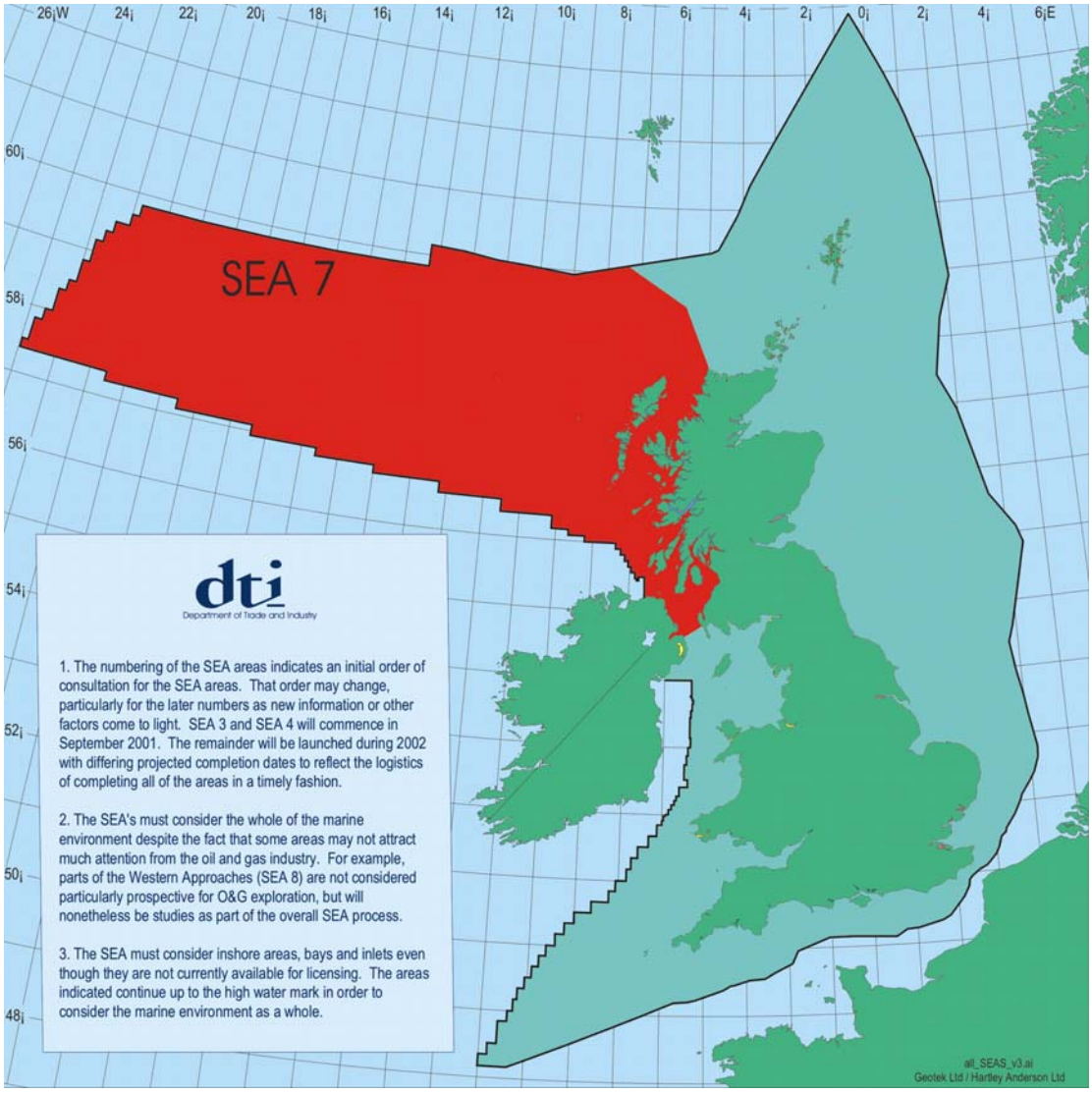
# Metadata report for DTI area 7 (approx. 54°N – 60°N, 5°W – 24°W)

## Plankton




### 1. Introduction

1.1 This report, prepared for the DTI as part of the Strategic Environment Assessment (area 7), aims to provide a comprehensive overview of all parties engaged in activities involving plankton research in the study area (approx. 54°N – 60°N, 5°W – 24°W). A number of organisations are interested in the study of the plankton community, as it can provide useful information as regards to the local environment, as well as an indication of much larger ecosystem-wide changes. A comprehensive list of such organisations, and a point of contact, is given under Section 2. Section 3 details the actual datasets that are available for SEA 7. Section 4 lists pertinent references of published plankton research.

1.2 Plankton can be divided into phytoplankton and zooplankton, representing plants and animals generally. The majority of the plankton occurs in the top 20m of the sea, known as the photic zone (the layer that light penetrates to allow photosynthesis). The pycnocline is a zone of marked density gradient between stratified upper layers and mixed lower waters, which form in summer months in the northern North Sea. Denser concentrations of plankton may accumulate in the pycnocline; this may enter up at the surface, forming a 'front'. The vertical position of the pycnocline can vary throughout the year (Richardson et al., 1998).

1.3 The phytoplankton community can be divided into larger entities such as diatoms and dinoflagellates, and the smaller flagellates. The latter are often referred to as pico or nano plankton because of their small size, but can at times make up a large proportion of the phytoplankton community. Diatoms are characterised by having a siliceous test, comprising 2 valves, and being autotrophic (produce energy by photosynthesis). Dinoflagellates differ in having 2 flagella and a rigid test. They are usually heterotrophic (consume substances), but can also photosynthesize under certain conditions.

1.4 In the plankton community a 'bloom' of phytoplankton occurs every spring, often followed by a smaller peak in the autumn. Phytoplankton (diatom) blooms are normally initiated by the establishment of a thermal stratification in spring, as a result of increased light and temperature. Dinoflagellate communities are associated with post spring bloom conditions, when surface waters are limited by the amount of phosphorus and nitrogen left after the initial diatom bloom (Williams and Lindley 1980). The factors that initiate the spring bloom are vertical mixing and stratification of the water column, along with the length of photoperiod. During the winter months, in periods of low light, phytoplankton growth is inhibited. In this period, the nitrogen, phosphorus and silicate and ammonia nutrients increase in concentrations, as little or no primary production is taking place to utilise them. When the water becomes stratified in the spring, advantageous diatom species increase rapidly in abundance, hence the term 'bloom'. As the spring progresses to summer, surface waters warm and a more permanent thermocline develops. Colder, nutrient-rich waters sink away from the photic zone; primary production slows and tends to be largely confined to deeper layers in the pycnocline. Silicate (essential for diatom growth, being incorporated into their 'test') eventually becomes limited and other groups, such as flagellates, bloom, followed later by the dinoflagellates. The resulting phytoplankton community is one that can cope with reduced nutrient levels. With the onset of autumn, and the increase in wind strength, the sea becomes mixed once again. This secondary bloom is limited in size by the amount of phosphorus and nitrogen left after the initial diatom bloom. As the light levels diminish in the latter part of the year, primary production once again decreases. The water then becomes mixed and this aids the distribution of nutrients throughout the water column.

1.5 The most common group of organisms in the zooplankton community are the copepods (small, insect-like crustaceans which range from 0.5mm to 6mm). These are known to reach large concentrations, and they form the main food source for higher trophic levels.

1.6 By using a long term dataset of plankton, broad scale processes can be identified, such as anthropogenic impacts and responses to hydro-climatic variation. As plankton represent the first level on the trophic chain, there importance as primary producers should not be underestimated. Similarly, in this position it has been hypothesised that the plankton community will respond first to climate change.

1.7. Acknowledgements for this report must be given to the staff at the Marine Biological Library in Plymouth, as well as Polly Hadziabdic at BODC.

## 2. Contacts for data and organisations involved with plankton research in SEA 7

2.1

**CENTRE-NAME:** Free University of Brussels, Laboratory for Ecotoxicology and Polar Ecology

**ADDRESS:** Pleinlaan 2
1050 Brussels
Belgium

**DESCRIPTION:**
The activities are in two main research areas: (1) Monitoring of stable pollutants (PCBs, organochlorine pesticides, heavy metals) at the different trophic levels of marine ecosystems (phytoplankton, zooplankton, benthos, fish, birds and mammals) with special interest for background concentrations (levels in Arctic and Antarctic areas); (2) At sea study of the distribution of marine birds and mammals: seasonal variations of distributions, linkage with hydrographical regimes, estimations of population sizes and densities. Estimations of food demands and energy fluxes through higher trophic levels of the marine ecosystems.

**CONTACT-NAME:** Prof. C. Joiris

**PHONE:** +32 2 629 34 14

**FAX:** +32 2 629 34 38

**EMAIL:** cjoiris@vub.ac.be

2.2

**CENTRE-NAME:** ICES Secretariat, International Council for the Exploration of the Sea

**ADDRESS:** Palaegade 2-4,
1261 Copenhagen K
Denmark

**CENTRE-WEBSITE:** www.ices.dk

**DESCRIPTION:**
ICES is the oldest international marine science organization. It was formed in 1902 to promote the scientific understanding of the mechanisms inducing variability in North Atlantic commercial fish stocks, including their ecological interactions. Its member countries, of which there are currently 19, are located around the North Atlantic and its adjacent seas, particularly the North Sea and the Baltic Sea. Although its original remit concerned the scientific aspects of fisheries, the current remit of ICES has matured into providing member countries and various North Atlantic Regulatory Commissions with scientific and management advice concerning fisheries and environmental quality. To meet this end ICES addresses a wide range of issues from fundamental marine science questions to technical questions relating to fish capture via approximately 100 Working and Study groups, who provide the basic material for consideration by its advisory committees.

To support its advisory role, ICES has sought to promote and support marine science programmes by means of stimulating member governments to participate in collaborative programmes. In particular the main thrust of the activities of the ICES Secretariat is to provide professional support and publication facilities for use by scientists working to meet ICES' objectives. In former days, ICES concerned itself with the publication of raw scientific data as well as the prominent research findings of the day, and this has evolved into the scientific management of a number of data banks concerned with fish catches, fisheries biological data, oceanographic data, and data on marine contaminants. ICES promotes the collection of data of the highest accuracy by means of, for example, co-ordinating intercalibration exercises, and providing advice on quality assurance procedures.

The oceanographic data activities of the Secretariat are concerned primarily with oceanographic profile data. These data are provided by member countries. ICES endeavours to work closely with existing National Data Centres, and provides advice and products to fisheries scientists on the use of oceanographic data. Data are not necessarily freely available. Details of restrictions will be provided on request. ICES also maintains a computerised inventory of cruise summary reports, which also doubles as a catalogue of its data holdings. Currently this inventory contains detailed information about 13,000 marine scientific cruises and programmes that have been conducted since 1967 when this inventory system was introduced.

ICES member countries are Belgium, Canada, Denmark, Estonia, Finland, France, Germany, Iceland, Ireland, Latvia, Netherlands, Norway, Russia, Spain, Sweden, Poland, Portugal, UK, and USA.

**CONTACT-NAME:** General Secretary

**PHONE:** +45 33 154225
**FAX:** +45 33 939215
**EMAIL:** ocean@ices.dk

2.3

**CENTRE-NAME:** CNRS / STATION BIOLOGIQUE DE ROSCOFF

**ADDRESS:** Place Georges Teissier,

BP 74, 29682,

ROSCOFF,

FRANCE

**CENTRE-WEBSITE:** http://www.cnrs.fr/index.html

**DESCRIPTION:**
La station a ete fondee en 1872. Elle heberge 55 laboratoires de recherche en biochimie, electrophysiologie, biologie moleculaire et oceanographie ansi que des aquariums. Enseignement universitaire annuel et ecoles d'ete. Navire PLUTEUS II

**CONTACT-NAME:** VAULOT Daniel

**PHONE:** +33(0)2 98 29 23 34

**FAX:**

**EMAIL:** vaulot@iznogoud.sb-roscoff.fr

**CONTACT-NAME:** MORIN Pascal

**PHONE:** +33(0)2 98 29 23 17

**FAX:**

**EMAIL:** pmorin@iznogoud.sb-roscoff.fr

2.4

**CENTRE-NAME:** MarLIN Marine Life Information Network

**CENTRE-HOST:** Marine Biological Association of the UK, Plymouth

**VISIT-ADDRESS:** MarLIN
MBA
The laboratory,
Citadel Hill
Plymouth
PL1 2PB
United Kingdom

**CENTRE-WEBSITE:** www.marlin.ac.uk/

**DESCRIPTION:**
MarLIN is an initiative of the marine Biological Association of the UK in collaboration with major holders and users of marine biological data and information. It provides a structure for linking available data on marine life around Britain and Ireland.

**CONTACT-NAME:** Dr. Keith Hiscock

**PHONE:** +44 (0)1752 633336

**FAX:** +44 (0)1752 633102

**EMAIL:** marlin@mba.ac.uk

2.5

**CENTRE-NAME:** Royal Holloway, University of London, School of Biological Sciences

**ADDRESS:** School of Biological Sciences,
Royal Holloway,
University of London,
Egham,
Surrey,
TW20 0EX,
United Kingdom

**CENTRE-WEBSITE:** www1.rhbnc.ac.uk/biological-sciences/

**DESCRIPTION:**
The School of Biological Sciences carries out academic and contract research, including marine ecology, phyto- and zooplankton, fish stocks, toxicology and diseases and parasites.

**CONTACT-NAME:** Prof. J.D. Dodge

**PHONE:** +44 1784 443774

**FAX:** +44 1784 471739

**EMAIL:** j.dodge@rhbnc.ac.uk

2.6

**CENTRE-NAME:** Sir Alister Hardy Foundation for Ocean Science (SAHFOS)

**VISIT-ADDRESS:** The Laboratory,
Citadel Hill,
Plymouth
PL1 2PB,
United Kingdom

**CENTRE-WEBSITE:** www.npm.ac.uk/sahfos/sahfos.html

**DESCRIPTION:**

The Foundation was established to study spatial patterns in the abundance of marine plankton. It is responsible for the Continuous Plankton Recorder Survey, inaugurated in 1931. A major remit is to maintain the integrity of a unique planktonic database. Area of operation includes the North Atlantic, particularly European Shelf Seas, and recently the North Pacific. Sister surveys operate in Australia, Finland and North West America.

**CONTACT-NAME:** Darren Stevens

**PHONE:** +44 1752 633271

**FAX:** +44 1752 670637

**EMAIL:** dpst@wpo.nerc.ac.uk

2.7

**CENTRE-NAME:** Plymouth Marine Laboratory (PML**)**

**ADDRESS:** Plymouth Marine Laboratory,
Prospect Place,
The Hoe,
Plymouth,
PL1 3DH,
Devon,
United Kingdom

**CENTRE-WEBSITE:** www1.npm.ac.uk/

**DESCRIPTION:**
The Plymouth Marine Laboratory (PML) was formed in 1988 through the merger of the former Institute for Marine Environmental Research and the Marine Biological Association. Research interests include the role of the oceans in the global carbon cycle; physical, chemical and biological processes in seas and estuaries; plant and animal communities; cell biology and response of marine organisms to pollutants. Facilities include a major library.

**CONTACT-NAME:** Prof. Nick Owens.

**PHONE:** +44 1752 222772

**FAX:** +44 1752 670637

**EMAIL:**

2.8

**CENTRE-NAME:** British Oceanographic Data Centre (BODC)

**ADDRESS:** Proudman Oceanographic Laboratory,
Bidston Observatory,
Bidston Hill,
PRENTON,
Merseyside,
CH43 7RA,
United Kingdom

**CENTRE-WEBSITE:** www.bodc.ac.uk

**DESCRIPTION:**

BODC operates on behalf of the Marine Science and Technology Board of the UK's Natural Environment Research Council and acts as the UK's focal point for international oceanographic data exchange. It participates within the Intergovernmental Oceanographic Commission (IOC)'s network of national oceanographic data centres (NODCs) and was a founding partner of the European Sea-Search network.

BODC maintains a national oceanographic database, and provides a data service to research scientists, industry, and local and central government, and to major oceanographic programmes. In particular, it provides active data management support to NERC's Thematic Projects, including the AUTOSUB, LOIS and PRIME projects and the UK components of JGOFS and WOCE. It is the WOCE Data Assembly Centre for sea level data and, on behalf of the IOC and IHO Joint Guiding Committee for the General Bathymetric Chart of the Oceans (GEBCO), is responsible for developing the GEBCO Digital Atlas. BODC also acts as the data centre for a number of EC/MAST projects including OMEX, INDIA and PROVESS.

BODC exchanges data freely with other NODCs on a bilateral basis, but reserves the right to charge other users the marginal costs involved in making data available e.g. costs of copying, materials and postage. These charges may be waived for reasonable requests in support of bona-fide scientific research. Some data held by BODC are of restricted availability, awaiting final clearance by the scientists involved in their original collection.

**CONTACT-NAME:** BODC Enquiries Officer

**PHONE:** +44 (0) 151 653 1510

**FAX:** +44 (0) 151 652 3950

**EMAIL:** enquiries@bodc.ac.uk

2.9

**CENTRE-NAME:** Southampton Oceanography Centre

**ADDRESS:** Southampton Oceanography Centre,
University of Southampton,
Waterfront Campus,
European Way,
Southampton.
SO14 3ZH

**CENTRE-WEBSITE:** www.soc.soton.ac.uk/

**DESCRIPTION:**
The Southampton Oceanography Centre comprises both the NERC oceanographic research institute and the Department of Oceanography at Southampton University. It is a multidisciplinary department covering all the major fields of oceanography. Research work is conducted through a variety of organisations. Data are retained in a variety of forms and individual members of staff of the Department should be contacted for particular data. Details of the Department are available from the Departmental Secretary. Degrees of B.Sc., M.Sc. and Ph.D. are awarded in Oceanography.

**CONTACT-NAME:** Head of Department

**PHONE:** +44 1703 595000

**FAX:** +44 1703 593059

**EMAIL:**

2.10

**CENTRE-NAME:** FRS, Marine Laboratory, Aberdeen

**ADDRESS:** Fisheries Research Services,
Marine Laboratory,
PO Box 101,
Victoria Road,
Aberdeen,
AB11 9DB,
United Kingdom

**CENTRE-WEBSITE:** www.marlab.ac.uk/

**DESCRIPTION:**

The Marine Laboratory, Aberdeen is one of two constituent parts of Fisheries Research Services (FRS) which is an executive agency of the Scottish Office (SO). The programme of the Laboratory is authorised by a committee chaired by the SO Fisheries Secretary. Research on freshwater and migratory species (principally Atlantic salmon and sea trout) is carried out by the other constituent part of FRS, the Freshwater Fisheries Laboratory, Faskally, Perthshire.

Within the United Kingdom, fisheries research and development are integrated by a Customer Group, composed of representatives of FRS, the Centre for Environment, Fisheries and Aquaculture (CEFAS) and the Department of Agriculture Northern Ireland (DANI). A UK Co-ordinator of Fisheries Research and Development ensures that liaison is maintained between FRS, CEFAS and DANI.

The main thrust of the Laboratory's scientific programme is in support of the fisheries management responsibilities of the Scottish Office Agriculture, Environment and Fisheries Department (SOAEFD). The objective is to monitor the state of the main fish and shellfish stocks, and effort is aimed at conserving and managing the fish and shellfish resources to support an efficient, market-orientated fishing industry. Thus, the largest part of the research programme is directed at investigation of the main fish stocks exploited by Scottish fishermen. Attention is also paid to investigating the various technical measures adopted to promote the conservation of fish stocks. The Laboratory maintains a strong interest in the events and processes taking place in the oceanic and coastal waters around Scotland, ranging from broad interactions between water movements and fisheries to the more local effects on fish nursery grounds. The Laboratory supports The Scottish Office in its environmental interests, conducting research aimed at monitoring and protecting the quality of the seas around Scotland and their fisheries from the adverse effects of environmental change. There is a need for information and advice on the circulation of waters around Scotland and the consequent dispersion of particular contaminants arising from man's activities. The Laboratory also has an interest in the field of fish farming. Here, some of the important roles are the statutory inspection of fish and shellfish farms and the prevention of the spread of fish diseases within the Much of the marine environmental data collected by the Laboratory is submitted to national (BODC) and international (ICES) organisations for inclusion in appropriate data bases. Other data appear in a variety of publications, ranging from internal reports and working papers to refereed papers in the scientific literature.

In general, any requests for data by bone fide researchers are generally granted with

possibly only a small charge for materials and time involved in putting together the data in a form to suit the enquirer. Requests for data from commercial organisations or from research institutes using the data for commercial gain shall be charged at rates laid down by FRS to recover costs of extracting and supplying the data.

Each year, FRS publishes its Annual Review describing the scientific activities of the Marine Laboratory, Aberdeen. A separate Annual describing the scientific activities of the Freshwater Fisheries Laboratory is Marine Laboratory, also produced. Copies of Working Papers describing particular aspects of the, work of the Laboratory are also freely available.

**CONTACT-TITLE:** Director

**PHONE:** +44 1224 876544

**FAX:** +44 1224 295511

2.11

**CENTRE-NAME:** Natural History Museum, London (NHM)

**ADDRESS:** The Natural History Museum,
Department of Zoology,
Cromwell Road,
London,
SW7 5BD,
United Kingdom

**CENTRE-WEBSITE:** www.nhm.ac.uk/zoology/index.html

**DESCRIPTION:**

The Natural History Museum in London, formerly known as the British Museum (Natural History), is internationally recognised as one of the world's foremost institutions for systematics - the study and classification of animals, plants and minerals. The Museum employs about 300 scientific staff in its five scientific departments - botany, entomology, mineralogy, palaeontology and zoology. In addition there is a separate department of library services.

The Museum's scientific collections of more then 68 million items are the largest and most comprehensive in existence. They are a major reference resource for mankind's endeavour in researching the flora and fauna of our planet. They are unique in their global coverage, richness of species represented, historical importance and their wealth of type and other reference specimens. The quality and orderliness of these collections is extremely high as they receive continual curation and benefit from regular enhancement by researchers - both Museum staff and visitors - who are internationally acknowledged authorities in their fields.

The Museum's library of over one million volumes is the world's most complete collection of published works about natural history. It has a comprehensive range of modern periodicals and books, and an unequalled collection of historical materials.

**CONTACT-NAME:** Keeper of Zoology

**PHONE:** +44 20 7942 5275

**FAX:** +44 20 7942 5054

**EMAIL:** psr@nhm.ac.uk

2.12

**CENTRE-NAME**: Centre for Environment, Fisheries and Aquaculture Science

**ADDRESS:** CEFAS, Lowestoft Laboratory,
Pakefield Road,
Lowestoft,
Suffolk,
NR33 OHT
United Kingdom

**CENTRE-WEBSITE:** www.cefas.co.uk/

**DESCRIPTION:**
CEFAS is a scientific research and monitoring centre for fisheries management and environmental protection. It provides contract research, consultancy, advice and training in fisheries science and management, marine environmental protection, aquaculture and fish and shellfish disease and hygiene to a variety of public and private sector clients around the world.

CEFAS is an agency of the UK government's Ministry for Agriculture Fisheries and Food (MAFF).

There are two broad aims for this research. Firstly, the assessment of the state of the stocks of fish and shellfish to provide a sound scientific basis for management policies at national and international level which will maintain the supply of fish and promote the efficiency of the industry; and secondly, the protection of the aquatic environment and especially its fish and shellfish resources, as well as man as a consumer of marine food, from the adverse effects of pollutants introduced through man's industrial and other activities.

There are Fisheries Laboratories at Lowestoft, Burnham-on-Crouch, Whitehaven and Weymouth. All enquiries should be directed to the Contracts Office, CEFAS, Lowestoft Laboratory, Pakefield Road, Lowestoft, Suffolk NR33 0HT, United Kingdom (Tel: +44 1502 562244; Fax: +44 1502 513865 (FAO Contracts Officer), Telex: 995543 (FAO Contracts Officer)).

At Burnham-on-Crouch research is concentrated on the protection of the aquatic environment from the disposal of non-radioactive waste and also the effects of other man-made changes such as offshore oil and marine gravel exploitation.

**CONTACT-NAME:** Contracts Office, CEFAS, Lowestoft

**PHONE:** +44 1621 562244

**FAX:** +44 1621 513865

2.13

**CENTRE-NAME:** Netherlands Institute for Sea Research (NIOZ)

**ADDRESS:** Nederlands Instituut voor Onderzoek der Zee (NIOZ) Data Management Group

Landsdiep 4
P.O. Box 59
1790 AB Den Burg/Texel
Netherlands

**CENTRE-WEBSITE:** www.nioz.nl/en/facilities/dmg/meta

**DESCRIPTION:**
The Netherlands Institute for Sea Research (NIOZ), on the Frisian island Texel, is supervised and financed by the Netherlands Organisation for Scientific Research (NWO). NIOZ is devoted to fundamental marine research and offers research opportunities for visiting scientists from The Netherlands and abroad. Various applied and fundamental research projects are carried out, mainly for governmental bodies but also for the industry.

NIOZ is organised in 7 working groups:

HYDROGRAPHICAL
1) physical oceanography
2) chemical oceanography and marine pollution
3) marine geology and geochemistry
BIOLOGICAL
4) coastal systems
5) benthic systems
6) pelagic systems
APPLIED SCIENTIFIC RESEARCH
7) BEWON

**CONTACT-NAME:** T.F. de Bruin

**PHONE:** +31 (0)222-369479

**FAX:** +31 (0)222-319674

**EMAIL:** bruin@nioz.nl

2.14

**CENTRE-NAME:** German Oceanographic Datacentre (NODC)

**CENTRE-HOST:** Deutsches Ozeanographisches Datenzentrum (DOD)

**VISIT-ADDRESS:** Bernhard-Nocht-Strasse 78,
20359 Hamburg,
Germany

**CENTRE-WEBSITE:** www.bsh.de/Meereskunde/DOD/972.htm

**DESCRIPTION:**
The DOD - Deutsches Ozeanographisches Datenzentrum (German Oceanographic Datacentre) is the National Oceanographic Datacentre (NODC) for Germany and serves as a focal point for the national and international exchange of oceanographic data.

The objectives of DODare:
- to acquire the marine data sampled by German institutes and agencies, archive it and maximize its utilisation by promoting data exchange on a national and intrnational level
- to meet Germany's international data exchange obligations according to the resolution of the Intergovernmental Oceanographic Commission (IOC), and under the Oslo/Paris and Helsinki Conventions regarding monitoring of the North Sea/North-East Atlantic and Baltic Sea, respectively.

**CONTACT-NAME:** Friedrich Nast

**PHONE:** +49 (0)40 3190 3530

**FAX:** +49 (0)40 3190 5000

**EMAIL:** friedrich.nast@bsh.d400.de

2.15

**CENTRE-NAME:** Instituto Espanol de Oceanografia (IEO)

**VISIT-ADDRESS:** Avenida del Brasil 31,
28020 Madrid,
Spain

**CENTRE-WEBSITE:** www.ieo.es

**DESCRIPTION:**

The Instituto Espanol de Oceanografia (IEO) of the Ministry of Science and Technology, was established in 1914 for the purpose of carrying out multidisciplinary oceanographic research on our seas and on specific aspects of other areas, as well as to counsel the State Administration and other Public Administrations.

Research and counsel encompass marine biology, physical, chemical and geological oceanography, pollution of the marine environment and fishing aspects, as well as research and experience in aquaculture.

The Instituto Espanol de Oceanografia maintain an Oceanographic Data Centre which was established in 1968, and is responsible for the compilation, storage and distribution of the data produced by the different research areas of the Institute. It acts as the Spanish representative at the international data exchange, and operates within the network of national oceanographic databases established by the IOC.

The IEO Data Centre freely exchanges its data with other national centres on the basis of bilateral agreements, but holds the right to charge marginal costs up to other consumers, e.g. copy, materials and postage expenses. The availability of certain data is restricted, and is subject to the authorization of the scientists who were responsible for the collection and reports thereof.

**CONTACT-NAME:** Alvaro Fernandez

**PHONE:** +34 91 5974443

**FAX:** +34 91 5974770

**EMAIL:** director@md.ieo.es

2.16

**CENTRE-NAME:** University of Wales, Bangor, School of Ocean Sciences

**VISIT-ADDRESS:** School of Ocean Sciences,
University College of North Wales,
Marine Sciences Laboratories,
Menai Bridge,
Gwynedd,
LL59 5EH,
United Kingdom

**CENTRE-WEBSITE:** www.sos.bangor.ac.uk/

**DESCRIPTION:**
The School of Ocean Sciences (SOS) is part of the University of Wales Bangor. It is one of the two United Kingdom universities specialising in oceanography. The SOS is one of the largest marine science academic departments in Europe. Its research interests are multi-disciplinary (i.e. biological, chemical, geological and hydrodynamical) and relate not only to the water mass and what is contained within it, but also the sediments lying below it.

The SOS is participating in several Natural Environment Research Council (NERC) Community Research Projects (CRPs), including the North Sea Project, the Biogeochemical Ocean Flux Study (BOFS), and the Land Ocean Interaction Study (LOIS). It acted as host laboratory to the NERC Community Research Project Plankton Reactivity in the Marine Environment (PRIME). In addition, the School is taking part in a number of CEC MAST projects, including PROFILE, MORENA, European Coastal Transition Zone project and Mapping of Sea Bottom Topography in a Multi-Sensor Approach.

Further details of the Department are available from the Departmental Secretary.

**CONTACT-NAME:** Head of Department
**PHONE:** +44 1248 351151
**FAX:** +44 1248 716367
**EMAIL:** enquiries@sos.bangor.ac.uk

2.17

**CENTRE-NAME:** Fisheries Research Centre (Aquaculture/Environmental Monitoring)

**VISIT-ADDRESS:** Fisheries Research Centre,
Department of the Marine,
Abbotstown,
Dublin 15,
Ireland

**DESCRIPTION:**
The Fisheries Research Centre is the research arm of the Department of the Environment, Ireland, and has programmes in three main areas - Fish Stock Assessment, Aquaculture and Environmental Monitoring. Data are held or published in various formats and may be exchanged with other bodies.

**CONTACT-NAME:** Ms. Jacqueline Doyle (or as specified on individual data sets)

**PHONE:** +353 1 210111

**FAX:** +353 1 205078

2.18

**CENTRE-NAME:** Department of Oceanography, Martin Ryan Institute

**VISIT-ADDRESS:** Department of Oceanography,
University College, Galway,
Ireland

**CENTRE-WEBSITE:**

**DESCRIPTION:**
The Department of Oceanography (OCE-UCG) maintains a research program of oceanographic monitoring along the north west and south coast of Ireland. This program and data stretches back eighteen years. The data storage medium is magnetic tape, formatted floppy disk with data organised in ICES code form which enables ready transfer to other DEC, FAX and compatible computer.

**CONTACT-NAME:** Prof. Michael Orren/Mr. John J. Coyne

**PHONE:** +353 91 67894

**FAX:** +353 91 64243

2.19

**CENTRE-NAME:** Carlingford Lough Marine Laboratory

**VISIT-ADDRESS:** Dept. of Experimental Sciences,
Regional Technical College,
Dundalk,
Co. Louth,
Ireland

**DESCRIPTION:**

Carlingford Lough Marine Laboratory was established to provide baseline data on environmental quality in Carlingford Lough and to advise local shellfish farmers on the best methods of husbandry. The laboratory also plays a role in site selection and investigation of growth of new species to the Lough. The laboratory provides a bacteriological service to the growers in the area.

This laboratory is no longer operational - C/O S. McQuaid, Dr. D. Douglas, 'The Emerald', Omeath, Co. Louth. Copy of M.Sc. held at the Irish Marine Data Centre.

**CONTACT-NAME:** Dr. Dermot J. Douglas

**PHONE:** +353 42 34785/6/7/8

**FAX:** +353 42 33505

**3. Metadata report**

3.1

**DATASET-NAME:** Phytoplankton Study in Loch Creran (1971-1982)

**CENTRE-NAME:** University of Wales, Bangor, School of Ocean Sciences

**TIME-PERIOD:** from 1971 to 1982

**GEOGRAPHIC-COVERAGE:** Loch Creran, Argyll, Scotland

**PARAMETERS:** temperature, salinity, chlorophyll, nutrients, phytoplankton species composition

**SUMMARY:**

The data are the results of a study of phytoplankton in relation to hydrography in Loch Creran. In some years, water samples were taken at weekly intervals from a pier and analysed for phytoplankton species composition and some other parameters. In other years a ship was used to profile temperature, salinity, chlorophyll and, in some cases, nutrients, at several sites in the loch, concentrating on key periods such as the spring phytoplankton increase.

**REFERENCE:** Tett, P. and Wallis, A. 1978. The general annual cycle of chlorophyll in Loch Creran. Journal of Ecology, 66, 227-239.

**STORAGE-MEDIUM:** Paper records (loose-leaf), reports and theses. HP9825, (digital) tapes

**AVAILABILITY:** by special arrangement

**CONTACT:** Paul Tett (Tel: +44 (0) 1248 382878; Email: osu001@clss1.bangor.ac.uk)

3.2

**DATASET-NAME:** Studies of Phytoplankton Ecology in Loch Striven (1980-1994)

**CENTRE-NAME:** University of Wales, Bangor, School of Ocean Sciences

**TIME-PERIOD:** from 1980 to 1994

**GEOGRAPHIC-COVERAGE:** Loch Striven, Argyll, Scotland

**PARAMETERS:** temperature, salinity, currents, optical measurements, nutrients, chlorophyll, zooplankton biomass, phytoplankton species composition

**INSTRUMENTS:** CTD, moored current meters, fluorometers, transmissometers, colour sensors

**SUMMARY:**
The data are the results of several studies of phytoplankton ecology in relation to hydrography carried out in Loch Striven in 1980 (March - August), 1988 (1 week in June), 1990 (May - June), 1991 (May) and 1994 (mid- March to mid-May). In 1980 - 1991, water samples were taken at regular intervals and analysed for chlorophyll, nutrients and phytoplankton species composition. T-S profiles were made. In 1990-1994, moorings equipped with current meters, transmissometers, fluorometers and (1991 onwards) colour sensors were deployed for periods of 1 to 2 months.

**REFERENCE:** Tett, P. et al 1986. The phytoplankton ecology of the Firth of Clyde sea lochs Striven and Fyne. Proceedings of the Royal Society of Edinburgh, 908, 223-238.

**STORAGE-MEDIUM:** Loose-leaf paper records, reports and theses; 5.25' and 3.5' disks with (digital) ASCII files

**AVAILABILITY:** by special arrangement

**CONTACT:** Paul Tett (Tel: +44 (0) 131455 2633 ; Email: p.tett@napier.ac.uk)

3.3

**DATASET-NAME:** Plankton Reactivity in the Marine Environment (PRIME) project dataset (1995-1998)

**CENTRE-NAME:** British Oceanographic Data Centre (BODC)

**TIME-PERIOD:** 1995-1998

**GEOGRAPHIC-COVERAGE:** Norwegian fjords (mesocosm experiment)
OWS India, NE Atlantic,
NE Atlantic, 20 West, 37-60 North

**PROJECT:** Plankton Reactivity in the Marine Environment (PRIME)

**PARAMETERS:** temperature, salinity, optics, chlorophyll, nutrients, dissolved tracers, phytoplankton community structure, biogeochemical cycling, genetic assays, productivity

**INSTRUMENTS:** CTD, profiling radiometers, zooplankton nets, optical plankton counters, Western dot blots, RFLPs, automated flow cytometer, autoanalyser, fluorometer, HPLC, tangential flow filtration, productivity incubations

**SUMMARY:**
The PRIME programme aimed to lay the basis for mathematical models to describe the role of plankton in biogeochemical fluxes within the oceans which have implications for climate regulation.

The PRIME programme drew on both historical data collected from Ocean Weather Station India in the NE Atlantic and undertook two major pieces of fieldwork; a 4 week mesocosm study in 1995 and a 6 week research cruise in the NE Atlantic.

Mesocosms Study

The mesocosm study was undertaken at the University of Bergen Field Station in the summer of 1995. The aim of the study was to investigate the circumstances surrounding the development of different plankton assemblages. The experiment was managed by setting up eight 11m3 mesocosms, constructed from transparent polyethylene, and then manipulating the inorganic nutrient environment to force the development of plankton assemblages. The bags were monitored at daily intervals for chlorophyll and the basic nutrients, and on every second day for most other ecosystem parameters. The intensive nature of the sampling provided a very detailed description of the development of the different plankton assemblages. The dominant phytoplankton forms were diatoms and flagellates, predominantly the coccolithophore *Emiliania huxleyi*, the relative proportion of these forms being controlled by the chemical environment. The calcareous forms such as *Emiliania huxleyi* are potentially important sink of carbon in the ocean, given their large inorganic carbon mass and the potential for its export from surface waters.

The mesocosms study served as a testing ground for many of the new methodologies and approaches and also provided the initial data for the first generation of models to describe and predict plankton dynamics. A number of research papers resulted from the study and have been published as a Special Issue of Estuarine Coastal and Shelf Science, entitled Coastal Plankton Dynamics: The PRIME Mesocosm Experiment. - ECSS, Volume 46 (supplement A).

North-East Atlantic Campaign

The PRIME Cruise took place in the North Atlantic in the summer of 1996. A wide range of disciplines was represented on the cruise ranging from physics to molecular biology. The cruise was divided into two legs with a mid-cruise port call being made at Reykjavik, Iceland, to allow change over of part of the scientific personnel. The first leg of the cruise departed from Southampton on the NERC Research Vessel Discovery and proceeded to a mesoscale eddy feature close to the 20oW meridian at latitude 59oN. The research vessel was guided to the eddy with the assistance of the NERC Remote Sensing Unit, which supplied updated sea-surface temperature satellite images on a daily basis. In the high energy eddy environment an eight day time series of observations were made in Lagrangian mode, with the successful deployment of a sulphur hexaflouride (SF6) tracer to track the movement of the eddy. A detailed hydrographic survey showed the eddy to be characterised by a deep warm core structure on which was superimposed a surface cold core structure exhibiting strong anticyclonic circulation. Within and outside the eddy there was strongly contrasting planktonic community composition and structure. The second leg of the cruise enabled a range of measurements at set stations along a transect between 59oN and 37oN along the 20oW meridian, and also provided a time series of measurements in the vicinity of 37oN comparable to those at the northern eddy There was demonstration of strong physical-biological interactions controlling the vertical structure and extent of the sub-surface chlorophyll maximum in the area of formation

of the sub-tropical component of the Eastern North Atlantic Central Water. Physical and biological changes were characterised in transiting from north temperate to sub-tropical waters along the 20oW meridian and the importance of associated frontal regions as biological boundary zones was confirmed

**REFERENCE:** PRIME Project data set - electronic publication BODC 2000
**DATA-WEBSITE:** www.bodc.ac.uk/
**STORAGE-MEDIUM:** CD-ROM
**AVAILABILITY:** The fully documented dataset is available on CD-ROM from BODC
**SUPPLY-DETAILS:** Please complete the order form on the BODC website site.

**CONTACT:** **:** Polly Hadziabdic

3.4
**DATASET-NAME:** Secondary Production data in Loch Ewe (Scotland)

**CENTRE-NAME:** Instituto Espanol de Oceanografia (IEO)

**TIME-PERIOD:** from April to September 1970

**GEOGRAPHIC-COVERAGE:** Loch Ewe (Scotland)

**PARAMETERS:** Grazing, chlorophyll-a, particulate organic carbon, zooplankton biomass, primary production

**SUMMARY:**
As part of the project for the study of the ecological conditions at a fixed station situated at Loch Ewe, samples and research were performed in order to know the seasonal variability of primary production and its control by means of zooplankton grazing. Seasonal follow-ups were carried out on primary production, phytoplankton biomass, particulate organic carbon, and ingestion and respiration of the main groups formed by copepods of the genera *Temora*, *Pseudocalanus* and *Acartia*.

**REFERENCE:** J.G. Braun (1976): 'Marine productivity (trophic relationship between phytoplankton and zooplankton communities)'. Thesis Doctoral at the University of La Laguna

**STORAGE-MEDIUM:** hard disk

**AVAILABILITY:** data available on request

**CONTACT:** dearmas@ieo.rcanaria.es

3.5

**DATASET-NAME:** Study of the soft clam 'Mya arenaria' L. in Irish waters (1990-1991)

**CENTRE-NAME:** Carlingford Lough Marine Laboratory

**TIME-PERIOD:** from 15 May 1990 to 15 October 1991 at 1 station

**GEOGRAPHIC-COVERAGE:** Carlingford Lough, Omeath, Co. Louth, east coast of Ireland (54deg 2'N, 6deg 8'W)

**PARAMETERS:** Primary productivity, phytoplankton, molluscs, current meters, subsurface temperature/salinity underway, surface temperature/salinity underway, oxygen, phosphates, nitrates, silicates, pH, ammonia, contamination in suspended matter

**INSTRUMENTS:** YSI S.C.T. meter, Syland DO/temperature meter, plankton sampling net of mesh 60 microns

**SUMMARY:**
A study of the soft clam *'Mya arenaria'* L. in Irish waters was carried out. The aims of the study were to identify locations where the soft clam is found around Ireland; to assess growth in the clam at Omeath and to evaluate the commercial potential for soft clam culture in Carlingford Lough; to investigate the clam's ability to burrow in different substrates and to age clam shells using a staining technique. In terms of sampling frequency, a monthly evaluation was carried out in 1990 of physical and chemical factors affecting growth. Clam growth was measured on five different occasions during trial.

**REFERENCE:** Unpublished M.Sc. thesis presented to the NCEA in 1993.

**STORAGE-MEDIUM:** Printed paper/tables

**AVAILABILITY:** Freely available

**CONTACT::** Mr. Joe Ryan

3.6

**DATASET-NAME:** Hydrographic stations in Irish coastal waters

**CENTRE-NAME:** Department of Oceanography, Martin Ryan Institute

**TIME-PERIOD:** from 1972 onwards

**GEOGRAPHIC-COVERAGE:** waters off the North, South and West coasts of Ireland

**PROJECT:** multiple use for research, training and consulting work

**PARAMETERS:** ship name, date, time, position, station number, depth, temperature, salinity, oxygen, P04 - P, N02-N, Si, Chl-a

**INSTRUMENTS:** temperature - salinity probes (M.C. 5 or similar), sampling bottles, oxygen probe, CTD, Clark Bumpus samplers, suspended solids, fluorometer, current meters, light meters

**SUMMARY:**
Files of temp - salinity, oxygen, sigma-t, nutrients P04P, N02-N, N03N, Si, chlorophyll, P.O.C., currents, phytoplankton, zooplankton for every station sampled. Field equipment calibrated with standard reversing thermometers and inductively coupled salinometer. Files sorted by research cruises.

**STORAGE-MEDIUM:** magnetic tape, floppy disc: MS-DOS ASCII text files

**AVAILABILITY:** On request for most data. Permission required for contract data from client.

**CONTACT:** John Coyne

3.7
**DATASET-NAME:** Phytoplankton in Irish coastal waters

**CENTRE-NAME:** Fisheries Research Centre (Aquaculture/Environmental Monitoring)

**TIME-PERIOD:** ongoing programme, start date not specified

**GEOGRAPHIC-COVERAGE:** Irish coastal waters

**PROJECT:** Phytoplankton Monitoring Programme

**PARAMETERS:** species, location, depth, numbers (cells/litre), date

**SUMMARY:**
The data set consists of all phytoplankton samples analysed in the course of monitoring for toxic and nuisance phytoplankton blooms. Some of the stations are monitored regularly; others only when there is a bloom. The method of collection varies from sample to sample. All samples are analysed and all phytoplankton determined to species level where possible. At the regular sampling stations data on depth temperature and salinity is often included.

**STORAGE-MEDIUM:** hard disk

**AVAILABILITY:** data available by special arrangement - contact Dr. David Jackson, FRC

**CONTACT:** Dr. D. Jackson

3.8

**DATASET-NAME:** Distribution of phytoplankton cysts in the sediments around the Irish coast (1992-1993)

**CENTRE-NAME:** Fisheries Research Centre (Aquaculture/Environmental Monitoring)

**TIME-PERIOD:** from 29 October 1992 to 19 August 1993 at 93 stations

**GEOGRAPHIC-COVERAGE:** Selected sites around the Irish coast

**PARAMETERS:** Phytoplankton, phytobenthos, molluscs, dredge, grab, core - soft bottom, aquaculture

**SUMMARY:**
This project involved mapping the distribution of phytoplankton cysts in the sediments around the Irish coast. Samples were taken at selected sites from Connemara to West Cork; Bantry Bay; Dunmanus Bay, Kenmare River; West Cork - (Rosscarbery, Lough Hyne, Baltimore); Cork Harbour; Dungarvan Harbour, Co. Waterford; Waterford Harbour; Wexford Harbour; Dublin Port, oil berths; Malahide dump site, Co. Dublin; Carlingford Lough, Co. Louth; Mulroy Bay, Co. Donegal; Fanad Fisheries, Kindrum, Co. Donegal. Sampling dates included 29-31 October 1992, 16-20 November 1992, 2 December 1992, 13-16 February 1993, 4 March 1993, 8-10 March 1993, 2 April 1993, 5 April 1993, 24 June 1993, 10-12 August 1993 and 19 August 1993.

**REFERENCE:** O' Mahony, J., 1993. Phytoplankton species associated with the imports of the Pacific oyster *'Crassostrea gigas'* from France to Ireland. ICES C.M./93F: 25.

**STORAGE-MEDIUM:** Floppy disk, maps/charts, printed paper/tables

**AVAILABILITY:** Restricted availability

**CONTACT:** Dr. J. O'Mahony

3.9

**DATASET-NAME:** Distribution of armoured planktonic dinoflagellates in the North East Atlantic and coastline (benthic) dinoflagellates around UK (1970-)

**CENTRE-NAME:** Royal Holloway, University of London, School of Biological Sciences

**TIME-PERIOD:** from approximately 1970 onwards

**GEOGRAPHIC-COVERAGE:** North East Atlantic, including the North Sea

**PARAMETERS:** planktonic dinoflagellates; benthic dinoflagellates around the coasts of UK

**SUMMARY:**
Over the past 20 years data have been accumulated on the distribution of armoured dinoflagellates in the area of the North East Atlantic bounded by latitude 20deg N and 70deg N, longitude 5deg E and 25deg W, and benthic dinoflagellates around the coasts of UK. Over 2500 samples, collected by a range of oceanographic techniques, have been examined. To date 250 species have been identified and their distributions plotted using a 5 degree grid.

**STORAGE-MEDIUM:** Unknown

**AVAILABILITY:** Contact Prof. J.D. Dodge for further details

**CONTACT:** J.D. Dodge

3.10

**DATASET-NAME:** IOS Deacon Laboratory Biological Database of the North East Atlantic (1969-)

**CENTRE-NAME:** Southampton Oceanography Centre

**TIME-PERIOD:** from 1969 onwards

**GEOGRAPHIC-COVERAGE:** Eastern North Atlantic Ocean, Western Mediterranean, Arabian Sea/Persian Gulf, off Bermuda, Weddell Sea

**PARAMETERS:** macroplankton, micronekton, benthic fish, amphipods, cephalopods, ctenophores, medusae, pteropods, heteropods

**INSTRUMENTS:** rectangular midwater trawl (1 and 8 metre), benthic nets

**SUMMARY:**
The Biology Group at IOS Deacon Laboratory has been engaged in a series of comprehensive mid-water sampling programmes in the North Atlantic between the equator and 60deg N and from offshore Europe and Africa mainly to 33deg W for many years.

Between 1969 and 1974 the sampler used was the opening/closing Rectangular Midwater Trawl (1+8), but in 1974 this was superseded by the multiple version (1+8m) Using both systems a macroplankton and a micronekton sample are collected simultaneously in an RMT1 and RMT8 net respectively, fished in tandem. At many stations a series of horizontal hauls were taken systematically in discrete depth strata 50-200m in thickness, so the whole water column was sampled. In the upper 900-1000m usually both day and night samples were collected; below these depths samples were taken irrespective of the light regime.

A relational database is used for storage and retrieval of the biological data relating to the vertical and geographic distribution of open ocean species of macroplankton and

micronekton. Data on the vertical distribution and maturity stages of the following taxonomic groups are included in the database: Decapoda, Ostracoda, Chaetognatha, Mysidacea, Fish, Siphonophora, Euphausiacea, amphipoda, cephalopoda, ctenophora, medusae, pteropoda, heteropoda. The total number of records entered into the database is 81523 and the number of specimens identified is over 4.5 million.

**REFERENCE:** Hargreaves, P.M. 1990 North East Atlantic data held in the biological database
of the Institute of Oceanographic Sciences Deacon Laboratory, U.K.
Arquipelago. Life and Earth Sciences 8:55-61

Angra do Heroismo. Domanski, P.
1981 BIOS data base for marine biological data. Journal of Plankton Research 3:3.

**STORAGE-MEDIUM:** Data on disk (Oracle RDBMS)

**AVAILABILITY:** These data may be made available to bona fide members of the scientific
community at negotiable cost. Further enquiries should be addressed to the
Biology Group at IOSDL, Wormley, Surrey, UK.

**CONTACT:** Phil Pugh (Tel: +44 1428 684141)

3.11

**DATASET-NAME:** Control Volume Experiment (CONVEX) North Atlantic (1991-)

**CENTRE-NAME:** Southampton Oceanography Centre

**TIME-PERIOD:** from 01 August 1991 onwards

**GEOGRAPHIC-COVERAGE:** North Atlantic (UK to Cape Farewell, Greenland)

**PROJECT:** World Ocean Circulation Experiment (WOCE), CONVEX

**PARAMETERS:** temperature, salinity, transmittance, dissolved oxygen, nitrate, silicate, oxygen-16/oxygen-18 ratio, CFCs, plankton, meteorological measurements, current profiles, bathymetry

**INSTRUMENTS:** thermosalinograph, XBT, CTD, transmissometer, rosette sampler, nets, multimet recorder, Simrad echo-sounder, shipborne ADCP, drifting buoys

**SUMMARY:**

This data set was collected on RRS Charles Darwin cruise 62 (CONVEX 91) as a contribution to WOCE core Project 3. The data set comprises high quality CTD, nutrient, dissolved oxygen, and CFC data between the UK and Cape Farewell, Greenland. These data were collected to investigate the distribution of water masses

and to derive full depth circulation. Two approximately meridional sections were completed with linking sections on 20deg W and 30deg W. Two drifting buoys were deployed during the cruise.

**STORAGE-MEDIUM:** Magnetic disk

**AVAILABILITY:** Contact Dr. W.J. Gould for details; data may be restricted to WOCE scientists

**CONTACT:** L.J. Rickards, BODC

3.12

**DATASET-NAME:** UK coastal sea water quality survey (1980-1982)

**CENTRE-NAME:** Centre for Environment, Fisheries and Aquaculture Science

**TIME-PERIOD:** from 1980 to 1982

**GEOGRAPHIC-COVERAGE:** 9 sites (Walton-on-the-Naze, Reculver, Whitstable, Beaulieu, Milford Haven, Inland Sea and Tal-y-foel (Anglesey), Conwy, Connel) on the UK coastline

**PARAMETERS:** Temperature, salinity, phytoplankton, pH, nutrients (silicate, nitrate, nitrite, orthophosphate, inorganic and organic carbon), *Vibrios* and total bacteria

**SUMMARY:**

Sea water was collected at high tide on a weekly basis from March to October inclusive. Temperature was taken at the time of collection using a thermometer. Sea water subsamples (0.1 ml) were spread over nutrient agar and TCBS medium immediately after collection for the assessment of total bacteria and Vibrio spp respectively. Salinity was measured by refractometer and pH with a pH meter. Nutrients were measured by colorimetric methods using an automatic analyzer.

Phytoplankton identification and enumeration were carried out using a binocular microscope

**DATA-WEBSITE:** www.cefas.co.uk/

**STORAGE-MEDIUM:** Magnetic disk

**AVAILABILITY:** Report - data available on application. Contact the Contracts Office, CEFAS, Lowestoft.

**CONTACT:** S.D. Utting

3.13

**DATASET-NAME:** NHM foraminifera collection from the oceans and seas adjoining Europe (1850-)

**CENTRE-NAME:** Natural History Museum, London (NHM)

**TIME-PERIOD:** from 1850 onwards

**GEOGRAPHIC-COVERAGE:** oceans and seas adjoining Europe; very extensive coverage

**PROJECT:** taxonomic research

**PARAMETERS:** plankton and benthos

**SUMMARY:**
The Palaeontology Department of the Natural History Museum holds one of the finest and largest collections in the world of recent as well as fossil foraminifera. These are both wet and dry preserved specimens and include historically important collections such as the 'Challenger', Terra Nova', 'Discovery' and other cruises of international importance. The Department holds extensive collections from European coastal regions and seas.

The foraminifera collection comprises material obtained by individuals and by cruises from the north east Atlantic, the Arctic Ocean, the North Sea, the Baltic, the Irish Sea, the west Irish coast, the English Channel and Western Approaches, the Mediterranean and the Black Sea. The Brady collection contains not only the famous Challenger collection, but also much material from European coasts obtained in exchange from Scandinavia and the Mediterranean. We hold material from the 'Porcupine' cruises, and much material in the Heron- Allen and Earland collection from European shores (e.g. Clare Island Survey). Other famous collections include the Parker and Jones' collection (North Atlantic and Grecian Archipelago) and the Williamson collection of British foraminifera.

Data are stored in a series of handwritten registers (species, geographical and donor indices). This is to be computerised in the near future. Active research is being undertaken on the more important historical collections (e.g. Heron-Allen and Earland, Parker and Jones' collections).

**REFERENCE:** Reference to the Heron-Allen and Earland collections published in the Journal of Micropalaeontology (Vol. 8, pt. 2, pp 149-156) and the Parker (and Jones) collections in the Bulletin of the British Museum (Nat. Hist.), (Geol.) (Vol. 48, pt.2, pp 45-78).

**STORAGE-MEDIUM:** Handwritten registers and indices. Computerization is being undertaken. Wet and dry preserved specimens.

**AVAILABILITY:** The collections are available for scientific study within the Museum and in some situations, for loan to institutions. The Heron-Allen Library houses one of the finest collections of books on foraminifera in the world.

**CONTACT:** Dr. J.E. Whittaker, Head, Micropalaeontology Division, Department of

Palaeontology, Natural History, Museum

3.14

**DATASET-NAME:** MLA Zooplankton Data (1986-)

**CENTRE-NAME:** FRS, Marine Laboratory, Aberdeen

**TIME-PERIOD:** from 1986 onwards

**GEOGRAPHIC-COVERAGE:** Scottish coastal waters, central and northern North Sea, Rockall, north east Atlantic

**PROJECT:** Various internal projects, national and international programmes

**PARAMETERS:** Species composition, biomass concentration, dry weight, feeding and growth rates, length/weight data, and other derived parameters

**INSTRUMENTS:** Dutch Gulf III, ARIES, 1m nets, optical plankton counter, OCEAN sampler, single and multiple METHOT nets, LOCH EWE net, and water bottle samplers

**SUMMARY:**

These data have been collected over a period of many years using a wide range of sampling gears. The ARIES sampler is a multiple net sampler which can be fitted with a variety of environmental sensors as well as a multiple water bottle sampler. It was designed and developed within the Laboratory. The OCEAN sampler was also designed and developed by the Laboratory and is a modified version of the traditional Gulf III high speed sampler. It is fitted with four nets, is acoustically controlled and can be fitted with an environmental sensor package if required. The LOCH EWE net is again an internally designed system and consisted of two concentric nets of different mesh sizes, one to trap zooplankton and the other for phytoplankton. These sampling gears have been operated in different modes - vertical hauls, oblique and double-oblique tows, at multiple depths on the one tow, and at a single fixed depth. The choice of sampling strategy was dependent on the scientific requirements of the programme.

Since many of the samples which have been collected were for a specific research project, a full analysis to stage and species level has not been done in many instances. This is particularly true of the samples collected during ICES Herring Larvae surveys. Here, the herring larvae are extracted from the sample for further study but the rest of the sample is not analyzed. In other instances, only selected samples from a particular cruise or survey may have been analyzed in detail. The other samples were not analyzed in detail but were dried to produce dry weight data.

In the present data base, data only goes back as far as 1986. There is the potential to include data back as far as the mid-60s but this is heavily dependent on the

availability of manpower resources. At present, the data are arranged by cruise but, as the integrated data base grows and extra features are added, better search and query facilities will be available.

Almost the entire data set was collected by research vessels operated by or on behalf of the Marine Laboratory, Aberdeen. The exception is the data set collected on the ICES Herring Larval surveys. The Laboratory acts as the international coordinator for the collation of these data and is also responsible for archiving the entire data set.

**DATA-WEBSITE:** www.marlab.ac.uk/

**STORAGE-MEDIUM:** Magnetic tape, optical disk, floppy disk, manuscript

**AVAILABILITY:** This data set is currently being assimilated into an integrated computerised relational data base. Until such time as this has been accomplished with the necessary examination and validation of all data prior to its inclusion in the data base, these data are not generally available.

**CONTACT:** Steve Hay (S.Hay@marlab.ac.uk)

3.15

**DATASET-NAME:** ACSOE/MAGE (Atmospheric Chemistry Studies in the Oceanic environment/Marine Aerosol and Gas Exchange) marine data set (1996-1998)

**CENTRE-NAME:** British Oceanographic Data Centre (BODC)

**TIME-PERIOD:** 1996-1998

**GEOGRAPHIC-COVERAGE:** Eastern Atlantic, North-Eastern Atlantic and Northern North Sea

**PROJECT:** UK NERC Thematic Research Programme Atmospheric Chemistry Studies in the Oceanic Environment (ACSOE)

**PARAMETERS:** CTD profiles and Seasoar transects (temperature, salinity, fluorescence, underwater PAR, attenuance, optical backscattering), current speed and direction, biomass measurements (chlorophyll and accessory pigments, particulate organic nitrogen, size-fractionation, micro- and nanophytoplankton abundance, microzooplankton abundance, bacterial diversity, bacterial abundance, seabirds and cetacean counts), suspended particulate matter, biological productivity and nutrient/gas cycling (size-fractionated carbon uptake, DOC production, PI 14C curves, size-fractionated ammonium and nitrate uptake, ammonium remineralisation, microzooplankton grazing, DMSlyase activity, DMS speciation and cycling), dissolved gases (SF6 tracer, DMS, DMSP, methyl bromide, nitrous oxide and methane, non-methane hydrocarbons, volatile

selenium, pCO2, carbon monoxide, methyl halides, oxygen), dissolved nutrients (nitrate, nitrite, silicate, phosphate and iron) and *Bacillus globigii* tracer.

**INSTRUMENTS:** CTD with fluorometer, underwater PAR sensor, transmissometer and nephelometer; XBT; SeaSoar with CTD and fluorometer; drifting buoys; underway ship's navigational, meteorological and hydrographic instruments; underway shipborne ADCP; CTD-rosette water samplers.

**SUMMARY:**
ACSOE was a 5-year UK NERC Thematic Research Programme investigating the chemistry of the lower atmosphere (0 - 12 km) over the oceans. The study aimed to bring about a clearer understanding of natural processes in the remote marine atmosphere, and how these processes are affected by atmospheric pollution originating from the continents. The marine component was only a small part of ACSOE which focused mainly on atmospheric processes through two of its three consortia: Oxidising Capacity of the Oceanic Atmosphere (OXICOA) and Aerosol Characterisation Experiment (ACE). The third consortia, Marine Aerosol and Gas Exchange (MAGE) was the only component of the ACSOE Project which included measurements in the marine environment. This consortia focused on the study of aspects of air-sea exchange relevant to atmospheric chemistry and aerosol production. It consisted of four cruises: the Eastern Atlantic Experiments EAE96 and EAE97 in June-July 1996 and in May 1997, the ASGAMAGE North Sea experiment in the Southern North Sea in October-November 1996, and the North Atlantic Experiment NAE in the North Eastern Atlantic in June-July 1998.

ACSOE data management was a shared responsibility between the British Atmospheric Data Centre (BADC) and the British Oceanographic Data Centre (BODC). BODC handled the management of ship data as well as all other data collected in the water column during the ACSOE/MAGE cruises. BODC assisted in the onboard collection and

**DATA-WEBSITE:** www.bodc.ac.uk

**STORAGE-MEDIUM:** BODC data storage system (Oracle RDBMS, optical and magnetic disk). The data will be available on CD-ROM.

**AVAILABILITY:** Unrestricted
**CONTACT:** BODC Enquiries Officer

3.16
**DATASET-NAME:** AUTOSUB microzooplankton data

**CENTRE-NAME:** Plymouth Marine Laboratory (PML)

**TIME-PERIOD:** 1998-2001

**GEOGRAPHIC-COVERAGE:** Waters off Southampton and Oban

**PROJECT:** AUTOSUB

**PARAMETERS:** Microzoplankton grazing, abundance and community structure

**INSTRUMENTS:** Microscopy and dilution experiments

**SUMMARY:**
The AUTOSUB project

Samples were taken during the various AUTOSUB missions and analysed for mcrozoplankton grazing, abundance and community structure

**ORIGINATOR:** Claire Widdicombe PML

**STORAGE-MEDIUM:** spreadsheets

**AVAILABILITY:** Data currently restricted to AUTOSUB project participants - contact Claire Widdicombe PML

**CONTACT:** Claire Widdicombe PML

3.17

**DATASET-NAME:** Zooplankton and optical plankton counter database for the North and South Atlantic

**CENTRE-NAME:** Plymouth Marine Laboratory (PML)

**TIME-PERIOD:** 1994 onwards

**GEOGRAPHIC-COVERAGE:** North and South Atlantic

**PROJECT:** Atlantic Meridional Transect, Plankton Reactivity in the Marine Environment plus various others

**PARAMETERS:** Zooplankton abundance

**INSTRUMENTS:** Microscopy and optical plankton counter, zooplankton nets

**SUMMARY:**
A database has been established covering optical plankton counter and more traditional methods of establishing mesozooplankton abundance. This covers both North and South Atlantic - cruises include those undertaken as part of the PRIME, AMT and other projects.

**REFERENCE:** Not yet published

**ORIGINATOR:** Chris Gallienne, PML

**STORAGE-MEDIUM:** database

**AVAILABILITY:** Contact Chris Gallienne, PML

**CONTACT:** Chris Gallienne, PML

3.18

**DATASET-NAME:** The North Atlantic Continuous Plankton Recorder Survey Data Set 1931-)

**CENTRE-NAME:** Sir Alister Hardy Foundation for Ocean Science (SAHFOS)

**TIME-PERIOD:** from 1931 onwards

**GEOGRAPHIC-COVERAGE:** North Atlantic (35deg N to 60deg N, 71deg W to 11deg E). The area east of about 15deg W has been sampled from the late 1930s whereas the area west of this line has been sampled only for the period 1961 to 1984, although sampling restarted in 1991 on a transect from Iceland to Newfoundland.

**PARAMETERS:** phytoplankton, zooplankton

**SUMMARY:**

The Continuous Plankton Recorder is a piece of apparatus towed by vessels for sampling plankton near the sea surface. The CPR now used is very little different from that described by Hardy (1939). The CPRs are towed by ships-of-opportunity at a depth of 10m and are deployed as far as possible, at monthly intervals over a standard set of routes.

Water enters through an aperture in the nose cone and is slowed to one thirtieth of its original speed before being filtered through a slowly moving band of bolting silk. The plankton is retained on the filtering silk and held in position by a second band of silk to form a 'sandwich' which is wound onto a spool in a tank containing a preservative (formalin). The silk is cut into lengths representing 10 nautical miles of tow, and the lengths of silk are then subjected to a standard routine analysis. Each 10 mile length of tow is regarded as a sample taken at its centre point and, for the purposes of constructing an atlas, allocated to a standard 1 degree latitude by 2 degree longitude rectangle.

The current catalogue of CPR records lists a total of 391 taxa identified to varying taxonomic levels. For each taxon the mean number per sample in each rectangle is calculated for each month, and the monthly means are averaged over a chosen period of years to give a mean value for each rectangle. Phytoplankton counts only are available for the years from 1958 onwards; before this only presence/absence is available. Data for the most abundant of the zooplankton taxa are available for the years from 1946, and data for all are available from 1958. For the pre-war years, when the survey was being developed, only a few taxa are as yet available. Some effort is being expended in an attempt to extract more data from the notebooks of the period.

Data handling procedures in the CPR survey have evolved alongside the development of the laboratory computer, with the data archive and retrieval systems being elaborated as computer systems became more sophisticated. Since the Survey was established over 60 years ago, over 155,000 samples have been analyzed and the data entered into the data archive.

**REFERENCE:** Hardy, A.C. 1939 Ecological investigations with the Continuous Plankton

**STORAGE-MEDIUM:** IBM compatible PC. CPR database (including access programs and some processed data) extends to approximately 64Mbytes.

**AVAILABILITY:** Contact the Sir Alister Hardy Foundation for details of access to the data set.

**CONTACT:** Darren Stevens dpst@mail.pml.ac.uk

3.19

**DATASET-NAME:** Marine Species Biology and Sensitivity Key Information

**CENTRE-NAME:** MarLIN Marine Life Information Network

**TIME-PERIOD:** present

**GEOGRAPHIC-COVERAGE:** Britain and Ireland

**PARAMETERS:** general biology, habitat preferences, distribution, taxonomy, reproduction,natural heritage importance

**INSTRUMENTS:** not known

**SUMMARY:**

As part of the MarLIN programme a web-based database of key information on marine species and biotopes is being produced.

**REFERENCE:** Hiscock K Jackson A and lear D 1999 Assessing seabed species and ecosystem senstivities. Existing approaches and development. Report to the DETR (MarLIN report no 1)

**DATA-WEBSITE:** www.marlin.ac.uk/

**STORAGE-MEDIUM:** web site

**AVAILABILITY:** See web site

**CONTACT:** Keith Hiscock MarLIN

3.20

**DATASET-NAME:** Marine Species Record Collections

**CENTRE-NAME:** MarLIN Marine Life Information Network

**TIME-PERIOD:** present

**GEOGRAPHIC-COVERAGE:** UK and Ireland

**PARAMETERS:** List of collections

**INSTRUMENTS:** not known

**SUMMARY:**

The list of marine species record collections has been compiled mainly from the results of a questionnaire circulated at the Marine Species Recording workshop held at the University of Newcastle-upon-Tyne on 29-30th January 1998.

**REFERENCE:** Foster-Smith 1998. Marine Species Recording Workshop held at the University of Newcastle-upon-Tyne 29-30th Jan 1998

**DATA-WEBSITE:** www.marlin.ac.uk/

**STORAGE-MEDIUM:** web site

**AVAILABILITY:** see web site

**CONTACT:** Keith Hiscock MarLIN

3.21

**DATASET-NAME:** German physical, chemical and biological oceanographic data collected in JGOFS North Atlantic Bloom Experiment (1989)

**CENTRE-NAME:** German Oceanographic Datacentre (NODC)

**TIME-PERIOD:** 1989

**GEOGRAPHIC-COVERAGE:** NE Atlantic

**PROJECT:** Joint Global Ocean Flux Study (JGOFS) - North Atlantic Bloom Experiment (NABE)

**PARAMETERS:** temperature, salinity, oxygen, NO3, NO2, NH4, SIO3, particulate organic carbon, particulate organic nitrogen, particulate PO4, particulate SIO3, chlorophyll-a, carbon nitrogen ratio, primary production

**INSTRUMENTS:** Thermometer, Salinometer, Bathythermograph, Titrations and Electrochemical Determination, Autoanalizer, GC-Mass

Spectrometry, weight and extraction

**SUMMARY:**
This will, upon completion, be the North Atlantic Bloom Experiment (NABE) contribution of Germany. So far only data collected by CTD and Rosette have been included. It is expected that net haul data, sediment trap data, sediment data, and underway data will be available in the near future.

**REFERENCE:** JGOFS reports

**DATA-WEBSITE:** www.bsh.de/Meereskunde/DOD/972.htm

**STORAGE-MEDIUM:** Magnetic tape

**AVAILABILITY:** The data set is available on request to the German Oceanographic Datacentre.

**SUPPLY-DETAILS:** E-mail, ftp or disk

**CONTACT:** dod@bsh.d400.de

3.22

**DATASET-NAME:** Bulletin Hydrographique - Physical, chemical and biological oceanographic data in the North Atlantic, North Sea and Baltic (1902-1956)

**CENTRE-NAME:** ICES Secretariat, International Council for the Exploration of the Sea

**TIME-PERIOD:** from 1902 to 1956

**GEOGRAPHIC-COVERAGE:** North Atlantic, North Sea and Baltic

**PROJECT:** Fisheries Oceanography

**PARAMETERS:** physical, chemical and biological oceanography

**SUMMARY:**
The observations published by ICES in the Bulletin Hydrographique were collected during ICES coordinated projects and routine programmes. The observations included (a) listings of surface temperature and salinity along 18 or so ship routes across the Atlantic, North Sea and Baltic and at light vessels (approximately 500,000 observations), (b) observations from classical hydro-chemical stations (approximately 200,000 stations), and (c) observations acquired from plankton hauls, principally in the North Sea (several thousand stations).

The listings are accompanied by detailed documentation of the instrumentation used, and other logistical matters of relevance to understanding the underlying accuracy of

the data. Until 1936 most of the observations were published quarterly, with separate listings for each ship or route. Subsequently observations were published in geosorted form.

This publication is available in most marine libraries of ICES member countries, as well as in the ICES Secretariat. The observations contained therein include the majority collected in the North Atlantic area during the first half of the 20th century. Most of the other data are published in other ICES publications (e.g. Rapports Atlantique).

All of these data are available in digital form from the ICES database, however some of the metadata is available only through these publications.

**REFERENCE:** ICES Bulletin Hydrographique

**STORAGE-MEDIUM:** Manuscript

**AVAILABILITY:** On application to marine libraries in ICES member countries

**CONTACT:** H.D. Dooley

3.23

**DATASET-NAME:** Organochlorines and heavy metals in marine life of North Sea, NE Atlantic, Arctic polar seas and Antarctica (1975 onwards**)**

**CENTRE-NAME:** Free University of Brussels, Laboratory for Ecotoxicology and Polar Ecology

**TIME-PERIOD:** from 1975 onwards

**GEOGRAPHIC-COVERAGE:** North Sea and NE Atlantic (1970 - 1985); Greenland and Norwegian Seas (from 1978 onwards), Barents Sea (from 1991 onwards); Antarctica (from 1989 onwards)

**PARAMETERS:** organochlorines (PCBs and pesticides) and heavy metals (total and organic Hg) in phytoplankton, krill, fish, seabirds and marine mammals. In collaboration, pathology of birds and mammals; other heavy metals, metallothioneins, Se.

**SUMMARY:**

Monitoring of stable pollutants (PCBs, organochlorine pesticides, heavy metals) in the different trophic levels of various marine ecosystems. Interpretation at the ecosystem level (transfer and accumulation mechanisms, fluxes) and the individual level: detoxification, excretion, lethality, mortality).

**REFERENCE:** A list of publications and reports is available from C. Joiris

**STORAGE-MEDIUM:** Apple MacIntosh: excel, statview MS Word

**AVAILABILITY:** by arrangement; contact C. Joiris or L. Holsbeek

**CONTACT:** C. Joiris

3.24

**DATASET-NAME:** Ecology of seabirds and marine mammals in North Sea, NE Atlantic, Arctic polar seas and Antarctica (1970 onwards)

**CENTRE-NAME:** Free University of Brussels, Laboratory for Ecotoxicology and Polar Ecology

**TIME-PERIOD:** from 1970 onwards

**GEOGRAPHIC-COVERAGE:** North Sea and NE Atlantic (1970-1985); Greenland and Norwegian Seas (from 1978 onwards), Barents Sea (from 1991 onwards); Antarctica (from 1989 onwards)

**PARAMETERS:** birds and mammals counts, density, link with other ecological factors (in collaboration: phytoplankton, zooplankton, pelagic and demersal fish)

**SUMMARY:**

At sea study of the distribution of marine birds and mammals: seasonal variations of distributions, linkage with hydrographical regimes, estimations of population sizes and densities. Estimations of food demands and energy fluxes through higher trophic levels of the marine ecosystems.

**REFERENCE:** A list of publications and reports is available from C. Joiris

**STORAGE-MEDIUM:** Apple Macintosh excel, statview, MSWord

**AVAILABILITY:** by arrangement; contact C. Joiris or L. Holsbeek

**CONTACT:** C. Joiris

3.25

**DATASET-NAME:** Abundance of Photosynthetic picoplancton mesasured by epifluorescence, microscopy and flow cytometry

**CENTRE-NAME:** CNRS / STATION BIOLOGIQUE DE ROSCOFF

**TIME-PERIOD:** 1987 a present

**GEOGRAPHIC-COVERAGE:** Roscoff, Sargasso Sea, East Atlantic, Pacific, East China Sea, Mediterranean Sea

**PARAMETERS:** Abundance (cell ml-1), Lignt scatter, Chl fluorescence

**INSTRUMENTS:** Flow cytometer

**SUMMARY:**
Abondance de Picoplancton photosynthetique mesuree par epifluorescence, microscopie et flux cytometrique, for each of the following groups:
- *Prochlorococcus*
- *Synechococcus*
- *Picoeucaryotes*
Data are obtained by flowcytometry.

**REFERENCE:** Flow cytometric determination of phytoplankton DNA in cultures and natural populations. Marine Ecology, Progress series, 1991, No 71, pp. 75-84., BOUCHER N., VAULOT F., PARTENSKY F.,

Wintertime presence of prochlorophytes in surface waters of the North-western Mediterranean Sea. Limnology and Oceanography, 1990, 35: 1156-1164., D. VAULOT, PARTENSKY F., NEVEUX J., MANTOURA RFC., LLEWELLYN C.,

Wintertime presence of prochlorophytes in surface waters of the North-Western Mediterranean Sea. Limnology and Oceanography. 1990, 35:1156-1164., VAULOT D., PARTENSKY F., NEVEUX J., MANTOURA R.F.C., LLEWELLYN C.,

**DATA-WEBSITE:** http://www.cnrs.fr/index.html

**ORIGINATOR:** CNRS

**STORAGE-MEDIUM:** Size of dataset 1MO, storage Disquettes

**AVAILABILITY:** jusqu'a publication

**SUPPLY-DETAILS:** Media Disquettes

**CONTACT:** The author of the description is usually one of the contact points. VAULOT Daniel, vaulot@iznogoud.sb-roscoff.fr, Tel:+33(0)2 98 29 23 34

3.26

**DATASET-NAME:** Deep Chlorophyll Maximum in the North Atlantic Ocean (1996)

**CENTRE-NAME:** Netherlands Institute for Sea Research (NIOZ)

**TIME-PERIOD:** From 22-06-1996 to 31-08-1996

**GEOGRAPHIC-** North Atlantic Ocean

**PROJECT:** Deep Chlorophyll Maximum

**PARAMETERS:** oxygen, chlorophyll, DOC, nutrients, POC, T, S

**INSTRUMENTS:** CTD, bottle samples,multinet, vertical net, optical instruments,

**SUMMARY:**
The inverse gradients of light and nutrients (nitrogen) with depth have resulted in a unique phytoplankton distribution and primary production in oligotrophic stratified (tropical) oceans.T hese gradients can only partly explain why a Deep Chlorophyll Maximum (DCM) is found here world-wide at depths of 80 or 150 m. The microbial composition of this layer is remarkably constant in spite of the high activity of the photosynthetic, microbial and heterotrophic components which indicate a highly dynamic system.

The phytoplankton composition is dominated by picoplankton (< 2 micron in diameter) and consists of a mixture of prokaryotic (Synechococcus and Prochlorococcus) and various (unknown) eukaryotic species of which various subpopulations dominate at different depths. By modelling the production processes and trophic interaction the contribution of the DCM to the sedimentation of particulate carbon will be studied.

The expedition on board Hr. Ms. Tydeman focuses on the factors which prevent (major) fluctuations in structures and organisation of microbial populations present near the Deep Chlorophyll Maximum.

**DATA-WEBSITE:** www.nioz.nl/projects/dcm

**STORAGE-MEDIUM:** Disk, CD-ROM

**AVAILABILITY:** Freely

**CONTACT:** T.F. de Bruin, +31-(0)222-369479, bruin@nioz.nl

## 4.Useful references


Adams, J. A. (1986). Zooplankton investigations in the Firth of Clyde. Proceedings of the Royal Society of Edinburgh. **90B:** 239-254.

Adams, J. A., J. H. Fraser, et al. (1973). The results obtained from plankton sampling in Loch Linnhe and Loch Eil during a study on the effect of the pulp and paper mill at Annat Point. Internal Reports. Marine Laboratory. Aberdeen. **73-1:** 53.

Adams, J. A., J. H. Fraser, et al. (1973). The results obtained from plankton sampling in Loch Linnhe and Loch Eil during a study on the effects of the pulp and paper mill at Annat Point. Scotland, Department of Agriculture and Fisheries**:** 53.

Adams, J. A., S. J. Hay, et al. (1976). A study of the plankton in a Scottish sea loch receiving effluent from a pulp and paper mill. ICES Committee Meeting Papers and Reports**:** 15.

Adlandsvik, B., S. H. Coombs, et al. (2001). Buoyancy and vertical distribution of eggs and larvae of blue whiting (*Micromesistius poutassou*): observations and modelling. *Fisheries Research*. **50:** 59-72.

Allen, J. T. (2001). RRS Discovery Cruise 253, 04 May-20 Jun 2001. Faeroes, Iceland, Scotland Hydrographic and Environmental Survey (FISHES). Southampton Oceanography Centre, Cruise Report**:** 206.

Allen, R. and A. Taylor (2001). The effect of salinity change on the oxygen consumption and swimming activity of the high-shore rockpool copepod *Tigriopus brevicornis*. *Journal of Experimental Marine Biology and Ecology*. **263:** 227-240.

Almatar, S. M. and R. S. Bailey (1989). Variation in the fecundity and egg weight of herring (*Clupea harengus* L.). Part I. Studies in the Firth of Clyde and northern North Sea. *Journal du Conseil*. **45:** 113-124.

Anderson, O. R. and A. Rogerson (1995). Annual abundances and growth potential of Gymnamoebae in the Hudson estuary with comparative data from the Firth of Clyde. *European Journal of Protistology*. **31:** 223-233.

Apte, S. C., A. G. Howard, et al. (1986). Arsenic, antimony and selenium speciation during a spring phytoplankton bloom in a closed experimental ecosystem. *Marine Chemistry*. **20:** 119-130.

Armstrong, M. J., M. Dickey-Collas, et al. (1999). The distribution of anchovy *Engraulis encrasicolus* in the northern Irish Sea from 1991 to 1999. *Journal of the Marine Biological Association of the United Kingdom*. **79:** 955-956.

Augustin, N. H., D. L. Borchers, et al. (1998). Spatiotemporal modelling for the annual egg production method of stock assessment using generalized additive models. *Canadian Journal of Fisheries and Aquatic Sciences*. **55:** 2608-2621.

Ayres, P. (1980). Toxins in Loch Striven and some suggestions regarding future fish kill Phytoplankton and the fish kills in Loch Striven. P. Tett. Oban, Scottish Marine Biological Association**:** 54-57.

Bailey, K. M. (1984). Comparison of laboratory rates of predation on five species of marine fish larvae by three planktonic invertebrates: effects of larval size on vulnerability. *Marine Biology*. **79:** 303-309.

Bailey, M. C. and M. R. Heath (1996). Spatial variability in the growth rate of blue whiting larvae at the shelf edge west of the UK. ICES Council Meeting Papers. **C.M.1996/S:22:** 17.

Bailey, M. C. and M. R. Heath (2001). Spatial variability in the growth rate of blue whiting (*Micromesistius poutassou*)larvae at the shelf edge west of the UK. *Fisheries Research*. **50:** 73-87.

Bailey, R. S. and S. M. Almatar (1989). Variation in the fecundity and egg weight of herring (*Clupea harengus* L.). Part II. Implications for hyptheses on the stability of marine fish populations. *Journal du Conseil*. **45:** 125-130.

Bailey-Watts, A. E. and A. Kirika (1994). Loch Leven NNR: water quality 1992 and 1993 with special reference to nutrients and phytoplankton, and an assessment of phosphorus levels in the loch sediments. Scottish Natural Heritage Research, Survey and Monitoring Report**:** 63.

Bainbridge, V. and D. C. T. Forsyth (1971). The feeding of herring larvae in the Clyde. *Rapports et Proces-verbaux des Reunions. Conseil Permanent International pour l'Exploration de la Mer*. **160:** 104-113.

Ball, B., R. Raine, et al. (1997). Phytoplankton and particulate matter in Carlingford Lough, Ireland: an assessment of food availability and the impact of bivalve culture. *Estuaries*. **20:** 430-440.

Barnes, H. (1950). A note on the barnacle larvae of the Clyde Sea area as sampled by the hardy continuous plankton recorder. *Journal of the Marine Biological Association of the United Kingdom*. **29:** 73-80.

Barnes, H. (1957). Process of restoration and synchronization in marine ecology. The spring diatom increase and the 'spawning' of the common barnacle *Balanus balanoides* (L.). *Annee Biologique*. **33:** 67-85.

Barnes, H. (1962). Note on variations in the release of nauplii of *Balanus balanoides* with special reference to the spring diatom outburst. *Crustaceana.* **4:** 118-122.

Barnett, P. R. O. (1985). The effect of temperature on the growth of planktonic larvae of *Tellina tenuis* da Costa. *Journal of Experimental Marine Biology and Ecology*. **89:** 1-10.

Bartsch, J. and S. Coombs (1997). A numerical model of the dispersion of blue whiting larvae, *Micromesistius poutassou* (Risso), in the eastern North Atlantic. *Fisheries Oceanography*. **6:** 141-154.

Beardall, J., G. E. Fogg, et al. (1978). Phytoplankton distributions in the western Irish Sea and Liverpool Bay, and their relation to hydrological factors : a progress report. *Biologia Contemporanea*. **5:** 163-175.

Beare, D. and E. Kenzie (1999). Continuous plankton recorder data and diel vertical migration in stage V and VI *Calanus finmarchicus*: a statistical analysis. *Fisheries Oceanography*. **8:** 126-137.

Beare, D. and E. Kenzie (1999). The multinomial logit model: a new tool for exploring Continuous Plankton Recorder data. *Fisheries Oceanography*. **8:** 25-39.

Beare, D. J. and P. G. Moore (1996). The distribution, growth and reproduction of *Pontocrates arenarius* and *P. altamarinus* (Crustacea: Amphipoda)at Millport, Scotland. *Journal of the Marine Biological Association of the United Kingdom*. **76:** 931-950.

Belikov, S. V., A. E. Dorchenkov, et al. (1991). Observations on post-spawning migration of the blue whiting and some results on the ichthyoplankton survey during April-May 1991. *ICES Council Meeting Papers*. **C.M.1991/H:55:** 11.

Belikov, S. V., V. A. Ignashin, et al. (1993). Preliminary results of the ichthyoplankton survey and observations on the post-spawning migration of blue whiting during April 1993. *ICES Council Meeting Papers*. **C.M.1993/H:45:** 9.

Berggren, W. A. and D. Schnitker (1983). Cenozoic marine environments in the North Atlantic and Norwegian-Greenland Sea Structure and development of the Greenland-Scotland Ridge - new methods and concepts. M. H. P. Bott, S. Saxov, M. Talwani and J. Thiede, Plenum Press**:** 495-548.

Bez, N. and J. Rivoirard (2001). Transitive geostatistics to characterise spatial aggregations with diffuse limits: an application on mackerel ichtyoplankton. *Fisheries Research*. **50:** 41-58.

Blaxter, J. H. S. (1971). Feeding and condition of Clyde herring larvae. *Rapports et Proces-verbaux des Reunions. Conseil Permanent International pour l'Exploration de la Mer*. **160:** 128-136.

Boney, A. D. (1986). Seasonal studies on the phytoplankton and primary production in the inner Firth of Clyde. Proceedings of the Royal Society of Edinburgh. **90B:** 203-222.

Borkin, I. V., V. A. Ermolchev, et al. (1992). Some ichthyoplankton and hydroacoustic observations in waters to the west and northwest of the British Isles during spring 1992. *ICES Council Meeting Papers*. **C.M.1992/H:32:** 9.

Boyd, P. W. (1990). Carbon fluxes in marine microbial ecosystems. Belfast, Queen's University**:** 403.

Boyd, R. J. (1973). A survey of the plankton of Strangford Lough, Co. Down. Proceedings of the Royal Irish Academy. B. **73:** 231-267.

Briggs, R. P., M. J. Armstrong, et al. (2002). The application of fecundity estimates to determine the spawning stock biomass of Irish Sea *Nephrops norvegicus* (L.)using the annual larval production method. *ICES Journal of Marine Science*. **59:** 109-119.

Bruce, R. H. and J. Aiken (1975). The Undulating Oceanographic Recorder - a new instrument system for sampling plankton and recording physical variables in the euphotic zone from a ship underway. *Marine Biology*. **32:** 85-97.

Bruno, D. W., G. Dear, et al. (1989). Mortality associated with phytoplankton blooms among farmed Atlantic salmon, *Salmo salar* L., in Scotland. *Aquaculture*. **78:** 217-222.

Bryan, A. (1994). The Minch review, Scottish Natural Heritage**:** [305 ].

Buchholz, F. and R. Saborowski (2000). Metabolic and enzymatic adaptations in northern krill, *Meganyctiphanes norvegica*, and Antarctic krill, *Euphausia superba*. *Canadian Journal of Fisheries and Aquatic Sciences*. **57:** 115-129.

Butler, E. I., E. D. S. Corner, et al. (1970). On the nutrition and metabolism of zooplankton. VII. Seasonal survey of nitrogen and phosphorus excretion by *calanu*s in the Clyde sea area. *Journal of the Marine Biological Association of the United Kingdom*. **50:** 52-60.

Cadman, P., J. Ellis, et al. (1993). A survey of the marine fauna of the St. Kilda archipelago. Godalming, Surrey, World Wide Fund for Nature**:** iv,38.

Campbell, D. A., M. S. Kelly, et al. (2001). Amnesic shellfish poisoning in the king scallop, *Pecten maximus*, from the west coast of Scotland. *Journal of Shellfish Research*. **20:** 75-84.

Cohen, B. L., P. Balfe, et al. (1993). Molecular and morphometric variation in European populations of the articulate brachiopod *Terebratulina retusa. Marine Biology*. **115:** 105-111.

Colebrook, J. M. (1986). Continuous plankton records: the distribution and standing crop of the plankton of the shelf and ocean to the west of the British Isles. Proceedings of the Royal Society of Edinburgh. **88B:** 221-237.

Commission, O. Quality Status Report 2000, Region V - Wider Atlantic. London, OSPAR Commission^C2000**:** xiii, 110.

Commission, O. (2000). Quality Status Report 2000, Region III - Celtic Seas. London, OSPAR Commission**:** xiii, 116.

Conway, D. V. P., S. H. Coombs, et al. (1997). Vertical distribution of fish eggs and larvae in the Irish Sea and southern North Sea. *ICES Journal of Marine Science*. **54:** 136-147.

Coombs, S. H., D. Morgans, et al. (1996). The vertical distribution of eggs and larvae of mackerel (*Scomber, scombrus). ICES Council Meeting Papers*. **C.M.1996/S:47:** 14.

Coombs, S. H., D. Morgans, et al. (2001). Seasonal and ontogenetic changes in the vertical distribution of eggs and larvae of mackerel (*Scomber scombrus* L.)and horse mackerel (*Trachurus trachurus* L.). *Fisheries Research.* **50:** 27-40.

Corten, A. (1999). Evidence from plankton for multi-annual variations of Atlantic inflow in the northwestern North Sea. *Journal of Sea Research*. **42:** 191-205.

Costello, M. J. and J. C. Gamble (1992). Effects of sewage sludge on marine fish embryos and larvae. *Marine Environmental Research*. **33:** 49-74.

Crockford, T. and I. A. Johnston (1993). Developmental changes in the composition of myofibrillar proteins in the swimming muscles of Atlantic herring, *Clupea harengus. Marine Biology*. **115:** 15-22.

Cronin, J. R. and R. J. Morris (1983). Rapid formation of humic material from diatom debris Coastal upwelling, its sediment record. Part A: responses of the sedimentary regime to present coastal upwelling. E. Suess and J. Thiede, Plenum Press**:** 485-496.

Cushing, D. H. (1992). The loss of diatoms in the spring bloom. Philosophical Transactions of the Royal Society of London, Series B. **335:** 237-246.

Cuzin-Roudy, J., E. Albessard, et al. (1999). The scheduling of spawning with the moult cycle in Northern krill (Crustacea: Euphausiacea): A strategy for allocating lipids to reproduction. *Invertebrate Reproduction and Development.* **36:** 163-170.

Cuzin-Roudy, J. and F. Buchholz (1999). Ovarian development and spawning in relation to the moult cycle in northern krill, *Meganyctiphanes norvegicus* (Crustacea: Euphausiacea), along a climatic gradient. *Marine Biology*. **133:** 267-281.

Damgaard, R. M. and J. Davenport (1994). Salinity tolerance, salinity preference and temperature tolerance in the high-shore harpacticoid copepod *Tigriopus brevicornis. Marine Biology*. **118:** 443-449.

Davenport, J., R. J. J. W. Smith, et al. (2000). Mussels *Mytilus edulis*: significant consumers and destroyers of mesozooplankton. *Marine Ecology Progress Series*. **198:** 131-137.

Davies, J. M. and P. J. L. B. Williams (1984). Verification of 14C and O2 derived primary organic production measurements using an enclosed ecosystem. *Journal of Plankton Research*. **6:** 457-474.

Davison, B. and C. N. Hewitt (1994). Elucidation of the tropospheric reactions of biogenic sulfur species from a field measurement campaign in NW Scotland. Chemosphere. **28:** 543-557.

Davison, D. M. (1996). An estimation of the total number of marine species that occur in Scottish coastal waters. Scottish Natural Heritage Review**:** 32.

Dickey-Collas, M., J. Brown, et al. (1997). Does the western Irish Sea gyre influence the distribution of pelagic juvenile fish. *Journal of Fish Biology*. **51:** 206-229.

Dickey-Collas, M., R. D. M. Nash, et al. (2001). The location of spawning of Irish Sea herring (*Clupea harengus*). *Journal of the Marine Biological Association of the United Kingdom*. **81:** 713-714.

Domingo, M., S. Kennedy, et al. (2001). Marine mammal mass mortalities Marine mammals. Biology and conservation. P. G. H. Evans and J. A. Raga. New York, Kluwer Academic/Plenum Publishers**:** 425-456.

Dong, L. F., D. B. Nedwell, et al. (2000). Environmental limitations of phytoplankton in estuaries. Final Report. Colchester, University of Essex**:** 51 + appendix.

Droop, M. R., K. Jones, et al. (1980). Phytoplankton ecology in Loch Striven, 8-10 May 1979 Phytoplankton and the fish kills in Loch Striven. P. Tett. Oban, *Scottish Marine Biological Association**:*** 88-98.

Ducklow, H. W., D. A. Purdie, et al. (1986). Bacterioplankton : a sink for carbon in a coastal marine plankton community. *Scienc*e. **232:** 865-867.

Edwards, A. (1980). The hydrography of Loch Striven 1977-1979 Phytoplankton and the fish kills in Loch Striven. P. Tett. Oban, *Scottish Marine Biological Association**:*** 82-87.

Edwards, A. (1989). The Loch Obisary surveys 1986/7. Peterborough, Nature Conservancy Council**:** [47 ].

Edwards, A. (1993). R.R.S. "Challenger" Cruise 105/93. Oban to Ardrossan. September 3rd to September 16th 1993. Cruise Report. Dunstaffnage Marine Laboratory. **Challenger Cruise 105/93:** 12.

Edwards, M. (2000). Temporal and spatial patterns of marine phytoplankton, University of Plymouth**:** ix,243.

Edwards, M. and A. W. G. John (1997). Coasts and seas of the United Kingdom. Region 14. South-west Scotland: Ballantrae to Mull Plankton. J. H. Barne, C. F. Robson, S. S. Kaznowskaet al. Peterborough, Joint Nature Conservation Committee**:** 77-79.

Edwards, M. and A. W. G. John (1997). Coasts and seas of the United Kingdom. Region 17 Northern Ireland Plankton. J. H. Barne, C. F. Robson, S. S. Kaznowskaet al. Peterborough, Joint Nature Conservation Committee**:** 71-73.

Ellett, D. J. and J. D. Gage (1978). Cruise report R.R.S. Challenger, 31 May-10 June, 1978. Cruise Report. Scottish Marine Biological Association**:** 14.

Ellett, D. J. and J. D. Gage (1990). RRS Challenger Cruise 67/1990 21 June - 5 July 1990. Cruise Report. Dunstaffnage Marine Laboratory and Scottish Marine Biological Association**:** [13 ].

Erwin, D. G., B. E. Picton, et al. (1990). Inshore marine life of Northern Ireland. The report of a survey carried out by the diving team of the Botany and Zoology Department of the Ulster Museum in fulfilment of a contract with Conservation Branch of the Department of the Environment (N.I.). Belfast, HMSO**:** iii,148.

Fadzen, I. and K. Cook (1996). The distribution of blue whiting (*Micromesistius poutassou*)larvae to the west of the British Isles in March/April 1996. *ICES Council Meeting Papers*. **CM:1996/S:19:** 5.

Ferreira, J. G., P. Duarte, et al. (1998). Trophic capacity of Carlingford Lough for oyster culture - analysis by ecological modelling. *Aquatic Ecology*. **31:** 361-378.

Findlay, M. and J. Lansley (1998). Plankton sample colour as a determinant of the abundance of stage I eggs in the western mackerel (*Scomber scombrus* L.)stock. *ICES Journal of Marine Science*. **55:** 141-144.

Foster, R. W. (1976). The effects of pollutants, in particular copper, on the zooplankton of a Scottish west coast sea loch, University of Aberdeen**:** 120.

Fox, C. J., M. Dickey-Collas, et al. (1997). Spring plankton surveys of the Irish Sea in 1995: the distribution of fish eggs and larvae. *Science Series Technical Report***:** 106.

Fullarton, J. G., P. R. Dando, et al. (1995). Fatty acids of hydrothermal vent *Ridgeia piscesae* and inshore bivalves containing symbiotic bacteria. *Journal of the Marine Biological Association of the United Kingdom*. **75:** 455-468.

Gallacher, S. and T. H. Birkbeck (1995). Isolation of marine bacteria producing sodium channel blocking toxins and the seasonal variation in their frequency in sea water Harmful marine algal blooms. Proceedings of the sixth international conference on toxic marine phytoplankton, October 1993, Nantes, France. P. Lassus, G. Arzul, E. Erard-Le Denn, P. Gentien and C. Marcaillou-Le Baut. Paris, Lavoisier Publishing**:** 445-450.

Gallego, A., J. Mardaljevic, et al. (1999). A model of the spring migration into the North Sea by *Calanus finmarchicus* overwintering off the Scottish continental shelf. *Fisheries Oceanography*. **8:** 107-125.

Gamble, J. C., J. M. Davies, et al. (1977). Loch Ewe bag experiment, 1974. *Bulletin of Marine Science.* **27:** 146-175.

Gamble, J. C. and E. D. Houde (1984). Growth, mortality and feeding of cod (*Gadus morhua* L.)larvae in enclosed water columns and in laboratory tanks The propagation of cod *Gadus morhua* L.. An international symposium, Arendal, 14-17 June 1983. E.

Dahl, D. S. Danielssen, E. Moksness and P. Solemdal. Arendal, Institute of Marine Research Flodevigen Biological Station**:** 123-143.

Gauld, D. T. (1950). A fish cultivation experiment in an arm of a sealoch. III. The plankton of Kyle Scotnish. *Proceedings of the Royal Society of Edinburgh. B.* **64:** 36-64.

Geffen, A. J. (2002). Length of herring larvae in relation to age and time of hatching. *Journal of Fish Biology*. **60:** 479-485.

Ghazzewi, F. H. and P. S. Meadows (1992). Multivariate analysis of antibiotic and heavy metal susceptability of marine bacteria from the deep-sea: the scope for classification, identification and ecology. Bulletin of the Marine Biology Research Centre. Tajura**:** 43-62.

Gilpin, L. C. (1993). Nitrogen uptake and assimilation in coastal and oceanic phytoplankton. Belfast, Queen's University**:** 184.

Gordon, J. D. M. and J. Mauchline (1990). Trophic relationships in the marine environment. Proceedings of the 24th European Marine Biology Symposium Depth-related trends in diet of a deep-sea bottom-living fish assemblage of the Rockall Trough. M. Barnes and R. N. Gibson, Aberdeen University Press**:** 439-452.

Gotto, R. V. (1951). Some plankton records from Strangford Lough, Co. Down. *Irish Naturalists' Journal*. **10:** 162-164.

Gowen, R. J. (1981). The primary stages of chlorophyll-a breakdown in sea-loch phytoplankton and cultured algae. Glasgow, University of Strathclyde**:** 293.

Gowen, R. J. and S. P. Bloomfield (1996). Chlorophyll standing crop and phytoplankton production in the western Irish Sea during 1992 and 1993. *Journal of Plankton Research.* **18:** 1735-1751.

Gowen, R. J., G. M. Cullough, et al. (1998). Copepod abundance in the western Irish Sea: relationship to physical regime, phytoplankton production and standing stock. *Journal of Plankton Research*. **20:** 315-320.

Gowen, R. J., M. Dickey-Collas, et al. (1997). The occurrence of *Calanus finmarchicu*s (Gunnerus)and *Calanus helgolandicus* (Claus)in the western Irish Sea. *Journal of Plankton Research*. **19:** 1175-1182.

Gowen, R. J., R. Raine, et al. (1998). Plankton distributions in relation to physical oceanographic features on the southern Malin Self, August 1996. *ICES Journal of Marine Science*. **55:** 1095-1111.

Gowen, R. J., P. Tett, et al. (1983). The hydrography and phytoplankton ecology of Loch Ardbhair: a small sea-loch on the west coast of Scotland. *Journal of Experimental Marine Biology and Ecology*. **71:** 1-16.

Gowen, R. J., P. Tett, et al. (1992). Predicting marine eutrophication: the yield of chlorophyll from nitrogen in Scottish coastal waters. *Marine Ecology Progress Series*. **85:** 153-161.

Gowen, R. J., P. Tett, et al. (1983). Changes in the major dihydroporphyrin plankton pigments during the spring bloom of phytoplankton in two Scottish sea-lochs. *Journal of the Marine Biological Association of the United Kingdom*. **63:** 27-36.

Graziano, C. (1988). Some observations on the plankton of the north Irish Sea, Liverpool University**:** 187.

Grigg, H., S. J. Bardwell, et al. (1987). Comparative observations on the biometry and development of *Calanus finmarchicus* and *C. helgolandicus* in Copepodite Stage V, with comments on other Calanidae. *Marine Biology*. **96:** 253-262.

Grigg, H., L. J. Holmes, et al. (1989). Patterns of variations in the dry body weight of *Calanus finmarchicus* in Copepodite Stage V during autumn and winter in the Firth of Clyde. *Journal of the Marine Biological Association of the United Kingdom*. **69:** 101-122.

Haarich, M., W. Kienz, et al. (1992). Heavy metal distribution in different compartments of the northern North Sea and adjacent areas. *ICES Council Meeting Papers*. **C.M.1992/E:45:** 19.

Hall, I. R., D. J. Hydes, et al. (1999). Seasonal variations in the cycling of aluminium, cadmium and manganese in a Scottish sea loch: biogeochemical processes involving suspended particles. *Continental Shelf Research*. **19:** 1783-1808.

Hannah, F. J. and A. D. Boney (1980). Standing crop and carbon fixation of rockpool phytoflagellates. *Marine Biology Letters*. **1:** 149-159.

Hannah, F. J. and A. D. Boney (1980). Summer nanophytoplankton chlorophyll and carbon fixation in two neighbouring sea lochs. *Marine Pollution Bulletin*. **11:** 186-188.

Hannah, F. J. and A. D. Boney (1981). Phytoflagellates in Firth of Clyde plankton. *Glasgow Naturalist*. **20:** 145-153.

Hannah, F. J. and A. D. Boney (1983). Nanophytoplankton in the Firth of Clyde, Scotland: seasonal abundance, carbon fixation and species composition. *Journal of Experimental Marine Biology and Ecology*. **67:** 105-147.

Hargreaves, P. M. (1989). The vertical and horizontal distribution of four species of the genus *Gnathophausia* (Crustacea: Mysidacea)in the eastern North Atlantic Ocean. *Journal of Plankton Research*. **11:** 687-702.

Harker, G. E. (1997). A comparison between optical properties measured in the field and the laboratory, and the development of an optical model. Bangor, University of Wales.

Harms, I. H., M. R. Heath, et al. (2000). Modelling the Northeast Atlantic circulation: implications for the spring invasion of shelf regions by *Calanus finmarchicus. ICES Journal of Marine Science*. **57:** 1694-1707.

Harris, A. S. D. (1995). The ecological role of diatom resting stages in coastal waters. London, University of Westminster.

Harris, A. S. D., L. K. Medlin, et al. (1995). *Thalassiosira* species (Bacillariophyceae)from a Scottish sea-loch. *European Journal of Phycology*. **30:** 117-131.

Hawkins, L. E. and S. Hutchinson (1999). The deep sea benthos (OSPAR Region V). Part I. Review of the benthic biology of the north-east Atlantic. Part II. Species list of the deep sea benthos of the north-east Atlantic, University of Southampton Southampton Oceanography Centre**:** 190.

Heath, M. and A. Gallego (1997). From the biology of the individual to the dynamics of the population: bridging the gap in fish early life studies. *Journal of Fish Biology*. **51:** 1-29.

Heath, M. R. (1995). Size spectrum dynamics and the planktonic ecosystem of Loch Linnhe. *ICES Journal of Marine Science*. **52:** 627-642.

Heath, M. R. (1996). Survival strategies in early life stages of marine resources
The consequences of spawning time and dispersal patterns of larvae for spatial and temporal variability in survival to recruitment. Y. Watanabe, Y. Yamashita and Y. Oozeki. Rotterdam, A.A.Balkema**:** 175-207.

Heath, M. R. and P. MacLachlan (1987). Dispersion and mortality of yolk-sac herring (*Clupea harengus* L.)larvae from a spawning ground to the west of the Outer Hebrides. *Journal of Plankton Research*. **9:** 613-630.

Higman, W. A., D. M. Stone, et al. (2001). Sequence comparisons of toxic and non-toxic *Alexandrium tamarense* (Dinophyceae)isolates from UK waters. *Phycologia*. **40:** 256-262.

Hinton, G. C. F. (1974). Studies on the phytoplankton of the Firth of Clyde, Glasgow University**:** 116.

Hinton, G. C. F. and A. D. Boney (1979). Chrysophycean loricae in the Firth of Clyde phytoplankton. *Glasgow Naturalist*. **19:** 469-474.

Holliday, N. P. and P. C. Reid (2001). Is there a connection between high transport of water through the Rockall Trough and ecological changes in the North Sea? *ICES Journal of Marine Sciences*. **58:** 270-274.

Holligan, P. M. and S. B. Groom (1986). Phytoplankton distributions along the shelf break. *Proceedings of the Royal Society of Edinburgh*. **88B:** 239-263.

Holmes, N. (1982). Diel vertical variations in abundance of some planktonic foraminifera from the Rockall Trough, northeastern Atlantic Ocean. *Journal of Foraminiferal Research*. **12:** 145-150.

Hopkins, P. (1991). Report of the herring larvae surveys in the North Sea and adjacent waters in 1990/91. *ICES Council Meeting Papers*. **C.M.1991/H:44:** 16.

Hopkins, P. and J. A. Morrison (1991). Evaluation of geostatistical methods for the estimation of total egg numbers in a herring spawning bed. *ICES Council Meeting Papers*. **C.M.1991/H:43:** 19.

Horwood, J. W. (1976). A model of primary and secondary production in Loch Striven, and its stability Proceedings of the 10th European Symposium on Marine Biology, Ostend, Belgium, September 17-23, 1975. Vol.2. G. Persoone and E. Jaspers. Wetteren, Belgium, Universa Press**:** 297-307.

Hunter, W. D. R. (1948). Settlement of diatoms during the spring increase. *Report of the Scottish Marine Biological Association*. **16-17**.

Hurd, C. L. and M. J. Dring (1991). Desiccation and phosphate uptake by intertidal fucoid algae in relation to zonation. *British Phycological Journal.* **26:** 327-333.

Ingle, R. I. (1990). Larval and post-larval development of *Anapagurus chiroacanthus* (Lilljeborg, 1855)Anomura: Paguroidea: Paguridae. *Bulletin of the British Museum (Natural History)(Zoology*). **56:** 105-134.

International Council for the Exploration of the, S. (1994). Report of the Joint Session of the Working Group on Harmful Algal Bloom Dynamics (WGHABD)and the Working Group on Shelf Seas Oceanography (WGSSO), Vigo, Spain 9-10 May 1994. *ICES Council Meeting Papers*. **C.M.1994/L:11:** 19.

International Council for the Exploration of the, S. (2001). Report of the ICES Advisory Committee on the Marine Environment, 2001, Helsinger, 5 - 9 June 2001. *ICES Cooperative Research Report***:** vii, 203.

International Council for the Exploration of the Sea, A. C. o. F. M. (1999). Report of the herring assessment working group for the area south of 62 degrees N. ICES Headquarters 15-24 March 1999. *ICES Council Meeting Papers*. **CM 1999/ACFM:12:** iv,392.

International Council for the Exploration of the Sea, A. C. o. F. M. (1999). Report of the working group on the assessment of mackerel, horse mackerel, sardine and anchovy. ICES Headquarters 28 September - 7 October 1998. *ICES Council Meeting Papers*. **CM 1999/ACFM:6:** vii,468.

International Council for the Exploration of the Sea, A. C. o. F. M. (2001). Report of the Herring Assessment Working Group for the Area South of 62 degrees N, Hamburg, Germany 13-22 March 2001. *ICES Council Meeting Papers*. **C.M. 2001/ACFM:12:** v, 402.

International Council for the Exploration of the Sea, L. R. C. (1999). Report of the planning group for herring surveys. Hirtshals, Denmark 2-4 February 1999. *ICES Council Meeting Papers*. **CM 1999/G:7:** i,49.

International Council for the Exploration of the Sea, L. R. C. (2001). Report of the Planning Group for Herring Surveys. Ijmuiden, The Netherlands 11-15 December 2000. *ICES Council Meeting Papers*. **C.M. 2001/G:2:** i, 148.

International Council for the Exploration of the Sea, O. C. (2000). Report of the Working Group on Recruitment Processes. Bergen, Norway, 8-10 March 2000. *ICES Council Meeting Papers*. **C.M. 2000/C:3:** i, 60.

Ireland. Marine, I. (1999). Ireland's marine and coastal areas and adjacent seas: an environmental assessment. Ireland, Marine Institute**:** 388.

Jenkinson, I. R. (1983). Water movement and plankton in Strangford Lough, Queen's University Belfast**:** 433.

Johnston, R., J. A. Adams, et al. (1974). Some observations on the hydrography, chemistry and plankton of the Firth of Clyde in relation to nitrate-rich effluents. *Natural Environment Research Council Publications, Series C***:** 16-21.

Jones, K. J. and R. J. Gowen (1990). Influence of stratification and irradiance regime on summer phytoplankton composition in coastal and shelf seas of the British Isles. *Estuarine, Coastal and Shelf Science*. **30:** 557-567.

Jones, K. J., R. J. Gowen, et al. (1984). Water column structure and summer phytoplankton distribution in the Sound of Jura, Scotland. *Journal of Experimental Marine Biology and Ecology*. **78:** 269-289.

Jones, K. J., B. Grantham, et al. (1995). Ecology of fjords and coastal waters
Physical controls on phytoplankton and nutrient cycles in the Clyde Sea, a fjordic system on the west coast of Scotland. H. R. Skjoldal, C. Hopkins, K. E. Erikstad and H. P. Leinaas, Elsevier**:** 93-104.

Jones, K. J., P. Tett, et al. (1978). The use of small, continuous and multispecies cultures to investigate the ecology of phytoplankton in a Scottish sea-loch. *Mitteilungen der Internationalen Vereinigung fur Theoretische und Angewandte Limnologie***:** 398-412.

Jones, K. T. (1979). Studies on nutrient levels and phytoplankton growth in a Scottish sea loch, University of Strathclyde**:** 530.

Kay, D. W. (1977). The distribution and abundance of herring larvae to the west of Scotland. *Cooperative Research Report*. ICES**:** 37-55.

Kay, D. W. (1977). The distribution and abundance of herring larvae to the west of Scotland in 1976. *ICES Committee Meeting Papers and Reports*. **C.M.1977/H:31:** [17 ].

Kee, D., A. Cunningham, et al. (1999). Simultaneous measurements of fluorescence and beam attenuation: Instrument characterization and interpretation of signals from stratified coastal waters. *Estuarine, Coastal and Shelf Science*. **48:** 51-58.

Kelly, K. S., M. J. Costello, et al. (1997). An indexed bibliography of Irish marine literature from 1839-1997. Dublin, Environmental Sciences Unit Trinity College**:** 243.

Kelly, M. S. and E. J. Cook (2001). The ecology of *Psammechinus miliaris* Edible sea urchins: Biology and ecology. J. M. Lawrence. Amsterdam, Elsevier Science B.V.**:** 217-224.

Kerr, G. (1912). Loch Sween. Glasgow Naturalist. **4:** 33-48.

Kloppmann, M. (1989). Zusammensetzung, Haufigkeit and Vertikalverteilung von Fischlarven uber der Hatton und der Rockall Bank (Westbritische Gewasser). *Archiv fur Fischereiwissenschaft*. **39:** 95-110.

Kloppmann, M., C. Mohn, et al. (1996). The effect of currents and hydrography on the distribution of blue whiting eggs and larvae on Porcupine Bank. *ICES Council Meeting Papers*. **C.M.1996/S:25:** 18.

Knudsen, M. and C. Ostenfeld (1899). Iagttagelser over Overfladevandets Temperatur, Saltholdighed og Plankton paa islandske og gronlandske Skibsrouter i 1898, Kjobenhavn**:** 93 +tabels.

Lampitt, R. S. (1979). Aspects of the nutritional ecology of the marine planktonic copepod *Oithona nana*, University of Aberdeen**:** 167.

Lass, S., G. A. Tarling, et al. (2001). On the food of northern krill *Meganyctiphanes norvegica* in relation to its vertical distribution. *Marine Ecology Progress Series*. **214:** 177-200.

Laybourn-Parry, J., A. Rogerson, et al. (1992). Temporal patterns of protozooplankton abundance in the Clyde and Loch Striven. *Estuarine, Coastal and Shelf Science*. **35:** 533-543.

Lewis, J. (1988). Cysts and sediments: *Gonyaulax polyedra (Lingulodinium machaerophorum*)in Loch Creran. *Journal of the Marine Biological Association of the United Kingdom*. **68:** 701-714.

Lewis, J. (1990). The cyst-theca relationship of *Oblea rotunda* (Diplopsalidaceae, Dinophyceae). *British Phycological Journal*. **25:** 339-351.

Lewis, J. (1991). Cyst-theca relationships in *Scrippsiella* (Dinophyceae)and related orthoperidinioid Genera. *Botanica Marina*. **34:** 91-106.

Lewis, J., A. S. D. Harris, et al. (1999). Long-term survival of marine plankton diatoms and dinoflagellates in stored sediment samples. *Journal of Plankton Research*. **21:** 343-354.

Lindeque, P. K. (2000). A molecular approach to *Calanus* (Copepoda: Calanoida)development and systematics, University of Plymouth.

Lindeque, P. K., R. P. Harris, et al. (1999). Simple molecular method to distinguish the identity of *Calanus species* (Copepoda: Calanoida)at any devlopmental stage. *Marine Biology*. **133:** 91-96.

Lindley, J. A., H. Call, et al. (1999). Resting cysts and eggs of marine plankton in Irish Sea sediments: a pilot study, Plymouth Marine Laboratory**:** 99.

Llewellyn, C. A. and R. F. C. Mantoura (1996). Pigment biomarkers and particulate carbon in the upper water column compared to the ocean interior of the northeast Atlantic. *Deep-Sea Research* I. **43:** 1165-1184.

Macdonald, E. and R. Davidson (1997). Ballast water project - final report, Spring 1997. Aberdeen, FRS Marine Laboratory**:** 81.

Maggs, C. A., M. D. Guiry, et al. (1991). *Aglaothamnion priceanum* sp. nov. (Ceramiaceae, Rhodophyta)from the north-easter Atlantic: morphology and life history of parasporangial plants. *British Phycological Journal*. **26:** 343-352.

Malin, G., S. Turner, et al. (1993). Dimethylsulphide and dimethylsulphoniopropionate in the northeast Atlantic during the summer coccolithophore bloom. *Deep-Sea Research I*. **40:** 1487-1508.

Mann, D. G. (1994). Auxospore formation, reproductive plasticity and cell structure in *Navicula ulvacea* and the resurrection of the genus Dickieia (Bacillariophyta). *European Journal of Phycology*. **29:** 141-157.

Marathon Oil Uk, L. Exploration Well 153/5-A tranche 37. Environmental statement. Aberdeen, Marathon Oil UK Limited^b1998**:** 106.

Marshall, S. M. (1925). A survey of Clyde plankton. Proceedings of the Royal Society of Edinburgh. **45:** 117-141.

Marshall, S. M., A. G. Nicholls, et al. (1934). On the biology of Calanus finmarchicus. V. Seasonal distribution, size weight and chemical composition in Loch Striven in 1933, and their relation to the phytoplankton. *Journal of the Marine Biological Association of the United Kingdom*. **19:** 793-819.

Marshall, S. M., A. G. Nicholls, et al. (1937). On the growth and feeding of the larval and post-larval stages of the Clyde herring. *Journal of the Marine Biological Association of the United Kingdom.* **22:** 245-267.

Marshall, S. M. and A. P. Orr (1927). The relation of the plankton to some chemical and physical factors in the Clyde Sea area. *Journal of the Marine Biological Association of the United Kingdom*. **14:** 837-868.

Marshall, S. M. and A. P. Orr (1932). Plankton. *Report of the Scottish Marine Biological Association. **7-13**.*

Marshall, S. M. and A. P. Orr (1934). Plankton. *Report of the Scottish Marine Biological Association*. **7-9**.

Marshall, S. M. and A. P. Orr (1948). Further experiments on the fertilization of a sea loch (Loch Craiglin). The effect of different plant nutrients on the phytoplankton. *Journal of the Marine Biological Association of the United Kingdom*. **27:** 360-79.

Marshall, S. M. and A. P. Orr (1962). Carbohydrate as a measure of phytoplankton. *Journal of the Marine Biological Association of the United Kingdom*. **42:** 511-519.

Matthews, J. B. L., F. Buchholz, et al. (1999). On the physical oceanography of the Kattegat and Clyde Sea area, 1996-98, as background to ecophysiological studies on the planktonic crustacean, *Meganyctiphanes norvegica* (Euphausiacea). *Helgoland Marine Research*. **53:** 70-84.

Mauchline, J. (1990). Aspects of production in a marginal oceanic region, the Rockall Trough, northeastern Atlantic Ocean. *Reviews in Aquatic Sciences*. **2:** 167-183.

Mauchline, J. (1991). Some modern concepts in deep-sea pelagic studies: patterns of growth in the different horizons Marine biology. Its accomplishment and future prospect. J. Mauchline and T. Nemoto, Elsevier**:** 107-130.

Mauchline, J. (1992). Restriction of body size spectra within species of deep-sea plankton. *Marine Ecology Progress Series*. **90:** 1-8.

Mauchline, J. (1992). Taxonomy, distribution and biology of *Euchaeta barbata (= E. farran*i)(Copepoda: Calanoida). *Sarsia*. **77:** 131-142.

Mauchline, J. (1994). Seasonal variation in some population parameters of *Euchaeta* species (Copepoda: Calanoida). *Marine Biology*. **120:** 561-570.

Mauchline, J. (1994). Spermatophore transfer in *Euchaeta* species in a 2000m water column. *Hydrobiologi*a. **292/293:** 309-316.

Mauchline, J. and J. D. M. Gordon (1991). Oceanic pelagic prey of benthopelagic fish in the benthic boundary layer of a marginal oceanic region. *Marine Ecology Progress Series*. **74:** 109-115.

Mauchline, J. and P. F. Harvey (1983). The Scyphomedusae of the Rockall Trough, northeastern Atlantic Ocean. *Journal of Plankton Research*. **5:** 881-890.

Maxwell, T. H. (1978). Coastal pollution assessment. Development of estuaries... Proceedings of a seminar held in Cork, Ireland, April 20-21 1978 The plankton of Belfast Lough. W. K. Downey and G. Ni Uid. Dublin, National Board for Science and Technology**:** 103-136.

Maxwell, T. H. (1978). The plankton of Belfast Lough, Queen's University Belfast**:** 397.

Mendez, N., I. Linke-Gamenick, et al. (2000). Variability in reproductive mode and larval development within the *Capitella capitata* species complex. *Invertebrate Reproduction and Development*. **38:** 131-142.

Montagnes, D. J. S., A. J. Pouton, et al. (1999). Mesoscale, finescale and microscale distribution of micro- and nanoplankton in the Irish Sea, with emphasis on ciliates and their prey. *Marine Biology*. **134:** 167-179.

Morris, R. J. (1984). Studies of a spring phytoplankton bloom in an enclosed experimental ecosystem. II. Changes in the component fatty acids and sterols. *Journal of Experimental Marine Biology and Ecology*. **75:** 59-70.

Morris, R. J., M. J. Cartney, et al. (1985). Further studies of a spring phytoplankton bloom in an enclosed experimental ecosystem. *Journal of Experimental Marine Biology and Ecology*. **86:** 151-170.

Morris, R. J., M. J. Cartney, et al. (1983). Studies of a spring phytoplankton bloom in an enclosed experimental ecosystem. I. Biochemical changes in relation to the nutrient chemistry of water. *Journal of Experimental Marine Biology and Ecology*. **70:** 249-262.

Morrison, J. R. (1998). Variability of natural fluorescence and its applicability to phytoplankton biomass and photosynthesis prediction: in situ evidence of quenching mechanisms. Bangor, University of Wales.

Mourente, G. and D. R. Tocher (1992). Lipid class and fatty acid composition of brain lipids from Atlantic herring (*Clupea harengus*)at different stages of development. *Marine Biology*. **112:** 553-558.

Muller, F. L. L., P. W. Balls, et al. (1995). Processes controlling chemical distributions in the Firth of Clyde (Scotland). *Oceanologica Acta*. **18:** 493-509.

Munk, P. and V. Christensen (1990). Larval growth and drift pattern and the separation of herring spawning groups in the North Sea. *Journal of Fish Biology*. **37:** 135-148.

Napier, I. R. (1995). Growth and collapse of a spring phytoplankton bloom in the Firth of Clyde, Scotland. *Marine Biology*. **123:** 189-195.

Natural Environment Research, C. (1974). The Clyde Estuary and Firth: an assessment of present knowledge compiled by members of the Clyde Study Group. *Natural Environment Research Council Publications, Series C***:** iv,62.

Neely, M. W. (1982). Plankton studies of inner Belfast Lough with special reference to the Rotifera, Ulster Polytechnic**:** 411.

Overnell, J. and R. S. Batty (2000). Scaling of enzyme activity in larval herring and plaice: effects of temperature and individual growth rate on aerobic and anaerobic capacity. *Journal of Fish Biology*. **56:** 577-589.

Overnell, J., A. Edwards, et al. (1995). Sediment-water column coupling and the fate of the spring phytoplankton bloom in Loch Linnhe, a Scottish fjordic sea-loch. Sediment processes and sediment-water fluxes. *Estuarine, Coastal and Shelf Science*. **41:** 1-19.

Park, J. S. (1995). Biology of deep-sea calanoid copepod genus *Pleuromamma* with particular references to phylogeny, pore signatures, moulting and life history, University of Stirling Department of Biological and Molecular Sciences.

Park, J. S. (1995). The development of integumental pore signatures in the genus *Pleuromamma* (Copepoda: Calanoida). *Journal of the Marine Biological Association of the United Kingdom.* **75:** 211-218.

Parker, J. G., R. S. Rosell, et al. (1988). The phytoplankton production cycle in Belfast Lough. *Journal of the Marine Biological Association of the United Kingdom*. **68:** 555-564.

Pipe, R. K. and S. H. Coombs (1980). Vertical distribution of zooplankton over the northern slope of the Wyville Thomson Ridge. *Journal of Plankton Research*. **2:** 223-234.

Pollard, R. and S. Hay (2002). Biophysical studies of zooplankton dynamics in the northern North Atlantic: winter, 1 Nov - 18 Dec 2001. Swindon, *Natural Environment Research Council***:** 112.

Poxton, M. G. (1986). The distribution of plaice eggs and larvae in the Clyde Sea Area. *Proceedings of the Royal Society of Edinburgh*. **90B:** 491-499.

Rankine, P. W., L. H. Cargill, et al. (1990). Variation in the hatching length of spring-spawned herring larvae (*Clupea harengus* L.)on Ballantrae Bank in the Firth of Clyde. *Journal du Conseil*. **46:** 333-339.

Rees, A. P., N. J. P. Owens, et al. (1995). Seasonal nitrogen assimilation and carbon fixation in a fjordic sea loch. *Journal of Plankton Research*. **17:** 1307-1324.

Reid, P. C. (1999). Development of towed phytoplankton sampling systems for time series monitoring in the Irish Sea. Plymouth, Sir Alister Hardy Foundation for Ocean Science**:** 50 + appendices + CDROM.

Richard, J. M. (1992). Investigation into zooplankton assemblages off the west coast of Scotland, Stirling University**:** 361.

Richardson, K., S. H. Jonasdottir, et al. (1995). Investigation of Calanus finmarchicus migrations between Oceanic and Shelf seas off northwest Europe (ICOS)
Marine sciences and technologies. Second MAST days and EUROMAR market. Volume 1. M. Weydert, E. Lipiatou, R. Goniet al. Luxembourg, Office for Official Publications of the European Communities**:** 235-243.

Ridout, P. S. and R. J. Morris (1985). Short-term variations in the pigment composition of a spring phytoplankton bloom from an enclosed experimental ecosystem. *Marine Biology*. **87:** 7-11.

Roberston, J. I. (1989). The coulometric determination of total inorganic carbon in seawater and the study of the inter-relationship between the planktonic metabolism of carbon dioxide and oxygen, University College of North Wales Bangor**:** 535.

Roberts, R. J. and R. H. Richards (1980). Fish pathology Phytoplankton and the fish kills in Loch Striven. P. Tett. Oban, *Scottish Marine Biological Association***:** 52-53.

Rodout, P. S. and R. J. Morris (1988). Further studies of short-term variation in the pigment composition of a spring phytoplankton bloom. *Marine Biology*. **97:** 597-602.

Rogerson, A. (1993). *Parvamoeba rugata* n.g., n. sp., (Gymnamoebia, Thecamoebidae): an exceptionally small marine naked amoeba. *European Journal of Protistology*. **29:** 446-452.

Rogerson, A., F. J. Hannah, et al. (1993). *Nitzschia albicostalis*: an apochloritic diatom worthy of ecological considerstion. *Cahiers de Biologie Marine*. **34:** 513-522.

Rogerson, A. and J. Laybourn-Parry (1992). The abundance of marine naked amoebae in the water column of the Clyde estuary. *Estuarine, Coastal and Shelf Science*. **34:** 187-196.

Rogerson, A. and J. Laybourn-Parry (1992). Bacterioplankton abundance and production in the Clyde estuary, Scotland. *Archiv fur Hydrobiologie*. **126:** 1-14.

Rosell, R. S. (1989). Eutrophication of Belfast Lough, Northern Ireland, in relation to nutrient loading from anthrophogenic sources. *ICES Council Meeting Papers*. **C.M.1989/E:27:** [13 ].

Ross, A., W. Gurney, et al. (1992). Ecosystem models of Scottish sea lochs for assessing the impact of nutrient enrichment. *ICES Council Meeting Papers*. **C.M.1992/Mini:7:** 34.

Ross, A. H., W. S. C. Gurney, et al. (1993). Ecosystem models of Scottish sea lochs for assessing the impact of nutrient enrichment. *ICES Journal of Marine Science*. **50:** 359-367.

Ross, A. H., W. S. C. Gurney, et al. (1994). A comparative study of the ecosystem dynamics of four fjords. *Limnology and Oceanography*. **39:** 318-343.

Saborowski, R., S. Brohl, et al. (2002). Metabolic properties of Northern krill, *Meganyctiphanes norvegica*, from different climatic zones. I. Respiration and excretion. *Marine Biology*. **140:** 547-556.

Saborowski, R. and F. Buccholz (2002). Metabolic properties of Northern krill, *Meganyctiphanes norvegica*, from different climatic zones. II. Enzyme characteristics and activities. *Marine Biology*. **140:** 557-565.

Savidge, G. (1988). Influence of inter- and intra-daily light-field variability on photosynthesis by coastal phytoplankton. *Marine Biology*. **100:** 127-133.

Savidge, G. and H. T. Hutley (1977). Rates of remineralization and assimilation of urea by fractionated plankton populations in coastal waters. *Journal of Experimental Marine Biology and Ecology*. **28:** 1-16.

Savidge, G. and J. P. Johnston (1987). Urea degradation rates by size-fractionated plankton populations in a temperate estuary. *Estuarine, Coastal and Shelf Science*. **24:** 433-447.

Savidge, G. and H. J. Lennon (1987). Hydrography and phytoplankton distributions in north-west Scottish waters. *Continental Shelf Research*. **7:** 45-66.

Shimmield, G. (2001). The use of science in understanding the marine environment of the Atlantic margin. *Continental Shelf Research.* **21:** 767-775.

Simpson, J. H., D. J. Edelsten, et al. (1979). The Islay front: physical structure and phytoplankton distribution. *Estuarine and Coastal Marine Science.* **9:** 713-726.

Simpson, J. H. and P. B. Tett (1986). Island stirring effects on phytoplankton growth Tidal mixing and plankton dynamics. M. J. Bowman, C. M. Yentsch and W. T. Peterson, Springer-Verlag**:** 41-76.

Smith, J. W. and R. Wootten (1978). Further studies on the occurrence of larval Anisakis in blue whiting. *ICES Council Meeting Papers*. **C.M.1978/H:53:** [9 ].

Smith, S. M. (1990). Checklist of the marine flora and fauna of Loch Sween and the adjacent seas. Peterborough, *Nature Conservancy Council**:*** 123.

Spicer, J. I. (1995). Ontogeny of respiratory function in crustaceans exhibiting either direct or indirect development. *Journal of Experimental Zoology*. **272:** 413-418.

Stancliffe, R. P. W. (1991). Dinoflagellate cysts from the Oxfordian (Upper Jurassic)of Skye, Scotland and southern Dorset, England. *Journal of Micropalaeontology*. **10:** 185-201.

Sumida, P. Y. G., P. A. Tyler, et al. (2000). Reproduction, dispersal and settlement of the bathyal ophiuroid *Ophiocten gracilis* in the NE Atlantic Ocean. *Marine Biology.* **137:** 623-630.

Tarling, G., M. Burrows, et al. (2000). An optimisation model of the diel vertical migration of northern krill (*Meganyctiphanes norvegica*)in the Clyde Sea and the Kattegat. *Canadian Journal of Fisheries and Aquatic Sciences.* **57:** 38-50.

Tett, P. (1973). The use of log-normal statistics to describe phytoplankton populations from the Firth of Lorne area. *Journal of Experimental Marine Biology and Ecology.* **11:** 121-136.

Tett, P. (1980). Phytoplankton and the fish kills in Loch Striven. Oban, *Scottish Marine Biological Association:* ii,110.

Tett, P. (1980). Phytoplankton, the Loch Striven fish kills, and recommendations Phytoplankton and the fish kills in Loch Striven. P. Tett. Oban, *Scottish Marine Biological Association***:** 3-30.

Tett, P. (1980). Poisonous chloromonad flagellates Phytoplankton and the fish kills in Loch Striven. P. Tett. Oban, *Scottish Marine Biological Association***:** 108-110.

Tett, P. (1980). A summary of phytoplankton ecology in Loch Striven, May and June 1979 Phytoplankton and the fish kills in Loch Striven. P. Tett. Oban, *Scottish Marine Biological Association***:** 76-81.

Tett, P. (1981). The Loch Eil project: planktonic pigments in sediments from Loch Eil and the Firth of Lorne. *Journal of Experimental Marine Biology and Ecology*. **56:** [1982], 101-114.

Tett, P. (1986). Physical exchange and the dynamics of phytoplankton in Scottish sealochs The role of freshwater outflow in coastal marine ecosytems. S. Skreslet, Springer-Verlag**:** 205-218.

Tett, P. and M. R. Droop (1980). Phytoplankton ecology in Loch Striven, 21 June 1979 Phytoplankton and the fish kills in Loch Striven. P. Tett. Oban, *Scottish Marine Biological Association***:** 99-107.

Tett, P., A. Edwards, et al. (1986). A model for the growth of shelf-sea phytoplankton in summer. *Estuarine, Coastal and Shelf Science*. **23:** 641-672.

Tett, P., R. Gowen, et al. (1986). The phytoplankton ecology of the Firth of Clyde sea-lochs Striven and Fyne. Proceedings of the Royal Society of Edinburgh. **90B:** 223-238.

Tett, P. and B. Grantham (1980). Variability in sea-loch phytoplankton Fjord oceanography. H. J. Freeland, D. M. Farmer and C. D. Levings. New York, Plenum Press**:** 435-438.

Tett, P., S. I. Heaney, et al. (1985). The Redfield ratio and phytoplankton growth rate. *Journal of the Marine Biological Association of the United Kingdom*. **65:** 487-504.

Thom, T., M. Connell, et al. (1999). A satellite tagging study of basking sharks (*Cetorhinus maximus*)and investigations of associated plankton distribution in the Firth of Clyde. Scottish Natural Heritage Research, Survey and Monitoring Report**:** 30.

Thom, T., M. Connell, et al. (1999). A satellite tagging study of basking sharks (*Cetorhinus maximus*)and investigations of associated plankton distributions in the Firth of Clyde. Scottish Natural Heritage Research, Survey and Monitoring Report**:** iii,24.

Thompson, A. B. (1989). Mackerel (*Scomber scombrus*)egg mortality: the Western mackerel stock in Biscay and the Western Approaches in 1977, 1980, 1983 and 1986. *Journal of Plankton Research*. **11:** 1297-1306.

Todd, C. D., W. J. Lambert, et al. (1998). The genetic structure of intertidal populations of two species of nudibranch molluscs with planktotrophic larval stages: are pelagic larvae "for" dispersal? *Journal of Experimental Marine Biology and Ecology*. **228:** 1-28.

Trimmer, M., R. J. Gowen, et al. (1999). The spring bloom and its impact on benthic mineralisation rates in western Irish Sea sediments. *Marine Ecology Progress Series*. **185:** 37-46.

Trowbridge, C. D. (2000). The missing links: larval and post-larval development of the ascoglossan opisthobranch *Elysia viridis*. *Journal of the Marine Biological Association of the United Kingdom*. **80:** 1087-1094.

Tuck, I. D., C. J. Chapman, et al. (1997). A comparison of methods for stock assessment of the Norway lobster, *Nephrops norvegicus*, in the Firth of Clyde. *Fisheries Research*. **32:** 89-100.

Tylor, T. J. M., J. Lewis, et al. (1995). A survey of *Alexandrium* sp. cysts in Belfast Lough, 1992 Harmful marine algal blooms. Proceedings of the sixth international conference on toxic marine phytoplankton, October 1993, Nantes, France. P. Lassus, G. Arzul, E. Erard-Le Denn, P. Gentien and C. Marcaillou-Le Baut. Paris, Lavoisier Publishing**:** 835-840.

Tyrrell, L. R. and A. H. Taylor (1996). A modelling study of *Emiliania huxleyi* in the NE Atlantic. *Journal of Marine Systems.* **9:** 83-112.

Tytler, P. and J. Ireland (2000). The influence of salinity and temperature change on the functioning of the urinary bladder in the early larval stages of the Atlantic herring *Clupea harengus* L. *Journal of Experimental Biology*. **203:** 415-422.

Veer, H. W. v. d., L. Pihl, et al. (1990). Recruitment mechanisms in North Sea plaice *Pleuronectes platessa. Marine Ecology Progress Series*. **64:** 1-12.

Vieira, V. L. A. and I. A. Johnston (1992). Influence of temperature on muscle-fibre development in larvae of the herring *Clupea harengus. Marine Biology*. **112:** 333-341.

Virtue, P., P. Mayzaud, et al. (2000). Use of fatty acids as dietary indicators in northern krill, *Meganyctiphanes norvegica*, from northeastern Atlantic, Kattegat, and Mediterranean waters. *Canadian Journal of Fisheries and Aquatic Sciences*. **57:** 104-114.

Walsh, M., M. Skogen, et al. (1996). The relationship between the location of mackerel spawning, larval drift and recruit distributions 1977 to 1995: a modelling study. *ICES Council Meeting Papers.* **C.M.1996/S:33:** 34.

Watts, L. J. (1994). The roles of hydrographic and biogeochemical processes in the distribution of dissolved inorganic nutrients in a Scottish sea-loch system, Southampton University**:** 446.

Watts, L. J., T. P. Rippeth, et al. (1998). The role of hydrographic and biogeochemical processes in the distribution of dissolved inorganic nutrients in a Scottish sea-loch: consequences for the spring phytoplankton bloom. *Estuarine, Coastal and Shelf Science*. **46:** 39-50.

Williams, P. J. l. (1981). Microbial contribution to overall marine plankton metabolism: direct measurements of respiration. *Oceanologica Acta*. **4:** 359-364.

Williams, P. J. L. (1982). Microbial contribution to overall plankton community respiration - studies in enclosures Marine mesocosms: biological and chemical research in experimental ecosystems. G. D. Grice and M. R. Reeve, Springer-Verlag**:** 305-321.

Williams, P. J. L. B., R. C. T. Taine, et al. (1979). Agreement between the 14C and oxygen methods of measuring phytoplankton production: reassessment of the photosynthetic quotient. *Oceanologica Acta*. **2:** 411-416.

Williams, R. and A. V. Holden (1973). Organochlorine residues from plankton. *Marine Pollution Bulletin*. **4:** 109-111.

Wishner, K. F. (1980). The biomass of the deep-sea benthopelagic plankton. *Deep-Sea Research A.* **27:** 203-216.

Woods, E. (1990). Phytoplankton primary production and vertical turbulent mixing on the Western Scottish Shelf. Bangor, University College of North Wales**:** 234.

Wyatt, T. and F. Saborido-Rey (1993). Toxic phytoplankton blooms in the sea Biogeography and time-series analysis of British PSP records, 1968 to 1990. T. J. Smayda and Y. Shimizu, Elsevier**:** 73-78.

Zong, Y. (1997). Implications of *Paralia sulcata* abundance in Scottish isolation basins. *Diatom Research*. **12:** 125-150.