First annual report (1 December 2001 - 30 November 2002)

Characterisation of the Baltic Sea Ecosystem (CHARM)

Contract EVK3-CT-2001-00065

Contents

Introduction

This report is divided into an administrative part and a technical part. The administrative part includes status and progress from the project Characterisation of the Baltic Sea Ecosystem (CHARM) – Contract EVK3-CT-2001-00065, covering the period 1 December 2001 to 30 November 2002. The technical part includes details on the progress of work carried out in the work packages.

Administrative part

Generally, there has been a good activity over the first 12-month period in the project. The first scientific products are now visible as a sign of the growing interest in the huge amount of available data among partners, institutions and countries. The power of existing data, covering a significant range in time and space, are acknowledged as a strong instrument to illustrate relationships between quantitative important ecological elements. This is a central issue in CHARM and the current spirit in the project will bring the products and deliverables to a high, sound and significant standard. A brief status on current events includes:

- The delayed deliverables are now on schedule and progress for the work is on time with few exceptions.
- The next annual workshop has been announced on the homepage. The workshop will be held during 8-11 April 2003 at The Isle of Vilm, Germany.
- A first draft of the Technological Implementation Plan (TIP) is now available and presented at the homepage.
- In addition to the agreed work in the DoW, two workshops have been carried out. A workshop on macrophytes was held on 3-4 September 2002 in Copenhagen, Denmark. The objectives included discussions of ideas and selection of vegetation indicators and analyses. Short presentations of data and ideas on how to test the ecological state of coastal waters were carried out. The agenda and minutes from the workshop are presented at the homepage under WP 3.
- During 2-3 September 2002 a workshop on phytoplankton was held in ISPRA, Italy. The objectives of the workshop included: 1) to get an overview of the situation with the data quality analysis, 2) discussion & decision on the further work and analyses, 3) agreement on the need of a possible joint database, 4) agreement on deliverables and task distribution, and 5) discussion on linkages with other CHARM WPs, and other national and EU WFD implementation activities. Minutes from the workshop are available on the homepage under WP 2 meetings.

1. Objectives

The overall objective of CHARM is to develop, test and validate a methodological approach to characterise type areas of the Baltic Sea coastal ecosystems and study the dynamics and function of these areas in relation to anthropogenic pressures. This study has been developed to provide a scientific foundation for fulfilling the requirements of the EC Water Framework Directive (WFD). The following key issues are addressed:

- Development of a common methodology for establishing coastal types in the Baltic Sea.
- Identification of the key factors triggering ecosystem alteration and their relative importance.
- Identification of the key indicators for ecosystem functioning in relation to alteration of the coastal ecosystems.
- Development of quantitative ecological relationships and empirical models that describe the relationship between anthropogenic pressure and key indicators in the coastal zone.
- Derive ecological reference conditions for Baltic coastal water bodies.
- Development of recommendations for new monitoring strategies for Baltic Sea coastal ecosystems based on the developed typology, reference conditions and key indicators.

During the first 12-month period, it has been an overall objective to develop sound ecosystem functional relationships that cover the entire region. In order to do this both monitoring and research data from coastal areas all around the Baltic Sea has to be combined.

This data-set covers both a large regional scale, huge annual temperature variation and degree of ice-cover and a strong salinity gradient from meso-haline to oligo-haline waters. The region also hosts more than one thousand different estuaries, coastal embayments and coast line conditions like deep Swedish hard bottom fjords, shallow Danish estuaries, low saline Baltic estuaries in addition to open coast that will be encompassed by the WFD. National monitoring programmes have been performed for more than 2 decades in most of the CHARM partner countries and in few selected estuaries even longer data series are available.

2. Status for delayed deliverables

In the first six-month report from CHARM, two deliverables were delayed. Deliverable 3: Quality controlled data sets for surface sediments, phytoplankton, macrophytes, benthic fauna and water chemistry, and deliverable 4: Morphometric inventory of the Baltic. Both deliverables were re-scheduled to September 2002.

Concerning deliverable 3: WP 4 has striven to accomplish a meta-table of data available within all the countries involved in CHARM (see *Appendix 1* below), and currently comparable data from some 550 stations from Finland, Sweden, Denmark, Germany, Poland, Lithuania, Latvia and Estonia are included in the database (in MS Excel-format). The database contains information (in “yes” and “no”-format) on the following parameters: country, region, sea area, station (place), programme, date (1990s), historical data, ID, latitude, longitude, depth, temperature, salinity, oxygen, loss on ignition (LoI), grab type, sieve (mesh size), replicates, publ./access to data, publications, comments.

The format follows that of a parallel national project in Finland, with close links to CHARM, currently including numerical, quantitative data on 6200 individual grab samples along the Finnish coasts. National efforts conducted independently of CHARM are not reported here.

In its current form the combined database contains information on about 550 stations, although the delivered raw data from all the countries contain much more data than that. We have chosen only to use readily available and comparative information in this case.

Overall, the deliverable has now been done.

Concerning deliverable 4: A preliminary version of the maps is now available on the homepage.

3. Status for deliverables

Below is inserted a section of the “Description of Work” document from CHARM (page 28) now including the status of the first ten deliverables with deadlines at or before month 12.

Out of the 10 deliverables planned for the first 12-month period, 11 deliverables are done and one (deliverable 8) is delayed.

Deliver-able no.	Deliverable title	Delivery date	WP no.	Dissemination level	Status
1	Workshop 1	Month 1	7	PU	done
2	Compilation of mailing list of authorities	Month 1	1	PU	done
3	Quality controlled data sets for surface sediments, phytoplankton, macrophytes, benthic fauna and water chemistry	Month 6	1-5	PU	done
4	Morphometrical inventory of the Baltic	Month 6	1	PU	done
5	Project web site	Month 6	7	PU	done
6	Report to the Commission	Month 6	1-7	PU	done
7	Draft of scientific paper on benthic monitoring data	Month 12	4	PU	done
8	Report on state-of-the-art monitoring	Month 12	6	PU	delayed
9	Map of sediment characteristics of the Baltic coastal zone	Month 12	1	Da	done
10	Report to the Commission	Month 12	1-7	PU	done

4. Comments on delayed deliverables and progress for the work to be carried out

A minor delay has occurred within deliverable 8. A questionnaire has been submitted to all partners and most of the work has been carried out. The report is expected to be ready by the end of February 2003. The report will be published on the homepage.

It is my general impression that there is a good scientific spirit in the project, and the first drafts of manuscripts to be published have arrived. The plans for the coming annual workshop are on time and I expect a very fruitful meeting.

5. Other plans

During the first 12 months the CHARM project has had 2 PhD students as exchange students under the Marie Curie Host Fellowship “CREAM”. The 2 students are Jens Perus from Åbo Akademi University, Finland and Kaire Torn from the Estonian Marine Institute, Estonia. The 2 students stayed in Denmark at NERI for four months during 2002. The CHARM project intends to include more students via this exchange system.

Interim Technological Implementation Plan

An interim Technological Implementation Plan (TIP) has been drafted. Part of the plan has been transferred (pasted) to the CORDIS eTIP (http://etip.cordis.lu), i.e. ‘Project Summary’, ‘Partners’ and ‘Expected project impact’. A number of topics are still to be transferred to the eTIP, i.e. ‘Quantified Data’ and ‘European Interest’. At present, only at limited number of results from the CHARM project have been produced. The results so far include an number of submitted papers as well as posters and oral presentations. However, and seen in a short perspective (2-3 years), the CHARM project will: (i) produce technical-scientific guidance on typology, reference conditions and relations between pressures and ecological response, (ii) support the implementation of the Water Framework Directive and the Habitat Directive as well, (iii) influence the up-coming EU Marine Strategy, including support to the work within HELCOM and OSPAR. Seen in a long perspective (+3 years), the CHARM project is likely to: (i) support management of coastal waters on an European level, (ii) improve the quality of life in the European Community, and (iii) support sustainable development and the utilisation of aquatic resources in European coastal waters.

Technical part

Work package 1

Task 1.0: Compilation of the addresses of all responsible authorities and a mailing-list for information exchange - deliverable no. 2

National authorities responsible for the implementation of the WFD in each partner country were contacted. A compilation of mailing list of authorities, as required in deliverable no. 2, is presented at the project web site.

Task 1.1: Map of sediment characteristics of the Baltic coastal zone - deliverable no. 9

Data on surface sediment types were requested from partner institutions with a special request form with the aim to establish a database and map providing information on sediment characteristics with a spatial resolution below 10 km in coastal waters. However, no raw data sets were submitted by the partners, mainly due to a lack of data or limited access to existing data. Therefore, it was necessary to change the strategy to fulfill the task. Instead of data sets, maps in a digitalized form (at least 1:500000 in scale) were requested from all partner countries. The general map was split into regional maps – mainly country-wide maps.

Despite the fact that not all contracting parties fulfilled that requirement and submitted digitalized map of their coastal zone, based on contributions received and own search done by work package 1, digital maps were obtained for the whole Baltic Sea area except the Gulf of Finland and Gulf of Bothnia. For some regions, namely the coast of Finland, there are no sediment data available for the entire coast. The area for which information on coastal sediments is available is presented on *Figure 1*.

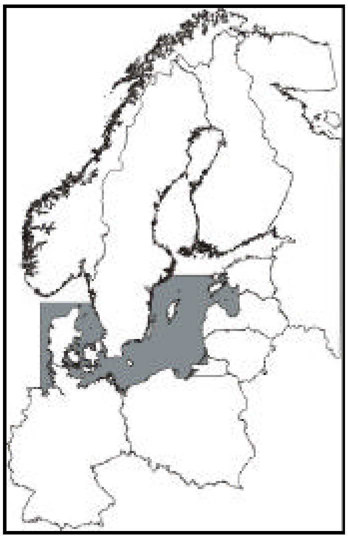

Figure 1 The area of the Baltic Sea bottom covered by sediment maps.

An overview map for the whole Baltic Sea bottom (including Gulf of Bothnia and Gulf of Finland) is also available; however, it gives only a very general idea of the sediment types at a scale coarser than the resolution needed. On the basis of the existing project more detailed sediment information could be prepared for specified regions if requested from other work packages during their work or if needed for publications. Available information can also be used for the first draft of typology (as planned in task 1.3).

National contributions were received from (*Figure 2a*):

1. National Environmental Institute Denmark, NERI (map of Danish coast)

2. Baltic Sea Research Institute, Germany, IOW (map of Central Baltic)
3. Baltic Sea Research Institute, Germany, IOW (map of German coast)
4. Sea Fisheries Institute, Poland, MIR (map of Polish coast)
5. Kleipeda University, COPRI (map of Lithuanian coast)
6. University of Latvia, IAE (for Latvia and Estonia, map of the Gulf of Riga)
7. Finnish Environmental Institute FEI (no full coverage of the coast is available)

Small-scale maps (not available in a digital form) for the Finnish coast and other small-scale maps obtained are presented on the *Figure 2b*.

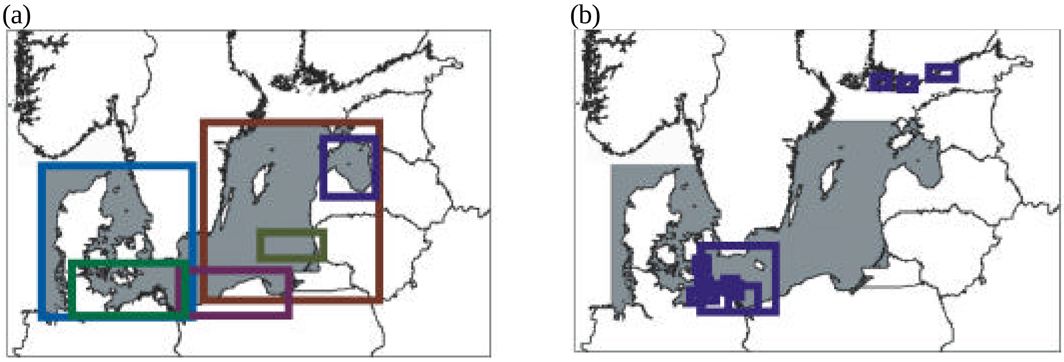

Figure 2 (a) Spatial extension of sediment maps covering the bottom of the Baltic Sea. (b) Location of the small-scale sediment maps.

All maps presented in *Figure 2a* are now prepared in the ARC/GIS software. To make the sediment maps available to a larger audience and the CHARM partners, all maps were prepared for the internet and can be accessed via the CHARM web page. Starting with an overview map the project allows accessing all maps systematically and provides the user with all necessary information about every single map and its content. Thus deliverable 9 is now available as a series of regional, national and large-scale sediment maps - which can be accessed from one source.

Task 1.3: First draft typology - deliverable no. 19

Information about draft outlines for national typologies was collected as a first step (before developing a draft typology for the entire Baltic Sea region). Information on the first typology outline for the Baltic waters is now available from Denmark, Germany, Latvia, Finland and Sweden. This information is now available for CHARM partners. More information will be requested as the work in the rest of partner countries proceeds.

A first draft of typology will be determined on the basis of physical parameters such as: depth, salinity, temperature, ice-cover and then compared with sediment data and finally with water retention time calculations. Due to the fact that there is no raw data on sediment granulometry instead, spatial sediment cover is available (maps), and also due to the fact that the water retention time is calculated for already predefined areas, the use of cluster analysis is not possible. Therefore, analysis of spatial gradients for all parameters will be performed with Surfer software and the first attempt to formulate draft typology will be formulated on the basis of the outcome of this analysis.

Data on physical parameters have already been submitted from partner countries. Morphometry of the Baltic Sea is now available too. However, at the moment there is still no authorization to use all available data for the work. The work will proceed as soon as authorization of the right to use all data is completed. The first draft of typology based on physical parameters will be compared with national typologies and later used for comparison of biological parameters.

List of sediment maps available in deliverable 9:

Maps available in a digital form:

Overwiev map
Winterhalter, B., Ignatius, H., Axberg, S., & L. Niemistö (1981): Geology of the Baltic Sea. In: Voipio, A. (Editor), The Baltic Sea. Oceanography Series. Elsevier, 121pp.

1. Map of Danish coast
B. Hermansen & J. B. Jensen (2000): Digital Sea Bottom Sediment Map around Denmark. Danmarks og Groenlands Geologiske Undersoegelse, Rapport, 68, 2000.

2. Map of Central Baltic
Gelumbauskaite, L.-Y., Grigelis, A., Cato I., Repecka M. & B. Kjellin (1999): LGT Series of Marine Geological maps No.1. SGU Series of Geological Maps Ba No. 54.

3. Map of German coast
This map is based on the map of Hermansen, B. & J. B. Jensen (2000): Digital Sea Bottom Map around Denmark. Geological Survey of Denmark and Greenland, Kopenhagen, and data from the German Federal Office for Shipping and Hydrography (BSH). Prepared by: H.-Ch. Reimers, State Agency for the Environment, Nature Conservation and Geology of Mecklenburg-Western Pomerania (LUNG). (unpublished).

4. Map of Polish coast
Geological Map of the Baltic Sea Bottom. 1: 200 000. J. E. Mojski (scientific editor). Polish Geological Institute, Warsaw, 1989-1995, (17 sheets).

5. Map of Lithuanian coast
Gulbinskas, S. (1995): Recent bottom sediments distribution in the Curonian Lagoon - Baltic Sea sedimentary area. Geografijos metraštis, 28 t. Vilnius, pp. 296-314. ISSN 0132-3156.

6. Map of the Gulf of Riga
O. Stiebrins & P. Väling (1996): Bottom sediments of the Gulf of Riga. 1:200 000. Riga, 54 pp. ISBN: 9984-9130-0-7.

Other maps:

Regional maps of Finland

J. Rantataro (1992): Pääkaupunkiseudun vedenalaiset maa-ainesvarat. Helsingin seutukaavaliiton julkaisuja C31. ISBN 952-9567-08-1. ISSN 0357-3214.
(Title in English: Mapping of sea floor deposits offshore Helsinki region) [four sub-maps].

A. Häkkinen (1989): Saaristomeren vedenalaisten maa-ainesvarojen kartoitus Gullkronan selällä 1989. Varsinais-Suomen Seutukaavaliitto. Turku 1990. ISBN 952-9532-07-5.
(Title in English: Seafloor sand and gravel investigations on Gullkrona fjärden, The Archipelago Sea, 1989).

J. Lehtoranta: Unpublished map of the accumulation areas offshore from Tammisaari region. Finnish Environment Institute.

Regional maps of Germany (including parts of the western coast)

State Office for Environment and Nature in Rostock (STAUN) Rostock, GIS Küste M-V. Version 2.0, 05.01.2000 (four sub-maps available in digital form).

Emeljanov, E. Neumann, G. & W. Lemke (1993): Recent Bottom Sediments of the Western Baltic. Baltic Sea Research Institute (IOW), Germany.

P. P. Shirshov Institute of Oceanology RAS, Atlantic Branch, Russia.

Tauber F. & W. Lemke (1995): Map of sediment distribution in the Western Baltic Sea (1:100.000), sheet: Darss. Deutsche Hydrographische Zeitschrift, 47, 3, pp. 171-178.

Tauber, F., Lemke W. & R. Endler (1999): Map of sediment distribution in the Western Baltic Sea (1:100.000), sheet: Falster-Moen. Deutsche Hydrographische Zeitschrift, 51, 1, pp. 5-32.

Bobertz, B. (1996): Untersuchen der regionalen Verteilung granulometrischer Eigenschaften der Oberflächensedimente der Pommernbucht mit geostatischen Verfahren und ihre genetische Interpretation. Diploma Thesis, Ernst-Moritz-Arndt-Universität Greifswald, 53 pp.

Annual report task 1.2

(i) A morphological inventory of the coastal zone

An explanatory letter has been distributed to national representatives asking for relevant data and other types of essential information. Some data have been delivered (see table *Appendix I* below) and a simple database model has been constructed. The list over prioritised areas has been completed (see *Appendix II* below). However, the inventory is still not complete, e.g. hyspographic information is lacking from Finland, Germany and Denmark.

(ii) A reconstruction of representative forcing relevant for coastal processes

An explanatory letter has been distributed to national representatives asking for relevant data and other types of essential information. Some data has been delivered (*Appendix I*) and a simple database model has been constructed. Relevant data has been compiled for a 3D ocean general circulation model, which will run for 10 years to get estimates on barotropic/baroclinic forced coastal exchange.

A 3-dimensional baroclinic model (Andrejev & Sokolov 1989) has been set up for the planned 10-year period simulation. The CHARM version of this model has a space resolution of 2 nautical miles and a depth resolution of 22 strata. The open boundary of the large-scale model domain is located in the Kattegat along the 57°35′N latitude.

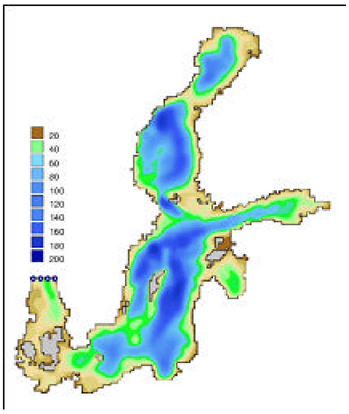

Figure 3 The Baltic Sea model domain.

Preparation of the model:

Vertical convection has been parameterised since the model uses the hydrostatic approximation. The following procedure is employed: first a check is made of whether the water in a grid cell is stable relative the water of the underlying cell. If not, the water of the unstable grid cell is moved into the lower cell and the same volume of water from the lower cell is displaced upwards and mixed with the upper-cell water. This procedure of water replacement proceeds cell by cell until the sinking volume finds itself in stable conditions of neutral buoyancy.
A combination of the radiation condition with 'sponge layer'-approach will be applied for all (except temperature) variables at open boundaries. Sponge layer is defined as a zone adjacent to open boundary where lateral diffusivity coefficient increases linearly toward open boundary.

A subroutine to realise open boundary conditions is now included into model. A simple method in form of smooth nudging of all grid points so that their salinity and temperature fields comply on a long-term basis to measurements as represented by the BED-database is formulated and inserted into the model.

Forcing data status:

Weather data for the entire 10-year period have been checked. Kattegat sea level boundary data for both Sweden and Denmark have been checked and prepared for use in the model run. Due to the lack of any systematic T and S Kattegat boundary data, the climatic data for salinity and zero heat flux condition will be used. River discharge data have also been prepared as an average over the decade with a temporal resolution of one month.

Output data:

Subroutines to save output data (sea level, salinity and temperature profiles) have been included in the model. The computed profiles should be located along the Baltic coastline at the 30 m isobath. The horizontal difference between these profiles will on the average be approximately 10 nautical miles or 19 km. These data will be saved as daily averages.

(iii) A compilation of computations of water exchange time (expressed as residence time, transit time and/or age for fresh water, surface water, deep water /and/or water beneath sill depth). It is expected that the final form of the aggregates delivered from the calculations will be developed through a dialogue with WP 2-5.

Model description

A modified version of the WMM (Gustafsson 2000 a and b) has been used to calculate the stratification and water exchange in the inshore areas in the Baltic Sea. The model is process-based and is forced by meteorology, freshwater supply, and offshore stratification.

The wind speed has been reduced by 80% to compensate for the coast and the calculated geostrophic wind speed in the data. The model time step used is the propagation time for a long wave through the area. Data from 1990 to 2000 have been used. Output data have a time resolution of 24 hours and a vertical resolution of about 1 m in the upper 20 m and 2-5 m below that. The freshwater height, age, and retention time are then estimated from the calculated stratification from the definitions given in Bolin and Rodhe (1972). The model was run for three different areas as described below. Note that only data from 1990 are shown in the figures for clarity.

Results – stratification

The Kramforsfjärd is located at the Swedish Bothnian Sea coast. A large supply of freshwater gives the Kramforsfjärd a thin but almost fresh surface layer. The basin is fjord-like with a narrow and shallow sill and a deep basin. The model results show a freshwater layer with very varying thickness over imported Bothnian Sea coastal water. A shallow thermocline develops during the summer months and stabilises the stratification.

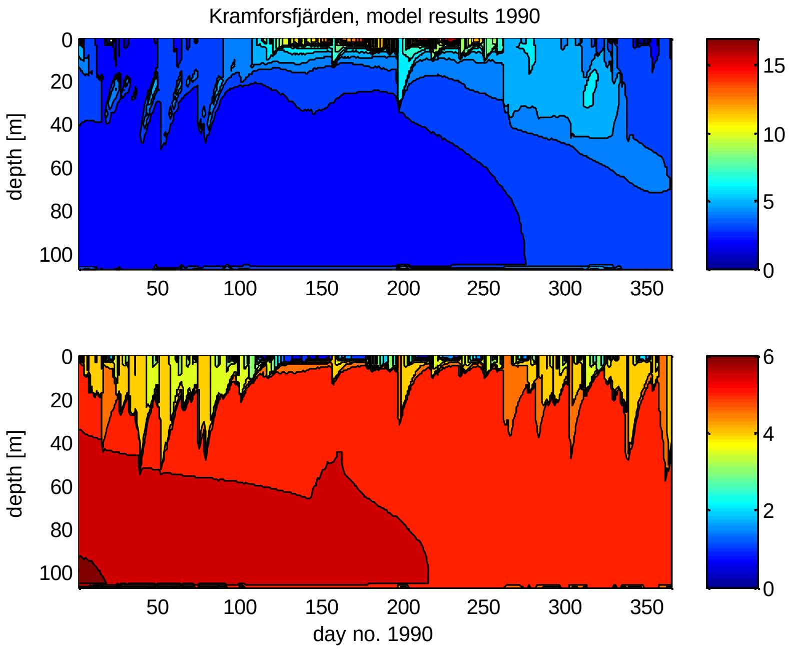

Figure 4 The modelled temperature (top) and salinity (bottom) in the Kramforsfjärd 1990.

Bråviken is a relatively large basin located at the Swedish east coast south of Stockholm. The connection to the Baltic Proper is wide and deep. The freshwater supply gives a slightly freshened surface layer on top of imported seawater. It cannot establish a fresh surface layer and a deep thermocline develops during the summer months.

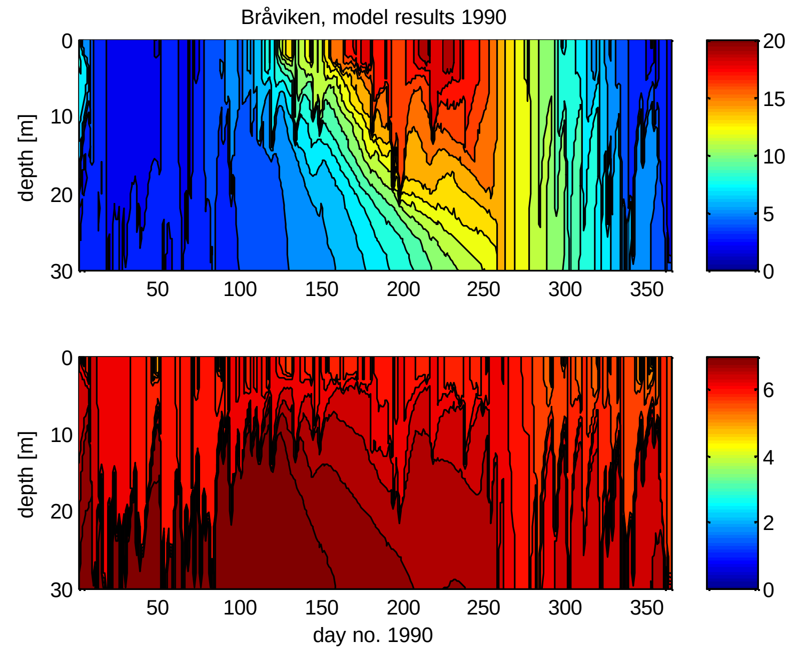

Figure 5 The modelled temperature (top) and salinity (bottom) in Bråviken 1990.

The Mariager Fjord is located at the Danish east coast. A very long and narrow channel connects a relatively shallow and small basin with the Kattegat. The freshwater supply is low. The model runs show almost homogeneous water in the basin, except during the summer when a thermocline develops and traps the freshwater added to the area.

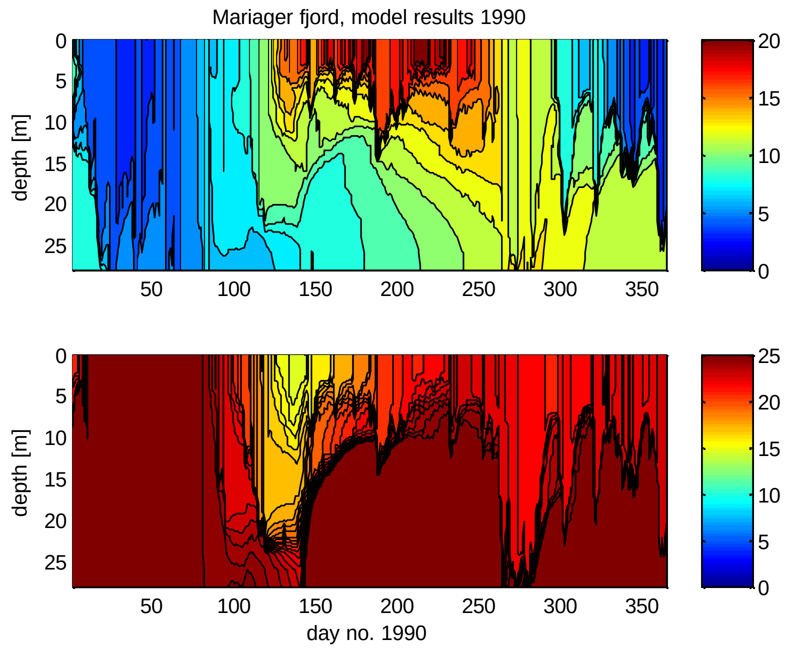

Figure 6 The modelled temperature (top) and salinity (bottom) in Mariager Fjord 1990.

Results – freshwater height

Shown below is the estimated freshwater height from the modelled stratification. The Kramforsfjärd has a high freshwater content with small variability. Bråviken has a stable low freshwater height whereas Mariager Fjord has a highly variable freshwater content over the year.

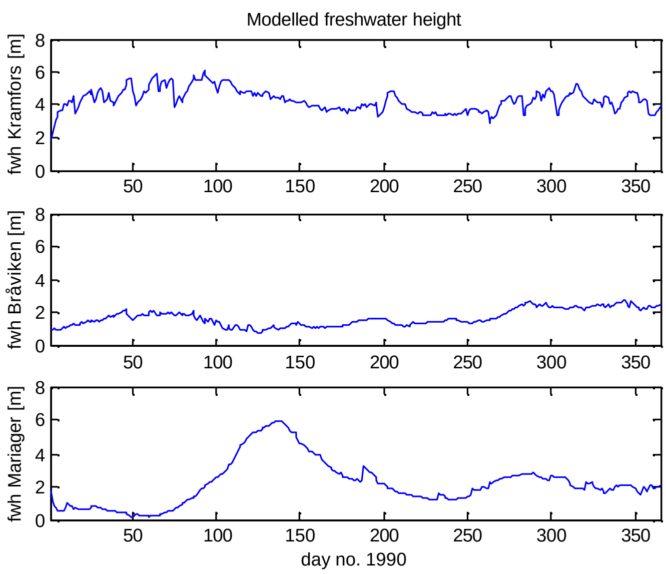

Figure 7 The calculated freshwater height from the model results in the Kramforsfjärd (top), Bråviken (middle) and Mariager Fjord (bottom).

References

Bolin, B. and H. Rodhe 1973: A note on the concepts of age distribution and transit time in natural reservoirs. – Tellus 25(1): 59-62.

Gustafsson, B. 2000a: Time-dependent modelling of the Baltic entrance area. 1. Quantification of circulation and residence times in the Kattegat and the straits of the Baltic Sea. – Estuaries 23(2): 231-252.

Gustafsson, B., 2000b: Time-dependent modelling of the Baltic entrance area. 2. Water and salt exchange of the Baltic Sea. – Estuaries 23(2): 253-266.

Appendix I – CHARM data delivery table

Type of data \ Country	Denmark	Estonia	Finland	Germany	Latvia
List of prioritised areas	Delivered	Delivered	Delivered	Delivered	Delivered
Digitised maps of coastal zone or hypsographic functions of basins and straits and information about open sea limit, in form of digitised base line and/or 30 m depth contour.	Hypsographic functions from basins are delivered, so far no information about straits	(3)		A srf file has been delivered but there are file format problems	Digitised coast line and bottom topography including 30 m isobath have been delivered
Runoff data		Delivered	Delivered	(2)	
Representative station data on ice, wind, water level, salinity and temperature stratification from prioritised sub-areas.	(1)	Temp and salinity data have been delivered	Ice data in paper format have been delivered	Temp and salinity data have been delivered	Temp and salinity data have been delivered

Type of data \ Country	Lithuania	Poland	Russia	Sweden
List of prioritised areas	Delivered	Delivered		Delivered
Digitised maps of coastal zone or hypsographic functions of basins and straits and information about open sea limit, in form of digitised base line and/or 30 m depth contour.	Bathymetry in raster format	Digitised coast line and bottom topography including 0, 10, 20 30 m isobath have been delivered		The coast is digitised, prioritised areas are ready
Runoff data	Delivered	Delivered		Delivered
Representative station data on ice, wind, water level, salinity and temperature stratification from prioritised sub-areas.	Metadata delivered	Temp and salinity data have been delivered		Temp and salinity, water level, and wind data have been delivered

1) Temp – salinity data have been delivered before the start of CHARM but it has not been confirmed that these can be used within the project.
2) With the exception of the Oder lagoon, rivers do not effect all chosen areas for the calculations in Germany. For Oder lagoon the existing calculations will be used and the river load data is already in BED.
3) Since there are only three sub areas, we are calculating the hypsographic information manually.

Appendix II – Prioritised areas

FINLAND

1. River Virojoki estuary (Virolahti Bay)
2. River Kymijoki estuary (Ahvenkoskilahti Bay)
3. River Porvoonjoki estuary (Porvoonselkä Bay)
4. River Mustijoki estuary (Svartbäckinselkä Bay)
5. River Vantaanjoki estuary (Vanhankaupunginselkä Bay)
6. River Karjaanjoki estuary (Pohjanpitäjänlahti Bay)
7. River Uskelanjoki estuary (Halikonlahti Bay)
8. River Paimionjoki estuary (Paimionlahti Bay)
9. River Kokemäenjoki estuary (Pihlavanlahti Bay)
10. River Närpiönjoki estuary (Närpesfjärd)
11. River Kyrönjoki estuary
12. River Perhonjoki estuary
13. River Temmesjoki estuary (Lumijoenselkä Bay)
14. River Iijoki estuary (?)
15. Sandöfjärd Bay
16. Espoonlahti Bay
17. Laajalahti Bay and Seurasaarenselkä Bay
18. Kotka Archipelago
19. Helsinki Archipelago
20. Hanko Archipelago
21. Inner Archipelago Sea
22. Middle Archipelago sea
23. Outer Archipelago Sea

ESTONIA

1. Pärnu Bay (Gulf of Riga)
2. Tallinn Bay (Gulf of Finland)
3. Narva Bay (Gulf of Finland)

LITHUANIA

1. Curonian Lagoon

LATVIA

POLAND

1. the Gulf of Gdansk - an estuary of Vistula River (note that Vistula River flows directly into the Gulf of Gdansk and that at present the Vistula Lagoon (= Frisches Haff) has no connection with Vistula River!)
2. the Szczecin Lagoon - an estuary of Oder River (Polish/Germantransboundary area)
3. open coast between Ustka (16 50 E) and Rozewie (18 20 E)

GERMANY

1. Flensburger Förde
2. EckernFörder Bucht
3. Kieler Förde
4. Lubecker Bucht
5. Wismar Bucht
6. Salzhaff
7. Greifwalder Bodden
8. Szczecin Lagoon

DENMARK

1. Aabenraa Fjord
2. Augustenborg Fjord
3. Dybsø Fjord
4. Flensborg Fjord
5. Gamborg Fjord
6. Genner Bugt
7. Guldborg Sund
8. Haderslev Fjord
9. Helnæs Bugt
10. Holbæk Fjord
11. Holsteinborg Nor
12. Horsens Fjord
13. Isefjord
14. Kalundborg Fjord
15. Karrebæk Fjord
16. Kolding Fjord
17. Køge Bugt
18. Lammefjord
19. Lunkebugten
20. Mariager Fjord
21. Nakkebølle Fjord
22. Nakskov Fjord
23. Odense Fjord
24. Præstø Fjord
25. Randers Fjord
26. Roskilde Fjord
27. Skælskør Fjord
28. Stege Bugt
29. Sydfynske Øhav
30. Vejle Fjord
31. Århus Bugt

SWEDEN

1. Kunsbacka fjord
2. Laholm Bay
3. Skälderviken

4. Bay of Lundåkra
5. Hanö Bight
6. Gamlebyviken
7. Syrsan
8. Slätbaken
9. Bråviken
10. Himmerfjärden
11. Hudiksvall viken
12. Sundsvallsfjärden
13. Kramforsfjärden
14. Österfjärden
15. Skellefteviken
16. Göta älv
17. Ångermanälven
18. Indalsälven
19. Torne älv
20. Luleå älv
21. Inner Stockhom archipelago
22. Middle Stockholm archipelago
23. Outer Stockholm archipelago
24. St Anna Gryt archipelago
25. Blekinge archipelago
26. Bothnian Bay archipelago (Piteå to Kemi)

Work package 2

Phytoplankton

A workshop was held for WP 2 participants at JRC in Ispra, Italy, on 2-3 September 2002, to get an overview of the status of data sheet compilation for the phytoplankton data, and to discuss the organisation of the future work. A detailed task distribution until June 2003 was agreed.

A meeting for discussion of the database structure, analysis of phytoplankton data, and organisation of data transfer to CORPI-KU was held and organised by CORPI-KU in Klaipeda on 25-27 September 2002. EMAUG (RU/ Schubert, Sagert), CORPI (Razinkovas & 5 colleagues), and JRC (Heiskanen) participated.

Compilation of phytoplankton data sheets (following the format that was agreed in May) is still underway; all data sheets should be finished by the end of November 2002, and sent to CORPI-KU who has provided a FTP-server access for all members of WP 2 for transfer of the national data-subsets to CORPI.

Expected progress for work package 2 for the next 6 months (until the end of May 2003)

All phytoplankton data sheets should be checked for integrity and transferred to a common database at the server of CORPI-KU by the end of December 2002. First statistical analyses (Cluster analysis for homogenous salinity groups and analysis for the seasonality of the phytoplankton data) will be carried out in January-March 2003. A meeting for partners involved in statistical analysis is provisionally foreseen at the end of March in Klaipeda. A presentation of the results of the statistical analyses will be prepared for the CHARM workshop in Vilm (8-10 April 2003). Statistical analyses of the whole dataset will continue in late April-May. First draft manuscript will be prepared in May - early June.

Status of tasks by the mid-November 2002

Task	Deliverable/Action	Deadline	Who
1. Complete final data sheets	Quality controlled data sheets	On-going; 30/11/02	ALL
6. Update linkages to other WPs	Letter asking for clarification what they/we need	Underway	ASH
7. Send relevant phyto-references to JRC (celine.duhamel@jrc.it, cc to anna-stiina.heiskanen@jrc.it)	Reference/bibliography available on web page	By 06/12/02	ALL

Task	Deliverable/Action	Deadline	Who
8. End-note library of relevant phytoplankton indicator papers	Reference bibliography available on CHARM web page	6 December	Celine Duhamel (JRC)
9. Establishment of database – meeting in Klaipeda	Agreement of database location & structure	DONE: 25-26 sept.	ASH, HS, RP, AR, ZG, SS
10. Plan of procedures: how to deliver data to database & carry out analysis	A discussion paper is distributed to other partners for further comments	DONE: 12 Nov.	HS, RP, AR, ZG, ASH
11. Commenting plan of procedures	Plan of procedures	On-going: 30/11/02	ALL
12. Discuss applicability of biodiversity indices	Start an email discussion of the applicability BD indices	November-02	ALL (HS/ EMAUG will initiate this)
13. Develop a method to define 'bloom' using monitoring data	Statistical method for definition what is a bloom	November-02	PH (NERI) & colleagues
14. Compile a list of easily identified ('no-problem') species	Send a template to everybody, compile & put a list of species on web page	November-02	ASH/ ALL
15. Collecting notes of possible problem phytoplankton species	Updated list of problem species for analysis	Continuous – January-03	ALL (Sigi/ EMAUG will compile this)

Work package 3

1. Overview of WP 3

1.1 Objectives

The objectives of WP 3 are:

- to determine the factors that regulate macrophyte communities and their temporal stability at local and regional scale
- to determine long-term changes in macrophyte communities in the Baltic Sea area
- to define macrophyte indicators that adequately describe the state of coastal ecosystems
- to define reference conditions for macrophyte communities, i.e. the status of vegetation under 'pristine' conditions, in different areas of the Baltic Sea

1.2 Hypotheses

We hypothesise that:

- water quality, temperature, salinity, insolation, exposure, ice cover and geomorphology (substratum, coastal slope) are important regulators of the distribution and abundance of macrophytes
- the relative importance of the various regulating factors changes with the scale of study. Thus, insolation, temperature, ice cover and salinity change across large spatial scales and are likely to regulate large-scale patterns of distribution and abundance of macrophytes across the Baltic distribution range. At the local scale, exposure, substratum and coastal slope change from site to site, and are likely to play an important regulating role together with secondary gradients in water clarity, nutrient concentrations and salinity
- short- and long-term changes in distribution and abundance differ among macrophyte species due to differences in susceptibility to changing water quality and differences in colonisation capacity
- robust key indicators of vegetation can characterise the ecological state of coastal waters
- reference conditions for selected key parameters can be identified based on historical records and/or models relating the key parameters to anthropogenic pressure

1.3 Deliverables

- No. 3: Quality controlled data sets for macrophytes
- No. 15: Small-scale vegetation models
- No. 20 & 32: Reference conditions for benthic vegetation. Draft (No. 20) and final version (No. 32)
- No. 21: Draft of scientific paper relating phytoplankton and macrovegetation to typology (WP 1-3)
- No. 25: Large-scale vegetation models
- No. 26: Draft of 2 scientific papers relating biological indicators and water quality to physical gradients (lead by WP 1)
- No. 29: Draft of 2 scientific papers relating biological indicators and water quality to physical gradients with emphasis on reference conditions (lead by WP 1)
- No. 30: Definition of vegetation indicators
- No. 31: Verified typology for vegetation (i.e. identification of the status of vegetation indicators in different type areas)
- No. 34: Monitoring recommendations for vegetation in the Baltic coastal zone

We have organised the work as illustrated by the flow diagram below.

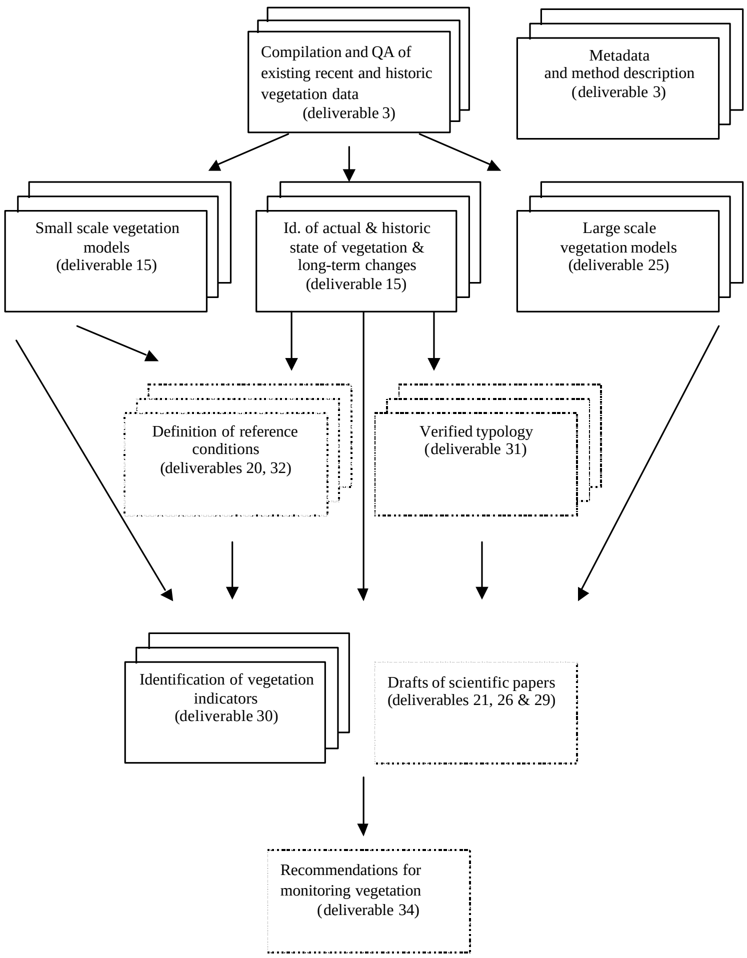

Figure 8 Flow diagram of work plan and deliverables for work package 3. More boxes behind each other illustrate that parallel analyses are made by several partners. Dashed lines indicate that the deliverables are part of a larger deliverable.

1.4 Partition of work

All CHARM partners are responsible for data compilation, quality assurance and establishment of metadata (Del. 3) – even the partners not actually engaged in WP 3. All partners engaged in WP 3 are further responsible for the tasks connected with the vegetation in their respective area, i.e. small-scale data analyses, definition of reference conditions, identification of vegetation indicators and definition of typology (Del. 15, 20, 30-32, 34). In addition, some partners are responsible for large-scale analyses of vegetation data (Del. 25) and contributions to drafts of scientific papers (Del. 21, 26 & 29, *Table 1*).

Each partner sends completed inputs to NERI, who is then responsible for compiling the inputs and finalising all deliverables within this work package.

Table 1 Responsibility of each partner in the various deliverables.

	NERI (1)	FEI (2)	AAU (3)	CORPI (5)	IOW (6)	EMI (7)	IAE (8)	SUSE (9)	MIR (10)	EMAUG (11)
person-months per partner:	24	11	8	3		9	4		4	15
Deliverable 3										
- Data compilation	X	X	X	X	X	X	X	X	X	X
- Quality assurance	X	X	X	X	X	X	X	X	X	X
- Metadata	X	X	X	X	X	X	X	X	X	X
- Evaluation of comparability	X									
Deliverable 15										
- Small scale veg. models	X	X	X	X		X	X			X
- Actual and historic state	X	X	X	X		X	X			X
Deliverable 20										
- Reference conditions	X	X	X	X		X	X			X
Deliverable 21										
- Draft of paper	X	X	X			X				X
Deliverable 25										
- Large-scale models	X	X	X			X				X
Deliverable 26										
- Draft of paper	X	X	X			X				X
Deliverable 29										
- Draft of paper	X	X	X			X				X
Deliverable 30										
- Id. of indicators	X	X	X	X		X	X			X
Deliverable 31										
- Verified typology	X	X	X	X		X	X			X
Deliverable 32										
- Verified reference con.	X	X	X	X		X	X			X
Deliverable 34										
- Recommendations	X	X	X	X		X	X			X

2. Status and progress of deliverables

2.1 Overview of deliverables

The status of each deliverable is summarised in *Table 2*. Details on the contents of each deliverable are available in the updated detailed work plan located on the homepage (file: Workplan_WP3_rev).

Table 2   Deadlines and status of the contributions of WP 3 to the deliverables where this work package plays a role.

	Internal deadline	PL-deadline	EU-deadline	Status
Deliverable 3 - Datacompilation & QA - Metadata	15 Apr-02	15 May-02	1 June-02	Completed
Deliverable 15 - Small scale veg. models - Actual and historic state	1 July-03	15 July-03	1 Aug-03	In progress
Deliverable 20 - Reference conditions	1 Nov-03	15 Nov-03	1 Dec-03	Initiated
Deliverable 21 - Draft of paper	1 Nov-03	15 Nov-03	1 Dec-03	Not started
Deliverable 25 - Large-scale veg. models	1 May-04	15 May-04	1 June-04	Not started
Deliverable 26 - Draft of paper	1 May-04	15 May-04	1 June-04	Not started
Deliverable 29 - Draft of paper	1 Nov-04	15 Nov-04	1 Dec-04	Not started
Deliverable 30 - Id. of veg. indicators	1 Nov-04	15 Nov-04	1 Dec-04	Not started
Deliverable 31 - Verified typology	1 Nov-04	15 Nov-04	1 Dec-04	Not started
Deliverable 32 - Verified reference con.	1 Nov-04	15 Nov-04	1 Dec-04	Not started
Deliverable 34 - Recommendations	1 Nov-04	15 Nov-04	1 Dec-04	Not started

2.2 Deliverables in progress

Deliverable 15: "Small-scale vegetation models"
This section summarises the status of deliverable 15. Details can be found in the updated detailed workplan located on the homepage (file: Workplan_WP3_rev).

The deliverable aims to 1) identify present and historic state of the vegetation and evaluate long-term changes and 2) establish models that explain and predict changes in the vegetation based on changes in physicochemical factors. The models should focus on individual areas of the Baltic Sea (i.e. small spatial scale). These aims will be fulfilled through the following tasks:

Task 1 – Selection of potential quality elements for vegetation
This task was completed during the meeting in the vegetation group on 3-4 September 2002 (see minutes of meeting). The selected quality elements are shown in *Table 3*. All further analyses in WP 3 should be based on the selected quality elements. The work on each quality element will be carried out in working groups that each has a responsible person (*Table 3*).

Task 2 – Generate templates for compilation of data on each vegetation parameter and associated physico-chemical factors
4 templates have been generated and sent out for everybody to be filled in.

- Template_Fucus
- Template_eelgrass
- Template_Furcellaria
- Template_all algae (info on annual/perennial algae and depth distribution of all algae)

Most Fucus data are ready. All remaining data should be sent to the task manager by 1 January 2003.

Table 3 Selected quality elements, the habitats they refer to and the working group taking care of the work to be done. The term "depth distribution" includes: "the depth limit of the deepest individuals", "the depth of maximum abundance"; in addition for Fucus "the depth limit of the continuous Fucus belt" and for eelgrass "the depth limit of meadows". The quality elements in parenthesis are of secondary priority. The responsible person within each working group is underlined.

Quality element	Habitats	Working group
Depth distribution of *Fucus vesiculosus*	Hard substrates	<u>Kaire</u>, Ari, Georg, Anda, Dorte
Depth distribution of total algal community	Hard substrates	<u>Kaire</u>, Ari, Georg, Anda, Sigrid, Hendrik, Dorte
Depth distribution of *Furcellaria lumbricalis*	Hard substrates	<u>Georg</u>
Depth distribution of *Zostera marina*	Soft/sandy substrates	<u>Dorte</u>, Christoffer
Annual/perennial macroalgae	Hard/soft substrates	<u>Georg</u>
(Filamentous algae/*Zostera marina*)	Soft/sandy substrates	<u>Dorte</u>, Christoffer
Sensitive species, e.g. Charophytes	Sheltered bays with soft bottom	<u>Kaire</u>, Georg
Area cover and bed structure of *Zostera marina* as input to typology (and as possible quality element in protected areas)	Protected areas	<u>Dorte</u>, Christoffer
Associated fauna – eelgrass	Soft/sandy substrates	<u>Christoffer</u>

Task 3 – Identify present and historic state (when info is available) of the quality elements
Based on the compiled data, present and historic levels of each of the possible quality elements are identified. The task is initiated.

Task 4 – Evaluation of long-term changes in vegetation
Long-term changes in each vegetation quality element are evaluated based on comparisons of historic versus present state of the quality elements. The task is initiated.

Task 5 – Small scale vegetation models
The ultimate goal of both small and large-scale vegetation analyses is to identify relations between quality elements and anthropogenic impact. The models should explain and predict changes in the distribution and abundance of vegetation in relation to changes in water quality and geomorphology. The models should preferably allow us to separate between "natural" and "anthropogenic" impact on vegetation. The task is initiated (see more details in. 3.2).

3. Scientific status and progress of WP 3

3.1 Data workshop in Copenhagen 3-4 September 2002

Main outcomes of the workshop:
- Presentations, discussions and evaluations of possible vegetation indicators
- Selection of a number of promising vegetation indicators to be analysed thoroughly through all remaining deliverables of WP 3 (Table 3)
- Definition of working groups to be in charge of the work to be done for each vegetation indicator (Table 3)
- Detailed planning of next years work
- Updating of the detailed workplan

The agenda, the minutes of the meeting as well as the updated workplan for WP 3 are available on the homepage.

3.2 Status on the work on quality elements

Macrophytes in general

Blümel C., Schubert M., Steinhart T. & Schubert H. (planned for early 2003): Development of ecological quality standards for submersed macrophytes of coastal lagoons of the German Baltic Sea. (in prep.).

This work analyses the fundamental conditions of ecology for macrophytes within the inner coastal waters of the German Baltic Sea. A system of typology for macrophytes has been developed which is based on the physio-chemical descriptors according to the WFD and the known ecophysiological requirements. The analysis of these requirements led to a minimum matrix of 14 factor combinations for a sufficient ecological characterisation of the communities. For three semi-enclosed lagoons along the characteristic salinity gradient of the southern Baltic Sea the macrophyte distribution for pristine ecological conditions were reconstructed based on herbarium records from the 18th century up to now. In total 80 species of macroalgae and angiosperms were verified. 13 communities were derived according to the concept of vegetation communities (*Enteromorpha*-stands, *Zostera noltii*-*Ruppia cirrhosa*-community, small Characeen stands, Characeen-*Ruppia cirrhosa* community, *Ruppia cirrhosa*-stands, *Najas marina*-stands, large Characeen stands, epilithic green algae community, Characeen-Zostera marina-community, *Chaetomorpha linum* drift algae mats, *Chorda filum*-stands, *Fucus*-stands and epilithic red algae community). Two species (*Lamprothamnium papulosum* and *Chara connivens*) have to be considered as extinct in these coastal areas.

Depth distribution of the total macrophyte community

Domin A., Schubert H., Krause J.C. & Schiewer U.: Modeling of pristine depth limits for macrophyte growth in the southern Baltic Sea. Hydrobiologia (submitted).

This work reconstructs the pristine habitats of macrophyte communities on the basis of specific physical and chemical properties of the habitat and ecophysiological potentials of macrophytes. In order to evaluate the most likely depth limits for macrophyte distribution, the annual depth-dependent light intensities were calculated for typical lagoons of the Southern Baltic Sea. Knowledge of minimum light requirements for the growth of main species allowed calculating potential maximum depth-distribution through the year. Comparisons of these potential growth limits were found to be in accordance with historical depth distributions. The results suggested that anthropogenic eutrophication and increased phytoplankton concentrations could indirectly be responsible for the presently observed loss of macrophytes coverage due to light limitation.

Sagert S., Feuerpfeil P. & Schubert H. : Depth limits of macrophyte communities along the salinity gradient of the German Baltic coast. In prep.

A first reconstruction to describe pristine habitats of macrophytes communities was developed for three coastal semi-enclosed waters of the southern Baltic Sea. This reconstruction based on the analyses of locally available herbarium-material. Unfortunately, such historical data sets are not available for the outer parts of the German Baltic coast. Therefore the classification system for macrophytes must be derived from recent data and from the ecophysiological requirements of selected macrophyte communities in this region.

In 1996 a regular monitoring program started along the outer German Baltic coast by order of the local federal authorities. The program comprised a yearly sampling along 14 transects. The main parameters were abundance/cover of higher taxonomic groups and depth distribution of main species. These data sets will be replenished with current samplings in hard bottom communities, which include resolutions down to the species level along the whole salinity gradient. The work aims at a first analysis of these data sets regarding to the requirements of the WFD. The main focus shall be directed to depth limits of growth for the main communities or species in relation to different salinities and underwater light climates.

Depth distribution of *Zostera marina*

Boström C., Baden S.P. & Krause-Jensen D.: Scandinavia and the Baltic Sea Region. In Green E.P., Short F.T., Spalding M.D. (Eds.): World Atlas of Seagrasses: present status and future conservation. Planned publication early 2003.

This work summarises the existing information on recent and historic depth- and area distribution of *Zostera marina* in the Baltic Sea region.

Krause-Jensen D., Greve T.M. & Nielsen K.: Eelgrass as a quality element: The European Water Framework Directive in practice. Submitted to Water Resources Management.

This work aims to test the implementation of the European Water Framework Directive (WFD) in practice using the depth limit of eelgrass in Danish coastal waters as example. A large historic data material from 1900 on depth limits of eelgrass provided unique opportunities to characterise “reference conditions” that reflect an “undisturbed” ecosystem (*Figure 9*). Actual depth limits were obtained from the Danish National Monitoring and Assessment Programme *(Figure 9*). Data represented a wide range of Danish coastal water bodies that were grouped into 10 water body types based on differences in salinity and depth as required by the WFD. The ecological status of each water body was then assessed according to the degree of deviation of actual depth limits from reference conditions defined for that particular water body type. The results showed that reference conditions varied markedly within given water body types and the use of type-specific reference conditions therefore implied a serious risk of misinterpretation of ecological status. Site-specific reference conditions and site-specific status classes seem to be a robust alternative that may be considered for the implementation of the WFD.

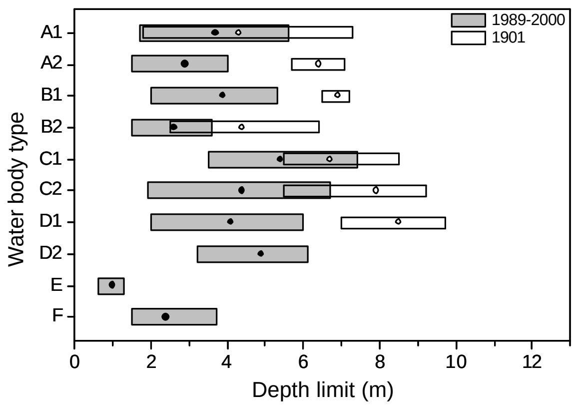

Figure 9 Depth limits of eelgrass in 10 different water body types. Open circles represent means and open bars the range (10-90% percentiles) of reference depth limits. Reference data represent conservative estimates of depth limits in 1901 and include a total of 95 observations in water bodies distributed with 2-27 observations within each water body type. Solid circles represent means and solid bars the range (10-90% percentiles) of maximum actual depth limits based on investigations under the National Danish Monitoring Programme in 1989-2000. The actual data include a total of 1925 estimates of depth limits distributed with 7-462 observations within each water body type.

Krause-Jensen D., Pedersen M.F. & Jensen C.: Regulation of eelgrass Zostera marina cover in Danish coastal waters. – Estuaries. Accepted.

Abstract: A large data set, collected under the national Danish monitoring programme, was used to evaluate the importance of photon flux density (PFD), relative wave exposure (REI), littoral slope and salinity in regulating eelgrass cover at different depth intervals in Danish coastal waters. Average eelgrass cover exhibited a bell-shaped pattern with depth, reflecting that different factors regulate eelgrass cover at shallow- and deep-water sites. The multiple logistic regression analysis was used to identify regulating factors and determine their role in relation to eelgrass cover at different depth intervals. PFD, REI and salinity were main factors affecting eelgrass cover while littoral slope had no significant effect. Eelgrass cover increased with increasing PFD at water depths of more than 2 m, while cover was inversely related to REI in shallow water. This pattern favoured eelgrass cover at intermediate depths where levels of PFD and REI were moderate. Salinity had a minor, but significant, effect on eelgrass cover that is most likely related to the varying costs of osmoregulation with changing salinity. The analysis provided a useful conceptual framework for understanding the factors that regulate eelgrass abundance with depth. Although the regression model was statistically significant and included the factors generally considered most important in regulating eelgrass cover, its explanatory power was low, especially in shallow water. The largest discrepancies between predicted and observed values of cover appeared in cases where no eelgrass occurred despite sufficient light and moderate levels of exposure (almost 50% of all observations). These discrepancies suggest that population losses due to stochastic phenomena, such as extreme wind events, play an important regulating role that is not adequately described by average exposure levels. A more thorough knowledge on the importance of such loss processes and the time scales involved in recovery of seagrass populations after severe disturbance are necessary if we are to understand the regulation of seagrass distribution in shallow coastal areas more fully.

In relation to the Water Framework Directive, shallow water eelgrass populations do not seem to be a useful quality element because they are largely dominated by physical forces. By contrast, the deep eelgrass populations respond more directly to changing water quality and are likely to be useful quality elements.

Depth distribution of *Fucus vesiculosus*

Ruuskanen A., Nappu N., Kiirikki M., Kinnunen V. and Bäck S.: Depth distribution of Fucus vesiculosus in the Finnish Archipelago (Preliminary title). In prep.

This work analyses changes in vertical distribution of Fucus in temporal and geographical scale during 1990s. We plot changes in growth depth to changes in secchi depth. Preliminary results indicate that the lower growth limit of the Fucus belt has become approximately 0,8 m deeper in the sheltered and moderately sheltered archipelago, but no changes occurred in the exposed archipelago. The trend is equal along the whole Gulf of Finland.

Kaire T. et al.:Depth distribution of Fucus vesiculosus in the Baltic Sea – past and present (Preliminary title). In prep.

This work analyses spatial and temporal variations in the depth distribution of *Fucus vesiculosus* in various districts of the Baltic Sea. Initial analyses of data from the period 1990-2001 show that the lower depth limit of Fucus individuals vary from an average of 1.4 m in the Kattegat (west) to an average of 4.5 m in the Gulf of Kiel and adjacent areas (*Figure 10*). Depth limits of the Fucus belt exist for only few districts (*Figure 11*) where they vary from 2.26 m in the Gulf of Riga to 2.82 m in the Gulf of Finland. The depth of maximum abundance of *Fucus vesiculosus* follow the same spatial pattern and that of the depth limit of the individuals varying from an average of 0.97 m in Danish Belts to an average of 2.53 m in Bornholm Sea (*Figure 12*). Historic depth limits exist from only few areas and are not yet analysed.

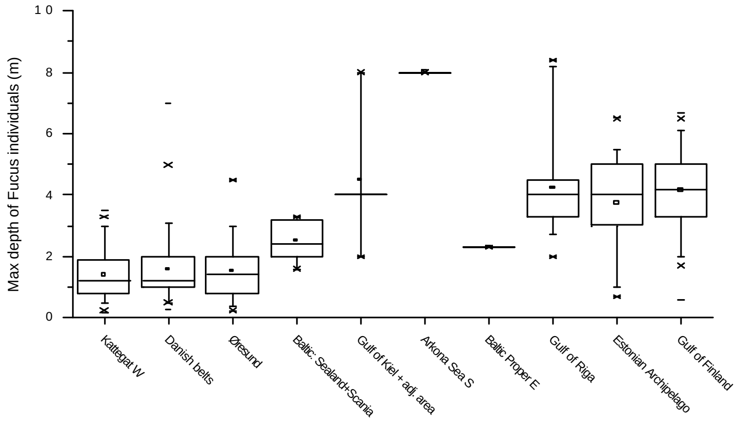

Figure 10 Maximum depth limit of Fucus vesiculosus *individuals in various districts of the Baltic Sea. Data represent the period 1990-2001. Squares represent mean values of the quality element, lines represent medians, boxes represent 25-75% percentiles, and whiskers represent 5-95% percentiles of the variation among observations within a given district.*

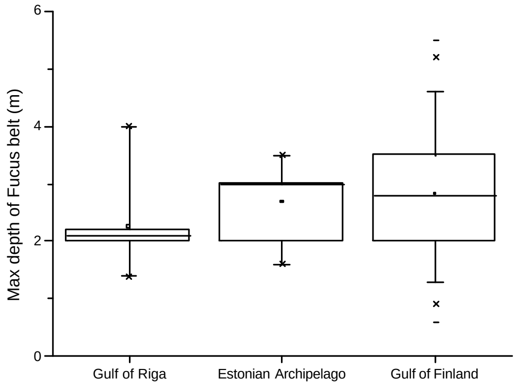

Figure 11 Maximum depth of the Fucus vesiculosus *belt in various districts of the Baltic Sea. Data represent the period 1990-2001. Squares represent mean values of the quality element, lines represent medians, boxes represent 25-75% percentiles, and whiskers represent 5-95% percentiles of the variation among observations within a given district.*

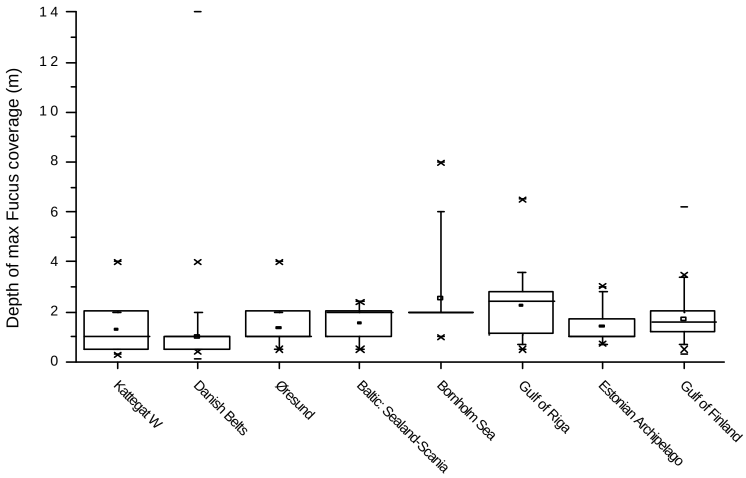

Figure 12 Depth of maximum coverage of Fucus vesiculosus *in various districts of the Baltic Sea. Data represent the period 1990-2001. Squares represent mean values of the quality element, lines represent medians, boxes represent 25-75% percentiles, and whiskers represent 5-95% percentiles of the variation among observations within a given district.*

Eelgrass-associated fauna

Böstrom C., Bonsdorff E., Kangas P. & Norkko A. 2002: Long-term changes in a brackish-water eelgrass (Zostera marina L.) community indicate effects of coastal eutrophication. – Estuarine Coastal Shelf Science 55: 795-804.

The distribution and importance of eelgrass (*Zostera marina L.*) meadows for associated faunal communities in the coastal waters of the Baltic Sea are still poorly known. In June 1993, a seagrass locality (Tvärminne, SW Finland) thoroughly studied in 1968-71 was revisited in order to detect possible long-term changes in both vegetation structure (distribution, density, biomass) and benthic infauna (species composition, abundance, biomass, distribution and diversity patterns). The same sampling design as in the 1979s was used in both sparse (< 20 shoots m^{-2}) and dense (> 150 shoots m^{-2}). In addition the feeding-efficiency of adult flounder (*Platichtys flesus L.*) on infauna was measured by counting feeding pits in vegetated and bare sand. The analysis shows that the shoot density had increased in sparse *Z. marina*, while dense *Z. marina* patches showed similar biomass values (20 g AFDW m^{-2}) as in the 1970s. In contrast to the vegetation, where little apparent change could be recorded, the total abundance and biomass of zoobenthos have increased significantly between 1968-71 and 1993 in the dense *Z. marina* patches. These changes are mainly attributed to significant increases of the bivalve *Macoma balthica L.*, mudsnails *Hydrobia* spp. and oligochaetes. In sparse *Z. marina* diversity in terms of number of taxa exhibited minor changes over time, whereas in dense *Z. marina* patches the mean number of taxa has increased from 16 to 20. This study represents a rare example of long-term persistence of seagrass communities in an area where the negative effects of nutrient enrichment are evident. The faunal changes in the *Z. marina* community indicate increased food availability, which is associated with positive effects of coastal eutrophication.

As seagrass responses to slowly increasing nutrient enrichment are not gradual, it was concluded that, even though stable over the past 25 years, the *Z. marina* communities in the northern Baltic Sea have reached a critical stage where continued eutrophication will most likely involve reduction of seagrass biomass and loss of valuable faunal habitats, and thus possible loss of overall biodiversity.

In CHARM we will take into account that faunal changes in seagrass meadows reflect eutrophication related changes in the marine environment, and thus are relevant in the classification of the state of coastal waters.

4. Publications

Oral presentations

Kauppila P., Nappu N., Ruuskanen A., Kiirikki M. og Bäck S. 2002: Trends of Secchi depth and growth depth of Fucus along the Finnish coast. – The Changing State of the Gulf of Finland Ecosystem symposium in Tallin, 28-30 October 2002.

Schubert H. 2002: (Implementation of the Water-Framework-directive: Characterisation of the ecological status for inner coastal waters, German) Umsetzung der EU-WRRL: Indikation des ökologischen Zustandes der inneren Küstengewässer. – Meeting of the German Federal Environmental Foundation (DBU), Osnabrück, April 2002.

Schubert H. 2002: (Development of ecological quality standards for submersed macrophytes of coastal lagoons of the German Baltic Sea, German). Entwicklung von leitbildorientierten Bewertungsgrundlagen für Übergangsgewässer entsprechend EU-Wasserrahmenrichtlinie. – Annual Meeting of the Federal Agency for Coastal Monitoring Programs (BLMP), Güstrow, May 2002.

Schubert H. 2002: (Ecological evaluation on the basis of submerged macrophytes along the German Baltic Coast, German). Bewertungsgrundlagen Makrophyten der Ostseeküste. – Kobio-Meeting, Essen, June 2002.

Posters

Nielsen K., Sømod B., Ellegaard C., Krause-Jensen D. 2002: Reference conditions – a case study in Randers Fjord, Denmark. – Poster presented at "12. Danske Havforskermøde", University of Århus, Denmark, January 9-11, 2002.

Publications – published or accepted

Boström C, Baden S.P., Krause-Jensen D.: Scandinavia and the Baltic Sea Region. In Green E.P., Short F.T. & Spalding M.D. (Eds.) World Atlas of Seagrasses: present status and future conservation. Planned publication early 2003.

Krause-Jensen, D., Pedersen, M.F. & Jensen, C.: Regulation of eelgrass *Zostera marina* cover in Danish coastal waters. – Estuaries. Accepted.

Nielsen K., Sømod B., Ellegaard C. & Krause-Jensen D.: Assessing reference conditions according to the European Water Framework Directive using modelling and analysis of historical data – an example from Randers Fjord, Denmark. – Ambio (accepted).

Publications – submitted

Domin A., Schubert H., Krause J.C. & Schiewer U.: Modelling of pristine depth limits for macrophyte growth in the southern Baltic Sea. – Hydrobiologia (submitted).

Krause-Jensen D., Greve T.M. & Nielsen K.: Eelgrass as a quality element: The European Water Framework Directive in practice. – Submitted to Water Resources Management.

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Kaire T. et al.: Depth distribution of *Fucus vesiculosus* in the Baltic Sea – past and present. In prep.

Ruuskanen A., Nappu N., Kiirikki M., Kinnunen V., Bäck S.: Depth distribution of *Fucus vesiculosus* in the Finnish Archipelago (preliminary title). In prep.

Sagert S., Feuerpfeil P. & Schubert H.: Depth limits of macrophyte communities along the salinity gradient of the German Baltic coast. In prep.

Work package 4

On the national basis, the typification system has been created for the entire Estonian coastal sea using the historical macrozoobenthos data (approximately 2000 grab samples). The system is now tested in three selected areas. The results indicate that the selected macrozoobenthos parameters are in very good accordance with each other as well as with macrophytobenthic parameters in describing the water quality in all three areas.

For the CHARM purpose we have created a special database with macrozoobenthos data with some additional information on water chemistry and plankton species.

The following are the references within CHARM activities:

Kotta, J., Simm, M., Kotta, I., Kanošina, I., Kallaste, K., & Raid, T.: Factors controlling the long-term changes of the eutrophicated ecosystem of Pärnu Bay, the Gulf of Riga. – Hydrobiologia (in press).

Kotta, I. & Kotta, J. 2003: Benthic invertebrate assemblages in highly productive areas of the Estonian coastal sea. – Proc. Estonian Acad. Sci. Biol. Ecol., 52 (in press).

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