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GLOBEC-Germany – Integrated Datasets

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Andreas Moll & Stefan Zabanski



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GLOBEC-Germany

Trophic Interactions between Zooplankton and Fish under the Influence of Physical Processes in the Baltic and North Sea (2002 – 2007)

The international Global Ocean Ecosystem Dynamics (GLOBEC) programme was initiated in 1991 by the Scientific Committee on Oceanic Research (SCOR) and the Intergovernmental Oceanographic Commission (IOC) of the UNESCO. It was a core project of the International Geosphere-Biosphere Project (IGBP) with its research topics aiming at understanding how global change impacts abundance, diversity and productivity of marine populations (Barange & Harris 2003).

GLOBEC-Germany was the national German contribution to this core project focussing on the Baltic Sea and North Sea, to which Germany has adjoining coastlines. The two seas exhibit a gradient from marine (North Sea) to almost fresh water conditions (outer ends of the Baltic Sea). Main topic of the project was the investigation of interactions between zooplankton and fish under the influence of physical processes (Alheit 2004). Main sampling areas were located in the southern North Sea and German Bight, as well as in the Bornholm Basin in the Baltic Sea (Tamm et al. 2007).

In these areas herring (*Clupea harengus* L.), sprat (*Sprattus sprattus* L.) and cod (*Gadus morhua* L.) as well as numerous copepod populations experienced high fluctuations in recruitment and biomass since the middle of the 20th century (Alheit et al. 2005). Whereas a substantial decrease of individual weight of herring and sprat at high biomass was documented in the Baltic Sea, no such similarities were observed in the North Sea. It was assumed that this phenomenon is caused by food limitation (mainly copepods) in the Baltic Sea. However, it was not clear whether this was due to direct effects of trophic interactions (internal dynamics) in the rather simple food web of the Baltic Sea, or whether the decrease of some copepod populations is a consequence of physical processes (external forcing).

An interdisciplinary team of fishery biologists, planktologists, physiologists, geneticists, physical oceanographers and modellers investigated these questions in concerted actions. Field studies, experimental approaches and modelling were combined and applied to investigate the influence of physical processes and trophodynamic interactions. Top-down and bottom-up processes were studied comparatively in both ecosystems. Results were used to elucidate principal mechanisms accounting for the high variability of copepod production and success in fish recruitment. They also form the basis for strategic modelling and estimating recruitment success of fish. Numerous scientific studies, including results from PhD and diploma theses, were conducted and have improved our current understanding of mechanisms governing population dynamics on short time scales (Alheit 2007).

To insure sustainable and citeable storage the GLOBEC data were archived in the information system PANGAEA and made public available through the World Data Center for Marine Environmental Sciences (WDC-MARE). The present WDC-MARE Report unites the various data sets acquired in the GLOBEC-Germany initiative and makes them publicly available. For more information about the scientific outcome see the publication list of the final report of the first phase (2002-2005) in Appendix 1. Publications of the second phase (2005-2007) are listed in Appendix 2. Dissertations and diploma thesis are listed in Appendix 3. Results of the project synthesis were presented at an international symposium organised by the German GLOBEC project from 14-15 November 2007 in Hamburg (see agenda in Appendix 4).

1 Project outline

Technical outline

Project title	GLOBEC-Germany
Coordinator	Dr. Jürgen Alheit Institut für Ostseeforschung - Warnemünde (IOW) (Baltic Sea Research Institute) Seestraße 15 D-18119 Warnemünde, Germany Tel.: +49 (381) 5197-208 Fax: +49 (381) 5197-440 Mail: juergen.alheit@io-warnemuende.de
Funding	Bundesministerium für Bildung und Forschung (German Federal Ministry for Education and Research) D-10115 Berlin Germany http://www.bmbf.de/
Funding period	1 st phase: 01.03.2002 – 28.02.2005 2 nd phase: 01.03.2005 – 31.12.2007
Staff	About 80 Scientists and technicians including PhD and Diploma students

Scientific outline

Aim	Clarification of trophodynamic interactions between zooplankton and planktivorous fish in relation to reproductive success under the impact of physical forcing
Target areas	North Sea (southern part German Bight) Baltic Sea (focus on Bornholm Basin, additionally Arkona and Gotland Basin)
System type	Shelf seas
Focus species	Fish: <ul style="list-style-type: none">- Sprat (<i>Sprattus sprattus</i> L.)- Herring (<i>Clupea harengus</i> L.)- Cod (<i>Gadus morhua</i> L.) Copepods: <ul style="list-style-type: none">- <i>Acartia longiremis</i>- <i>Acartia bifilosa</i>- <i>Temora longicornis</i>- <i>Pseudocalanus</i> spp.

Affiliated institutes

AWI	Alfred-Wegener-Institut für Polar- und Meeresforschung Postfach 12 0161 D-27515 Bremerhaven, Germany
BFAFI-H	Bundesforschungsanstalt für Fischerei Institut für Seefischerei Palmaille 9 D-22767 Hamburg, Germany
IHF	Institut für Hydrobiologie und Fischereiwissenschaft Fischereiwissenschaft und Biologische Ozeanographie Universität Hamburg Olbersweg 24 D-22767 Hamburg, Germany
IfM	Institut für Meereskunde Zentrum für Meeres- und Klimaforschung Universität Hamburg Bundesstraße 53 D-20146 Hamburg, Germany
IfM-GEOMAR	Leibniz-Institut für Meereswissenschaften Dienstgebäude Ostufer Wischhofstr. 1-3 24148 Kiel, Germany
IOW	Institut für Ostseeforschung - Warnemünde Seestraße 15 D-18119 Warnemünde, Germany
MarZoo	Universität Bremen Fachbereich 2, Marine Zoologie Postfach 330440 D-28334 Bremen, Germany

Work packages & workflow

For concerted processing of the scientific work GLOBEC-Germany was organised in several work packages and working groups, coordinated by work package leaders from different institutes:

# ID	Work package	Leader	Institute(s)
1	Spatial and temporal distribution, growth and mortality rates of fish spawn under the influence of physical processes	Dietrich Schnack	IfM-GEOMAR
2	Predation pressure of fish on zooplankton and fish larvae and zooplankton abundance	Axel Temming	IHF
3	Influence of meso-scale physical structures and processes on population dynamics of copepods, micro-zooplankton and trophodynamic relationships between fish larvae and their prey	Jürgen Alheit	IOW
4	Copepod population dynamics	Hans-Jürgen Hirche	AWI, IOW
5	Interactions between phytoplankton and zooplankton dynamics under the influence of hydrographic conditions	Justus van Beusekom	AWI
6	Food preferences, food quality and condition of target species of zoo- and ichthyoplankton	Wilhelm Hagen	MarZoo
7	Coupled modelling of trophodynamics and advection	Dietrich Schnack (Fritz Köster)	IfM-GEOMAR
8	Modelling of the Baltic Sea ecosystem with particular emphasis on zooplankton	Wolfgang Fennel	IOW
9	Regional ecosystem model of the lower trophic levels of the North Sea including population dynamics of zooplankton	Andreas Moll	IfM
10	Modelling drift and development of fish larvae based on active tracers and of the 3D current field of the southern North Sea	Thomas Pohlmann	IfM
11	Data organisation of German GLOBEC Project	Susanne Tamm (Stefan Zabanski)	IfM

Depending on the respective task, the groups closely cooperated and provided information on field data, laboratory experiments, process models, as well as three-dimensional ecosystem-, zooplankton- and fish-larvae-models.

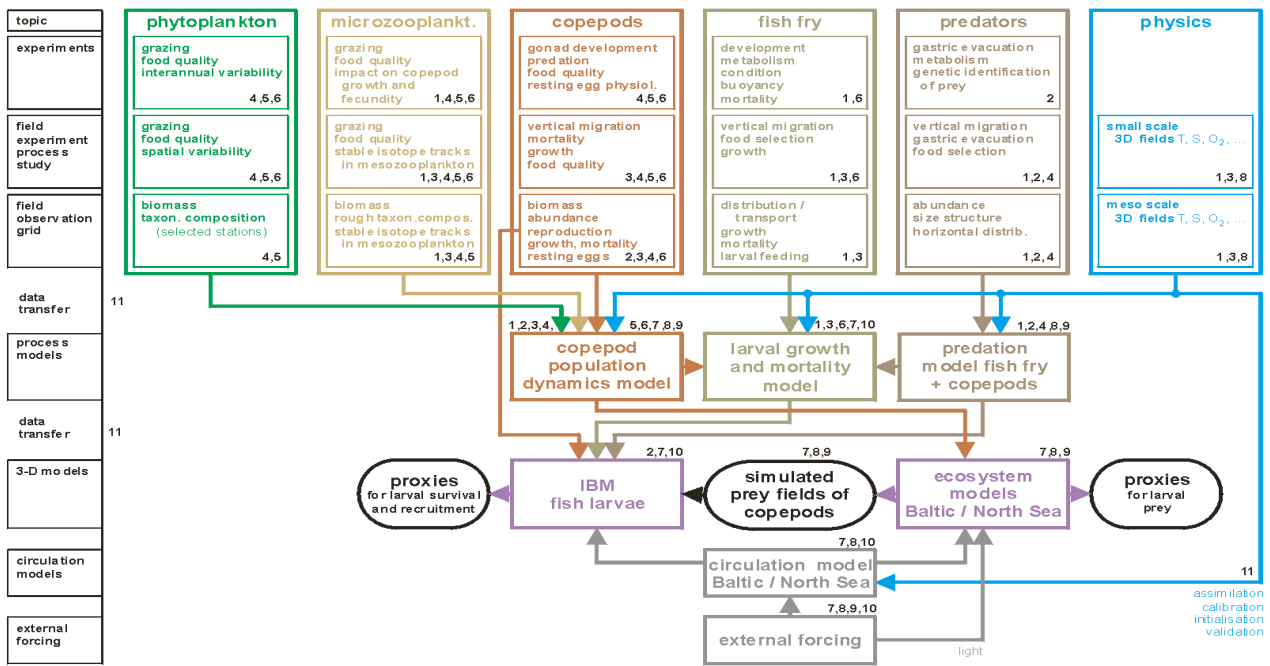


Figure 1: Structure and workflow of analysis in GLOBEC-Germany. Numerals used within or next to the boxes are numbers of the work package ID's.

2 GLOBEC-Germany datasets

Investigation areas

Areas investigated by GLOBEC-Germany include the North Sea and the Baltic Sea. Beside a fixed station grid in both areas several additional stations were sampled. Figure 2 shows a plot of positions from which data are available.

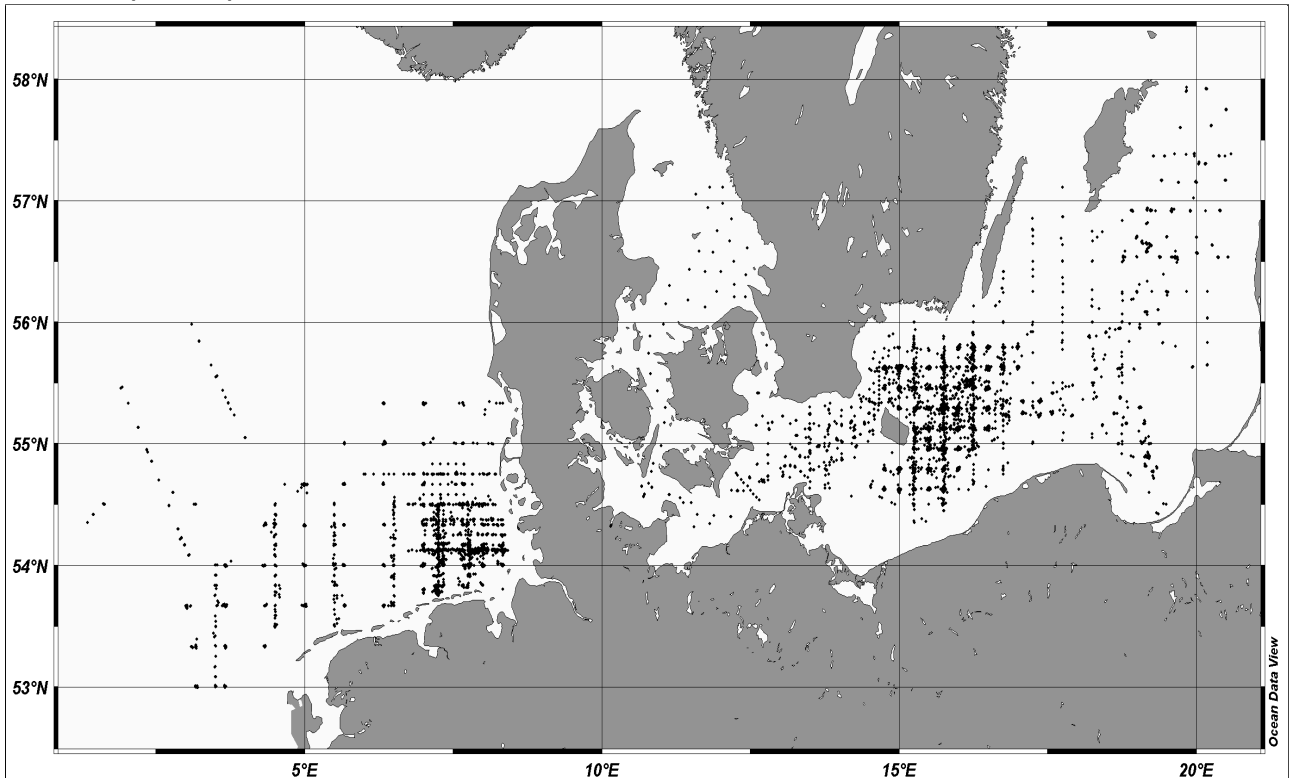


Figure 2: Plot of all GLOBEC-Germany stations from which data are available in PANGAEA.

Time schedules

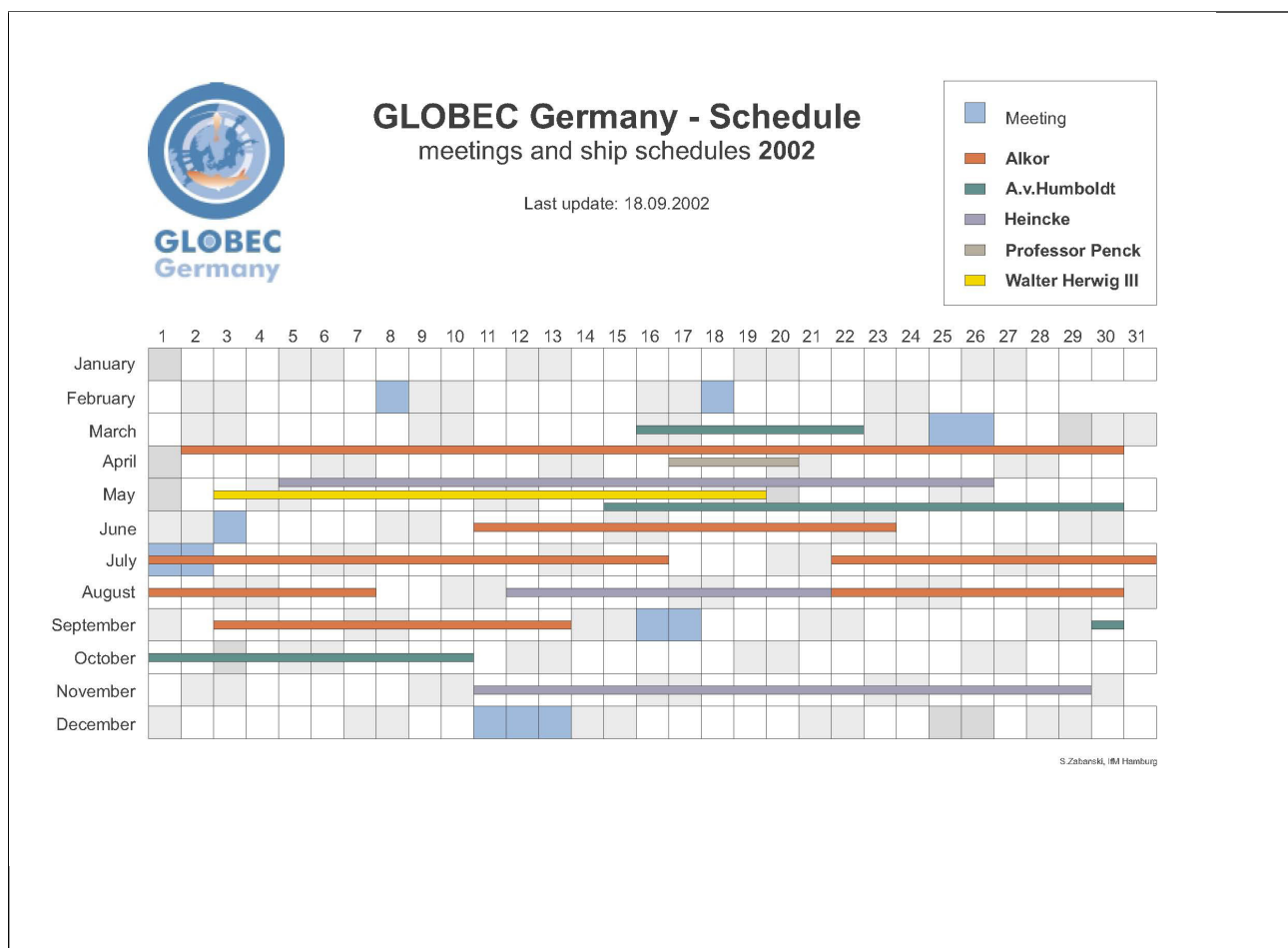
Between March 2002 and November 2006 a total of 52 cruises with various research vessels took place. The list of research vessels as working platforms include

- 'Alexander von Humboldt'
- 'Alkor'
- 'Dana'
- 'Heincke'
- 'Professor Penck'
- 'Poseidon'
- 'Walter Herwig III'

The Baltic Sea (BS) was surveyed during 35 cruises and the North Sea (NS) during 17 cruises. A complete list, including cruise legs, is given in appendix 5.

Scientific information exchange happened on regular work package and community meetings. Two status seminars for project evaluation were held in January 2004 and November 2007.

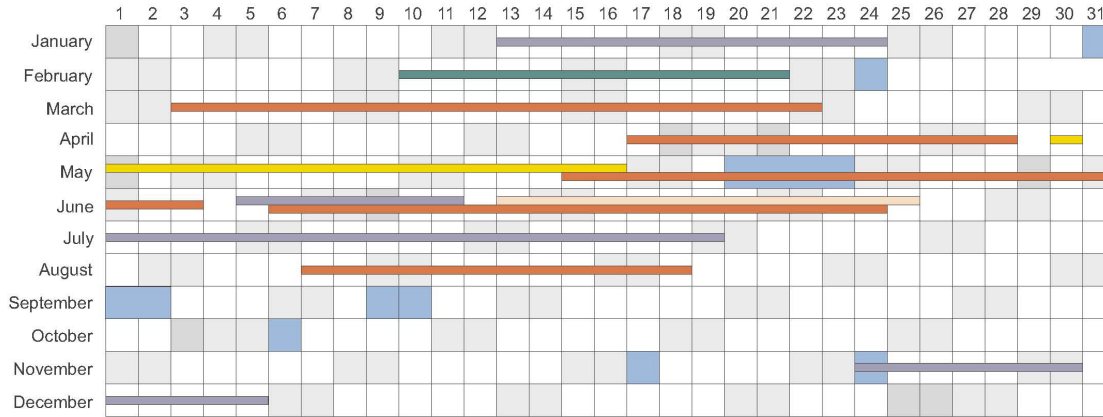
Conducted activities between 2002 and 2006 are charted annually on the next pages:





GLOBEC Germany - Schedule meetings and ship schedules 2003

Last update: 11.11.2003

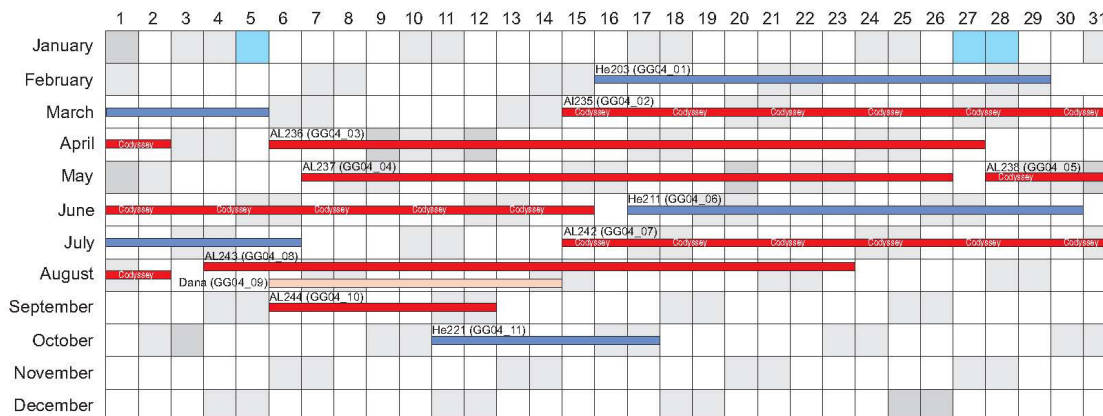


S.Zabanski, IIM Hamburg



GLOBEC Germany - Schedule meetings and ship schedules 2004

Last update: 17.09.2004



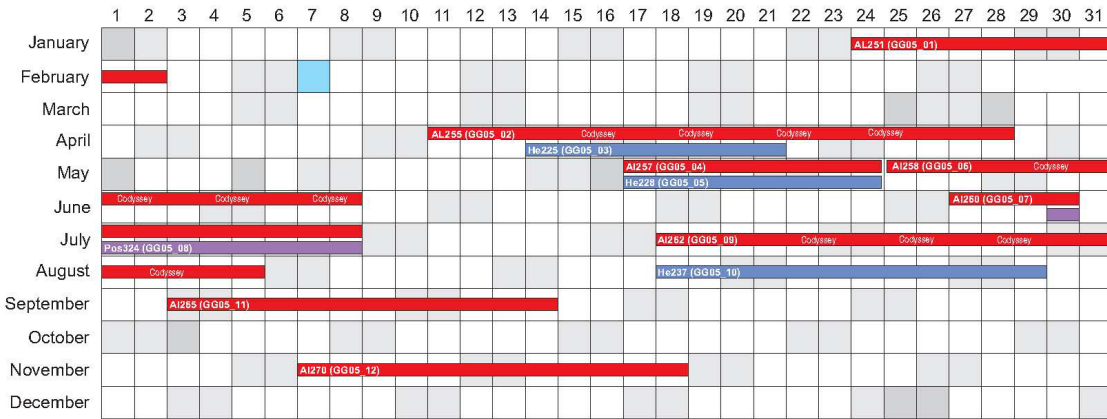
S.Zabanski, IIM Hamburg



GLOBEC Germany - Schedule meetings and ship schedules 2005

Last update: 10.02.2005

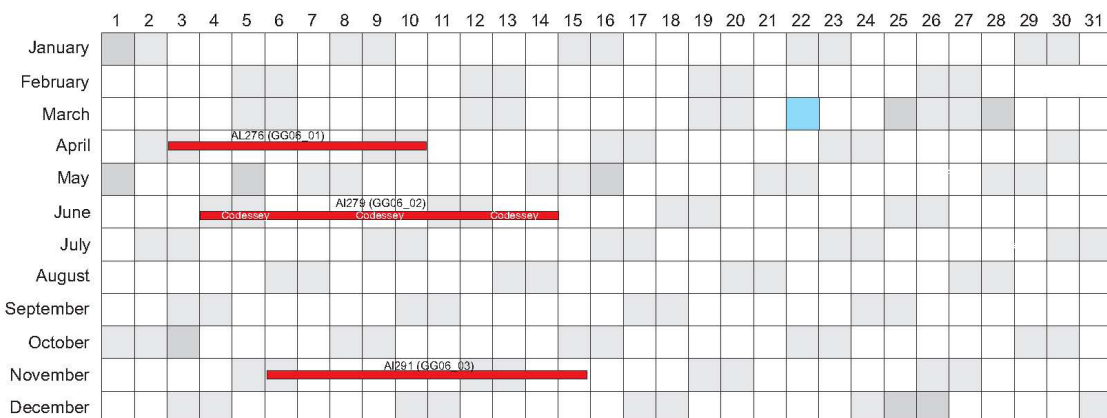
- Meeting
- Alkor
- A.v.Humboldt
- Heincke
- Poseidon
- Walter Herwig III



GLOBEC Germany - Schedule meetings and ship schedules 2006

Last update: 22.03.2007

- Meeting
- Alkor
- A.v.Humboldt
- Heincke
- Poseidon
- Walter Herwig III



3 Data archiving and quality

With the integration of this data collection in the information system PANGAEA, the data centre WDC-MARE has archived data with various parameters to give them the added value for data mining and future use through easy electronic availability. The GLOBEC data collection comprises 824 different parameters, which are added as a list on this CD in the file *parameter-globec.txt*. A total of 4236 data sets are included with the CD accompanying this report.

The data tables as stored on the CD were generated by the relational database management system of PANGAEA which ensure a consistent organisation of the metadata documentation, heading each file. The universal search capability added as front end software enables the user to find and download data of interest through individual queries.

The data underwent scientific quality checks by the originators during the project, and thus, scientific quality is in the responsibility of the authors cited in each respective data set. Whenever users find errors, WDC-MARE should be contacted so that corrections, additions or quality flags can be added. PANGAEA will always present online the most recent version of the GLOBEC data compilation.

During its runtime GLOBEC-Germany has operated the working database GLOBAN (WP11). The GLOBAN content was migrated to PANGAEA for long-term archiving at the end of the project. Data storage in GLOBAN did not track the relation between data and publication. Thus this report includes a publication list without the relations to the data; in PANGAEA data are made citable with the principle investigator as the author but not with its original publication or thesis. This decision was in the responsibility of the project.

4 Policy and citation

As data publishing system and repository, WDC-MARE makes use of the information system PANGAEA® – Publishing Network for Geoscientific & Environmental Data <http://www.pangaea.de>. PANGAEA can be defined as an electronic library on the Internet for georeferenced data from earth system research. It is operated in the sense of the Budapest Open Access Initiative 2002 (<http://www.soros.org/openaccess/>) and guarantees long-term availability of scientific primary data of projects and as supplements to publications. The policy follows the *Recommendations of the Commission on Professional Self Regulation in Science for Safeguarding Good Scientific Practice*, 1998 and the *Principles and Responsibilities of ICSU World Data Centers*, 1987 (<http://www.ngdc.noaa.gov/wdc/guide/gdsystema.html>). The availability of scientific primary data in public repositories consequently follows the recommendations of the OECD *Principles and Guidelines for Access to Research Data from Public Funding* (2007, www.oecd.org/dataoecd/9/61/38500813.pdf) and the *ERC Scientific Council Guidelines for Open Access* of the European Research Council (2007), see erc.europa.eu/pdf/ScC_Guidelines_Open_Access_revised_Dec07_FINAL.pdf.

It may seem unnecessary to publish data as a static collection on CD, if the data are available on the Internet. This print-publication has a global distribution through the major libraries and marine research institutes and will help to bridge the 'digital divide' between developed and developing countries with limited Internet access demanded by IOC/IODE (Intergovernmental Oceanographic Commission of UNESCO, International Oceanographic Data and Information Exchange).

Under the terms of the WDC data policy, the compiled and harmonized data on this CD will have entered the public domain by the time the CD is published. The data is intended mainly for scholarly use by the academic and scientific community, with the express understanding that any such use will properly acknowledge the originating references as provided in the data description.

All data/metadata are made available under a Creative Commons License **CC-by-3.0** see <http://creativecommons.org/licenses/by/3.0> - which means:

Whenever using data from this CD or from the PANGAEA system, the user is advised to quote the citation!

5 Data format and access

The scientific data of GLOBEC on this CD is a copy of the PANGAEA content at the time of publication. The inventory will continue to grow because further publications might be added at with time. Via www.pangaea.de always the most recent status of data will be available. This CD enables the user to access the data through a computer system locally. Data sets are stored in the folder `\docs\datasets\` as tab-delimited text (ASCII) files organized in ZIP-archives.

Each name of a file in the ZIP-archive consist of a six digit number followed by the extension *.tab*. This number is also part of the DOI (Digital Object Identifier); e.g. if a filename is *701414.tab* the related DOI is *10.1594/pangaea.701414*. Each DOI is the persistent identifier to find the data set on the Internet (not on the CD).

See <http://www.doi.org> for further information about the DOI system.

All data sets have a similar format, which consists of the **Data Description** (metadata) followed by the factual **Data** in a table.

Data Description (consists of the following fields, not necessarily all are used):

- (1) Citation: is the formal correct citation to use if you refer to a specific data set (e.g., in a publication). Part of the citation is a DOI (Digital Object Identifier) as a persistent identifier for reliable long-term access;
- (2) Reference(s): is the related publication, which the data belongs to;
- (3) Project(s): is the framework under which the data set has been produced; (for this compilation it is mostly = GLOBEC);
- (4) Coverage: gives the four geographic boundaries (W-E-S-N) of a rectangle around the area where the data was measured or sampling occurred (if the data is related to one sampling point only, W and E as well as N and S have identical values);
- (5) Event(s): gives the label of the deployment followed by its latitude, longitude, and elevation, as well as device type, campaign label, and the name of the ship;
- (6) Comment: may contain individual remarks (only shown if filled);
- (7) Parameter(s): shows the list of parameters with units for each column in the data set. Each parameter is related to at least one column showing a 'Short Name' as used in the header of the data matrix, the 'Principle Investigator' (PI), the method and (optional) comments;
- (8) Size: displays the number of data points of a data set.

Data

The data table consist of a header followed by the data columns:

- Event label i.e. the lable of the deployment as explained in (5) (only shown in tables containing data from several locations);
- one to several geo-codes, i.e. latitude; longitude; depth, water [m]; depth, sediment [m]; altitude [m]; date/time;
- one to many parameter with unit.

Data Access

The data collection is supplied with a simple search engine, allowing access to and navigate in the inventory by the submission of querries. The search engine is running on a local auto installing web server supplied with the CD. Both, the web server and the database engine, are built on Java™ Technology. Usually, no manual installation is needed since the CD starts automatically while inserted.

In the WDC-MARE efforts to archive data in a reliable format, which is readable on a long-term scale, data are ASCII (text) formatted. Access through a long-term stable URI (Uniform Resource Identifier) is ensured by the use of persistent identifiers (DOI). The search engine on this CD is provided for current convenient access but may not run stable on a long-term due to the continuously changing constraints through further development of the Java technology. This is out of control of WDC-MARE.

The following software is recommended (minimum requirement):

- *Linux*: SUSE, Debian, Ubuntu, Gentoo, Redhat
- *Macintosh*: Mac OS X
- *Solaris*: Version 8
- *Windows*: Windows 2000/XP using Java Runtime Engine JRE 1.4 or higher

In order to run the database properly, your computer must have a Java Runtime Engine 1.4 or higher (JRE) installed. On *Linux*, *Macintosh*, and *Solaris* computers JRE is already part of the operating system. Computers using the *Windows* operating system need separate installation of JRE. The start-up routine supplied on the CD will automatically detect the respective computer system, the version of its operating system check the JRE version. If JRE is not installed or the version number is not appropriate, the start-up routine will offer to install the bundled JRE version from CD-ROM.

The CD will start automatically once you have inserted it in your CD device. If the CD does not start automatically, you can launch it manually:

- *Windows*: double-click the file **winstart.exe**;
- *MacOS X*: double-click the **macstart** application;
- *Unix (Linus, Solaris, BSD, ...)*: execute **sh ./unixstart.sh** from terminal and follow the instructions; Solaris users have to mount the CD/DVD explicitly as Rockridge/ISO9660 volume

Important: The local search engine requires a Java VM installed on your system. If for some reason the Java environment is not found, the starting procedure offers the option to install the latest JRE from Sun (see folder support). In addition JavaScript must be enabled in your browser.

If your browser does not display the homepage after starting the local webserver, you should disable proxies in your browser configuration. If you cannot do this because of firewall or access restrictions (ask your system administrator), add 127.0.0.1 to the proxy exemptions or send an email to tech@pangaea.de.

Data search and processing

Assuming that the search engine properly displays the search query mask the user can create queries. To enter a search query, just type in one to several descriptive words and hit the <Enter> key or click on the <Search> button. Since the search engine only returns data sets that contain all the words in your query, refining or narrowing your search is as simple as adding more words to the search terms. A 'Help' text with search examples is provided below the 'Search' button. With *Show map* a simple map with minimum functionality will open, showing the location of sites.

The user may search for any words included in a data set, e.g. a name of a principle investigator or a parameter. A link to the *parameter list* is provided on the search mask. A search query typically results in a list of data sets that subsequently can be accessed by striking a hot link. The outcome displays the *Data description* and at its end the options to:

- *Download data set as tab-delimited text* or
- *View data set as HTML.*

Additionally, the entire result set (i.e. all data sets found and listed) can be loaded as a ZIP-archive, see:

- *Download complete results as ZIP-file*

The ZIP-file can be processed with a variety of analysis and visualization software packages, including **Ocean Data View**, (<http://odv.awi.de/>), PanPlot or PanMap (<http://www.pangaea.de/Software>) or other GIS systems by convenient conversion with the software **Pan2Applic**. This converter is provided with the CD and can be used to transfer single files, folders of files, or a ZIP-archive from the PANGAEA output format to formats of the applications listed above. Also a georeferenced flat text file may be produced for individual processing. Further output formats of general importance may be included in Pan2Applic on request to info@pangaea.de. (The reference and the link to the most recent version of Pan2Applic can be found at doi:10.1594/pangaea.288115).

Please contact the WDC-MARE office with any comments or questions pertaining to this publication at info@pangaea.de.

6 Acknowledgements

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- Barange M., Harris R. (2003): *Marine ecosystems and global change*. IGBP Science, 5:32pp.
- Tamm S., Moll A., Zabanski S. (2007): *The GLOBEC-Germany database*. GLOBEC International Newsletter, 13(2):57-58.

Appendix 1: Publications 2002-2004 (first GLOBEC phase)

- Alheit J. (2004): *The German GLOBEC-Project*. GLOBEC International Newsletter 10(1):9.
- Baumann H, Hinrichsen H.-H., Koester F., Temming A. (2004): *A new retention index for the Central Baltic Sea: long-term hydrodynamic modelling used to improve Baltic sprat recruitment models*. GLOBEC International Newsletter 10(1):11-12.
- Clemmesen C., Voss R., Dickmann M., Peck M. (2004): *Variation in nutritional condition of larval sprat (*Sprattus sprattus*) caught during the 2002 spawning season in the Bornholm Basin, Baltic Sea*. GLOBEC International Newsletter 10(1):9-10.
- Dutz J., Mohrholz V., Peters J., Renz J., Alheit J. (2004): *A strong impact of winter temperature on spring recruitment of a key copepod species in the Bornholm Basin: potential linkages to climate variability*. GLOBEC International Newsletter 10:13-14.
- Hinrichsen H.-H., Lehmann A., Möllmann C., Schmidt J. O. (2003): *Dependency of larval fish survival on retention/dispersion in food limited environments: The Baltic Sea as a case study*. Fish. Oceanogr. 12:425-433.
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- Luff R., Moll A. (2004): *Seasonal dynamics of the North Sea sediments using a three-dimensional coupled water-sediment model system*. Continental Shelf Research, 24(10):1099-1127.
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Appendix 2: Publications 2005-2008 (second GLOBEC phase)

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Appendix 3: PhD and diploma theses

PhD Thesis:

2008

Cristoph Stegert (2008): Modellierung der jahreszeitlichen Entwicklung einer Zooplankton-Population in der Nordsee.

2007

Cristian Agurto (2007): Assessing mesozooplankton trophic levels in the Baltic Sea and North Sea: stable isotope study.

Matthias Bernreuther (2007): Investigations on the feeding ecology of Baltic Sea herring (*Clupea harengus* L.) und sprat (*Sprattus sprattus* L.).

Anne Wesche (2007): Life-cycle strategies and impact of cannibalism in calanoid North Sea copepods. PhD Thesis, Universität Bremen, 121 pp.

2006

Christina Augustin (2006): Food and climate effects on copepod reproduction in the North and Baltic Seas. Christian-Albrechts-Universität zu Kiel, 110 pp.

Kristina Barz (2006): Influence of pelagic invertebrate predators on the zooplankton in the Baltic Sea and the North Sea. Universität Bremen, 107 pp.

Hannes Baumann (2006): Young-of-the-Year Baltic Sprat, *Sprattus sprattus* L.: Growth Characteristics, Transport Patterns & Implications for Recruitment Variability. Universität Hamburg, 181 pp.

Susanna Knotz (2006): Trophic interactions in the pelagic. Christian-Albrechts-Universität zu Kiel, 121 pp.

Ute Kuehrs (2006): Einfluß von Temperatur und Nahrung auf Wachstum und Kondition juveniler Sprotten (*Sprattus sprattus*).

Arne Malzahn (2006): Larval fish dynamics in changing environments. Christian-Albrechts-Universität zu Kiel, 98 pp.

Janna Peters (2006): Lipids in key copepod species of the Baltic Sea and North Sea - implications for life cycles trophodynamics and food quality. Universität Bremen, 185 pp.

Jasmin Renz (2006): Life cycle and population dynamics of the calanoid copepod *Pseudocalanus* spp. in the Baltic Sea and North Sea. Universität Bremen, 142 pp.

Jörn Schmidt (2006): Small and meso-scale distribution patterns of key copepod species in the Central Baltic Sea and their relevance for larval fish survival. Christian-Albrechts-Universität zu Kiel, 99 pp.

Jan Schulz (2006): Spatial and temporal distribution patterns of zooplankton in the central Baltic Sea and methods to detect them. Universität Bremen, 196 pp, hdl:10013/epic.28007.d001.

Daniel Stepputtis (2006): Distribution patterns of Baltic sprat (*Sprattus sprattus* L.) - causes and consequences. Christian-Albrechts-Universität zu Kiel, 153 pp.

2005

Miriam Dickmann (2005): Feeding ecology of sprat (*Sprattus sprattus* L.) and sardine (*Sardina pilchardus* W.) larvae in the Baltic Sea and in the North Sea. Universität Rostock, 97 pp, hdl:10013/epic.31760.d001.

2004

Mohammad Mukhlis Kamal (2004): Growth and condition of sprat (*Sprattus sprattus*) larvae inferred from otolith microstructure analysis and RNA/DNA ratio in the Bornholm Basin (Central Baltic Sea) during spawning season 2001.

Diploma Theses

2007

Phillip Kanstinger (2007): Growth and condition of larval sprat (*Sprattus sprattus*) - A combined laboratory and field investigation.

Klas Ove Möller (2007): In situ distribution and vertical migration of plankton in the North Sea.

2006

Berenike S. Diekmann (2006): Copepod phytoplankton interactions : significance of bloom temporal dynamics - variation in biochemical composition of *Thalassiosira weissflogii* during a simulated bloom and its effect on the herbivorous copepod *Acartia tonsa*.

Markus Kreuz (2006): Untersuchung der Generationszeiten von Zooplanktonpopulationen in Abhängigkeit der physikalischen und biologischen Umweltbedingungen für verschiedene Nordseeregionen. Universität Hamburg, 76 pp.

2005

Matthias Fladda (2005): Saisonale Entwicklung der Körperzusammensetzung der Sprotte (*Sprattus sprattus*).

Steffen Gehnke (2005): Die zeitliche Veränderung in der Abundanz des Copepoden *Temora longicornis* im Verlauf einer Frühjahrsblüte in der Deutschen Bucht unter besonderer Berücksichtigung des Einflusses von Diatomeen auf die Reproduktion. Universität Rostock, 106 pp.

Christian Müller (2005): Analyse der Konsumption und Nahrungswahl piscivorer Fische in ausgewählten hydrographischen Frontengebieten der Nordsee.

Kornelia Paul (2005): Feeding dynamics of different life stages of the jellyfish *Aurelia aurita*.

Eske Teschner (2005): Ansätze zur Verbesserung der fischereilichen Mehrartenmodellierung in der zentralen Ostsee.

2004

Dominik Gloe (2004): Räumliche Verteilung von Clupeiden in der Südlichen Nordsee in Relation zu hydrographischen Strukturen.

Linda Holste (2004): The influence of temperature, salinity and feeding history on population characteristics of Baltic *Acartia tonsa*: egg production, hatching success and cohort development.

Bastian Huwer (2004): Larval growth of *Sardina pilchardus* and *Sprattus sprattus* in relation to frontal systems in the German Bight.

Moritz Holtappels (2004): Nutritional condition of sprat and sardine larvae in the frontal systems of the German Bight. Universität Rostock, 88 pp.

Marlon Müller (2004): Variabilität in der klein- und mesoskaligen Verteilung von Fischbrut im Bornholm Becken.

Christoph Petereit (2004): Experimente zum Temperatureinfluss auf frühe Entwicklungsstadien des Ostseedorsches *Gadus morhua*. Universität Hamburg, 83 pp.

Christoph Stegert (2004): Untersuchung der physikalischen und biologisch-chemischen Steuerung einer Zooplanktonpopulation im Nordseeökosystem mit Hilfe von Modellstudien. Universität Hamburg, 125 pp.

2003

Cordula Schmitz (2003): Histologische Untersuchungen zur Entwicklung der Oozyten beim Dorsch in der zentralen Ostsee.

Anne Wesche (2003): Zeitliche Entwicklung des gelatinösen Zooplanktons bei Helgoland und Einfluss auf die Populationsdynamik von Copepoden. Diploma Thesis, Christian-Albrechts-Universität zu Kiel, 104 pp.

Appendix 4: German GLOBEC Symposium (14-15 November 2007)

Bundesforschungsanstalt für Fischerei, Palmaille 9, D-22767 Hamburg

Programme

14 November

- 09:00-09:30 Reception
- 09:30-10:00 GLOBEC Germany - Introduction
Jürgen Alheit, Warnemünde
- 10:00-10:30 Driving forces of population dynamics of zooplankton in the Central Baltic Sea: I. Abiotic factors
Jörg Dutz, Copenhagen
- 10:30-11:00 Driving forces of population dynamics of zooplankton in the Central Baltic Sea: II. Biotic factors
Janna Peters, Bremen
- 11:30-12:00 The vertical distribution of zooplankton in the central Baltic Sea - A link from climate towards trophic interactions?
Jan Schulz, Bremerhaven
- 12:00-12:30 Modelling copepods in the Baltic Sea
Thomas Neumann, Warnemünde
- 14:30-15:00 UK GLOBEC
Roger Harris, Plymouth
- 15:00-15:30 Life cycle of *Pseudocalanus elongatus* in the German Bight: a synthesis of observations, field experiments, and model simulations
Jasmin Renz, Bremerhaven
- 15:30-16:00 Modelling zooplankton dynamics in the North Sea
Christoph Stegert, Hamburg
- 16:30-17:00 Utilising individual-based modelling to understand trophic interactions in the German Bight (Southern North Sea)
Wilfried Kühn, Hamburg
- 17:00-17:30 A comparative study on the impact of physical and biological factors on the horizontal late larval stage distribution of Baltic and North Sea sprat
Hans-Harald Hinrichsen, Kiel
- 18.30-22:00 Poster Session

15 November

- 09:30-10:00 Impact of climate variability on North and Baltic Sea ecosystems and regime shifts
Jürgen Alheit, Warnemünde
- 10:00-10:30 GLOBEC Norway – Response of marine ecosystems to climate variability
Ken Drinkwater, Bergen
- 10:30-11:00 Life history and ecophysiology of sprat (*Sprattus sprattus*) in the Baltic and North Sea
Myron Peck, Hamburg
- 11:30-12:00 Comparing recruitment processes in Baltic sprat 2002 vs. 2003
Rüdiger Voss, Kiel
- 12:00-12:30 Seasonal development of sprat stock abundance, growth and feeding in the Bornholm Basin: Is the basin all that matters?
Hannes Baumann, Hamburg
- 14:00-14:30 Spatio-temporal dynamics of species interactions in the Central Baltic Sea: implications for trophic cascades (and regime shifts)
Christian Möllmann, Hamburg
- 14:30-15:00 How to use GLOBEC Germany results in Ecosystem-based Fisheries Management
Axel Temming, Hamburg
- 15:30-16:00 GLOBEC Germany: What have we learned? How to proceed?
Jürgen Alheit, Warnemünde
- 16:00-18:00 Final evaluation (closed session)

Appendix 5: List of GLOBEC expeditions (2002-2008)

Baltic Sea

Exp/leg	ExNo	GLOBEC	Ship	Begin	End	Chief Scientist
AvH44/02/08/1	1	GG02_01a	A. von Humboldt	2002-03-12	2002-03-16	Krüger, S
AvH44/02/08/2	1	GG02_01b	A. von Humboldt	2002-03-16	2002-03-21	Hansen, F
AL200/1	2	GG02_02a	Alkor	2002-04-02	2002-04-16	Möllmann, C
AL200/2	2	GG02_02b	Alkor	2002-04-16	2002-04-23	Stepputtis, D
PAP40/02/27	3	GG02_03	Prof. Albrecht Penck	2002-04-17	2002-04-20	Krüger, S
AL200/3	2	GG02_02c	Alkor	2002-04-23	2002-04-27	Mees, S
AL200/4	2	GG02_02d	Alkor	2002-04-27	2002-04-30	Mees, S
WH239	4	GG02_04	Walther Herwig III	2002-05-03	2002-05-19	Böttcher, U
HE168/1	5	GG02_05a	Heincke	2002-05-05	2002-05-11	Lüthje, R
HE168/2	5	GG02_05b	Heincke	2002-05-11	2002-05-18	van Beusekom, J
AvH44/02/03	6	GG02_06	A. von Humboldt	2002-05-15	2002-05-30	Alheit, J
HE168/3	5	GG02_05c	Heincke	2002-05-18	2002-05-24	Möllmann, C
AL205	7	GG02_07	Alkor	2002-06-11	2002-06-23	Voss, R
AL206	8	GG02_08	Alkor	2002-07-01	2002-07-16	Flöter, J
AL207/208	9	GG02_09	Alkor	2002-07-22	2002-08-07	Kraus, G
HE174	10	GG02_10	Heincke	2002-08-12	2002-08-21	Hirche, H
AL209	11	GG02_11	Alkor	2002-08-22	2002-08-30	Hirche, H
AL210	12	GG02_12	Alkor	2002-09-03	2002-09-13	Voss, R
AvH44/02/11	13	GG02_13	A. von Humboldt	2002-09-30	2002-10-10	Dutz, J
HE181	14	GG02_14	Heincke	2002-11-11	2002-11-29	Herrmann, J
HE182	15	GG03_01	Heincke	2003-01-13	2003-01-24	Kraus, G
AvH44/03/01/1	16	GG03_02a	A. von Humboldt	2003-02-10	2003-02-20	Dutz, J
AvH44/03/01/2	16	GG03_02b	A. von Humboldt	2003-02-20	2003-02-23	Dutz, J
AL217	17	GG03_03	Alkor	2003-03-03	2003-03-22	Hinrichsen, H
AL219	18	GG03_04	Alkor	2003-04-17	2003-04-28	Herrmann, J
WH251	19	GG03_05	Walther Herwig III	2003-05-07	2003-05-20	Böttcher, U
AL220/1	20	GG03_06a	Alkor	2003-05-15	2003-05-27	Voss, R
AL220/2	20	GG03_06b	Alkor	2003-05-27	2003-06-03	Renz, J
HE193	21	GG03_10	Heincke	2003-07-01	2003-07-19	Hinrichsen, H
AL226	22	GG03_11	Alkor	2003-08-07	2003-08-18	Peters, J
HE201	23	GG03_12	Heincke	2003-11-24	2003-12-05	Herrmann, J
AL235	24	GG04_02	Alkor	2004-03-15	2004-04-02	Hinrichsen, H
AL238	25	GG04_05	Alkor	2004-05-28	2004-06-15	Hinrichsen, H
AL241	26	GG04_07	Alkor	2004-07-15	2004-08-02	Haslob, H
AL251	27	GG05_01	Alkor	2005-01-24	2005-02-02	Haslob, H
AL255	28	GG05_02	Alkor	2005-04-11	2005-04-28	Hinrichsen, H
AL258	29	GG05_06	Alkor	2005-05-25	2005-06-08	Schmidt, J
AL262	30	GG05_09	Alkor	2005-07-18	2005-08-05	Hinrichsen, H
AL265	31	GG05_11	Alkor	2005-09-02	2005-09-14	Mohrholz, V
AL270	32	GG05_12	Alkor	2005-11-07	2005-11-19	Herrmann, J
AL276	33	GG06_01	Alkor	2006-04-03	2006-04-10	Herrmann, J
AL279	34	GG06_02	Alkor	2006-05-31	2006-06-17	Schaber, M
AL291	35	GG06_03	Alkor	2006-11-06	2006-11-14	Baumann, H

North Sea

Exp/leg	ExNo	GLOBEC	Ship	Begin	End	Chief Scientist
AL221/1	1	GG03_08a	Alkor	2003-06-06	2003-06-15	Alheit, J
HE190	2	GG03_07	Heincke	2003-06-06	2003-06-12	Temming, A
Dana03/3	3	GG03_09	Dana II	2003-06-13	2003-06-25	Möllmann, C
AL221/2	1	GG03_08b	Alkor	2003-06-15	2003-06-24	Flöter, J
HE203/1	4	GG04_01a	Heincke	2004-02-16	2004-02-24	Kraus, G
HE203/2	4	GG04_01b	Heincke	2004-02-24	2004-03-05	Stepputtis, D
AL236/1	5	GG04_03a	Alkor	2004-04-06	2004-04-14	Voss, R
AL236/2	5	GG04_03b	Alkor	2004-04-14	2004-04-27	Schmidt, J
AL237/1	6	GG04_04a	Alkor	2004-05-07	2004-05-14	Dutz, J
AL237/2	6	GG04_04b	Alkor	2004-05-14	2004-05-26	Herrmann, J
HE211/1	7	GG04_06a	Heincke	2004-06-17	2004-06-25	Barz, K
HE211/2	7	GG04_06b	Heincke	2004-06-25	2004-07-06	Alheit, J
AL242/1	8	GG04_08a	Alkor	2004-08-04	2004-08-12	Renz, J
Dana04/8	9	GG04_09	Dana II	2004-08-06	2004-08-14	Möllmann, C
AL242/2	8	GG04_08b	Alkor	2004-08-12	2004-08-23	Alheit, J
AL244	10	GG04_10	Alkor	2004-09-06	2004-09-12	Herrmann, J
HE221	11	GG04_11	Heincke	2004-10-11	2004-10-16	Baumann, H
HE225	12	GG05_03	Heincke	2005-04-14	2005-04-21	Hansen, F
HE228	13	GG05_05	Heincke	2005-05-17	2005-05-28	Hansen, F
AL257	14	GG05_04	Alkor	2005-05-17	2005-05-24	Herrmann, J
AL260	15	GG05_07	Alkor	2005-06-27	2005-07-08	Herrmann, J
PO324	16	GG05_08	Poseidon	2005-06-30	2005-07-08	Hansen, F
HE237	17	GG05_10	Heincke	2005-08-18	2005-08-29	Temming, A

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