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REPORT OF THE STUDY GROUP ON NORTH SEA BENTHOS PROJECT 2000 (SGNSBP)

12–15 APRIL 2005

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Contents

Executive summary

The ICES SGNSBP was formed to co-ordinate the analysis of data on North Sea benthos collected during 1999–2001, following the earlier ICES 1986 North Sea Benthos Survey. The data were gathered opportunistically either from new sampling or the collation of existing data with the emphasis on spatial coverage. There were 15 data contributors from 8 countries, with the data management being conducted by The Flanders Marine Institute, VLIZ, Belgium.

As with previous meetings, the SG combined plenary and sub-group activity, involving the analyses of data on various topics. Significant progress was made on further analysis of these data, details of which are presented in the report. An intersessional seminar/writing workshop was planned for November 2005 at Oostende, in order to develop the *Cooperative Research Report*, followed by a final meeting in April 2006 at NIOZ, Texel. Joint sessions were held with ICES WGECO to discuss the scope for identifying benthic indicators from the surveys of the North Sea in support of a WGECO Term of Reference.

The Study Group addressed a variety of ToR's including those relating to:

1) Publication of an *ICES Cooperative Research Report*, in parallel with scientific papers for peer-reviewed publication.
2) Scope for contribution to North Sea spatial models.
3) Future uses of the data.
4) Prospect for a repeat survey in 2007–2010.

Additional ideas for ICES/OSPAR discussed during the meeting included the desire for extending the spatial coverage beyond the North Sea and to incorporate earlier historical data into the NSBP 2000 database for evaluating the influence of long-term climatic change. It was noted that these initiatives would be greatly facilitated by establishing closer links with other groups such as the EU MARBEF network of marine institutes.

Finally the NSBP recommends an intersessional and annual meeting to address the Terms of Reference of the report and to endorse the production of a *Cooperative Research Report*. The SG also recommends that ICES holds a Theme Session in 2007 entitled 'Structure and Dynamics of the North Sea Benthos'.

1 Opening of meeting

The Study Group on the North Sea Benthos Project 2000 (SGNSBP) met from 12–15 April 2005 at ICES Headquarters, Copenhagen, Denmark. Dr Hubert Rees (Chair) welcomed the participants listed at Annex 1, especially Wouter Willems (PhD student from University of Ghent), and recorded apologies from Ingrid Kröncke (Germany), Gerard Duineveld (the Netherlands) and R. Smith (UK).

2 Appointment of Rapporteur

Jackie Eggleton (UK) was appointed as Rapporteur.

3 Terms of Reference for the ICES SGNSBP 2000

Terms of Reference for the 2005 SGNSBP meeting were as follows:

a) review the outcome of an intersessional Workshop held at CEFAS Burnham-on-Crouch, UK from 3–5 November 2004 to:

   i) finalise the draft of an overview paper on benthic communities of the North Sea 2000, including comparisons with 1986 NSBS data,

   ii) progress analyses/interpretation of the ICES NSBP 2000 data on the following themes:

   • fishing activities/impacts;

   • natural and human impacts (other than fishing);

   • functional properties – in particular feeding types;

   • comparison of epifaunal and infaunal community patterns;

   • benthos/habitat linkages;

   • NSBP 2000 data management.

   iii) assess/report on the status of physico-chemical data for sediments sampled as part of the NSBP 2000;

   iv) review the suitability of biomass data for North Sea-wide *versus* sectoral appraisal;

   v) identify/locate additional information sources (data/maps);

   vi) identify specific questions(s) regarding statistical analyses of NSBP 2000 data (e.g., formal tests for similarities in patterns) for consideration by WGSAEM 2005.

b) conduct further analysis of the NSBP 2000 data in relation to fishing activities, natural and other human influences, functional properties and epifaunal/infaunal patterns, and draft texts for publication;

c) report on the distributions of sub-sets of opportunistic and sensitive species identified by the ICES Study Group on EcoQOs for opportunistic and sensitive species, and examine the utility of the recommended metrics;

d) apply biotic/diversity indices to NSBP 2000 data;

e) consider the scope for contributing to North Sea spatial models, through liaison with experts;

f) identify products suitable for habitat mapping;

g) commence preparation of an *ICES Cooperative Research Report* on the ICES NSBP 2000 survey;

h) identify additional analytical/reporting ideas relevant to ICES/OSPAR interests;

i) review the cost/benefits of a repeat ICES North Sea Benthos Survey in 2007–2010;

j) liaise with the ICES Database Manager regarding the future operational interface with the NSBP 2000 database.

SGNSBP will report by 26 April 2005 for the attention of the Marine Habitat, ACME, and ACE Committees.

4 Agenda

The draft agenda (Annex 2) was accepted by the Study Group.

5 Election of Chair (2006)

Hubert Rees (Chair) asked all participants to consider the election of Chair for 2006. The Study Group recommended that Hubert Rees continue as Chair for the next year (see proposed ToR for 2006 at Annex 8).

6 National/International activities relevant to SGNSBP 2000

Three participants gave short presentations on current activities based on North Sea Benthos data. A summary of each presentation is attached at Annex 3. Titles for the presentations are listed below:

- Wouter Willems (University of Gent, Belgium) – Habitat suitability models for the analysis and prediction of the macrobenthos in the North Sea.
- Gert Van Hoey (University of Gent, Belgium) – The importance of *Lanice conchilega* in marine soft-bottom sediments.
- Jackie Eggleton/Hubert Rees (CEFAS, UK) - Summary of the benthic ecology of the Western North Sea.

7 Outcome of the Intersessional Workshop, November 2004 (ToR [a])

An intersessional workshop was held on 3–5 November 2004 at the CEFAS Laboratory, Burnham-on-Crouch, Essex, UK. A report of the meeting is attached at Annex 4.

8 Overview paper on North Sea benthic communities: (E. Rachor)

Eike Rachor reported on progress to date. He planned to produce a final draft of a paper on 'Structure and characterising species' by the end of June 2005 (see also Section 14.2).

9 Status of NSBP 2000 database/website (E. Vanden Berghe)

Edward Vanden Berghe gave an account of the current status of the database. An inventory of feeding types for all benthos species encountered in the NSBP 2000 is presently being incor-

porated (see also Section 14.4). It was agreed at the meeting that the species abundance matrix should now be 'frozen' to ensure consistency of outputs across collaborators in the preparation of final reports. The NSBP database is currently accessible through the VLIZ website. Access to the raw data is restricted to data contributors until completion of publications.

The following rules with respect to access to, and use of individual or institutional datasets were agreed at the SGNSBP 2000 workshop held in Oostende, January 2002, with minor amendments added at the SGNSBP 2000 intersessional workshop at Oostende in November 2003:

1. The raw data compilation will only be available for participants in the SGNSBP 2000 for the purpose of data analysis aimed at the production of common reports/publications. At a later moment it will be decided when public access to the raw data can be allowed. Individual datasets, which comprise the data compilation remain the property of the original data collectors and may be made available through other national sources.
2. All data contributors can be co-authors on any publication based on the integrated dataset. For each publication there will be a group decision regarding the name of the 'first' author and the order of co-authors.
3. The timing of any common report or publication will consider and respect any national requirement with regard to reporting on national datasets.
4. Any participant who wants to use data from another data owner can do so only after given consent by the respective data owners.
5. The meta-data regarding individual or institutional datasets will be made available to public access via the web. These meta-data will not include any raw data as mentioned under (1) nor species lists.

10 Status of biomass and environmental data

Edward Vanden Berghe has a total of 15 datasets for biomass. Work is still in progress on resolving inconsistencies and will require further intersessional work to complete the compilation. Hubert Rees informed the group of apparent inconsistencies in biomass values between 1986 and 2000 for the Western North Sea and that these may be due in part to differences in methodology. An assessment of the status of particle size data is given in Section 14.1. A compilation of environmental parameters available for SGNSBP authors is presented in table 14.6.1 below.

11 Identification of sub-groups

The Study Group agreed the following sub-groups to address the various topics of interest at the meeting:

- Community structure (T of R b): SG 1 ER, SD;
- Species distributions: T of R [c]): SG 1 JE;
- Predictive modeling SG 1 WW, SD;
- Community function (T of R b): SG 2 ML, JC;
- Infauna/epifauna/fish interactions (T of R b): SG 2 Henning R;
- Fisheries impacts (T of R b) SG 3 JC, Heye R;
- Non-fisheries (including natural) impacts (T of R b): SG 3 Henning R;
- Sediments SG 3 HH;
- Biotic/diversity indices (including opportunistic/sensitive species) (T of R [d]): SG 4 GVH, HR, Henning R;
- Database matters/supporting activity: SG 5 EVB;

The meeting then proceeded through the combination of subgroups and plenary activity.

12 Scope for contributing to North Sea spatial models (ToR [e])

Ongoing initiatives were discussed. Biomass and derived measures of production should be of interest to ecosystem modelling of energy flow (e.g., ERSEM, ECOPATH). The compilation of biomass data across contributors was still in progress and its value will depend on the satisfactory resolution of methodological inconsistencies (see Section 10 above). The work of Wouter Willems on predictive modelling of the spatial distribution and composition of assemblages represented a promising new application of the N Sea benthos dataset (Annex 3), as did work by Gert Van Hoey on the role of *Lanice* in structuring benthic communities (Annex 3). The SGNSBP 2000 will promote operational links with those presently engaged in North Sea modelling initiatives, as the analytical and reporting exercise moved towards the concluding phase.

13 Products suitable for habitat mapping: nature/availability (ToR [f])

Available data on sediment particle size from various data contributors had been provided intersessionally to the ICES WGMHM, for possible use in their task of developing a habitat map for the North Sea. However, discussion at WGMHM 2005 identified some of the difficulties in proceeding with their task and, as a result, no further progress on the analyses/mapping of sediment type through this route was possible (see Annex 5). Refinement and statistical analyses of the data was done by Hans Hillewaert during the present SGNSBP meeting, and would be available prior to the planned November 2005 intersessional workshop.

Data on North Sea benthic communities will become available according to the reporting schedule and protocol for access agreed previously, while various derived products appear as maps in the SG reports. Plots of densities of individual species identified as influential in separating TWINSPAN station groups were provided to WGECO in joint session to help in their assessment of indicator potential (see Section 14.3 and Annex 4).

14 Draft summaries for *Cooperative Research Report* (ToR [g])

The study group produced a revised draft structure for the proposed *Cooperative Research Report* (see Annex 6). Progress with the various sections including, where feasible, the drafting of text, is given below.

14.1 Section 3a. Sediment (PSA) – Hans Hillewaert

Progress:

i) A working classification of sediment types, using a combination of field observations and, where available, quantitative analysis, had been produced by the Study Group in 2004 and had assisted in the preparation of an overview paper on North Sea benthos distributions (see 14.2, below)

ii) Most partners had submitted datasets as granulometric fractions. They were standardized and combined into one database.

iii) Additional datasets (EU epibenthos survey 2000 and North Sea Benthos Survey 1986) were identified, that could be helpful in filling gaps in sedimentological data.

iv) Mud content (grain size <= 63µ) is already available for all processed stations.

v) Problems identified related to the various formats in which the data were submitted. It would be advisable to set up guidelines for collection of sediment parameters in a follow up of the North Sea Benthos survey.

vi) The next step will be to uniformly calculate median grain size and sorting coefficient. These should be available to the group before 15 May 2005.

14.2 Section 4a. Structure and characterising species - E. Rachor and S. Degraer

Sublittoral macrozoobenthos communities

As the biological database still needed some amendments, which were ready only on April 15, new and final assemblage analyses with TWINSPAN and CLUSTERING will be performed during May/June 2005.

Nevertheless, several univariate analyses were repeated; the new results are presented below.

For the further assemblage analyses, the main procedures and selection criteria were accepted.

Some comments regarding Material and Methods:

Specific information is summarized in Table 14.2.1.

Taxonomic questions were coordinated and solved during several workshops of the ICES Study Group on the North Sea Benthos Project 2000. Taxonomic problem-solving included the lumping of taxa that were insufficiently identified in some laboratories (taking into account 1986 and 2000 surveys), while records for species which were correctly identified and correct in their synonymy were termed as "valid".

Only valid species and lumped taxa data will be used for further assemblage analyses. In addition, all species that occurred in less than 1% of the stations and did not occur with more than 5 individuals per sample will not be considered in the analyses. Cut levels for TWINSPAN, density categories (and, thus, for "pseudospecies") are 0, 15, 50, 100, 500, 1000, 10000 ind. m^{-2}.

The analyses for separation and identification of assemblages will be carried out using PC-ORD software packages for TWINSPAN (Hill, 1979) and for clustering with PRIMER 5.0 (using Bray-Curtis similarity and group average linkage).

Untransformed abundance data were used. Furthermore, in TWINSPAN, only groupings that include more than three to five stations will be considered as 'main' assemblages.

Table 14.2.1: Summary of data sources in the form submitted for the NSBP 2000 survey.

Area (and sampling time)	Sampling device	Sample size (m^2)	No. of stations & Replicates per stat.	Notes	Contact Name
Eastern English Channel (2001)	Hamon grab	0.1 and 0.2	102 & 1-2	Replicates separate, Data per m^2	Newell (nw, only di)
English Channel French coast (2000)	Hamon grab	0.25	15 & 2	Repl. sep., Aggregated data, 2 mm mesh	Dewarumez (dw)
French coast (2000)	Hamon grab	0.25 2	94 & 2	Repl. sep., 2 mm mesh	Desroy (dr)
Belgian coast (2000)	Van Veen grab	0.1	256 & 1	Repl. sep., Autumn & spring sampling	Degraer (dg)
Belgian coast (2000)	Van Veen grab	0.1	8 & 3	Repl. sep., Autumn & spring sampling; fixed before sieving	Hillewaert (hi)
Dutch waters (2000, 2001)	Box corer	0.068	100 & 1	Repl. sep., Sampling of repl. in 2000 and 2001	Duineveld (du)
German estuaries (2001)	Van Veen grab	0.1	10 & 6	Repl. sep.	Nehring (ne)
Eastern German Bight (1999, 2000)	Van Veen	0.1	19 & 1-6	Repl. sep	Rumohr (ru)
German Bight, Dogger Bank, central North Sea (mainly June 2000, one in 2002)	Van Veen grab	0.1	181 & 2 (1–4)	Repl. sep., Data per m^2	Rachor (ra)
Dogger Bank (2000)	Van Veen grab	0.1	12 & 5	Aggregated data	Van Dalfsen (do)
Western North S. (1999-2001)	Hamon/Day grabs	0.1	53 & 3(2–3)	Separate	Rees (re)
North Sea (2001)	NIOZ corer	0.25	38 & 2 (1-3)	Separate	Robertson (ro)
Norwegian offshore waters (2000, 2001)	Van Veen grab	0.1	36 & 5 (4-10)	Sep.data	Cochrane (co)
Norwegian southern coastal waters (May 2000)	Day / Van Veen grabs	0.1	12 & 4	Separate	Oug (ou)

(Note: The mesh size is 1 mm unless otherwise specified).

The characteristic species of each main cluster will be determined using the SIMPER tool within PRIMER. Expanded criteria to identify such species are:

1. Fidelity in abundance (FA [DAI in Salzwedel *et al*., 1985]), total number of a species within a cluster/total number in the survey; highest ranks, > 60 %);
2. Presence (P, share of stations within an assemblage, where the species was found; highest ranks, > 70 %);
3. 3. Fidelity in presence (FP [DAS in Salzwedel *et al*., 1985]), number of presences within a community/total number of presences in the survey; highest ranks, > 60 %, not < 40 %);

4. Numerical dominance (ND, highest ranks, as a rule not less than 3 %);
5. Rank of species contribution to dissimilarity (RD, ranks 1-5 only).

For a characteristic species, at least three of the criteria have to be fulfilled, with ND as a rule not less than 3 % and FP not less than 40 %.

Some preliminary new results:

A. Species lists and species distributions

A full list can be found in the NSBP database (www.vliz.be/vmdcdata/nsbp/); see contribution of Vanden Berghe *et al*, (Section 9 above).

The distributions of important species across the survey area are currently in preparation (see Annex 4 and 6). Several species showed distributions linked to depths, substratum types and a more northern or southern prevalence.

B. General Trends

Diversity

Rarefaction analyses have shown increasing trends in the expected number of species per 50 individuals (ES 50) with latitude north of 51° N, while south of 51° sampling methods and biogeographical differences "disturb" this general picture (Figure 14.2.1) as well as in some parts of the German Bight (e.g., estuarine areas, east of 6° E), cf. Figure 14.2.2. The open circles in Figure 14.2.1 represent the English Channel and East English coastal gravel areas, sampled mainly with a 0.1m^2 Hamon grab.

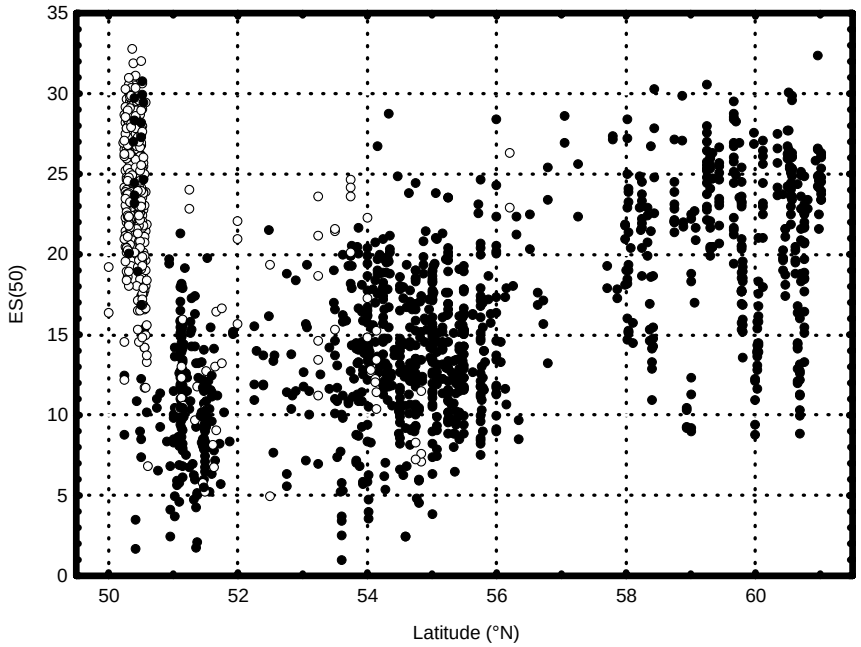

Figure 14.2.1: Diversity vs. latitude (single grabs)

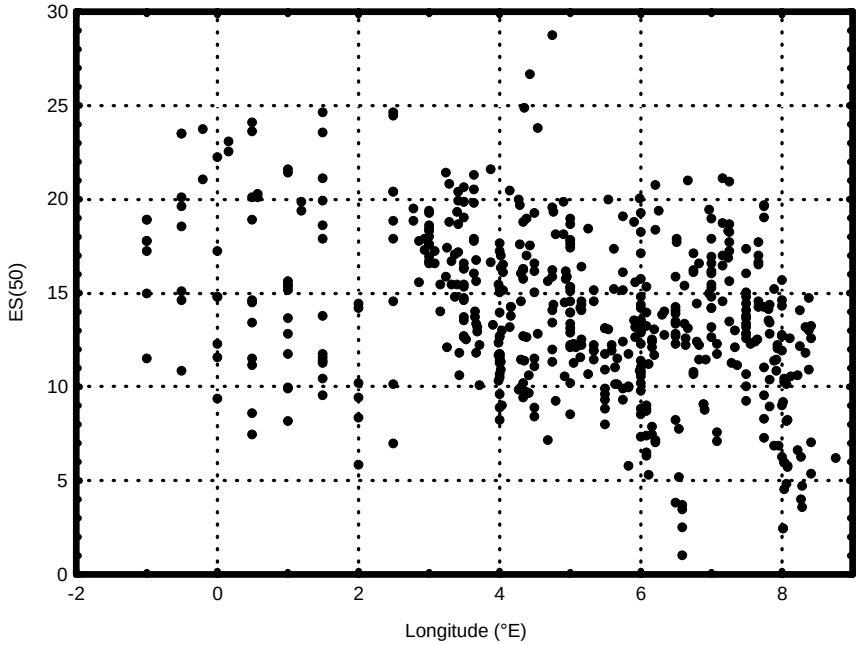

Figure 14.2.2: Diversity vs. longitude (area between 53° and 56° N only).

Density

A general latitudinal trend was identified (Figure 14.2.3) especially when the southern and the northern North Sea parts were compared. Lowest and highest densities (2 to 26000 ind./m²) were found south of 52°N. North of 52°N, macrobenthic densities generally varied between 100 and 10000 ind./m². In the southeastern North Sea, relatively low densities were recorded in specific areas (e.g., stations under estuarine influence).

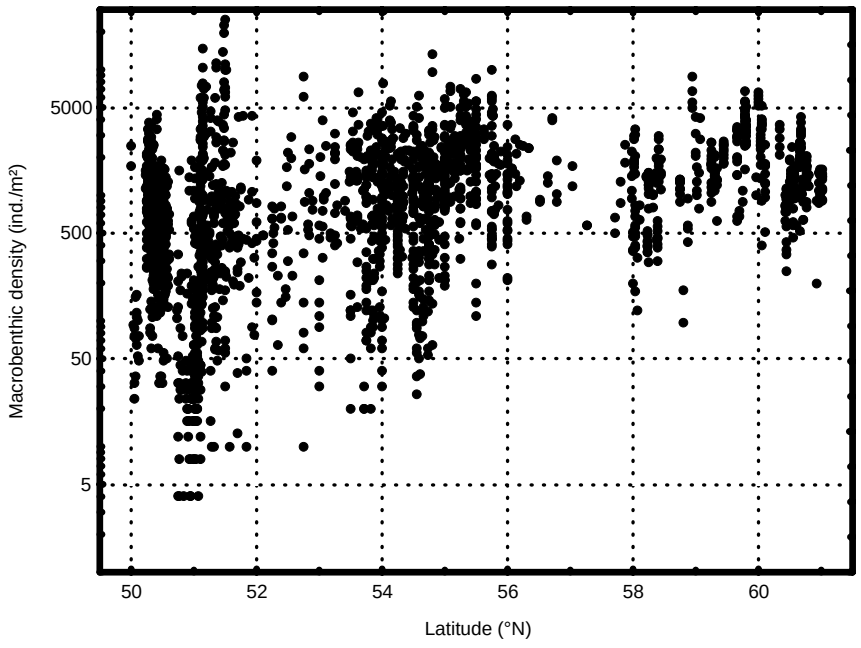

Figure 14.2.3: Density vs. latitude.

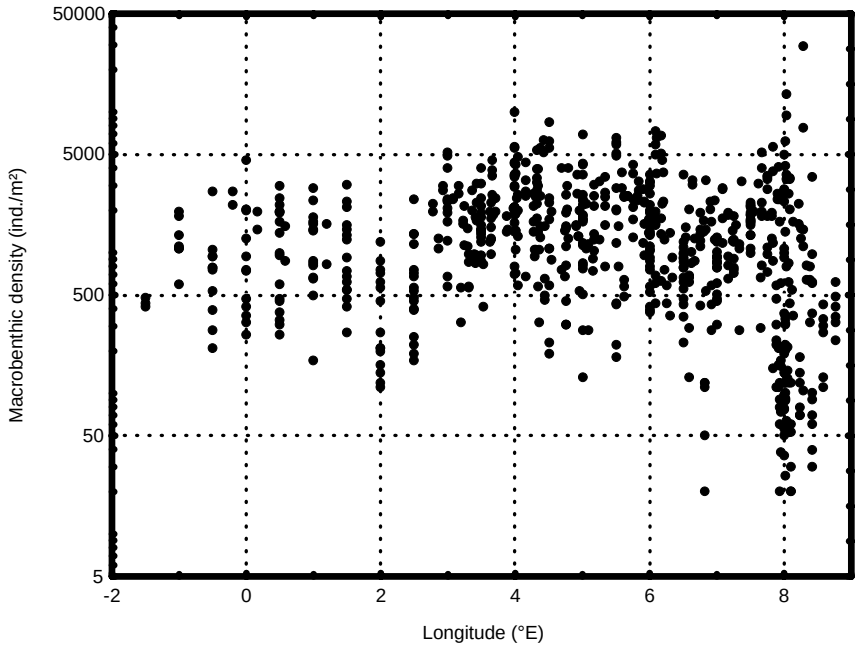

Figure 14.2.4: Densities vs. longitude (area between 53° and 56° N only)

There was evidence of a W-to-E decrease in the southern North Sea, which seems mainly related to specific environments such as those under estuarine influence (Figure 14.2.4.).

Sediment relationship:

Macrobenthic densities decreased from clay/silt to coarse sands, but tended to increase in more gravely and coarse mixed substrata (Figure 14.2.5). Sediment categories correspond with those identified in the 2004 report of the SGNSBP 2000, namely:

A – Mud (silt and clay)

B – Mud and sand

C – Fine sand (fine to medium sand)

D – Coarse sand (medium to coarse sand)

E – Sand and gravel

F – Gravel

G – Stones

H – Mixed (from mud to gravel/shells)

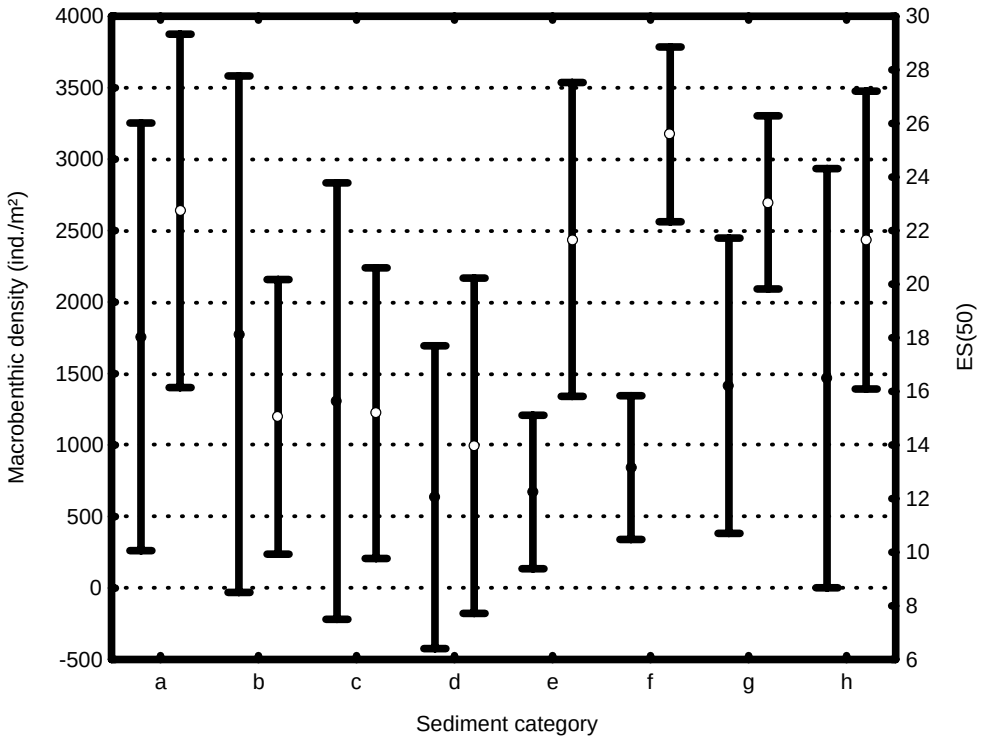

Figure 14.2.5: Macrobenthic densities (means ± SD) in relation to sediment conditions

C. General North Sea wide assemblage patterns (results of multivariate analyses)

Macrozoobenthos assemblages, as preliminarily identified by different methods, are well distinguished between the northern (north of the Dogger Bank) and the southern North Sea. Within this general scheme, clusters mainly indicate local biotope ("habitat") conditions, which broadly correspond with differences in sediment type.

Both TWINSPAN and PRIMER broadly show initial separations/groupings on the basis of coarse vs. fine substratum types. Thus the pattern of assemblages from both of these methods are similar to each other.

Updated (final) multivariate outputs will be produced in May/June 2005. Preliminary results are given in the 2004 SGNSBP 2000 report (see also 14.6 below).

The specific local conditions revealed by very intensive sampling as, e.g., in the English Channel, near the Belgian coast and in parts of the German Bight will not be discussed in detail, but have been treated in separate publications and reports (e.g., Van Hoey *et al*., 2004, Rachor and Nehmer, 2003).

A table to summarise specific features and some parameters of the main communities found is proposed as follows;

Table 14.2.2

Community name & symbol	Area	Depth range (m)	Sediments	Characterizing species	Densities (m^{-2})	Biomass	Diversities
Tellina fabula	Southern NS, Dogger B.	15-30	F-MSd	T. fabula, Bathyporeia gui. ?, Urothoe spp.?	500-3000	?	?

The discussion for the *Cooperative Research Report* will include:

1. A comparison between multivariate analyses (TWINSPAN - PRIMER).
2. Similarities and differences in diversity and in the occurrences of some characterizing species (see Smith *et al*.,) 1986– 2000;
3. Explanations of (assemblage/zonation) patterns found (compared with 1986 interpretations: depth zonation, sediment relations, food conditions)
4. Short hints on temporal/spatial changes in patterns (if they appear);
5. New "insights" (e.g., that very coarse [stoney?] sediment assemblages are separated from other groups)
6. First proposals regarding biotope ["habitat"] classification including "biotope/community complexes" and considerations of "rarity", "sensitivity" and any protection needs.

14.3 Section 4b. Species distributions - Rebecca Smith/Jackie Eggleton

Species distribution plots were produced based on Twinspan outputs from 2000 and 1986 (see Appendix 7 of the November 2004 SGNSBP 2000 Intersessional workshop report at Annex 4). All stations in both years are shown, therefore distributions may look more widespread in 2000 as there were more stations sampled. A selection of these species will be chosen for inclusion into the *Cooperative Research Report*. Final plots will be produced based on the final Twinspan output and therefore may differ slightly from the current version.

Species abundance plots were also produced within the workshop to show more clearly where changes have occurred between 1986 and 2000. Only the corresponding or nearest stations in both 1986 and 2000 were used. These had been previously calculated using a query on the NSBP database. Calculations to show the species abundance changes between the 2 years were also produced as a query in the NSBP database. Dividing the abundance difference between the two years by the abundance sum of the two years gives a value of between –1 and +1. A positive value indicates that there were higher abundances in 2000 and a negative value indicates that there were higher abundances in 1986. Species were selected from a list generated by the ICES Study Group on Ecological Quality Objectives for Sensitive and Opportunistic Benthos Species (see ICES Report of the SGSOBS, 2004) (ToR [c]). Examples of changes in species abundance and distribution are presented in the maps below for a species sensitive to mechanical disturbance, *Arctica islandica* (Figure 14.3.1.), and an opportunistic species that is known to become dominant in response to chemical and physical stress, *Capitella* spp. (Figure 14.3.2.):

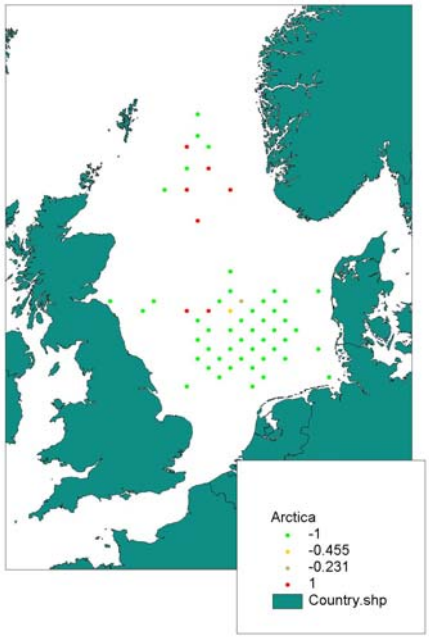

Figure 14.3.1. Changes in abundance of *Arctica islandica* between 1986 and 2000.

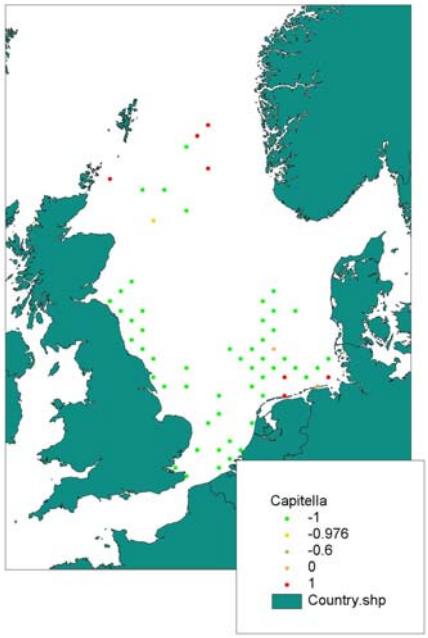

Figure 14.3.2. Changes in abundance of *Capitella* spp. between 1986 and 2000.

14.4 Section 4c. Function – Marc Lavaleye, Gerard Duineveld, Johan Craeymeersch and SGNSBP-members

Within the theme functional groups, we focused, so far, on the feeding types. For all species within the database for the 1986–2000 comparison of the infaunal macrobenthos of the North Sea the feeding type was determined on the basis of literature or expert judgement. For only a small percentage the feeding type could not yet be identified. The feeding types were eventually divided in to four main groups, namely: Filter feeders (Figure 14.4.1), Surface deposit feeders (Figure 14.4.2), Subsurface deposit feeders and Predators (including omnivores and scavengers). The parasites were put into a separate (fifth) group.

For the four main feeding guilds distribution plots were made based on the data of 2000. During the workshop the database was refined. These changes have not yet been incorporated in these maps, so they really form a preliminary result. In these maps each feeding guild is plotted as a percentage of the total number of macrobenthos in a square metre for each station.

Results

The percentage of filter feeders is high on the Oyster Grounds and in a part of the German Bight. On the Dogger Bank and north of that bank in the deeper water of the North Sea filter feeders form a minority of the macrobenthos. In the shallow part south of the Frisian Front the percentage of filter feeders is also low. This is also the case along the Belgian and French coast and in the English Channel, though there are some stations with high percentages. Notice that in the last mentioned area a high number of stations are situated close together.

Surface deposit feeders form an important part of the infauna over the whole North Sea, except for the Oyster Grounds. On many stations the percentage of this feeding guild is higher than 50%. Subsurface deposit feeders form a minority in the North Sea. Only in the German Bight, in the Channel and along the Belgian and French coast they are found in higher numbers, but not often more than 50%. Predators, scavengers and omnivores together show more or less the same pattern as the subsurface deposit feeders, though with some higher percentages.

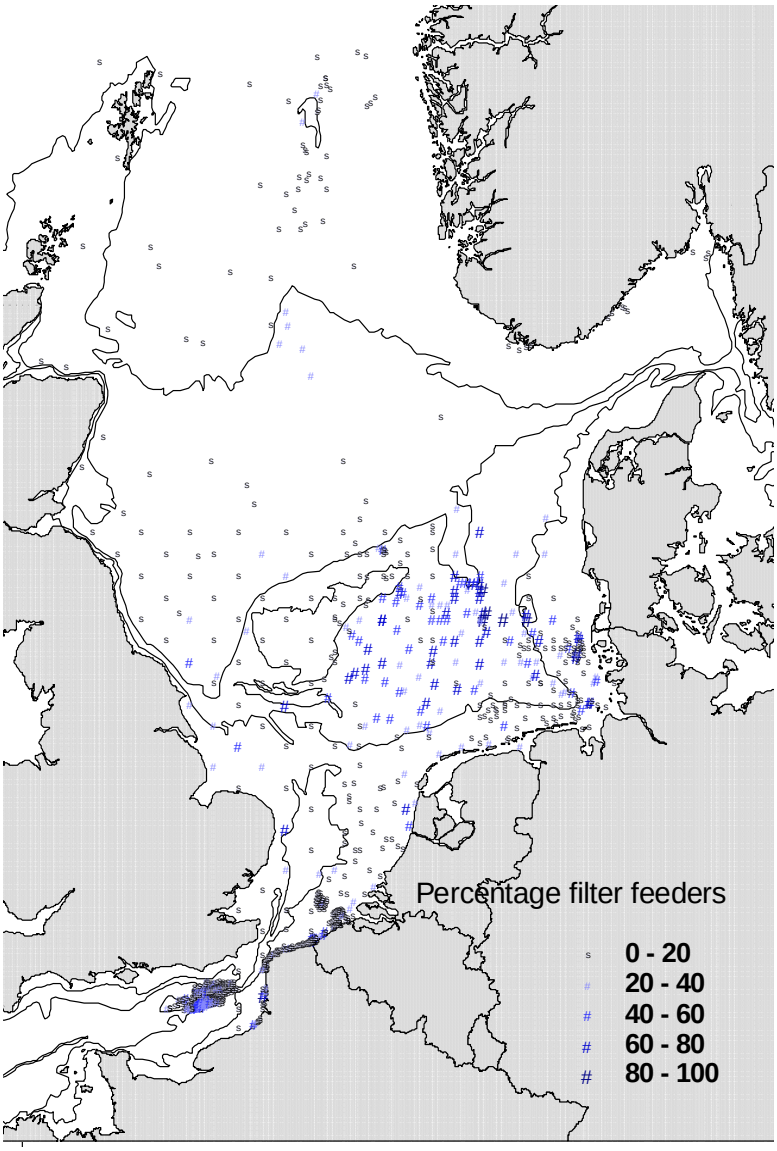

Figure 14.4.1: Distribution map of percentage filter feeders (based on 2000 dataset).

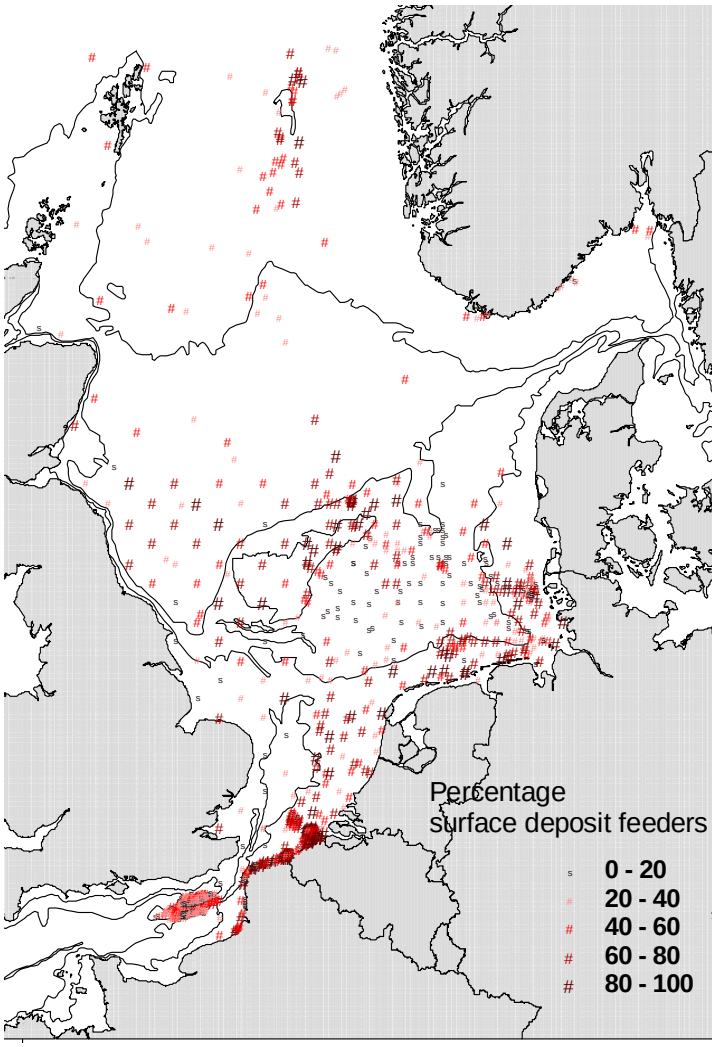

Figure 14.4.2: Distribution map of percentage surface deposit feeders (based on 2000 dataset).

14.5 Section 4 d. Role of biotic/diversity indices

The aim of this section is to consider if biotic indices can detect changes in community structure or other features of the North Sea Benthos between 1986 and 2000. We begin with the Borja index and this will be compared with the BQI (Swedish Index).

4.d.1 AMBI-index: Biotic index

The AMBI-biotic index is based on the discrimination of sensitive and opportunistic species. During the 2005 SGNSBP workshop we compared the NSBP species list with that of Borja. Species that were unclassified according to Borja were researched and classified where possible. More than 90% of the species in every NSBP station were classified (with the exception of 10 stations, which were excluded from the analysis).

The table below summarizes the different categories as defined by Borja *et al.* (2000).

TABLE 1

Summary of the BC and BI (modified from Grall and Glémarec, 1997).

Site pollution classification	Biotic Coefficient	Biotic index	Dominating ecological group	Benthic community health
Unpolluted	$0.0 < BC \leq 0.2$	0	I	Normal
Unpolluted	$0.2 < BC \leq 1.2$	1		Impoverished
Slightly polluted	$1.2 < BC \leq 3.3$	2	III	Unbalanced
Meanly polluted	$3.3 < BC \leq 4.3$	3		Transitional to pollution
Meanly polluted	$4.5 < BC \leq 5.0$	4	IV–V	Polluted
Heavily polluted	$5.0 < BC \leq 5.5$	5		Transitional to heavy pollution
Heavily polluted	$5.5 < BC \leq 6.0$	6	V	Heavy polluted
Extremely polluted	Azoic	7	Azoic	Azoic

a) Patterns in the North Sea in 2000

Most NSBP 2000 stations were classified as impoverished to unbalanced according to the Borja characteristics (see Figure 14.5.1). Some stations along the Belgian coast and in the North Sea were classified as transitional to polluted. Patterns within these results will be analysed further.

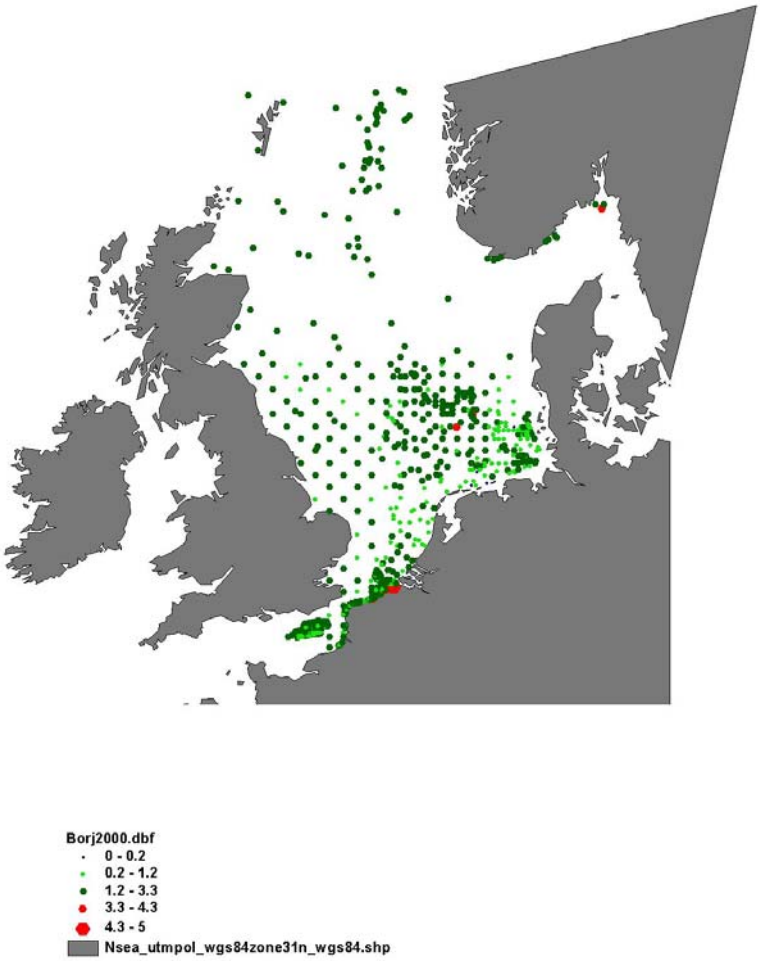

Figure 14.5.1: Patterns in the North Sea in 2000 according to the AMBI biotic index.

b) Patterns in the North Sea in 1986

In 1986 most stations were classified as unbalanced, especially in the central part of the North Sea (see Figure 14.5.2). Coastal areas were more impoverished. No stations were classified as transitional to polluted.

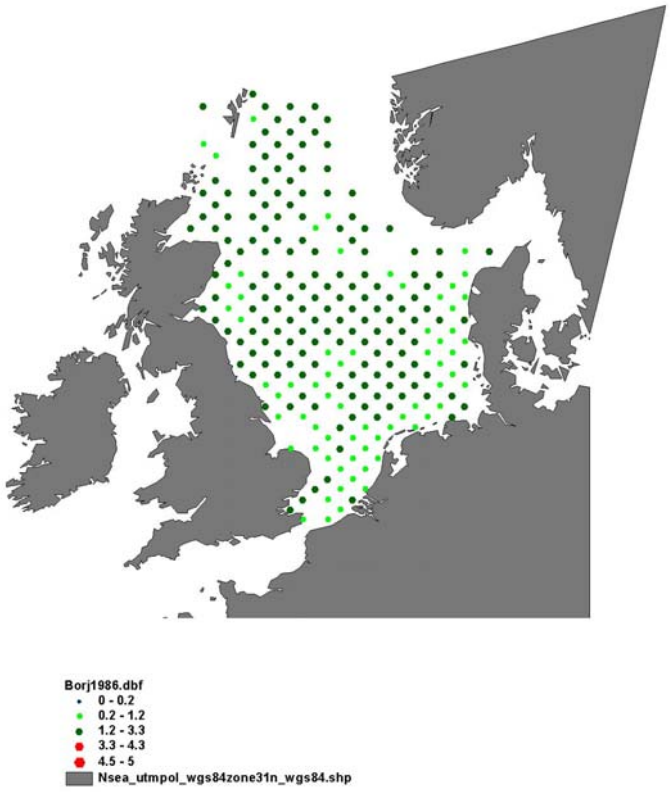

Figure 14.5.2: Patterns in the North Sea in 1986 according to the AMBI biotic index.

c) Differences in Biotic index between 2000 and 1986

In Figure 14.5.3, the circles indicate stations in 2000 that have improved in benthic community health in comparison with 1986. A triangle indicates deterioration in 2000 compared to 1986. 'Deterioration' tends to be North Sea wide rather than in particular areas. Further analysis will involve identifying stations that have changed status between 1986 and 2000.

Figure 14.5.3: Comparison of 1986 and 2000 data.

4.d. 2. BQI (Swedish index)

The system for the BQI index is presently being incorporated into the NSBP 2000 database, therefore no analysis using this index has been performed to date. Comparison of the patterns between the BC and the BQI indices will be carried out in future analyses. It is also planned to test these indices on particular areas within the North Sea.

14.6 Section 5a, b/d. Ecosystem interactions (1986–2000) - Henning Reiss

Environmental data compilation

During the NSBP several environmental parameters were gathered simultaneously to the infaunal sampling, such as contaminants (heavy metals) and sediment structure, or the data were received from external sources. Table 14.6.1 shows an inventory of the environmental data compiled during the workshop, which may be of significance for the analyses and interpretation of the spatial and/or temporal patterns of the benthic communities.

Table 14.6.1: Environmental parameters compiled during the NSBP; (X = no request in the reporting period).

	Data source	Available for NSBP		Possible influence on spatial patterns	Possible influence on temporal patterns
		1986	2000		
Parameters of small-scale impact only:					
- Aggregate extraction	www.sandandgravel.com	?	Yes	(local)	(local)
- Oil- and gas production	CEFAS (Burnham)	?	Yes	(local)	(local)
- Engineering works	?	?	?	(local)	(local)
- Sewage disposal	?	?	?	(local)	(local)
- Oxygen deficiency	?	?	?	(local)	(local)
- Dredging disposal	?	?	?	(local)	(local)
Parameters of North Sea wide impact:					
- Temperature	Hamsom-model	Yes	Yes	Yes	Yes
- Salinity	Hamsom-model	Yes	Yes	Yes	Yes
- Fisheries	Mafcons	?	Yes	Yes	Yes
- Chlorophyll	Revamp (2003)	No	X	Yes	Yes
- Primary production	Ecoham1-Model (1986-?)	(Yes)	Request	Yes	Yes
- Phytoplankton	CPR	X	X	Yes	Yes
- Bottom sheer stress (tidal currents or wave action)	Hamsom-model	Yes	Yes	Yes	Yes
- Sediment structure	NSBP data	Yes	Yes	Yes	No
- Contaminants (heavy metals)	NSBP data (G. Irion)	Yes	Yes	Yes	Yes
- Nutrients (Eutriphication)	ICES ?	?	?	Yes	Yes
Integrating parameters:					
- Climatic regime (NAO Index)	Published literature	Yes	Yes	Yes	Yes
- Inflow of Atlantic waters	Published literature	Yes	Yes	Yes	Yes
- Depth	NSBP data	Yes	Yes	Yes	No

The parameters such as dumping, aggregate extraction and engineering works are likely to have an influence on the temporal and spatial patterns of benthic communities on a small-scale only. Nevertheless, these parameters have to be followed up and potentially taken into account when analysing the faunal data.

Comparison of 1986 and 2000 – natural and anthropogenic impacts

The data analysis for the comparison of the NSBP endobenthos data of 1986 and 2000, which was started during the SGNSBP 2000 Intersessional workshop in Burnham (2004), was continued following the proposed two approaches. In order to get an indication of the large-scale differences/similarities between both periods, the multivariate analyses should be based on a) the total dataset including all stations sampled in 2000 and b) a reduced data set including only stations of the 2000 dataset, which are situated in the vicinity of the stations sampled in 1986. In case of a) the results of a separate analyses of both datasets (1986 and 2000) can only be compared qualitatively to reveal general differences in the benthic patterns. In case of b) the similarity matrices of both datasets can be compared directly to detect significant differences in the benthic patterns (Spearman rank correlation; RELATE routine in the PRIMER package).

The analyses were carried out using cluster analysis (Bray-Curtis similarity, group average linkage) in the PRIMER package with fourth root transformed abundance data.

a) Figures 14.6.1 and 14.6.2 show the results revealed with whole datasets of 1986 and 2000, respectively. The analysis of the 2000 data show that the main clusters were rather similar to previous analysis with PC-ORD (SGNSBP 2000 intersessional report 2004 – see Annex 4). Details of the communities can be found in the draft manuscript of Rachor *et al*., (see Section 14.2). The clusters revealed with the dataset of 1986 show similar results to 2000 data and to previous analysis with Twinspan by Künitzer *et al*. (1992) at least for the main clusters (Figure 14.6.2).

By comparing the clusters of both periods, differences between 1986 and 2000 were found for the northern part of the North Sea, the southwestern part of the English coast and parts of the German Bight-Oyster Ground area. For example, in 1986 a clear separation between areas of 100-200 m and < 100 m water depth was found, whereas in 2000 this separation was not as conspicuous.

b) Figures 14.6.3 and 14.6.4 show the results of the cluster analyses based on the reduced datasets. In total 146 stations were analysed and compared. The comparison of the similarity matrices of 1986 and 2000 data with the RELATE routine of PRIMER revealed no significant similarity between both periods ($R=0.011$; $p > 0.5$).

The comparison of the clusters in Figures 14.6.3 and 14.6.4 indicate differences between 1986 and 2000 in the several parts of the southern North Sea, such as the north eastern part of the Dogger Bank, the southern German Bight and the south eastern part of the English coast. The differences between 1986 and 2000 in the northern parts of the North Sea, already mentioned above (a), was also apparent in the reduced datasets. Whether this distinction is caused by methodical differences within the dataset of 1986, where a 0.5 mm sieve was used in areas > 100m only, or by 'real' differences have still to be tested.

In order to get an indication of the relative importance of spatial differences between the stations and of temporal differences between both periods, an additional cluster analysis was carried out, where both (reduced) datasets were compiled. Of the 146 directly comparable samples from 1986 and 2000, 57 (39 %) are placed in the same clusters. The remaining 89 samples from each year were placed in different clusters. Three of seven clusters contained only samples of one period (1986 or 2000) indicating major differences between both periods.

Furthermore, a correspondence analysis was carried out with the compiled dataset to detect differences between 1986 and 2000. The distance between the stations of each corresponding station pair displays the change in community composition between 1986 and 2000 at this station. The first results showed that the most striking changes occurred in the southwestern North Sea on coarse substrate, whereas only slight changes were found for the eastern part of the North Sea and especially the Oyster Ground.

These analyses have to be repeated with the final dataset (which is now available) and the standardisation of data processing upon which we agreed during this workshop (see Section 14.2).

Furthermore, a detailed comparison within selected areas of the North Sea has to be carried out. The proposed areas are (1) the south-western North Sea along the English coast, (2) the German Bight and the (3) central North Sea including the Dogger Bank.

Links between infauna/epifauna/fish distribution

For the comparison of infauna, epifauna and fish communities the data compilation, which was already started in Burnham, was continued and the final epifauna data set was prepared for analyses. The epifauna data were gathered in 1999 and 2000 during the EU-project 'Monitoring Biodiversity of Epibenthos and Demersal Fish in the North Sea and Skagerrak' and are

available for the SGNSBP and will be integrated in the NSBP database. The accessibility of these data will be restricted to NSBP internal use until the whole database is made freely available for public use following the publication of findings.

The data on the fish fauna were extracted from the ICES International Bottom Trawl Survey (IBTS) Database for the year 2000. The IBTS data are now available for the SGNSBP, and data analyses will proceed intersessionally.

For the comparison of the infauna and the epifauna (and at a later time also the fish fauna) only those samples from 2000 were used, which are situated in the vicinity of the stations were infauna data of the NSBP data set were available. Thus, 140 stations were used in the analyses. The analyses were carried out using cluster analysis (Bray-Curtis similarity, group average linkage) in the PRIMER package with fourth root transformed abundance data and presence/absence data.

The community structure of free-living epifauna revealed with fourth root transformed abundance data (Figure 14.6.5) and sessile and free-living fauna revealed with presence/absence data (Figure 14.6.6) were, as expected, similar to the community structure found by Callaway *et al*. (2002), who used the same data set.

The preliminary results of the comparison of the similarity matrices of the epifauna and infauna data with the RELATE routine of PRIMER (see above) revealed no significant similarity between infaunal and epifaunal community patterns ($R=-0.084$; $p>0.05$).

References

Callaway, R., Alsvag, J., de Boois, I., Cotter, J., Ford, A., Hinz, H., Jennings, S., Kröncke, I., Lancaster, J., Piet, G., Prince, P., and Ehrich, S. 2002. Diversity and community structure of epibenthic invertebrates and fish in the North Sea. ICES Journal of Marine Science, 59: 1199–1214.

Künitzer, A., Basford, D., Craeymeersch, J.A., Dewarumez, J.M., Dörjes, J., Duineveld, G.C.A., Eeleftheriou, A., Heip, C., Herman, P., Kingston, P., Niermann, U., Rachor, E., Rumohr, H., and de Wilde, P.A.J. 1992. The benthic infauna of the North Sea: species distribution and assemblages. ICES Journal of Marine Science, 49: 127–143.

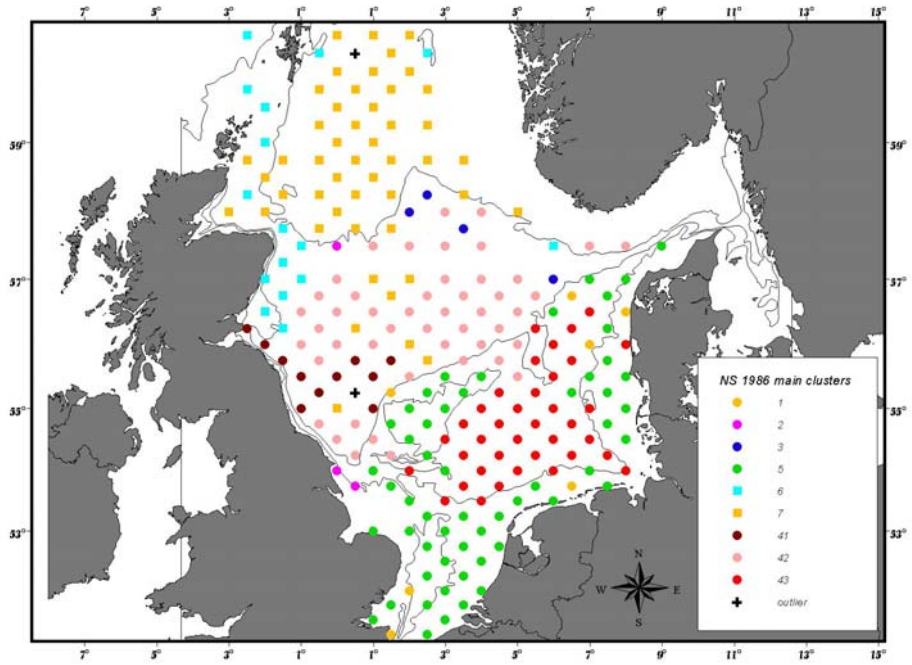

Figure 14.6.1: Main clusters in 1986.

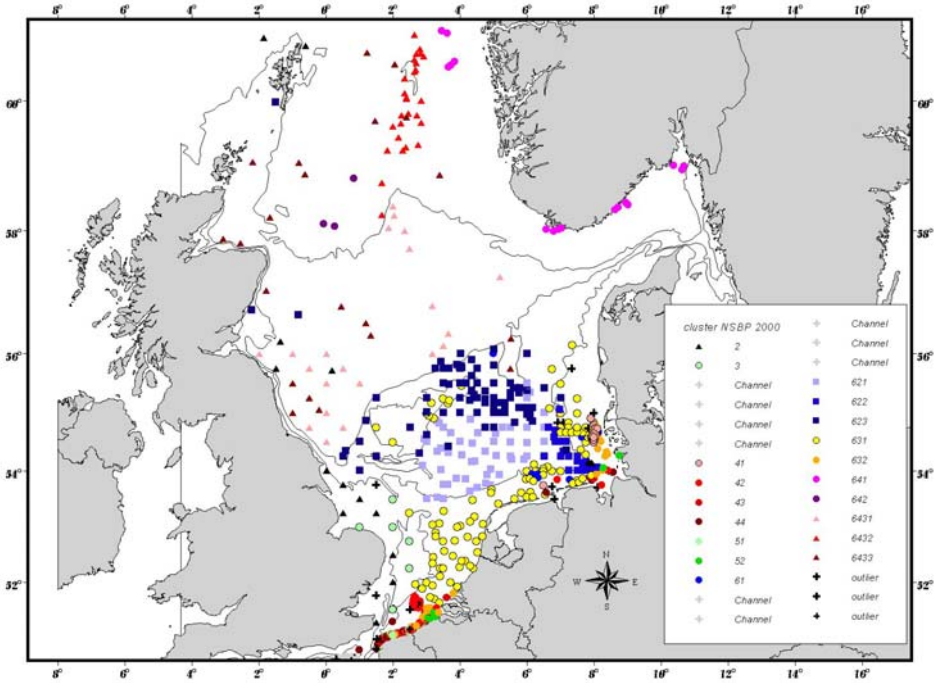

Figure 14.6.2: Main clusters in 2000.

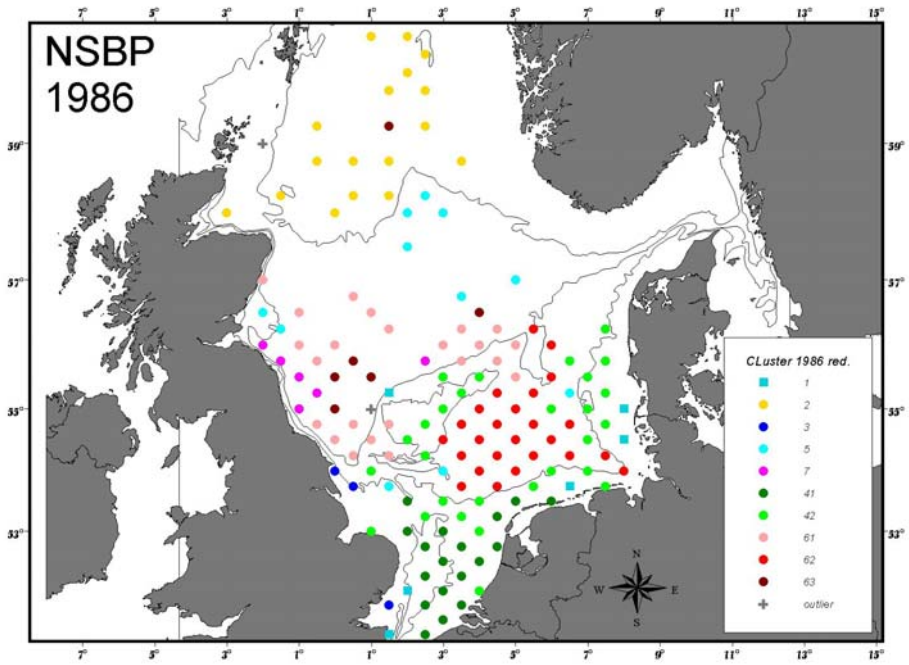

Figure 14.6.3: Reduced dataset (1986).

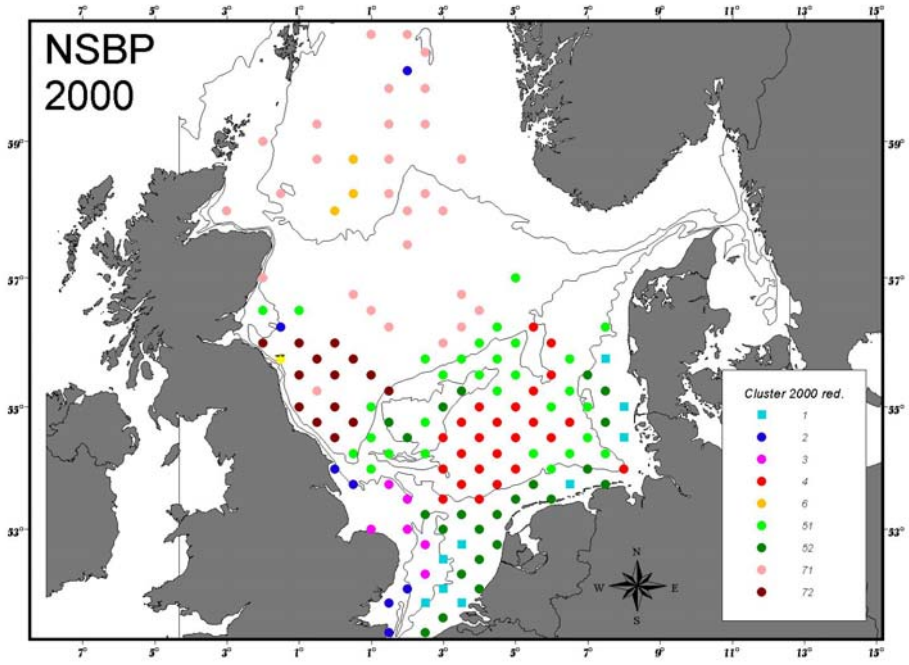

Figure 14.6.4: Reduced dataset (2000).

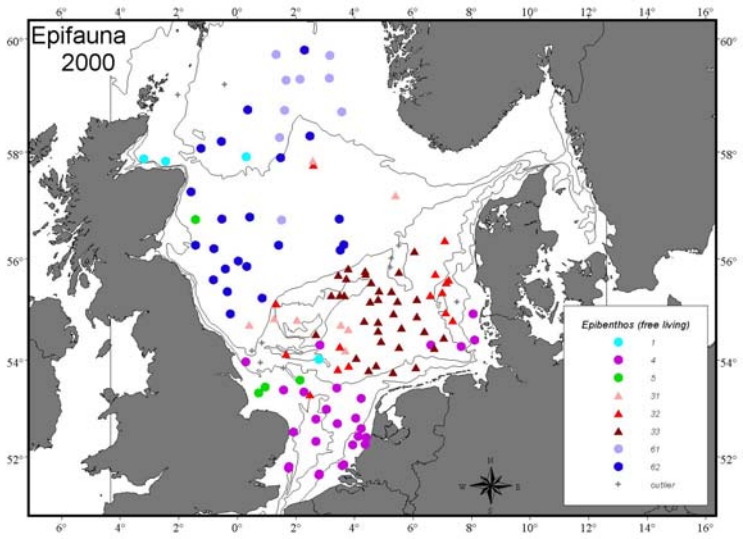

Figure 14.6.5: Epifauna: freeliving.

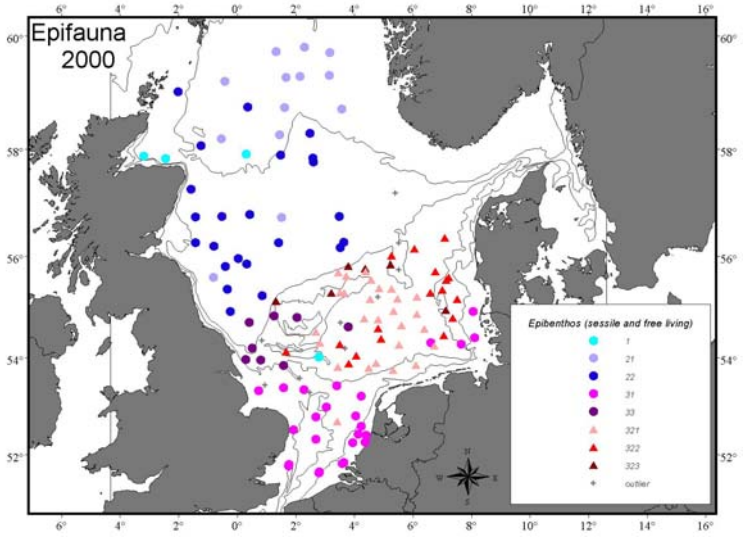

Figure 14.6.6: Epifauna: freeliving and sessile.

14.7 Section 5c. Fishing practices – Johan Craeymeersch

In the North Sea, the national fishing effort statistics based on logbook data are given at a scale of the ICES rectangle (30 by 30 nm). An international database of demersal fishing effort, constructed for the years 1990–1995 by Jennings *et al.* (1999) and updated for 1998 by Callaway *et al.* (2002), is presently updated up to 2002 by partners of the EU-project MAFCONS. The SGNSBP had access to the data at a scale of the ICES rectangle for the years 1997–2002, provided by MAFCONS, for a first analysis of the infauna data of 2000/2001 in relation to fishing effort. At present, not all fleets have been included. It is anticipated that the whole database will become available for further analyses.

Since 2000 EC registered fishing vessels over 24 m have to report their location every 2 hours using the VMS system (European Community Satellite Vessel Monitoring System). Access to the data for scientific research purposes is, however, not always possible. The Dutch fleet data are available for 30% of the fleet, while the German data are available for the whole fleet. Scottish and English fleets are restricted. For other countries (as, e.g., Belgium, Denmark, Norway) it is not known whether there is any access to data. As there is a spatial variation in the benthic composition in at least some ICES rectangles, and fishing within rectangles is not random, it is probably better to analyze the relationship between the benthic fauna and fishing effort using these VMS data. SGNSBP is trying to get these data. At the meeting only the Dutch data were available.

The relationship between fishing effort and infaunal community structure was analyzed by a direct gradient analysis. Environmental variation was partitioned out using depth, sediment characteristics and latitude/longitude as co-variables. At the workshop sediment characteristics were available as sediment types (e.g., mixed sediment, sand and gravel) and, thus, as nominal variables. Sediment grain sizes and data on, e.g., temperature and salinity were not, yet, accessible.

Species density data were square-root transformed. All analyses were done with the CANOCO program of ter Braak (1988).

Sediment type and depth explain a significant part of the total variance in species composition (12.7 % of total variance of species data; $p = 0.005$).

Effort does account for a significant part of the variance ($p = 0.005$; 0.9% of total variance of species data explained). For some species the negative or positive relationships with fishing effort are easily to explain (e.g., lower densities of some bivalves in the most heavily fished areas). But for many species the relationship is hard to explain, and probably not related to fisheries (e.g., lower densities of *Phoronis muelleri* or *Spio martinensis* in heavily fished areas, higher densities of *Upogebia deltaura* at the most heavily fished stations).

The relationship between fishing effort and community structure might, therefore, be largely correlative and not causal. Thus, the data will be analyzed at various levels (community, index functions, species level) using a wide variety of statistical techniques (univariate and multivariate).

15 Additional ideas for ICES/OSPAR (ToR [h])

As with T of R (i) below, more detailed proposals for follow-up work will accompany the intersessional drafting of the Co-op. Res. Rep and associated publications in the coming year.

Ideas discussed at the meeting included the desirability of extending spatial coverage beyond the North Sea, for example, to encompass benthic communities in the Skagerrak/Kattegat and Baltic Sea, along with data from the western Atlantic seaboard. There would also be benefits (e.g., for evaluating the influence of long-term climatic trends) to incorporating earlier histori-

cal data into the NSBP 2000 database. It was noted that these initiatives would be greatly facilitated by establishing closer links with other groups such as the EU MARBEF network of marine institutes. There was significant scope for the employment of North Sea benthos data in innovative modelling of the responses of species and assemblages to a variety of biotic and environmental influences, as well as the incorporation of findings into existing models. Further ideas for exploiting the NSBP 2000 database included the provision of a wider spatial context for the interpretation of smaller-scale benthic surveys, especially those designed to assess human impacts.

For uptake of these and other ideas, the benefits for international regulatory interests such as the EU 'Water Framework' and 'Habitats' Directives, implementation of EcoQOs under OSPAR auspices, and the evolving European Marine Strategy, must be clearly identified. It was proposed that, on completion of current SGNSBP 2000 activities, proposals for additional collaborative work could be developed under the auspices of the ICES BEWG and then conducted under a re-constituted SG with new Terms of Reference.

16 Cost/benefits of a repeat ICES NSBS in 2007–2010 (ToR [i])

A positive view was taken on the prospect of a follow-up survey involving international collaborative effort. Some of these views are summarised at Annex 7. A more detailed rationale for such follow-up work, including timing and resource needs, was required. It was felt that this topic should be addressed in greater detail by the study group when more information from the *Cooperative Research Report* is available. Recommendations would then be drafted for inclusion in this report. Further discussion will therefore take place intersessionally and at the 2006 NSBP 2000 meeting.

17 Future interface between NSBP 2000 and ICES databases (ToR [j])

Edward Vanden Berghe discussed the interfacing between NSBP 2000 and ICES databases with ICES. It was suggested that data contributors would need to agree that data could go to the ICES central database after a moratorium of 10 years from the date of submission to the NSBP 2000 project. This will need to be agreed with all NSBP 2000 data contributors.

18 Joint session with ICES WGECO (sub-group on indicators) (ToR [c])

On 13 and 15 April, sub-groups from WGECO and SGNSBP met for discussion on the topic of benthic indicators and, in particular, the scope for identifying taxa from benthic surveys of the North Sea, which might usefully support the following WGECO T of R:

"In the context of fisheries effects on the ecosystem, continue the identification of fish and invertebrate taxa which are appropriate to use as indicators of habitat quality. Criteria should include those used in past WGECO meetings and adopted by ACE".

SGNSBP had compiled information from North Sea benthos surveys in 1986 and 2000 on the quantitative distribution of some 65 taxa indicative of different assemblages and/or habitat types. The information was derived from a TWINSPAN analysis of each survey and was provided to the WGECO sub-group in order to identify taxa, which might fulfil the above T of R, according to their distributional properties in space and over time. The outcome of this evaluation was discussed at a second joint meeting, where information was exchanged on criteria for determining the indicator utility of a sub-set of species. Both sub-groups emphasised the importance of community-level metrics to accompany any evaluations of changes in qual-

ity status employing individual 'indicator' taxa. The relative utility of various community metrics was the subject of present work under SGNSBP (see above), as well as earlier assessment by the ICES SG on EcoQOs for Sensitive and for Opportunistic Species (see ICES website).

Discussion also took place on draft strategy documents for employment of ecosystem indicators in an ICES/OSPAR/EU context. These were circulated to the SGNSBP sub-group for comment, which were later communicated to WGECO via Dr Piet.

19 Statistical advice from WGSAEM (ToR [a])

It was suggested to highlight the current data analytical activities of SGNSBP 2000 to WGSAEM, and to notify Rob Fryer, Chair of WGSAEM, of any problems encountered intersessionally, if these could not be resolved by in-house statisticians. The topic was further addressed under the auspices of the 2005 meeting of the ICES BEWG, including a proposal for a workshop to deal with statistical aspects of data analysis. This would be very relevant to SGNSBP 2000.

20 Terms of Reference for 2005/2006

The proposed Terms of Reference are given at Annex 8.

21 Actions

Actions arising from the present NSBP 2000 meeting are given at Annex 9.

22 Recommendations to ICES

- SGNSBP 2000 requests ICES support for the publication in 2006 of a *Cooperative Research Report* entitled 'The ICES North Sea Benthos Project 2000'.
- The SGNSBP recommends to organize a theme session entitled 'Structure and dynamics of the North Sea benthos' at the ASC 2007. The session will be chaired by H. Rees, E Vanden Berghe, S. Degraer and H. Rumohr.
- The Theme session shall attract presentations about joint North Sea studies on benthic ecology and related fields (sedimentology, fishery impact, anthropogenic disturbance and others). Also examples of biotope/habitat mapping are welcome. The basis is the 1986 North Sea Benthos Survey of the BEWG and the North Sea Benthos Project 2000 of the SGNSBP, as well as additional studies in the same time frame. Historical comparisons and the search for environmental change will be the main focus of this theme session as well as a look forward and the goals of future studies.

23 Dates/Venues for 2005/2006 intersessional and annual SGNSBP meetings

SGNSBP 2000 proposed to hold an intersessional meeting at VLIZ, Oostende 16–18 November 2005.

SGNSBP 2000 proposed to hold an annual meeting at NIOZ, the Netherlands 10–13 April 2006.

24 Close of meeting

The meeting was closed at 17.00 on Friday, 15 April.

Annex 1: List of participants – SGNSBP

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Annex 2: Draft agenda

ICES Study Group on the North Sea Benthos Project 2000:
Annual Meeting at ICES Headquarters, Copenhagen, 12–15 April 2005

12 April

10.00 – 13.00

- Set-up/data analysis

14.00 – 17.00

- Introduction (H Rees)
- Appointment of Rapporteur
- Election of Chair (2006)
- National/international activities relevant to SG NSBP 2000 (short presentations accepted)
- Outcome of intersessional workshop, November 2004 (T of R [a])
- Overview paper on North Sea benthic communities: actions (E Rachor)
- Status of NSBP 2000 database/website (E Vanden Berghe)
- Status of biomass and environmental data

Identify Sub-Groups* to address:

- Community structure (T of R b): SG 1?
- Species distributions (including opportunistic/sensitive species): T of R [c]): SG 1?
- Community function (T of R b): SG 2?
- Infauna/epifauna/fish interactions (T of R b): SG 2?
- Fisheries impacts (T of R b) SG 3?
- Non-fisheries (including natural) impacts (T of R b): SG 3?
- Biotic/diversity indices (T of R [d]): SG 4?
- Database matters/supporting activity: SG 4?

13 April

09.00 – 17.00

Sub-Group activity and plenary review, including:

- Scope for contributing to North Sea spatial models (T of R [e])
- Products suitable for habitat mapping: nature/availability (T of R [f])
- Draft summaries for Co-op. Res. Rep. (T of R [g])

14 April

09.00 – 17.00

Sub-Group activity and plenary review, including:

- Additional ideas for ICES/OSPAR, e.g., testing of EcoQOs (T of R [h])
- Cost/benefits of a repeat ICES NSBS in 2007 – 2010 (T of R [i])
- Future interface between NSBP 2000 and ICES databases (T of R [j])

15.30 – 17.00 Joint session with ICES WGECO (sub-group on indicators).

15 April

09.00 – 16.00

Sub-Group activity and plenary review, including:

- Statistical advice from WGSAEM (T of R [a])
- Agree T of R and Actions: 2005/6
- Agree report of meeting
- Dates/venues for 2005/6 intersessional and annual SGNSBP 2000 meetings
- Close of meeting

*Sub-Group objectives: data analysis and drafting of text (papers/Co-op. Res. Rep.). Clearly, some products will cut across SG activity.

Annex 3: Summary of short presentations

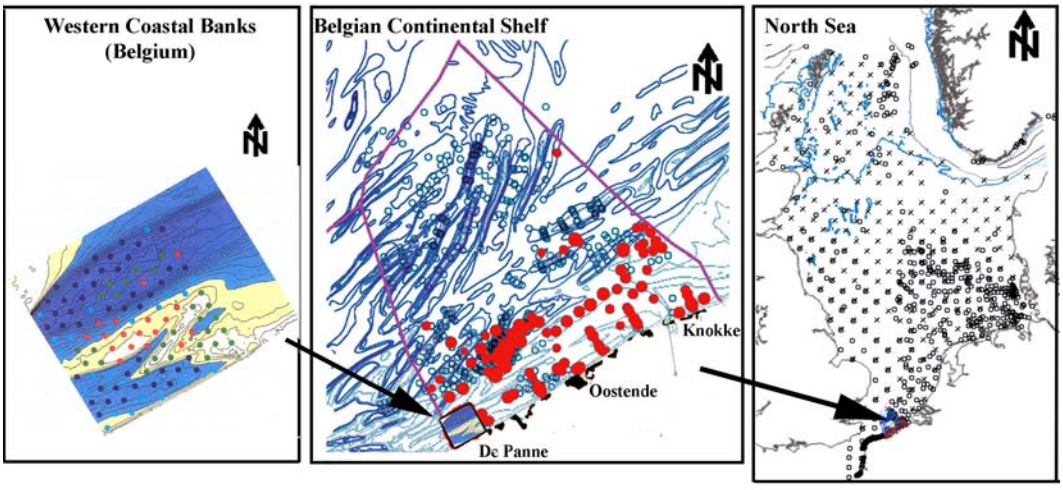
Presentation 1.

Habitat suitability models for the analysis and prediction of the macrobenthos in the North Sea – PhD-research (Wouter Willems)

The occurrence of macrobenthic species is strongly linked with the physico-chemical environmental variables. Macrobenthos grab sampling is very time consuming and consists of only point observations, while environmental variables are often sampled at a higher resolution. When the relationship between environmental variables and the occurrence of macrobenthos species will be modelled, it will be possible to predict the occurrence of macrobenthos from only environmental variables. The developed models can be regarded as habitat suitability models: the models will tell if the habitat is suitable for the species.

Goals of this research are: 1) thorough prediction of macrobenthic species in places were no biological data are available, 2) identify variables which determine the spatial distribution of macrobenthic species, 3) later stage: full coverage species distribution maps, 4) develop a modelling methodology which can be applied to a series of species and in other studies.

To develop the models, three inclusive datasets with increasing spatial scale and decreasing resolution will be used (see figure): two datasets on the Belgian continental shelf and the NSBS-data.



In order to search the best performing modelling technique, two data driven techniques will be compared: regression and Artificial Neural Networks (ANN). Regression is already commonly used in habitat suitability models (e.g., Brinkman *et al.*, 2002; Ysebaert *et al.*, 2002), while ANN are believed to handle complex and non-linear ecological patterns better.

Presentation 2.

The importance of *Lanice conchilega* in subtidal soft-bottom sediments (Gert Van Hoey)

The aim of this study is to find a relationship between the occurrence of *Lanice conchilega* and the occurrence and abundance of other species and the diversity in subtidal soft-bottom sediments. The analyses are based on the NSBP 2000 dataset. The samples in this dataset are taken by three sampling strategies: Hamon grab (0.1 or 0.2 (Newell), 0.25 m² (Dewarumez, Desroy)), Van Veen/Day grab (0.1 m² (Degraer, Hillewaert, Nehring, Rumohr, Rachor, Van Dalfsen, Rees, Cochrane, Oug)) or Box corer ((0.068 (Duineveld) or 0.25 m² (Robertson)). For the analysis on the importance of *Lanice conchilega*, the samples with a sampling surface of 0,1m² are selected.

Lanice conchilega is characterised by a wide distribution in the North Sea and occurs in different sediment types (mud, muddy sand, fine sand, coarse sand, sand and gravel, gravel, stones and mixed type). It has the highest occurrence and abundance in muddy sand and fine sand. It is also found in mud, coarse sand and mixed type, but in lower abundance. It is seldom found in gravel and stones and has a low occurrence in sand and gravel. The effect of *Lanice conchilega* on the community characteristics differs from the sediment type, where it occurs. The abundance of the other species increases with increasing abundance of *Lanice conchilega* in mud, muddy sand, fine sand, coarse sand, mixed sediments. Species richness (individuals/0.1m²) increases in muddy sand, fine sand, coarse sand and not in the others. The diversity, calculated by Hill indices, is only correlated with the abundance of *Lanice conchilega* in fine sand.

These results will be refined by incorporating more detailed sediment calculations or using the community classification. But this dataset contains enough information to make conclusions on the effect *Lanice conchilega* has on its surroundings.

Presentation 3.

Benthic Ecology of the Western North Sea (Jackie Eggleton and Hubert Rees)

Aim: to provide a strategic evaluation of the status of the benthic communities of the western North Sea in relation to natural and anthropogenic influences.

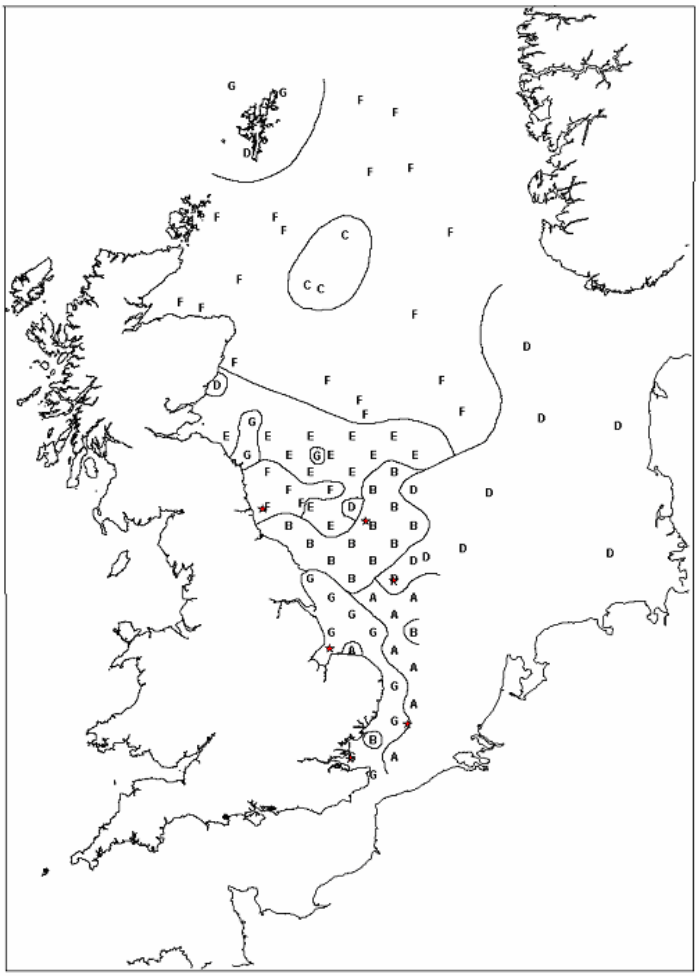


Figure A3.1: Location of samples collected in 2000 with contouring based on PRIMER cluster analysis.

PRIMER Cluster analysis of the western North Sea species abundance data indicated the following species assemblages:

In the southern North Sea there were 2 major clusters consisting of offshore impoverished clean sands (A) and inshore species rich gravels (G). Cluster G was also subdivided into northern and southern assemblages.

The central North Sea was characterised by a high abundance of *Spiophanes bombyx* and other species indicative of sandy substratum such as *Scoloplos armiger*, *Amphiura filiformis* and *Bathyporeia elegans*.

The Northern North Sea was dominated by two clusters dominated by several species of tube-dwelling polychaetes. Cluster C coincided with deep water (134–146 m) in the vicinity of the Fladden Ground with a high % silt/clay content. Characterising species included *Paramphinome jeffreysii*.

When compared with clusters based on the 1986 species abundances, similar clustering was apparent in the two surveys.

Summary of Conclusions:

1. There is no evidence of major structural change in the benthic communities of the western North Sea between 1986 and 2000.

2. Spatial variations in the numbers of species and densities of the benthic macrofauna in both surveys are mainly accounted for by a trend towards increasingly fine substrata, increasing water depths and reduced tidal current strengths from south to north. Species-rich assemblages associated with gravelly substrata along parts of the southern English coast provide a notable exception to this general trend. Other environmental factors associated with this latitudinal gradient may be important, but are difficult to isolate due to confounding influences.

3. A comparison between the biomass of the major groups in 1986 and 2000 was problematic due to methodological constraints. However, there was evidence of reduced values (and occurrences) of echinoderms from areas off the Norfolk coast, although the cause of this is uncertain.

4. The absence of any 'footprint' associated with oil and gas installations (the most widely distributed anthropogenic activity, other than demersal fishing) adds weight to the view that adverse effects on the benthic macrofauna remain very localised in extent. It follows that, similarly, there is no evidence of large-scale cumulative consequences arising from oil and gas exploitation, or from the activities of aggregate extraction and dredged material disposal (at least offshore). The inclusion of site-specific biological and chemical survey data from the NMMP and FEPA programmes to assess, respectively, the representativeness of stations and the influence of spatial scale on evaluations of anthropogenic impacts have provided useful insights into scale-related perceptions of the "significance" of local activities and will be the subject of further analyses.

5. The distribution of commercial beam trawling effort is confounded with latitude, and hence with natural environmental factors such as substratum type and depth, as well as with trends in the benthic macrofauna. There is no evidence of any causal relationship between the distribution of benthic assemblages in the western North Sea and this activity, although more subtle effects cannot be dismissed. As with other human impacts and activities, more localised effects arising from intensive fishing activity could not be resolved by the present relatively coarse sampling grid.

Annex 4: Outcome of intersessional workshop November 2004

ICES Study Group on the North Sea Benthos Project 2000

Intersessional Workshop: Cefas, Burnham-on-Crouch, U.K., 3-5 NOVEMBER 2004

Present:

H Rees (Chair)

R Smith (Rapporteur)

J Eggleton

Edward Vanden Berghe

Johan Craeymeersch

Eike Rachor

Gert Van Hoey

Hans Hillewaert

Marc Lavaleye

Henning Reiss

Apologies:

Heye Rumohr

Ingrid Kroncke

Steven Degraer

Gerard Duineveld

1. INTRODUCTION

Hubert Rees welcomed participants to the meeting (see Appendix 1). The meeting commenced on the morning of the 3rd November with agreement on the Agenda (Appendix 2). Rebecca Smith was appointed as Rapporteur. The Terms of Reference for 2004/5 activities of the SGNSBP 2000 (Appendix 3) and Action List arising from the SG NSBP 2000 meeting in Wilhelmshaven in March 2004 (Appendix 4) were reviewed. (***NB.*** **Note the change of meeting date to 12 – 15 April for the 2005 NSBP 2000 annual meeting in Copenhagen**).

2. PRELIMINARY ACTIVITIES

2.1. The following actions were highlighted for special attention at the workshop:

i. Eike Rachor's overview paper required further work, partly to account for the findings from the present workshop. He agreed to produce a revised draft by the end of January 2005 for review by others.

ii. Biomass: the data were presently in various forms, ranging from weights at the level of individual species to those at the level of higher taxa. Inter-laboratory variability in methodology was such that the 'quality' and hence utility of the data was still uncertain. It was agreed that Rebecca Smith, Edward Van Den Berg and Johan Craeymeersch would review the available data and decide how to proceed.

iii. Taxonomy: minor additional changes were necessary, following the 2004 SG NSBP 2000 meeting in March 2004. These were made at the beginning of the workshop (e.g., species within the genus *Ophelia* were pooled due to inconsistencies in identification between countries), prior to data analyses.

2.2 The following topics were identified for attention by sub-groups at the workshop:

i. Assessment of sediment data (Hans Hillaewert, Eike Rachor)

ii. Comparison of 1986 and 2000 biological data using multivariate techniques (Henning Reiss, Johan Craeymeersch)

iii. Comparison of endobenthos vs. epibenthos (Henning Reiss)

iv. Feeding types (Johan Craeymeersch, Marc Lavaleye)

v. Changes in species distributions between 1986 and 2000 (Rebecca Smith, Jackie Eggleton)

vi. Univariate measures of diversity (Gert Van Hoey)

vii. SG NSBP 2000 text for VLIZ website (Hubert Rees, Edward Vanden Berghe)

A report to accompany data analyses by each sub-group is provided below and will contribute to the overview paper in preparation by Eike Rachor.

3. REPORTS OF SUB-GROUPS

3.1 Assessment of sediment data (Hans Hillaewert, Eike Rachor)

Datasets were not complete and additional data was requested from data providers during the meeting. All sediment datasets will be collated into a uniform database and should contain **at least** percentages for mud content (grain size <= 63µ), sand (grain size between 63µ and 2000µ), gravel (grain size > 2000µ), median grain size and sediment sorting coefficient. For that purpose data providers should ideally submit granulometric data as fractions. Further environmental data can be obtained from the HAMSOM model (Hamburg Shelf Ocean Model) *via* two possible providers (Senckenberg and NIOZ). These parameters involve shear stress, carbon flux, water temperature, stratification, salinity and benthic oxygen consumption. A complete dataset should be available by the end of 2004 and will be distributed to the partners via the NSBP website.

3.2 Comparison of 1986 and 2000 biological data using multivariate techniques (Henning Reiss, Johan Craeymeersch)

For the comparison of the NSBP endobenthos data of 1986 and 2000 two approaches were proposed. In order to get an indication of the large-scale differences/similarities between both periods, the multivariate analyses should be based on a) the total dataset including all stations sampled in 2000 and b) a reduced data set including only stations of the 2000 dataset, which are situated in the vicinity of the stations sampled in 1986. In case of a) the results of a separate analyses of both datasets (1986 and 2000) can be only compared qualitatively to reveal general differences in the benthic patterns. In case of b) both datasets can be compared directly to detect significant differences in the benthic patterns (RELATE model in the PRIMER package).

The analyses were carried out using cluster analysis (Bray-Curtis similarity, group average linkage) in the PRIMER package with fourth root transformed abundance data.

a) Figures 1 and 2 (Appendix 5) show the results revealed with whole datasets of 1986 and 2000, respectively. The reanalysis of the 2000 data show that the main clusters were rather similar to previous analysis with PC-ORD (see ICES SG NSBP 2000 report for 2004), but the accuracy of the clusters and especially subclusters could be improved. Details of the communities can be found in the draft manuscript of Rachor *et al*. The clusters revealed with the dataset of 1986 show similar results to 2000 data and to previous analysis with Twinspan by Künitzer *et al.* (1992) at least for the main clusters (Figure 1: Appendix 5).

By comparing the clusters of both periods, differences between 1986 and 2000 were found for the northern part of the North Sea, the southwestern part of the English coast and parts of the German Bight-Oyster Ground area. For example, in 1986 a clear separation between areas of 100-200 m and < 100 m water depth was found, whereas in 2000 this separation was not as conspicuous.

b) Figures 3 and 4 (Appendix 5) show the results of the cluster analyses based on the reduced datasets. In total 146 stations were analysed and compared. The comparison of the similarity matrices of 1986 and 2000 data with the RELATE model of Primer revealed no significant similarity between both periods ($R=0.011$; $p > 0.5$).

The comparison of the clusters in Figure 3 and 4 (Appendix 5) indicate differences between 1986 and 2000 in several parts of the southern North Sea, such as the north eastern part of the Dogger Bank, the southern German Bight and the south eastern part of the English coast. The differences between 1986 and 2000 in the northern parts of the North Sea, already mentioned above (a), was also apparent in the reduced datasets. Whether this distinction is caused by methodical differences within the dataset of 1986, where a 0.5 mm sieve was used in areas > 100m only, or by 'real' differences have still to be tested.

In order to get an indication of the relative importance of spatial differences between the stations and of temporal differences between both periods, an additional cluster analysis was carried out, where both (reduced) datasets were compiled. Of the 146 directly comparable samples from 1986 and 2000, 57 (39 %) are placed in the same clusters. The remaining 89 samples from each year were placed in different clusters. Three of seven clusters contained only samples of one period (1986 or 2000) indicating major differences between both periods. Nevertheless, since this analysis has only a preliminary status, further detailed analyses will focus on these differences and will be included in the manuscript of Kröncke *et al.* and partly of Rachor *et al*.

3.3 Comparison of endobenthos *vs*. epibenthos (Henning Reiss)

For the comparison of epibenthic and endobenthic community structures, data were compiled and prepared for analyses. The epibenthos data were gathered in 1999 and 2000 during the EU-project 'Monitoring Biodiversity of Epibenthos and Demersal Fish in the North Sea and Skagerrak' and are available for the NSBP. The locations of the stations are shown in Figure 1 (Appendix 6). For the comparison of epi- and endobenthos mainly samples from 2000 will be used. Furthermore, the comparative assessment is proposed to include also the demersal fish fauna by using IBTS data of 2000.

The epibenthos data will be integrated in the NSBP database. The accessibility of these data will be restricted for NSBP internal purposes until the whole database is released for public use.

3.4 Feeding types (Johan Craeymeersch, Marc Lavaleye)

Original lists of descriptions of feeding types became available from the following people: J. Craeymeersch (RIVO), G. Duineveld (NIOZ), A. Schroeder (AWI), I. Kröncke (Senckenberg), S. Groenewold (AquaSense/NIOZ), T. Ysebaert (NIOO).

The original descriptions were grouped into the following feeding groups:

feeding-group	description
I	suspension feeding
II	interface feeding, facultative suspension-feeding, surface deposit-feeding
III	subsurface deposit feeding, grazing
IV	omnivore, predator, scavenger
na	not appropriate at this taxonomic level
U	Unknown
VI	parasite

During the workshop differences between contributors in the assignment of particular species to a feeding-group were discussed, and additional information was looked for and checked. For some species, no final assignment could be made. Information on the species' feeding habits should be checked in the literature: *Pisione, Chaetoderma, Aricidea, Nebalia, Atylus, Megaluropus, Aoridae, Thyasira flexuosa, Echinocyamus pusillus* (sub-surface deposit?), *Trachythyone elongata.*

In a next step the information was extrapolated to taxa (restricted to benthic invertebrates incorporated in TISBE) where no direct information on their feeding habit was found. For species where no information was available, the feeding-group was assigned based on other species within the same taxon (genus or family). Feeding information for individual species was not available for all genera. Where available, all species within a genus had the same feeding mode. Within the following families, more then one feeding mode was recorded: Isaeidae, Syllidae, Mysidae, Aoridae, Caprellidae, Lysianassidae, Phoxocephalidae, Opheliidae, Stenothoidae, Dexaminidae, Eusiridae, Sabellidae, Serpulidae, Chaetopteridae, Oedicerotidae, Capitellidae, Montacutidae, Hesionidae, Ophiacanthidae, Aphroditidae, Leuconidae, Lucinidae, Leucothoidae, Echinidae, Orbiniidae, Paraonidae, Melitidae. For 184 families all members apparently have the same feeding mode. For several families, however, no information on the feeding of genera or species was available.

A draft version of the feeding-type compilation will be made available at the NSBP website and made freely available to the scientific community. All users will be asked to send comments and amendments to the NSBP Study Group.

At stations incorporated in the NSBP-database 1677 taxa were recorded. For 278 taxa the feeding mode could not be assigned during the course of the workshop. Many of these taxa (118) are at the family-level or higher and, probably, it is not appropriate to assign a feeding mode.

3.5 Changes in species distributions between 1986 and 2000 (Rebecca Smith, Jackie Eggleton)

A list of approximately sixty species regarded as important in the 1986 and 2000 surveys were collated from the results of multivariate analyses of the 1986 (Kunitzer *et al.,* 1992) and 2000 data. The densities of these species were logged and distributions mapped using the GIS software Mapinfo. Examples are shown in Figures 1-3 (Appendix 8). The aim was to look at whether species distributions have changed between 1986 and 2000. Further work on this topic will be conducted intersessionally.

3.6 Univariate measures of diversity (Gert Van Hoey)

Assessment of available methods

The following univariate indices were included in analysis of the data:

- Abundance
- ES(100)
- Diversity indices (e.g., Shannon-Wiener)
- Taxonomic diversity and distinctness
- Hurlbert index
- AMBI (AZTI Marine Biotic Index)
- BQI (Benthic Quality Index)

An assessment was then made on the ease of calculation for the different indices.

The following are present in the database and are easily calculated:

- Abundance;
- Species richness;
- ES(100);
- Taxonomic diversity/ distinctness (Edward Vanden Berghe has written a small program to calculate these, based on tisbe: see VLIZ website);
- Other Hill indices;
- Hurlbert index.

The following biotic/environmental quality indices require that further information on species tolerances is incorporated into the database:

- AMBI: the currently available (web-based) species list to allow calculation of AMBI has to be compared with the NSBP species list to identify any taxonomic inconsistencies and gaps in information on species tolerances;
- BQI: presently, a list of tolerance levels for 300 species is available; this has to be extended to the whole NSBP dataset, i.e., tolerance levels for each species has to be determined.

Gert Van Hoey will contact the originators of these indices intersessionally to explore the scope for future applications (see below and Action List).

Results of univariate analyses

1) Diversity

Rarefaction analyses have shown increasing trends in the expected number of species per 100 individuals with latitude north of 51° N, while south of 51° sampling methods (Hamon grab) and biogeographical differences (English Channel versus North Sea) “disturb” this general picture (FigureA4.1).

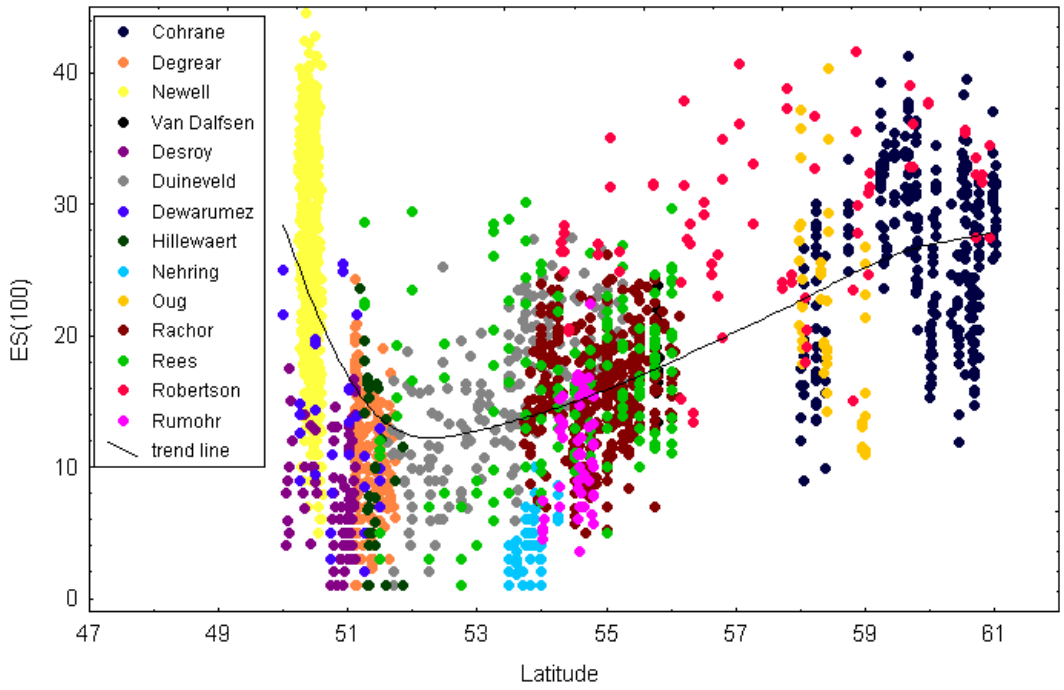


Figure A4.1. ES(100) against latitude

The strong latitudinal gradient within the macrobenthos does not necessarily indicate a causal relationship between the macrobenthos and latitude. Other environmental variables that are likely to have a causal relationship with the macrobenthic distribution are known to be correlated with latitude. Unfortunately, at this moment, information on the major part of these ecologically relevant variables is largely missing. As an example, the latitudinal depth gradient has to be considered (Spearman rank correlation between latitude and depth: p=0.00). There is an increase in diversity towards the 100-metre depth line (Figure A4.2). But it should be noted that the data of the English Channel (Newell), which is characterized by high diversity, is not yet included in this picture.

Nevertheless, latitude can serve as a proxy for several existing ecological gradients throughout the North Sea.

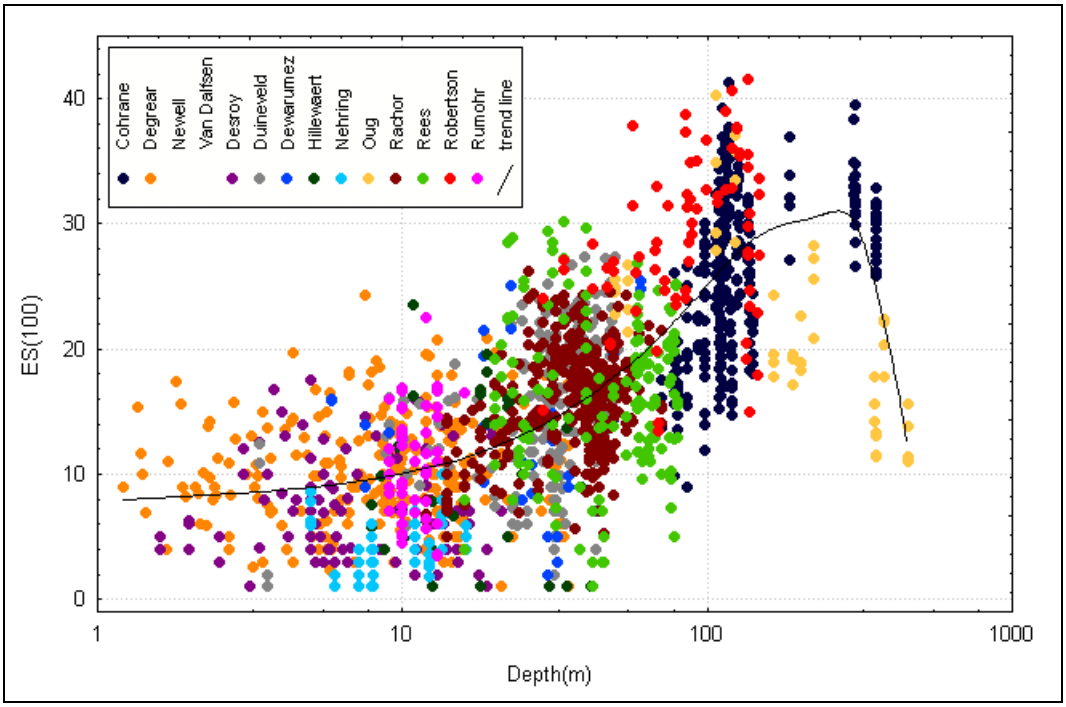


Figure A4.2: ES(100) against depth (log transformed).

2) Abundance

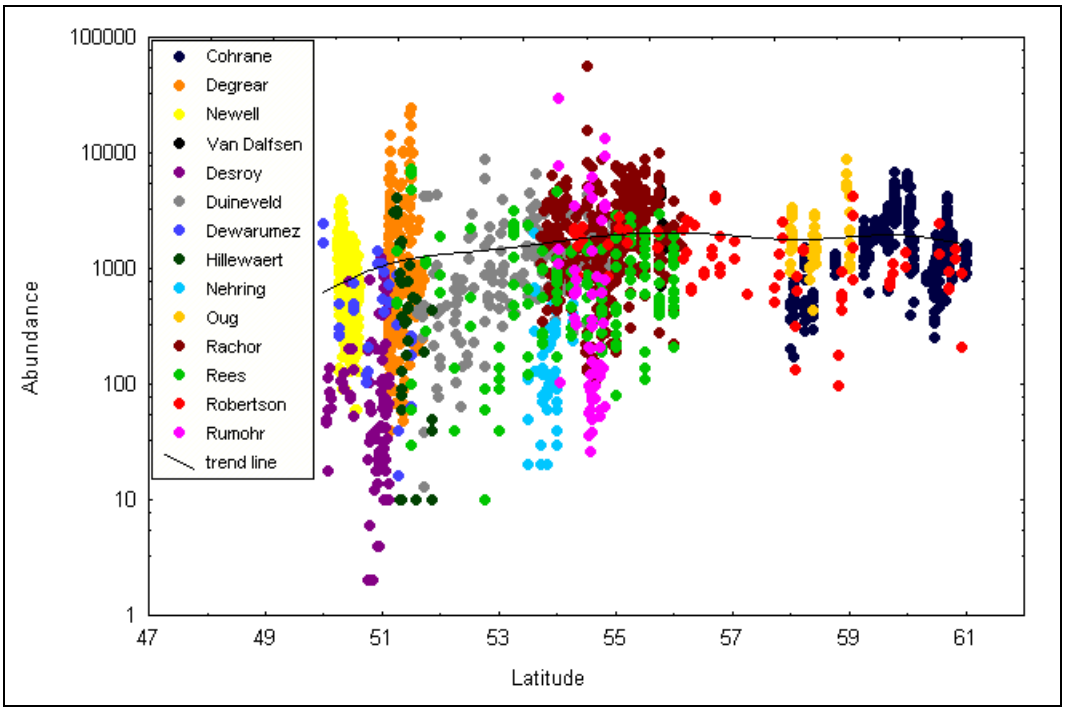
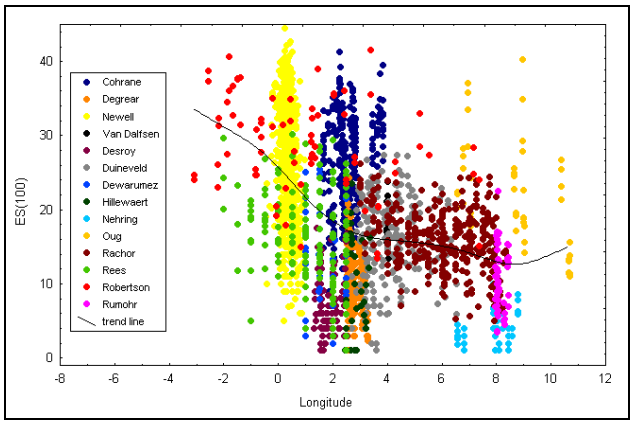


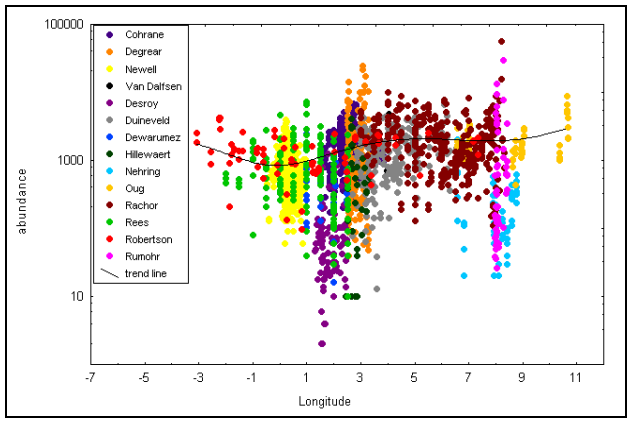
Figure A4.3: Abundance (log transformed) against latitude

There is no obvious general latitudinal trend in abundance. Lowest and highest abundance (respectively 2 and 26000 ind/m²) were found South of 52°N. North of 52°N macrobenthic abundance generally varied between 100 and 10000 ind./m². The possible effect of *Lanice conchilega* on the abundance is separately discussed (see below).

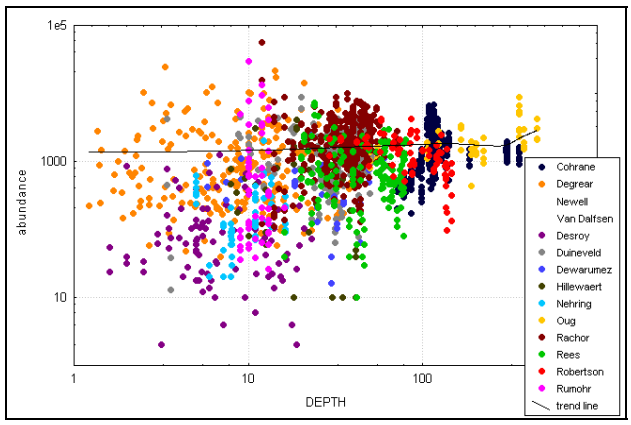
3) Other trends

In this part a summary is given of the distribution of the ES(100) and abundance against longitude and depth. There is no obvious general longitudinal or depth trend in abundance. The expected number of species per 100 individuals decreases towards the east.





ES(100) and abundance against longitude



Abundance against depth

Figure A4.4.

Correlation analyses (Spearman Rank) have been made between latitude, longitude, depth and ES(100) and abundance (N) (Table1) . There is a significant correlation between all these variables and the patterns are shown in Figures A4.1–4. However it is clear from the plots that there is not always a discernible trend (e.g., abundance *vs* depth).

Table A4.1: Spearman Rank correlations for selected variables.

	N	R	t(N-2)	p-level	
LAT & ES_100	2210	,045895	2,158869	0,030968	Figure 1
LAT & N	2210	,383324	19,50182	<0,001	Figure 3
LONG & ES_100	2210	-,420621	-21,7856	<0,001	Figure 4
LONG & N	2210	,216562	10,42348	<0,001	Figure 4
DEPTH & ES_100	1387	,709584	37,47768	<0,001	Figure 2
DEPTH & N	1387	,386530	15,59718	<0,001	Figure 4

4) Relation between sediment categories and ES(100) and abundance

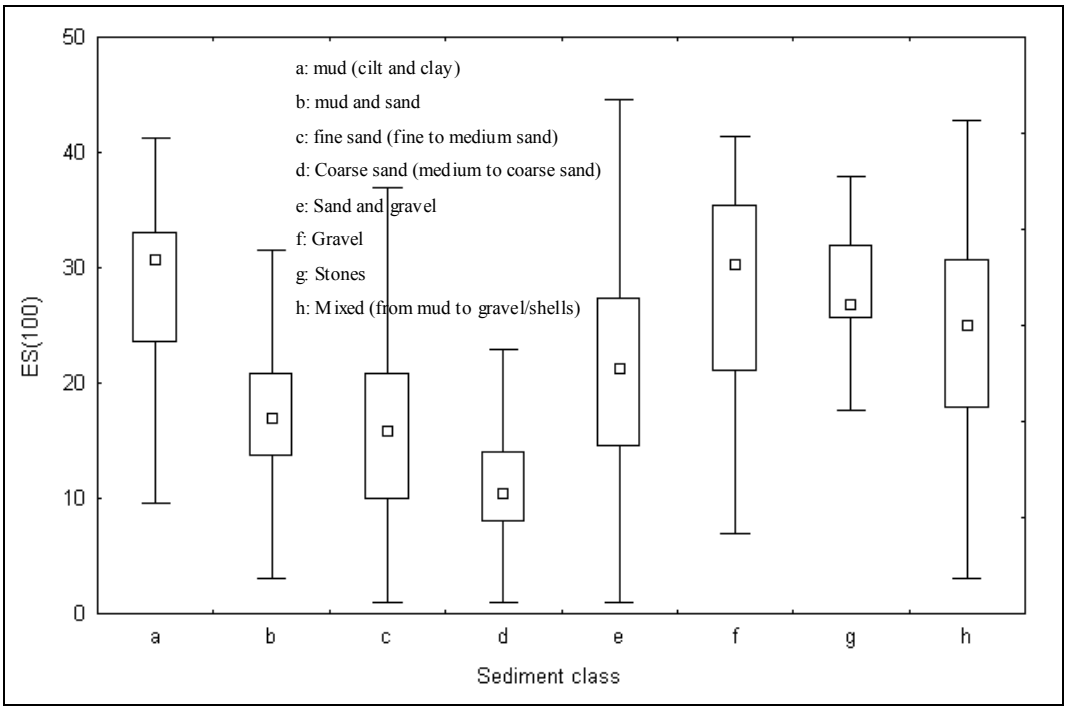


Figure A4.5: Box-whisker plot of ES(100) for each sediment class.

The highest number of species per 100 individuals were associated with sediment categories defined as mud, gravel, stones and mixed habitat (Figure A4.5). The ES(100) values decline from a muddy to a coarse sand habitat (a-d).

Coarse sand, sand and gravel, gravel, and stone habitats were characterised by low abundances (Figure A4.6). The highest abundances can be found in muddy and in mud and sand habitats.

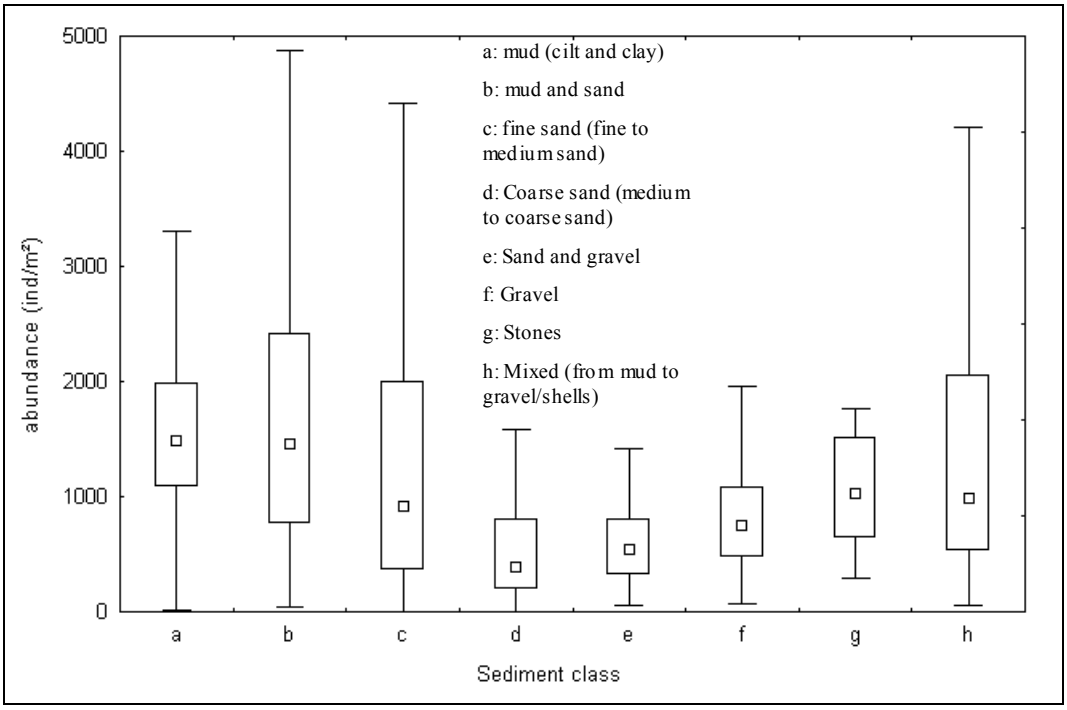


Figure A4.6. Box-whisker plot of abundance for each sediment class.

5) *Lanice conchilega*

Lanice conchilega, which may be regarded as an "environmental engineer" by structuring, aerating and enriching with food particles the bottom substrate of its habitat, support other zoobenthos there. The influence of *Lanice conchilega* on the community characteristics (abundance, diversity and biomass) will be described in more detail in the PhD thesis of Gert Van Hoey for the Belgian Continental Shelf. The scope of this study would be usefully extended by incorporating relevant data from the NSBP 2000 survey (see 4.3, below). The results will be reported to the ICES SG NSBP 2000.

A preliminary assessment shows that:

- *Lanice conchilega* occur only in samples that are characterized by mud, mud and sand, fine sand, coarse sand and mixed sediments. But it is found most frequently and in highest abundance in muddy sand to medium sands.
- *Lanice conchilega* occurs also in the deep offshore sediments (in low abundance), which are characterized by a high diversity. This is not caused by the occurrence of *Lanice conchilega* (see later).
- Only samples taken with a Van Veen grab or Day grab were considered, because they have the same sampling size, and were collected from softer sediments. Other sampling devices/locations need to be analyzed separately, as they may reveal different trends.
- Figure 7 shows only the result from the effect of *Lanice conchilega* on other benthos in muddy sand to medium sandy environments (Sediment categories B and C). The other environments have to be separately analyzed. The abundance of other benthos increases with increasing abundance of *Lanice conchilega* and the diversity follows the same pattern. However, at very high abundances of *Lanice conchilega* (> 1000 ind./m²) the diversity decreases.
- More detailed analyses will be done to support these preliminary observations.

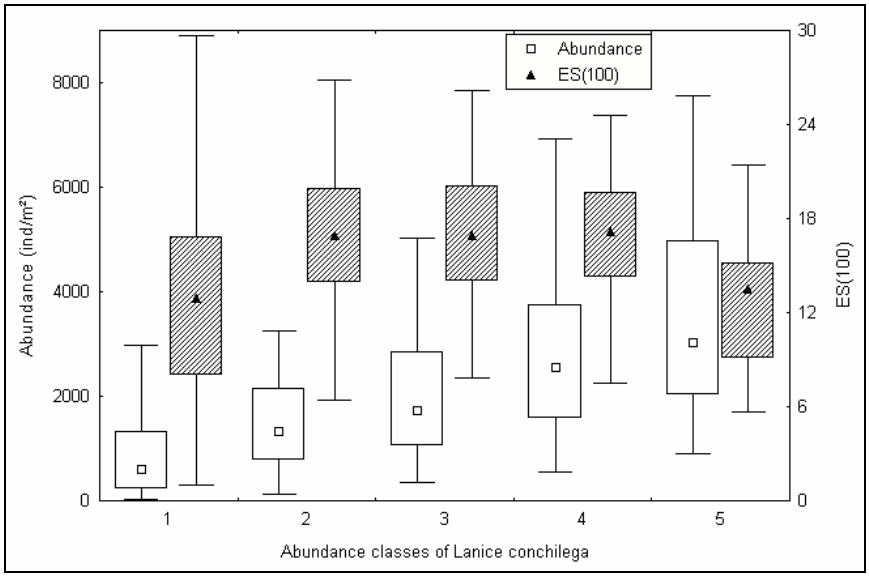


Figure A4.7: Box-whisker plot of abundance and ES(100) for each abundance class of *Lanice conchilega* (1: 0 ind/m²; 2: 0-10 ind/m²; 3: 10-100 ind/m²; 4 :100-1000 ind/m²; 5: > 1000 ind/m²)

6) Environmental/Biotic Quality Indices

Two recently developed indices were selected, namely the AMBI (Angel Borja) and the BQI (Swedish index: Mats Blomqvist). It will be useful to test the utility of such indices over the large geographical range of the NSBP 2000 survey. The originators were contacted during the Workshop, and they indicated that they would be happy to offer technical support. Gert Van Hoey will pursue this objective intersessionally with a view to making further progress at the 2005 meeting of the SG NSBP 2000.

3.7 ICES SG NSBP 2000 text for VLIZ website (Hubert Rees, Edward Vanden Berghe)

Hubert Rees produced draft text for the introduction to the ICES NSBP 2000 website. This was agreed by the Workshop participants and will be added to the VLIZ website by Edward Vanden Berghe.

4. OTHER OUTCOMES

4.1 Sediments

It was recommeneded that, once the psa data had been compiled and was consistent, these should be offered to the ICES MHWG to contribute to their pilot project on the production of a habitat map for the North Sea. Hubert Rees would seek the approval of data contributors before further action. If approved, the data would be sent to D Connor (Chair) copied to D Limpenny (MHWG member and sedimentologist, CEFAS, Burnham Laboratory) by end-January 2005.

4.2 Publications and plan for a *Cooperative Research Report*

It was agreed that the proposed topics and leads for papers which appeared in the 2004 ICES NSBP 2000 report were still appropriate. Workshop participants also reviewed the proposal for a *Cooperative Research Report*. In view of the high level of interest in the work of the SG in relation to assessments of the North Sea benthos and wider ecosystem status, it was agreed that a summary of findings would be produced for December 2005 to meet the shorter-term needs of ICES and other international fora. A draft structure with lead authors was prepared and agreed (Appendix 8). Work towards this Report would be conducted at the 2005 SG NSBP 2000 meeting and intersessionally.

4.3 Contribution of NSBP 200 findings to an assessment of Belgian coastal waters

Observations on the role of *Lanice* as a 'sediment/habitat engineer' were relevant to the North Sea 2000 data, and would be reported by Eike Rachor in his paper. However, a more detailed study is in progress in Belgian waters (Gert Van Hoey/Steve Degraer). It was AGREED that relevant observations arising from NSBP 2000 analyses could be used in the Belgian assessment, if accompanied by acknowledgement of the sources.

4.4 Facilitation of 1986/2000 data comparisons

Edward Vanden Berghe produced a short program to permit the selection of stations from the 2000 survey that were closest to the 1986 survey stations. This was necessary to allow more detailed statistical analyses of summary data from the 2 sampling occasions. *Add a table and figure to the report detailing the process.*

4.5 Extension of community-level comparisons to demersal fish

Henning Reiss would pursue the analysis/write-up of a comparative assessment of epifaunal and infaunal communities intersessionally. The source of the former data would be a recently-completed EU Biodiversity project, where data for 1999/2000 had been published and was available. He also proposed to include an examination of the community status of demersal fish using data from the ICES IBTS survey. There are also data available from other sources which can be used. The approach was endorsed by NSBP 2000 Workshop participants. The work would be carried out under the ICES NSBP 2000 umbrella, with links to the ongoing EU MAFCONS project.

5. ACTIONS ARISING FROM NOVEMBER 2004 WORKSHOP

These are given at Appendix 9.

6. CLOSE OF MEETING

The meeting concluded at 15.00 on 5 November. Dr Rees thanked all participants for their constructive and enthusiastic contributions.

Appendix 1: List of participants

NAME	ADDRESS	TELEPHONE	TELEFAX	E-MAIL
Johan Craeymeersch	Netherlands Institute for Fisheries Research (RIVO-CSO) PO Box 77, 4400 AB Yerseke The Netherlands	+31-(0)113 672306	+31-(0)113 573477	johan.craeymeersch@wur.nl
Gert Van Hoey	University of Gent Dept. of Biology Marine Biology Section Krijgslaan 281/S8 B-9000 Gent Belgium	+32-(0)9-2648533	+32-(0)9-26 45 344	G.vanhoey@Ugent.be
Hans Hillewaert	Sea Fisheries Department Ankerstraat 1 B-840000 Ostende Belgium	+32-(0)59-34 22 59	+32-(0)59-33 06 29	H@dvz.be http://www.dvz.be
Rebecca Smith (Rapporteur)	Centre for Environment Fisheries and Aquaculture Science (CEFAS) Burnham Laboratory Remembrance Av. Burnham-on-Crouch Essex CMO 8HA UK	+44 1621 787358	+44 1621 784989	R.Kilbride@cefas.co.uk
Eike Rachor	Alfred-Wegener-Institute for Polar and Marine Research, D-27515 Bremerhaven, Germany	+49-(0)471-48311310	+49-(0)471-48311918	erachor@awi-bremerhaven.de
Hubert Rees (Chair)	Centre for Environment Fisheries and Aquaculture Science (CEFAS) Burnham Laboratory Remembrance Av. Burnham-on-Crouch Essex CMO 8HA UK	+44 1621 787200	+44 1621 784989	h.l.rees@cefas.co.uk
Henning Reiss	Forschungsinstitut Senckenberg Suedstrand 40 D-26382 Wilhelmshaven Germany	+49-(0)4421 9475 267	+49 4421 9475 222	henning.reiss@senckenberg.de
Edward Vanden Berghe	Vlaams Instituut voor de Zee Vismyn Pakhiuzen 45-52 B-8400 Oostende Belgium	+32-(0)59-34 21 30	+32-(0)59-34 21 31	Wardvdb@vliz.be

NAME	ADDRESS	TELEPHONE	TELEFAX	E-MAIL
Jackie Eggleton	Centre for Environment Fisheries and Aquaculture Science (CEFAS) Burnham Laboratory Remembrance Av. Burnham-on-Crouch Essex CMO 8HA UK	+44 1621 787200	+44 1621 784989	J.D.Eggleton@cefas.co.uk
Marc Lavaleye	Netherlands Institute for Sea Research (NIOZ) PO Box 59 1970 AB Den Burg-Texel The Netherlands	+31-(0)222 369520	+31-(0)222 319674	Lava@nioz.nl

Appendix 2: Workshop agenda

ICES SGNSBP 2000: Intersessional Workshop, 3–5 November 2004 (CEFAS Burnham Laboratory, UK).

Wednesday, 3 November

10.00 – 11.00:

- Introduction/Appointment of Rapporteur/set-up
- Review of 2004 SG NSBP 2000 Terms of Reference and Action List
- Summary of current project status:
    i. Status of NSBP biological data/database
    ii. Status of environmental data
    iii. Additional data sources
- Agree plan for Workshop and partitioning of responsibilities (analyses/drafting of text)*

11.30 – 13.00

- Review/resolve any remaining inconsistencies in the NSBP 2000 and NSBS 1986 taxon lists
- Commence data analyses (individuals/sub-groups)

14.00 – 15.30

- Lab welcome/L A Murray
- Progress with overview paper on the NSBP 2000 (Eike Rachor)
- Continue data analyses by sub-group

16.00 – 17.30

- Continue data analyses by sub-group

Thursday, 4 November

09.00 – 10.30

- Conduct further analyses of NSBP 2000 data

11.00 – 11.30

- Review progress against Workshop plan/resolve problems

11.30 – 13.00

- Conduct further analyses of NSBP 2000 data
- In parallel, initiate write-up of findings

14.00 – 15.30

- Continue analyses/drafting of text

16.00 – 17.30

- Continue analyses/drafting of text

Friday, 5 November

09.00 – 09.30

- Review progress against Workshop plan

09.30 – 12.00

- Continue analyses/drafting of text

12.00 – 13.00

- Review/agree Workshop report
- Agree future actions/invitees for April 2005 SG NSBP 2000 meeting (Copenhagen)
- Agree final draft of an overview paper on benthic communities of the North Sea 2000, including comparisons with 1986 NSBS data
- Any other business

14.00 – 15.30

- Complete analyses/refine outputs for reporting purposes
- End of workshop

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*This plan will take account of the need to make progress in the assessment of:

a) fishing activities/impacts

b) natural and human impacts (other than fishing)

c) functional properties – in particular feeding types

d) comparison of epifaunal and infaunal community patterns

e) benthos/habitat linkages

The plan will also require that the following items are addressed during the Workshop, either in combination with the above effort, or separately:

- assess/report on the status of physico-chemical data for sediments sampled as part of the NSBP 2000;
- Initiate work on the distributions of opportunistic/sensitive species and biotic/diversity indices (*NB*. recommendations of the ICES Study Group on Eco-QOs for opportunistic and sensitive species);
- review the suitability of biomass data for North Sea-wide *versus* sectoral appraisal;
- identify/locate additional information sources (data/maps);
- identify specific questions(s) regarding statistical analyses of NSBP 2000 data (e.g., formal tests for similarities in patterns) for consideration by WGSAEM 2005.

Appendix 3: Terms of Reference for SGNSBP 2000 (November 2004 Intersessional Workshop and April 2005 Annual meeting)

2E04 The **ICES Study Group on the North Sea Benthos Project 2000** [SGNSBP] (Chair: H. Rees, UK) will meet at ICES Headquarters, Copenhagen, from 12 - 15 April 2005 to:

a) review the outcome of an intersessional Workshop held at CEFAS Burnham-on-Crouch, UK from 3–5 November 2004 to:

  i) finalise the draft of an overview paper on benthic communities of the North Sea 2000, including comparisons with 1986 NSBS data,

  ii) progress analyses/interpretation of the ICES NSBP 2000 data on the following themes:

    • fishing activities/impacts;

    • natural and human impacts (other than fishing);

    • functional properties – in particular feeding types;

    • comparison of epifaunal and infaunal community patterns;

    • benthos/habitat linkages;

    • NSBP 2000 data management.

  iii) assess/report on the status of physico-chemical data for sediments sampled as part of the NSBP 2000;

  iv) review the suitability of biomass data for North Sea-wide versus sectoral appraisal;

  v) identify/locate additional information sources (data/maps);

  vi) identify specific questions(s) regarding statistical analyses of NSBP 2000 data (e.g., formal tests for similarities in patterns) for consideration by WGSAEM 2005.

b) conduct further analysis of the NSBP 2000 data in relation to fishing activities, natural and other human influences, functional properties and epifaunal/infaunal patterns, and draft texts for publication;

c) report on the distributions of sub-sets of opportunistic and sensitive species identified by the ICES Study Group on EcoQOs for opportunistic and sensitive species, and examine the utility of the recommended metrics;

d) apply biotic/diversity indices to NSBP 2000 data;

e) consider the scope for contributing to North Sea spatial models, through liaison with experts;

f) identify products suitable for habitat mapping;

g) commence preparation of an *ICES Cooperative Research Report* on the ICES NSBP 2000 survey;

h) identify additional analytical/reporting ideas relevant to ICES/OSPAR interests;

i) review the cost/benefits of a repeat ICES North Sea Benthos Survey in 2007–2010;

j) liaise with the ICES Database Manager regarding the future operational interface with the NSBP 2000 database.

SGNSBP will report by 26 April 2005 for the attention of the Marine Habitat, ACME, and ACE Committees.

Supporting Information

Priority:	High (the assessment of benthic biological status in the North Sea is relevant to the ongoing interests of ICES, OSPAR and the EU, particularly with regard to its contribution to the development of an ecosystem-level approach to environmental management).
Scientific Justification and relation to Action Plan	Proposed TOR a)–j) will be met through a combination of Workshop and Plenary activity by Study Group members, as follows: a) a sub-group, representative of the major data contributors will meet intersessionally from 3–5 November 2004 (at CEFAS Burnham, UK) to make further progress with the analyses and write-up of recent North Sea benthos data. This practical (workshop-based) activity is essential to maintain the momentum of the exercise in order to ensure timely outputs; b) progress to date, with particular reference to the outcome of the November 2004 Workshop, will be reviewed by the wider Study Group membership at the April 2004 meeting (Copenhagen), and recommendations will be made for immediate resolution, or later (intersessional) work; c) this work will provide a practical follow-up to the important issue of EcoQO development for benthic species, in response to a recommendation of the Chair of the EcoQO Study Group; d) various derived measures of data structure will be compared to identify their 'indicator' value; the work will also complement ToR c.) above; e) this work is aimed at establishing collaborative links with those engaged in modelling of various elements of the North Sea ecosystem; the NSBP 2000 data may be very valuable in this context; f) this will further the collaborative link with WGMHM; g) as well as the drafting of papers for peer-reviewed publications, it is intended to produce a detailed overall assessment of the ICES NSBP 2000 exercise, including information on future data access, as a complement to the earlier report on the 1986 NSBS; h) this will ensure that important features of the ICES NSBP 2000 database are exploited to the maximum extent possible; i) it is important to take a longer view of the possible strategic value of future comparable exercises in relation to resource needs; j) progress will be sought with respect to the important issues of further database development (including the interface with the ICES Biological Community Database), and univariate and multivariate methodologies for data analyses. The work of this SG contributes to Action Plan Nos. 1.2.1, 1.11, 2.8, and 2.9.
Resource Requirements:	N/A
Participants:	Primarily benthos ecologists participating in the project
Secretariat Facilities:	N/A
Financial:	None
Linkages to Advisory Committees:	ACME, ACE
Linkages to other Committees or Groups:	BEWG, WGECO, WGEXT, WGMHM, WGSAEM, WGMDM, SGQAE Reports to BEWG too.
Linkages to other organizations:	OSPAR, EU
Secretariat Cost Share:	ICES 100 %

Appendix 4: Actions for intersessional activity (ARISING FROM WILHELMSHAVEN MEETING APRIL 2004)

1. **ALL: FURTHER REVIEW DATABASE INTERSESSIONALLY FOR MINOR INCONSISTENCIES;**
2. Edward Vanden Berghe to obtain raw data all data surveys currently aggregated;
3. Edward Vanden Berghe to contact all data contributors for re-submission of biomass data following preparation of a form for biomass data submission;
4. Edward Vanden Berghe to determine statistical relationships between TWINSPAN and PC-ORD outcomes, and between 1996 and 2000 patterns, from chi squared contingency tables;
5. Ingrid Kroncke to liaise with the Institute of Physical Oceanography at Hamburg University in order to identify output from hydrographic models which may be suitable for analysis of relationships with the NSBP 2000 data;
6. Eike Rachor, Ingrid Kroncke and Henning Reiss (and others as necessary) to make further progress on the draft overview paper prior to the Nov 04 meeting;
7. Rebecca Kilbride to contact G Irion regarding raw data on trace contaminants at UK NSBP sites, and any further material for analyses;
8. Hubert Rees to liaise with the chair of WGSAEM regarding future collaboration on analytical issues arising from the NSBP 2000 exercise;
9. Hubert Rees to contact the chair of WGMHM regarding progress with analyses of the NSBP 2000 data and the scope for future interaction;
10. Hubert Rees to report SG progress to the BEWG (April 2004);
11. Edward Vanden Berghe/Rebecca Kilbride to review the status of physico-chemical data for sediments sampled as part of the NSBP 2000;
12. Edward Vanden Berghe to place certain elements of the NSBP 2000 data onto the VLIZ website, including a full species list;
13. Hubert Rees to provide introductory text for the NSBP 2000 web page;
14. Johan Craeymeersch to circulate remaining queries regarding feeding types for benthic species in order to complete the information necessary for application to the NSBP 2000 data by November 2004;
15. ALL – to consider availability of additional data relating to the N Sea for the November 2004 intersessional workshop;
16. Hubert Rees – to further explore sources of contemporary information on non-fisheries human activities and inputs;
17. Ingrid Kroncke – to explore sources of information relating to eutrophication (nutrient, CPR data, ERSEM);
18. Ingrid Kroncke and Eike Rachor – To examine contemporary distributions of species in relation to earlier information on biogeographical preferences;
19. Edward Vanden Berghe/Hubert Rees to compile a list of relevant biodiversity initiatives with a view to development of new projects within and beyond the North Sea;
20. ALL: To provide Ingrid Kroncke with any recent papers/national reports they have on the status of the North Sea to contribute to the overview paper on the NSBP 2000;
21. Steven Degraer – to develop ideas for establishing quantitative links between benthic biota and habitats (“time-and cost- efficient spatial extrapolation”).

Appendix 5

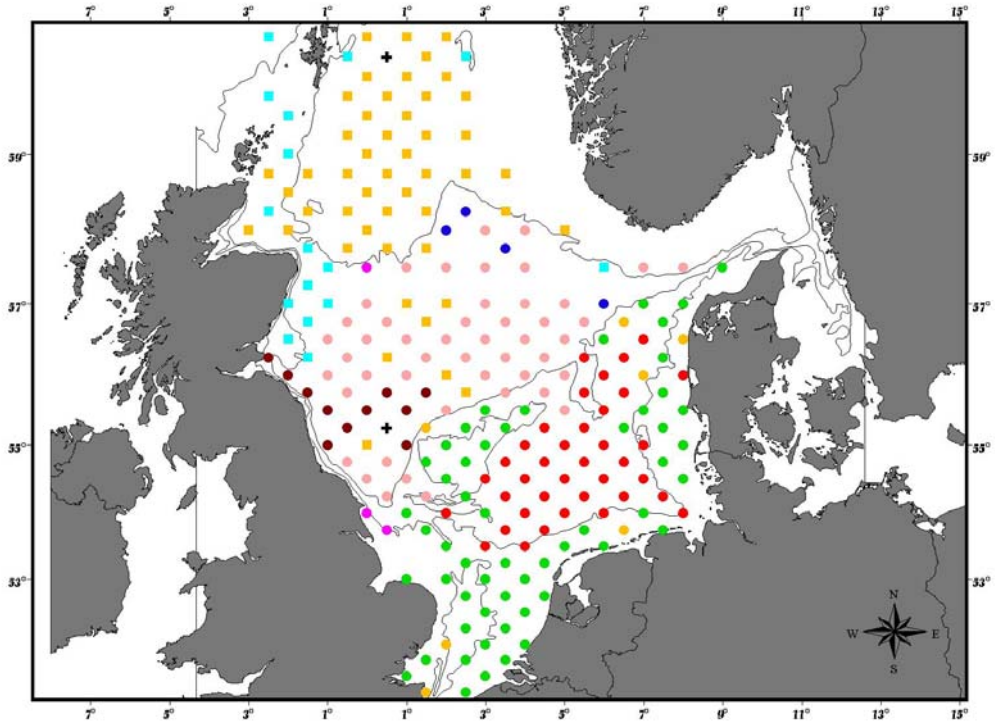

Figure 1. Map showing the clusters generated from the 1986 data using PRIMER (all data analysed)

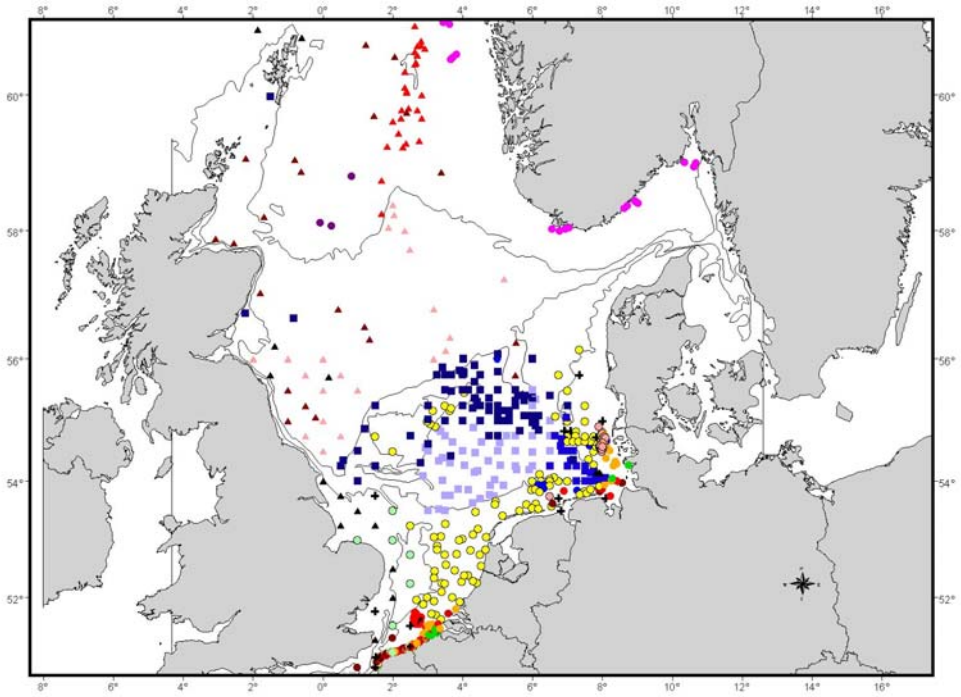

Figure 2. Map showing clusters generated from the 2000 data using PRIMER (all data analysed)

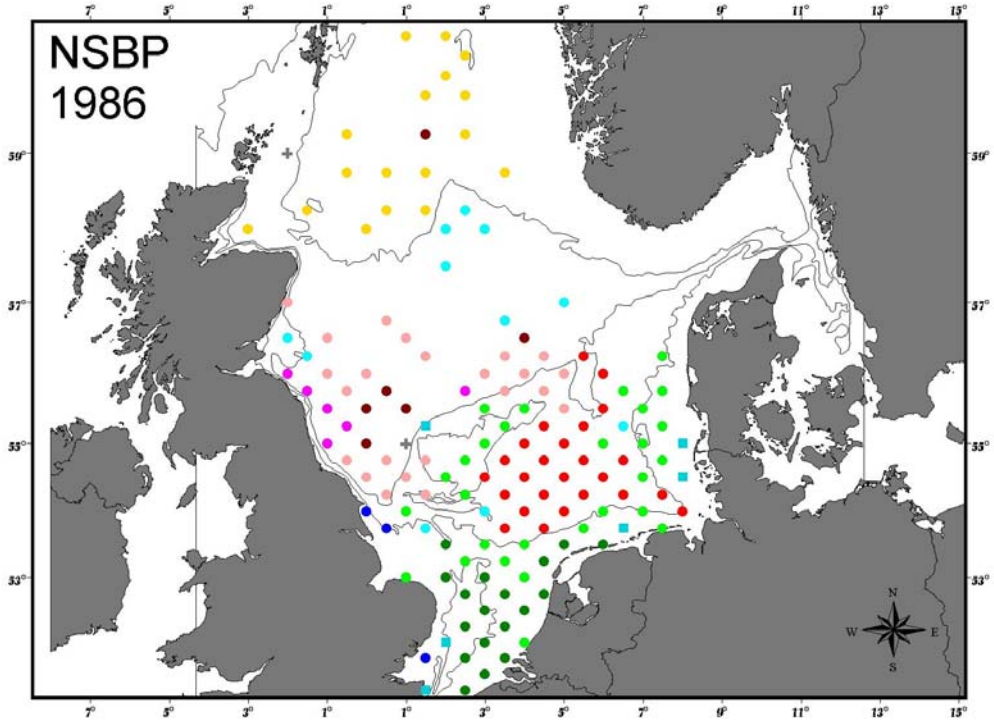

Figure 3. Map showing the locations of clusters generated from a reduced 1986 dataset using PRIMER

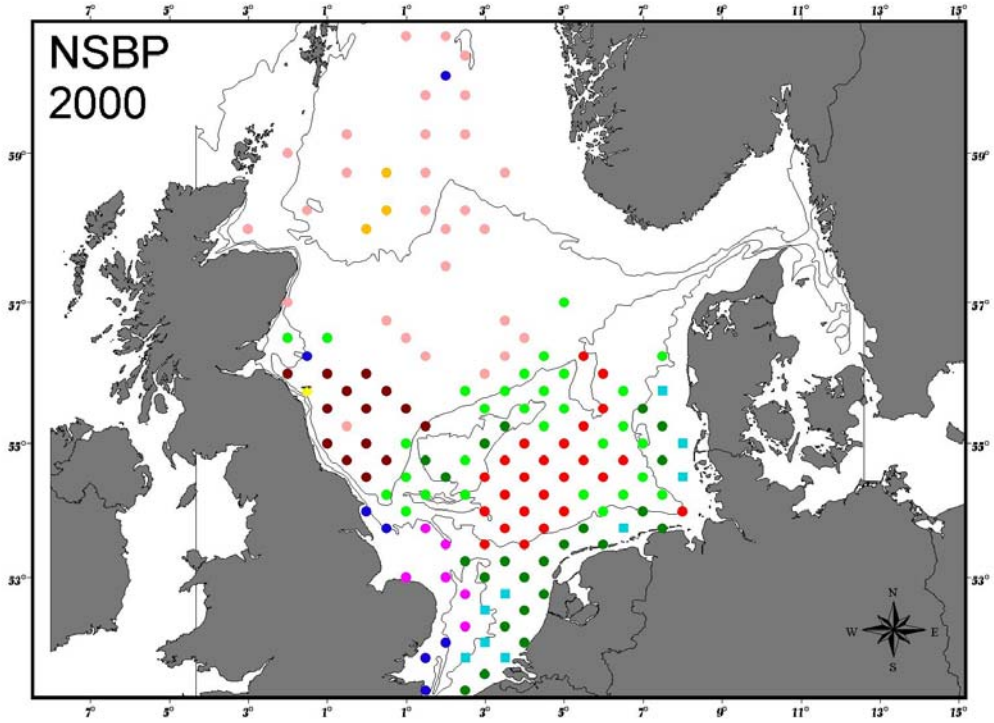

Figure 4. Map showing the locations of clusters generated from a reduced 2000 dataset using PRIMER

Appendix 6

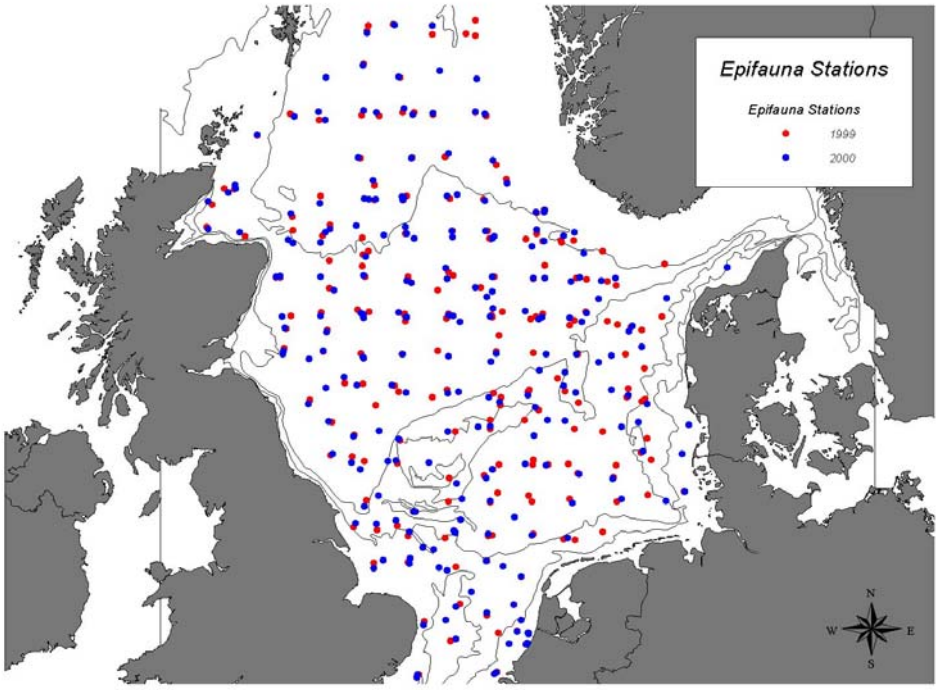

Figure 1. The location of epifauna sampling stations in 1999 and 2000.

Appendix 7.

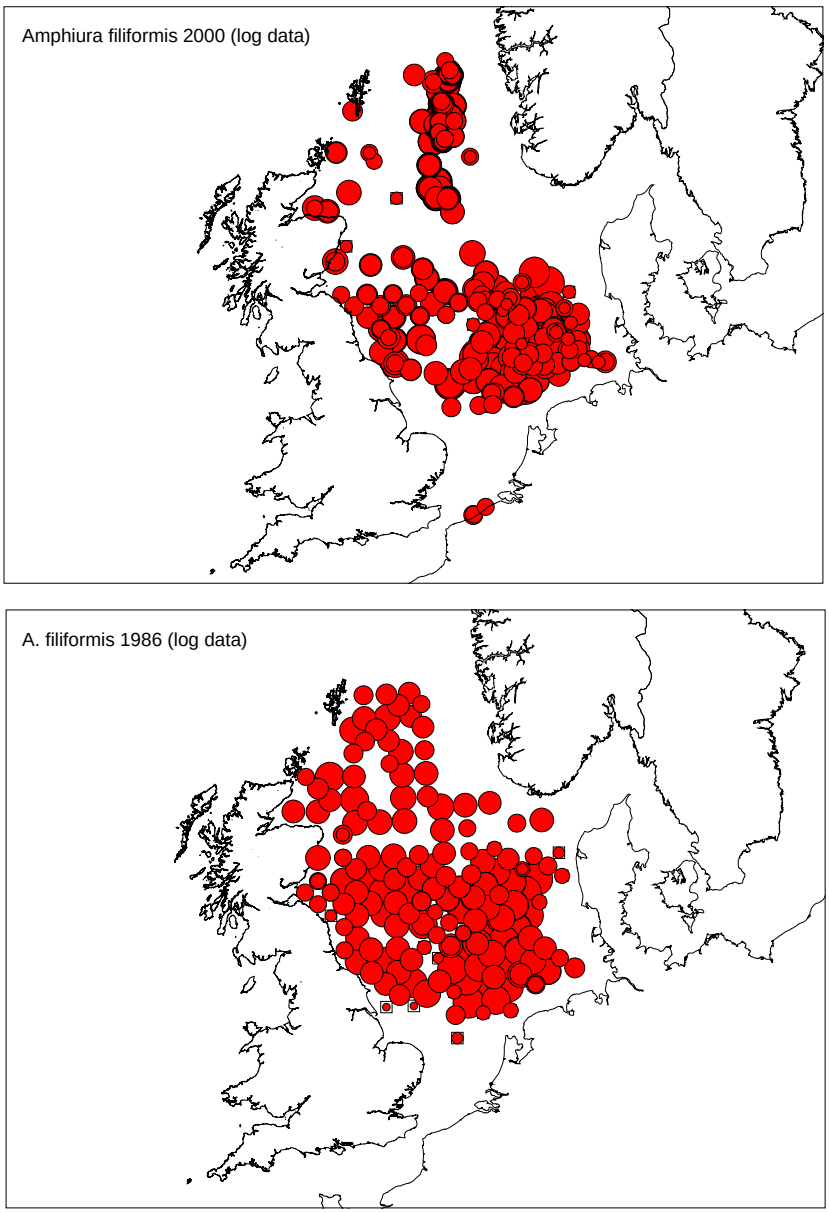

Figure 1. Logged distributions (individuals per m^2) of the echinoderm species *Amphiura filiformis* in 2000 (top) and 1986 (bottom)

Appendix 7 (Cont'd)

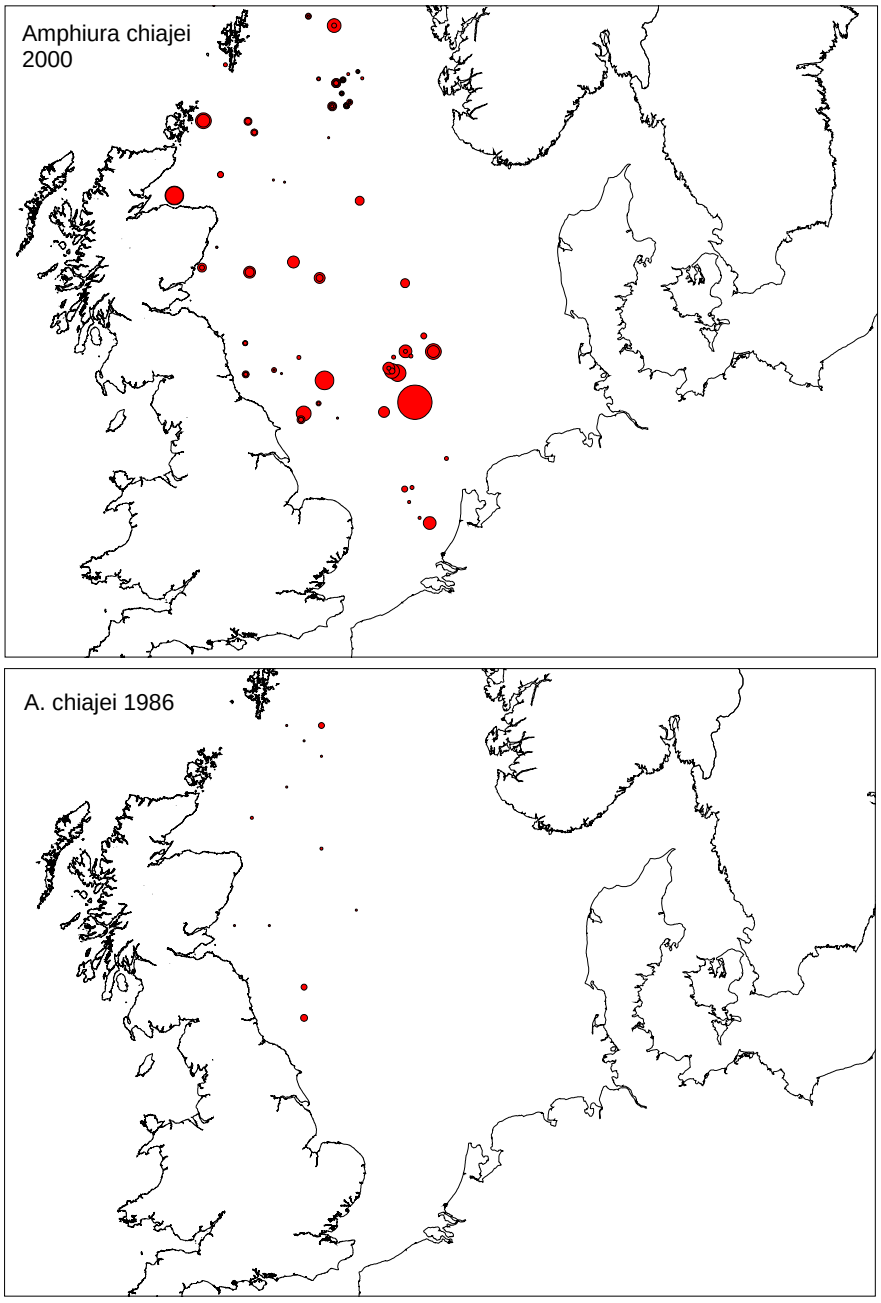

Figure 2. Logged distributions (individuals per m^2) of the echinoderm species *Acrocnida brachiata* in 2000 (top) and 1986 (bottom)

Appendix 7 (Cont'd)

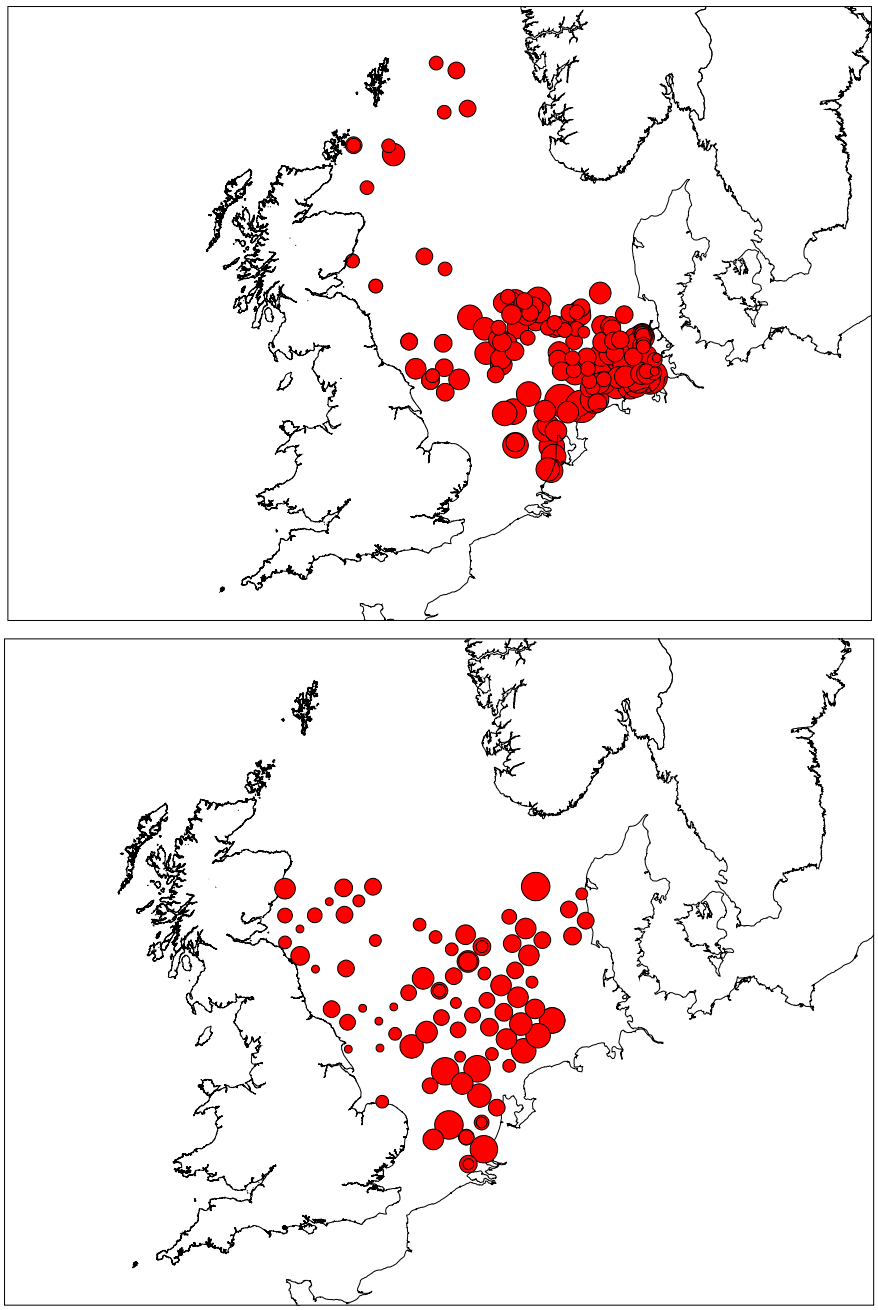

Figure 3. Logged distributions (individuals per m^2) of the bivalve species *Tellimya ferruginosa* in 2000 (top) and 1986 (bottom)

Appendix 8: *ICES Cooperative Research Report* – draft structure

1. Introduction

2. NSBP 2000 Data Management

Authors: Edward Vanden Berghe ….

a. Database structure

b. Species/stations

c. Access

d. etc.

3. SUMMARY OF OUTPUTS

NB. The following are summaries of the main findings so far from topics identified for future peer-reviewed publications. Some of these findings may therefore be amended, and new observations added, in response to the more detailed analyses and interpretations which are still underway.

i. Sediments and contaminants

Authors: Georg Irion …

ii. Community patterns/changes (1986 – 2000)

Authors: Eike Rachor ….

iii. Species distributions/changes (1986 – 2000)

Authors: Rebecca Smith….

iv. Fishing activities/impacts

Authors: Johan Craeymeersch ….

v. Natural *versus* human impacts (other than fishing)

Authors: Ingrid Kroencke ….

vi. Functional properties (including feeding types)

Authors: Gerard Duineveld, Marc Lavaleye ….

vii. Benthos/habitat linkages

Authors: Steven Degraer ….

viii. Links between infaunal, epifaunal and demersal fish distributions

Authors: Henning Reiss….

ix. Biological indicators

Authors: Gerd Van Hoey ….

4. CONCLUSIONS

5. RECOMMENDATIONS

6. ACKNOWLEDGEMENTS

7. REFERENCES

8. ANNEXES…

Appendix 9: Actions arising from the ICES NSBP 2000 Intersessional Workshop, November 2004

1. Rebecca Smith and Jackie Eggleton to plot maps for distributions of selected species which are responsible for differences identified from multivariate analyses and provide these to Eike Rachor for his draft paper.

2. Johan Craeymeersch to complete the feeding-types database and disseminate to interested parties via the NSBP 2000/VLIZ website on the understanding that any amendments and comments (with accompanying literature) are communicated *via* the website.

3. Sediment categories need to be assigned to the 1986 data to allow comparison. *BY whom?*

4. Hans Hillewaert to complete the compilation of PSA datasets from the NSBP 2000 survey and forward to Edward Vanden Berghe by end-December 2004

5. Rebecca Smith and Jackie Eggleton to complete the required species distribution plots and disseminate them to all SG members before the April 2005 SG NSBP 2000 meeting.

6. Edward Vanden Berghe to release the proposed SG NSBP 2000 website in December 2004.

7. Henning Reiss to gather appropriate ERSEM data for February 2005 (before he and Ingrid depart on a 2-month survey at sea).

8. Henning Reiss to speak with Georg Irion regarding progress with trace metals analyses.

9. ??Rebecca Smith to update names and addresses ?of SG members for the November 2004 report and for the Coop. Res. Rep.

10. Gert Van Hoey to contact Angel Borja in order to update the AMBI list

11. Gert Van Hoey to contact Hans Nielsson to explore the scope for utilising the Swedish Benthic Quality Index (BQI)

12. ??Rebecca Smith to forward biomass data for 'Rees' and 'Ro' data contributors to Edward Vanden Berghe.

13. Hubert Rees to contact MES (Prof Newell) re obtaining higher-resolution biomass data

14. Gert Van Hoey to look into the availability of ??biomass data from the Belgian coast (Degraer dataset) at species-level and forward to Edward Vanden Berghe

15. Eike Rachor to look into the availability of ??biomass data from the German Bight at species-level and forward to Edward Vanden Berghe

16. Edward Vanden Berghe, Johan Craeymeersch and Rebecca Smith to decide on the appropriate level of resolution for NSBP 2000 biomass data ??by March 2005

17. All to commence work towards the production of a Coop. Res. Rep. to summarise the main findings of analyses to date (including maps and species lists which would not be appropriate for wider publication). Target date for completion: December 2005.

18. 278 taxa unassigned to feeding groups. Johan Craeymeersh/Edward Vanden Berghe to add the feeding-type list to the website in a format allowing easy updating – version 0.1, by March 2005l. (The information will be included as an excel spreadsheet on the private NSBP 2000 web-pages in the meantime.

19. Edward Vanden Berghe to add all available biomass data to the NSBP 2000 database and ???extrapolate where it is missing

20. Biomass data providers to submit details on methodology to Edward Vanden Berghe by …?

Annex 5: Summary from ICES WGMHM sub-group meeting

Summary from ICES WGMHM North Sea Benthic Habitat Map Sub-group meeting on 6 April 2005

Sub-group members:

Kjell Magnus Nordstrong (NIVA, Norway)

Brian Todd (GSC, Canada)

David Limpenny (CEFAS, UK)

Roger Coggan (CEFAS, UK)

Neil Golding (JNCC, UK)

Kerstin Geitner (DIFRES, Denmark)

Chris Cogan (AWI, Germany)

TOR [b]

Develop a benthic/pelagic habitat map for the North Sea to EUNIS level 4 or similar, based on data sources compiled or made available to the WG and to assess future data requirements and issues arsing from the process.

Background:

During 2004/2005, various applicable datasets were obtained and posted on a working group ftp site, with a further view to developing a North Sea benthic habitat map. To this end, an ArcIMS platform was developed and initiated by Chris Cogan (AWI). Kerstin Geitner was charged with processing datasets on the ftp to a common geographic projection (ftp:\\gsca.nrcan.gc.ca/ICES[1]). The planned activity at the 2005 WGMHM was to initiate the compilation of the North Sea habitat map using the aforementioned datasets. However, it became apparent on day one of the WGMHM meeting that KMN has completed a version of a North Sea habitat map for the EEA. Clearly, the amount of effort expended in obtaining and compiling the disparate data sets need not at this time be duplicated. On day two of the WGMHM, German university researchers presented another version of a habitat map of the North Sea.

Current status:

1. EUNIS level 3 map developed by Kjell Magnus Norderhaug (NIVA) under the auspices of the EEA (European Environment Agency). Supporting documentation to be supplied to the North Sea sub-group.

2. MarGIS: Kerstin Jerosch and Roland Pesch will produce a broad-scale predicted habitat map for the North Sea, but have produced a more detailed geo-statistically derived habitat map for the German EEZ

Future development:

From the presentations made at the WGMHM, it was evident that considerable effort had gone into the production of these prototype maps. It was similarly evident that it would not be

1 This ftp site is password protected as a consequence of licence restrictions imposed by data providers.

within the scope of this WG to prepare a comparable map. Given that two prototype benthic habitat maps of the North Sea will have been developed[2], we see our role as:

1. Obtain pre-publication version of methodology report for internal review (ICES WGMHM only) for each mapping study.
2. Assess the datasets/methods used in the production of these habitat maps.
3. Based on the assessment, identify appropriate additional datasets (or replacement data sets) that the WGMHM can recommend to the original mappers to improve horizontal resolution[3].
4. Advise on further geo-spatial processing methodologies where applicable.

Funding issues:

The EEA is presently considering the continuation of the initiative *'Holistic mapping of potential occurrence of marine habitats'*. ICES WG MHM would wish to provide a letter to the EEA supporting the development of a broad scale habitat map of the North Sea, outlining the current needs and calls for such maps within the wider international community. If this funding is forthcoming, then the ICES WGMHM will continue to advise under 'future development' (above). If funding is not forthcoming, then this ICES WG will suggest opportunities for alternative sources of further funding outside the EEA. Kerstin Jerosch (AWI) and Roland Pesch (University of Vechta) are currently carrying out marine habitat mapping work in the North Sea, and anticipate completing their habitat mapping project by end 2005. MarGIS Marine Geo-Information System for Visualising and Typologisation of the Sea Floor. Funded by BMBF (Federal Ministry for Education and Research) and DFG German Research Foundation). This map may be available for use by REGNS ICES group.

Summary:

Although we acknowledge the request by REGNS to supply marine habitat mapping data at EUNIS level 4 or above [TOR L], it is clear from the considerable effort expended by ICES WG members over the past year or so that marine habitat data collation and mapping is beyond the remit (and resource) of the ICES WGMHM. However, WG members have produced potentially suitable marine habitat maps under independently funded initiatives, which may fulfil REGNS requirements.

2 Production of a North Sea benthic habitat map from German academic community is still in progress.

3 Certain key marine data sets require licensing at considerable cost, which may limit their utility for use within this habitat mapping work.

Annex 6: Revised draft structure for *ICES Cooperative Research Report*

Draft

13 April 2005

1. INTRODUCTION

2. NSBP 2000 DATA MANAGEMENT (Edward)

vii) Database structure

viii) Species/stations

ix) Access

x) *etc.*

3. Sediments and contaminants*

k) Sediment particle size (HH …)

l) Sediment contaminants (GI …)

4. Patterns and changes in the benthos (1986–2000)*

m) Structure and characterising species (ER, SD …)

n) Species distributions (RS, JE …)

o) Function (ML, JC …)

p) (Role of) biotic/diversity indices (GVH, HR, HeR, JC …)

q) Predictive modelling (WW, SD …)

r) Supporting studies (*e.g.*, meiofauna: MS)

5. Ecosystem interactions and causal influences (1986–2000)*

s) Natural environmental influences (IK, HeR …)

t) Links between infauna/epifauna/fish distributions (HeR …)

u) Fishing practices (JC, HeRu …)

v) Other human activities (IK, HeR …)

6. CONCLUSIONS

7. RECOMMENDATIONS

8. ACKNOWLEDGEMENTS

9. REFERENCES

10. ANNEXES ….

***These are summaries of the main findings from topics identified for future peer-reviewed publications.

Annex 7: Advantages/constraints of a repeat exercise (survey and/or data compilation) in 2010

ICES NORTH SEA BENTHOS PROJECT

ADVANTAGES	CONSTRAINTS
Application of a uniform methodology.	A lot of work (i.e., requires adequate resources).
The process (sampling, analysis, data management, etc.) will take less time, since much of the groundwork for a repeat survey has already been done.	Local and North Sea-wide methods have to be comparable.
Homogeneous spatial distribution and quality of samples.	'Opportunistic' exploitation of ship-time and available personnel can, in the absence of adequate resources and planning at an international level, lead to QA problems.
Time-series (1986–2000–2010): climate changes, NAO oscillations.	
Local and regional developments can be compared with the total.	
Evaluation of the success of actions, *e.g.*, by WFD, Natura 2000, OSPAR activities.	
Evaluation of the success of fisheries management measures.	
Standard-setting for monitoring activities in restricted areas (e.g., at wind farms, sand and gravel extraction areas, oil and gas platforms, marine nature reserves); incorporation of such data into a wider assessment framework..	Insufficient availability of such ('private') data sets.
Quasi-synoptic; agreed methods.	If sampling is 'scattered' (*i.e.*, conducted for different purposes and therefore not quasi-synoptic), then comparability as well as data availability will be reduced.
Support for ecosystem studies, including modelling.	Lack of funding.
Keeps a well-trained and experienced group of scientists 'alive' to the process of international collaboration, and the pursuit of excellence.	If there is no longer-term planning of a repetition, it will be difficult to find the (experienced) scientists.
Generates important sea-wide data on benthic biological status for historical comparisons (effects of: global warming, fishing impacts, alien/invasive species, etc.).	Lack of public interest.
Basis for exchange of experience and innovations.	Lack of properly-trained benthos specialists.
Benefits to science community/individual specialists arising from the practice of collaboration at an international level; important training ground for younger scientists.	Lack of academic interest.
Strategically important benefit of integrating/amending national approaches for the greater good of North Sea ecosystem assessment and management.	
Sets a realistic (10-year) time-scale for sea-wide re-	

ADVANTAGES	CONSTRAINTS
assessment.	
Provides a 'global' framework for contextualising regional or local surveys, including tests of indicator effectiveness.	
Opportunity for identifying 'representative' (habitat- or assemblage-based) stations for long-term monitoring.	
Fits with the international momentum towards holistic (sea-wide) ecosystem assessments, especially under OSPAR, ICES and EU auspices.	
Achievable given good collaboration, international support and adequate resources.	Earlier proposals for funding of collaborative sea-wide assessments of the benthos have tended to founder on the view that responsibilities and therefore funding rest with individual countries (leading to a circular argument).
New co-ordinated survey work would be an excellent opportunity to implement recent improvements in QA of benthic studies (sampling and analytical procedures; data management) and further exploit the high level of scientific skills of representatives from all North Sea countries.	Opportunistic data compilation can be a 'hostage to fortune', given limitations in spatial coverage and data quality at a given time.

Annex 8: Proposed Draft Terms of reference 2005

The ICES Study Group on the North Sea Benthos Project 2000 [SGNSBP] (Chair: H Rees, UK) will meet at NIOZ, The Netherlands, from 10 –13 April, 2006 to:

a) review the outcome of an intersessional Seminar/Writing Workshop held at VLIZ, Belgium, from 16 – 18 November, 2005 to:

i) present summaries of findings to date on the following topics:

- sediments and contaminants
- patterns and changes in the benthos (1986 – 2000)
- ecosystem interactions and causal influences (1986 – 2000)

ii) evaluate and integrate findings across topics;

iii) produce a draft of a *Cooperative Research Report* on the ICES North Sea Benthos Project 2000;

iv) progress any outstanding analyses and interpretation of data;

v) produce additional material for peer-reviewed publications.

b) finalise a *Cooperative Research Report* on the ICES North Sea Benthos Project 2000;

c) progress the drafting of text for peer-reviewed publication;

d) explore strategic alliances with other relevant initiatives (*e.g.*, MARBEF) to maximise the future utility of data and products arising from the North Sea Benthos Project 2000;

e) agree structure for a proposed ICES Theme Session on the North Sea benthos in 2007;

f) make recommendations on the utility of North Sea benthos indicators at the species and community level;

g) make recommendations for future work on the North Sea benthos, including a procedural framework.

Supporting information

Priority:	High (the assessment of benthic biological status in the North Sea is relevant to the ongoing interests of ICES, OSPAR and the EU, particularly with regard to its contribution to the development of an ecosystem-level approach to environmental management).
Scientific Justification and relation to Action Plan	Proposed TOR a)–g) will be met through a combination of Workshop and Plenary activity by Study Group members, as follows: a) a sub-group, representative of the major data contributors, will meet intersessionally from 16-18 November 2005 (at VLIZ, Ostend) to maximise progress with the production of an ICES Co-op. Res. Rep. This will involve presentations of findings to allow integration across topics, and to eliminate unnecessary overlap; b) finalisation of the Co-op. Res. Rep. for publication by ICES in 2006 is the top priority for the meeting; c) further progress on the production of peer-reviewed publications will be made as time permits; d) the SG considers that the establishement of such links are essential to ensure that best use is made of the work to date, special attention will be paid to issues of future data access and additions to the data archive; e) the proposed Theme Session in 2007 will provide a showcase for the outcome of the work of the SG, and will also address wider questions regarding the scope and utility of

	comparable collaborative exercises in the future; f) the SG will draw from the experience of evaluating recent and historical North Sea benthos datasets in order to highlight best practice in the implementation of an indicator-based approach to ecosystem assessments; g) the SG will produce recommendations for future North Sea-wide collaborative assessments, based on experiences to date and a realistic cost/benefit analysis of different options. The work of this SG contributes to Action Plan Nos. 1.2.1, 1.11, 2.8, and 2.9.
Resource Requirements:	N/A
Participants:	Primarily benthos ecologists participating in the project
Secretariat Facilities:	N/A
Financial:	None
Linkages to Advisory Committees:	ACME, ACE
Linkages to other Committees or Groups:	BEWG, WGECO, WGEXT, WGMHM, WGSAEM, WGMDM, SGQAE Reports to BEWG too.
Linkages to other organizations:	OSPAR, EU
Secretariat Cost Share:	ICES 100 %

Annex 9: Actions

- Henning to contact Georg Irion to produce some summary text for contaminants for *Cooperative Research Report*.
- Edward/Hubert to contact Carlo Heip/ John Gray (Marbef) - similar approach – patterns of biodiversity. Make sure they are aware of the North Sea Benthos work.
- Edward to integrate biomass data into database – needs information about whether biomass data available or not from countries that have not yet forwarded biomass data by end June 2005.
- Hubert communicate to data contributors to point out objectives of Wouters study, that it is part of the NSBP and that it is in agreement with protocols of NSB study group.
- Hubert to send ICES study group report to MESH.
- Hans to combine 1986 and 2000 and epifauna sediment data to get better coverage of North Sea. Hans to inform Hubert of how long will take to do by end of meeting.
- Hubert to contact MESH to inform them that sediment data will be available to them (western North Sea) subject to completion by Hans and under the same arrangement for reciprocal benefits as agreed earlier with WGMHM.
- Eike to contact MarGIS regarding eastern North Sea sediment data subject to completion by Hans and under the same arrangement for reciprocal benefits as agreed earlier with WGMHM.
- Edward to put draft *Cooperative Research Report* on NSBP website after meeting so that people can add to it.
- Eike to produce draft paper on 'Structure and characterising species' by end June 2005.
- Henning circulate list of environmental variables during meeting - all participants to agree final list for inclusion in *Cooperative Research Report*. Database will still be receptive to additional environmental variables as available for the purpose of publication of papers.
- Edward to follow up offer to copy NSBP data to ICES.
- Edward to circulate MARBEF data policy document to all data contributors with a view to augmenting with NSBP data access policy.
- Jackie to forward oil and gas coordinates to Henning.

Annex 10: Action Plan Progress Review 2005

Year	Committee Acronym	Committee name	Expert Group	Reference to other committees	Expert Group report (ICES Code)	Resolution No.		
2004/2005	MHC	Marine Habitat	SGNSBP		2005\E:04	E:04		
Action Plan	Action Required	ToR's	ToR	Satisfactory Progress	No Progress	Unsatisfactory Progress	Output (link to relevant	Comments (e.g., delays, problems, other types of progress, needs, etc.
No.	Text	Text	Ref. (a, b, c)	S	0	U	Report code and section	Text
1.21, 1.11, 2.8, 2.9	Please see Action Plan items below	Review the outcome of an intersessional workshop held at CEFAS Burnham-on-Crouch from 3–5 November 2004 to: i) finalise the draft of an overview paper on benthic communities of the North Sea 2000, including comparisons with 1986 NSBS data (lead author: ER); ii) progress analyses/interpretation of the ICES NSBP 2000 data on the following themes: - fishing activities/impacts; - natural and human impacts (other than fishing); - functional properties – in particular feeding types; - comparison of epifaunal and infaunal community patterns; - benthos/habitat linkages; - NSBP 2000 data management; iii) assess/report on the status of physico-chemical data for sediments sampled as part of the NSBP 2000 iv) review the suitability of biomass data for North Sea-wide versus sectoral appraisal v) identify/locate additional information sources (data/maps) vi) identify specific questions(s) regarding statistical analyses of NSBP 2000 data (e.g., formal tests for similarities in patterns) for consideration by WGSAEM 2005.	a)	S				
1.21, 1.11, 2.8, 2.9	Please see Action Plan items below	Conduct further analysis of the NSBP 2000 data in relation to fishing activities, natural and other human influences, functional properties and epifaunal/infaunal patterns, and draft texts for publication;	b)	S				
1.21, 1.11, 2.8, 2.9	Please see Action Plan items below	Report on the distributions of sub-sets of	c)	S				
1.21, 1.11, 2.8, 2.9	Please see Action Plan items below	Apply biotic/diversity indices to NSBP 2000 data;	d)	S				
1.21, 1.11, 2.8, 2.9	Please see Action Plan items below	Consider the scope for contributing to North Sea spatial models, through liaison with experts;	e)	S				
1.21, 1.11, 2.8, 2.9	Please see Action Plan items below	Identify products suitable for habitat mapp	f)	S				
1.21, 1.11, 2.8, 2.9	Please see Action Plan items below	Commence preparation of an ICES Cooperative Research Report on the ICES NSBP 2000 survey;	g)	S				1. Recommendation for ICES for Publication of Co-op Res Rep. in 2006. 2. Recommendation to ICES to hold a Theme session in 2007 entitled 'Structure and Dynamics of the North Sea Benthos
1.21, 1.11, 2.8, 2.9	Please see Action Plan items below	Identify additional analytical/reporting ide	h)	S				
1.21, 1.11, 2.8, 2.9	Please see Action Plan items below	Review the cost/benefits of a repeat ICES North Sea Benthos Survey in 2007–2010;	i)	S				
1.21, 1.11, 2.8, 2.9	Please see Action Plan items below	Liaise with the ICES Database Manager regarding the future operational interface with the NSBP 2000 database.	j)	S				

Action Plan Progress Review 2005 (continued):

Action plan nos. to be crosslinked to tors	
1.2.1	Understand and quantify the biology and life history, stock structure, dynamics, and trophic relationships of commercially and ecologically important species. [LRC/OCC/BCC/MHC/DFC]
1.11	Continue to improve the coordination, conduct, and analysis of oceanographic and biological surveys to assure their accuracy and precision. [LRC/RMC/OCC/MHC/DFC]
2.8	Continue and further improve assessments of the transport, fate, and biological effect of contaminants on the marine ecosystem through sampling, analyses, data collection, and evaluation of sampling, analytical, and data processing techniques. [MHC/OCC/LRC/BCC]
2.9	Determine the biological response to eutrophication taking into account oceanographic conditions. [OCC/MHC/LRC]*