sub-fields. For non-taxonomic data, the first field defines the parameter and its measuring unit, the second field specifies the protocol. For taxonomic data, the first field defines the genus and the measuring unit, and the second field characterises the species and ancillary information such as life stage, specific protocol or non standardized information.

Taxonomic codes have so far been developed to the species or to a higher taxonomic level for 2455 marine organisms.

Biological parameters are currently distributed into 9 categories: zooplankton (ZOOP), fish (FISH), microzooplankton (MZOO), phytoplankton (PHYT), pigments (PIGS), bacteria (BACT), production and biogeochemical cycling (PROD), benthic fauna (BFNA) and benthic fluxes (BFLX).

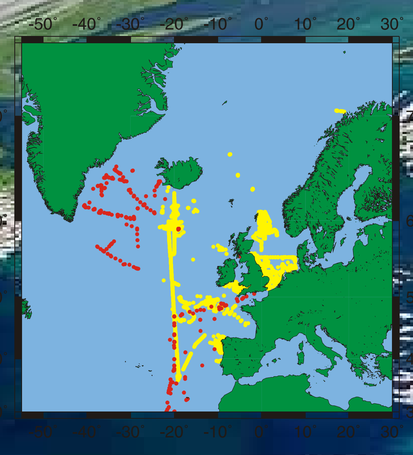
Distribution of BODC biological parameter codes in each main category according to four types of measurements.

| | Number of individual taxon codes | additional biodiversity and biomass data | Taxon or group specific biological activity and ecological measurements | Primary Production and biogeochemical cycling |
|---|---|---|---|---|
| zooplankton | 916 | 126 | 73 | 0 |
| microzooplankton | 123 | 32 | 15 | 0 |
| phytoplankton | 1176 | 528 | 0 | 0 |
| bacteria and viruses | 9 | 25 | 11 | 5 |
| pigment | 0 | 137 | 0 | 0 |
| pelagic production and biogeochemical cycling | 0 | 0 | 39 | 311 |
| benthic algae and macrofauna | 166 | 107 | 0 | 0 |
| benthic fluxes | 0 | 0 | 0 | 57 |
| fish | 65 | 0 | 0 | 0 |

The existing parameter codes in the category 'Primary Production and Biogeochemical Cycling' cover phytoplankton photosynthetic activity and an extensive range of biogeochemical processes related to the cycling of carbon, macro-nutrients, oxygen, trace metals and sulphur in the ocean.

## Biological data in the Research Project Database

The Project Database currently holds data from 951 cruises corresponding to some 247 thousand sampling events, using over 100 different types of sampling gear and recording instrument. Overall, 6,000 of these sampling events are related to at least one biological measurement other than chlorophyll and associated pigments.




The maps and table illustrate the geographical and temporal distribution of BODC's biological and biogeochemical data holdings. Data from completed projects are mainly concentrated in the north-eastern Atlantic Ocean and in areas around the British Isles and the western European margins. Some areas were repeatedly sampled during successive projects.

Current projects such as the UK-NERC Marine Productivity programme and the Atlantic Meridional Transect consortium co-ordinated by the Plymouth Marine Laboratory will extend the coverage to the Irminger Sea/Icelandic Basin and to the South Atlantic respectively.

| | | zooplankton | microzooplankton | phytoplankton | bacteria | pigment composition | pelagic production and biogeochemical cycling | benthic fauna | benthic fluxes |
|---|---|---|---|---|---|---|---|---|---|
| NE Atlantic and W. European margins | | | | | | | | | |
| OWS INDIA | 1970 | | | | | | ✓ | | |
| OWS INDIA | 1971-1974 | ✓ | ✓ | ✓ | | | ✓ | | |
| OWS INDIA | 1975 | ✓ | | ✓ | | | ✓ | | |
| BOFS | 1989-1991 | | ✓ | ✓ | ✓ | ✓ | ✓ | | |
| OMEX I (Norwegian S) | 1994 | ✓ | ✓ | ✓ | | | | | |
| OMEX I (W European S) | 1993-1994 | | ✓ | ✓ | ✓ | ✓ | ✓ | | ✓ |
| OMEX I (W European S) | 1994-1995 | | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | |
| LOIS(SES) | 1995 | | | ✓ | | | ✓ | ✓ | ✓ |
| LOIS(SES) | 1996 | | | ✓ | | | ✓ | | ✓ |
| PRIME | Jun-Jul 1996 | ✓ | ✓ | ✓ | ✓ | | ✓ | | |
| PRIME | Dec 1996 | | | | | | | | |
| OMEX II | 1997-1998 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| ACSOE | Jun-Jul 1998 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | | |
| OMEX II | 1999 | ✓ | ✓ | ✓ | ✓ | | ✓ | ✓ | ✓ |
| MARPROD | Nov-Dec 2001 | ✓ | ✓ | ✓ | | ✓ | | | |
| MARPROD | Apr-Dec 2002 | ✓ | ✓ | ✓ | | ✓ | ✓ | | |
| Irish Sea, W. English Channel and Celtic Sea | | | | | | | | | |
| Bristol Channel | 1971-1975 | ✓ | | ✓ | | | | | |
| Bristol Channel | 1976-1978 | ✓ | | | | | | | |
| PML core programmes | 1991 | | | | ✓ | | ✓ | | |
| PML core programmes | 1992 | | | | ✓ | ✓ | ✓ | | |
| PML core programmes | 2000 | | ✓ | ✓ | ✓ | ✓ | ✓ | | |
| PML core programmes | 2002 | | | | | ✓ | | | |
| North Sea | | | | | | | | | |
| North Sea Project | 1988-1989 | ✓ | ✓ | ✓ | | | ✓ | | ✓ |
| North Sea Project | Apr 1989 | ✓ | ✓ | ✓ | ✓ | | ✓ | | ✓ |
| North Sea Project | 1990 | | | | | | | | ✓ |
| LOIS(RACS) | 1992 | | | | | | | ✓ | ✓ |
| LOIS(RACS) | 1993-1995 | | ✓ | ✓ | | | ✓ | ✓ | ✓ |
| LOIS(RACS) | 1996 | | | | | | | | ✓ |
| PROVESS | 1998 | ✓ | | | | | ✓ | | ✓ |
| PROVESS | 1999 | | | | | ✓ | ✓ | | ✓ |
| PML core programmes (DISCO) | Jun 1999 | ✓ | ✓ | ✓ | ✓ | ✓ | | | |
| Atlantic Ocean | | | | | | | | | |
| Atlantic Meridional Transect | 1995-2000 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | | |
| Atlantic Meridional Transect | 2001-2005 | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | | |
| Indian Ocean | | | | | | | | | |
| ARABESQUE | Sep+Nov 1994 | | ✓ | ✓ | ✓ | ✓ | ✓ | | |
| M&FMB (AMBITION) | Sep 2001 | | ✓ | ✓ | ✓ | ✓ | ✓ | | |
| Southern Ocean | | | | | | | | | |
| BOFS | Nov-Dec 1992 | | ✓ | | ✓ | ✓ | ✓ | | |