BALANCE Interim Report No. 7

The BALANCE Cruise Report: The Kattegat

1st of April – 23rd of November 2006

Baltic Sea Region
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BALANCE

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0 PREFACE

This cruise report presents a short concise description of the habitat mapping activities conducted by the National Environmental Research Institute (NERI) in Kattegat in May, June and august 2006 and by The Geological Survey of Denmark and Greenland (GEUS) in November 2006. The activities are part of the BSR INTERREG IIIB project "BALANCE". The area of activity in Kattegat is part of the BALANCE pilot area 1.

Four separate cruises have been performed.

The first cruise with R/S 'Gunnar Thorson' was carried out in conjunction with the national (Danish) soft bottom benthic monitoring cruise in May 2006. The sampling in pilot area 1 was completed during a very intense period over 24 hours.

The second cruise took place at the end of June 2006 with R/S 'Havternen' focussing on hard bottom habitats. Furthermore, some hours was spend in August 2006 in conjunction with the national reef monitoring cruise with R/S 'Havternen' exploring sea grass beds south of the island of Læsø. Finally a cruise was conducted by GEUS in November 2006 using R/S 'Føniks Miljø' for acquiring acoustic data within the area surveyed by NERI in May and June.

Tabel 1: Cruise participants

"Soft bottom survey" with R/S 'Gunnar Thorson'	Jørgen Hansen, cruise leader and marine biologist Alf B. Josefson (marine biologist) Hanne Ferdinand, technician Jan Damgaard Nielsen, technician
"Hard bottom" and "sea grass" surveys with R/S 'Havternen'	Karsten Dahl, cruise leader Steffen Lundsten, marine biologist Jan Damgaard Nielsen, technician (only in June) Michael Bo Rasmussen, marine biologist (only in August)
"Acoustic survey" with R/S 'Føniks Miljø'	Jørgen O. Leth, cruise leader Zyad Alhamdani, geophysicist

Further information on the BALANCE project can be achieved at www.balance-eu.org.

Karsten Dahl

The National Environmental Research Institute

1 INTRODUCTION

BALANCE (Baltic Sea Management – Nature Conservation and Sustainable Development of the Ecosystem through Spatial Planning) is a BSR INTERREG IIIB co-funded project that aims to develop informed marine management tools for the Baltic Sea on the basis of spatial planning and cross-sectoral and transnational co-operation. One of its main objectives is to define marine landscapes for the Baltic Sea and develop marine habitat maps within four pilot areas.

The field investigations of the Danish National Environmental Research Institute (NERI) took place in summer 2006 in Kattegat in the BALANCE Pilot area 1. NERI's field activities in pilot area 1 support necessary biological and geological data for marine habitat mapping in the area and provide field data for the validation process of the marine landscapes and habitat models.

The purpose of NERI's field survey was to sample data within the case study area in the central Kattegat to verify landscape and habitat modelling. The sampling focused on:

- Sediment and benthic soft bottom fauna samples
- Visual description of hard bottom seabed and the associated cover of epibentic macroalgae vegetation and fauna
- Sea grass cover in selected areas in shallow water areas

Soft and hard bottom sampling was performed in a specific area within pilot area 1 in the central Kattegat (see figure 1). The area was chosen due to very complex bathymetry with deep canals and known presence of boulder reef areas.

Work with identification of areas with sea grass and estimation of sea grass cover was done in the shallow water south of the Island Læsø. Large sea grass beds previously have been found in this area.

The aim of the acoustic survey conducted by GEUS was to acquire data of high resolution, which together with the ground truth information sampled by NERI, is considered to be useful for seabed habitat mapping.

The survey areas are shown in figure 1.

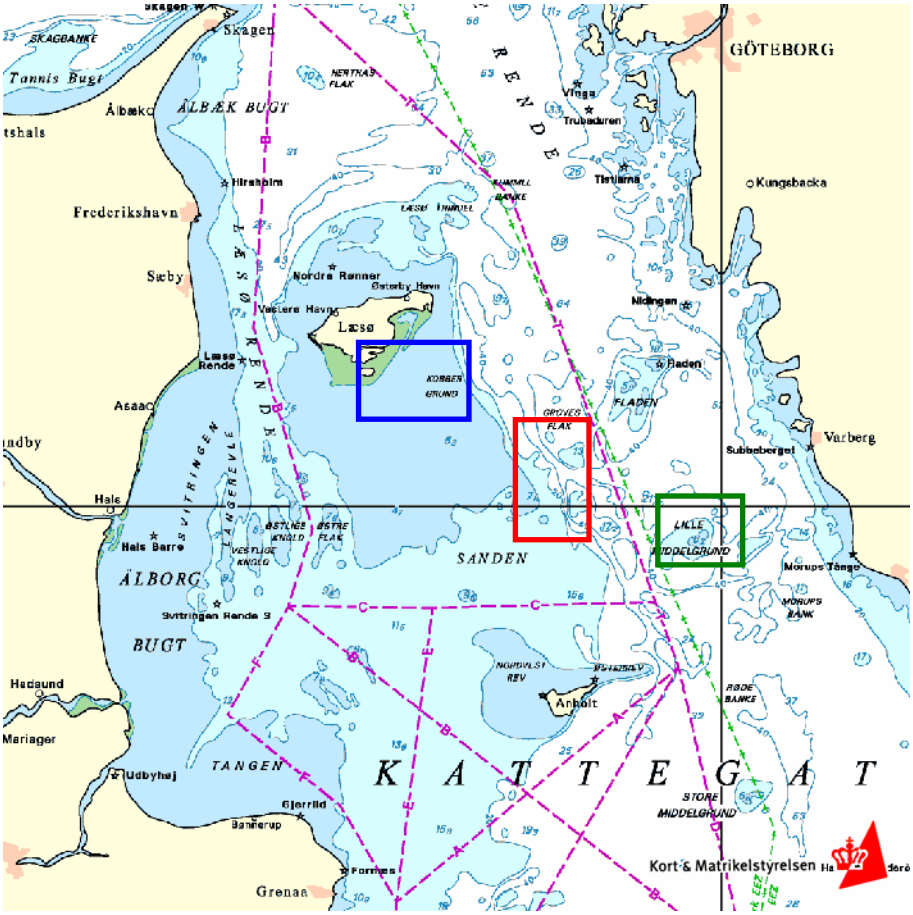

Figure 1. Case study areas within BALANCE pilot area 1 in Kattegat/Skagerrak. Sea grass investigation took place in the shallow water area (<6 m.) marked with blue. Investigations of soft bottom fauna, hard bottom flora and fauna and sediment took place in the area marked with red at water depth between 14 and 110 m and hard bottom flora and fauna and sediment investigation as well as the side scanning was carried out in the area marked with green at water depths between 15 and 50m.

2 METHODS

The Royal Danish Administration of Navigation and Hydrography has previously mapped the survey area in the central Kattegat with multibeam echosounder. The Geological Survey of Sweden (SGU) has been involved in similar mapping exercises in the Swedish territorial waters around Lille Middelgrund.

According to the workplan a preliminary identification of landscapes present in the central area of Kattegat should be delivered by GEUS before NERI's two cruises in May and June. The landscapes should be based on available data from the Royal Danish Administration Navigation and Hydrography as well as from GEUS and SGU' own investigations.

2.1 Transects and points to be investigated

The preliminary analysis was unfortunately not ready in time before the field investigations, partly due to unforeseen lack of sidescan data. Alternatively a number of transects were planed based on expectations that they could be used to verify the following acoustic analysis

The preliminary analysis was unfortunately not ready in time before the field investigations. Alternatively a number of transects were planed based on expectations that they could be used to verify the following acoustic analysis:

- Five long sampling transects for sediment/soft bottom fauna was established based on the bathymetric map of the Royal Danish Administration Navigation and Hydrography. The transects were located so they covered interesting bathymetric features and a largest possible difference in depth.

- 60 transects, and 9 point investigations for television inspections for hard bottom epifauna and macroalgal vegetation as well as visual description on sediment was chosen based on:

    - the bathymetric map of the Royal Danish Administration Navigation and Hydrography covering the Danish part of the case story area

    - on locations where the soft bottom sampler failed to work (points) in the Danish area and

    - on existing bathymetric and geological maps from SGU at Lille Middelgrund and Fladen in the Swedish part of the case story area.

- Five dives also took place at boulder reefs to gather information on species composition of epifauna and macroalgal vegetation. The locations for diving were planed during the cruise based on information gathered by the television inspection.

- Sidescan sonar transects was planned to cover the NERI transect lines acquiring full coverage sidescan data of the sampling and visual inspections locations.

Due to very bad weather conditions in 3 days during the cruise in there were only funding to investigate 6 television transects and 3 point investigations in the Danish area and 3 transects at Lille Middelgrund in the Swedish area.

Bad weather during the cruise in November hindered the performance of all the planned lines i.e. only 4 transect lines plus one transit line were cover (see figure 2a) by the side scan sonar.

The distribution of the individual transects and point investigations are shown in figure 2a-b.

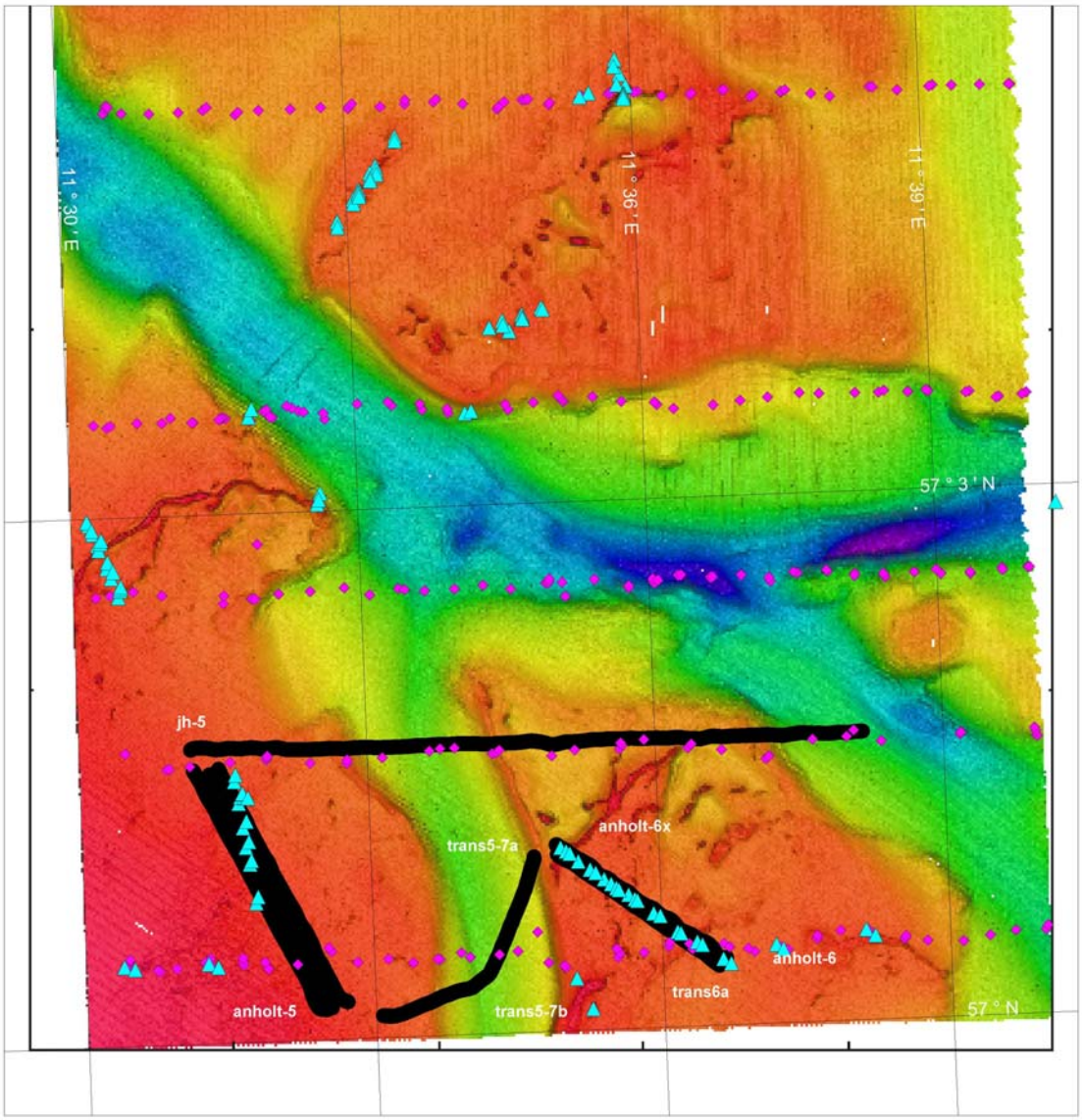

Figure 2a. The actual location of the activities performed by NERI and GEUS in pilot area 1. The individual lines from the sidescan sonar survey are shown in black. The width of the lines is indicative for the coverage by the sidescan swath. The NERI sampling positions are shown as purple dots. The light blue triangles indicate diving stations and positions of benthic descriptions based on underwater video. Due to bad weather conditions the NERI transects were only partly covered by sidescan sonar. The multibeam echosounder base map is by courtesy of The Royal Danish Administration Navigation and Hydrography.

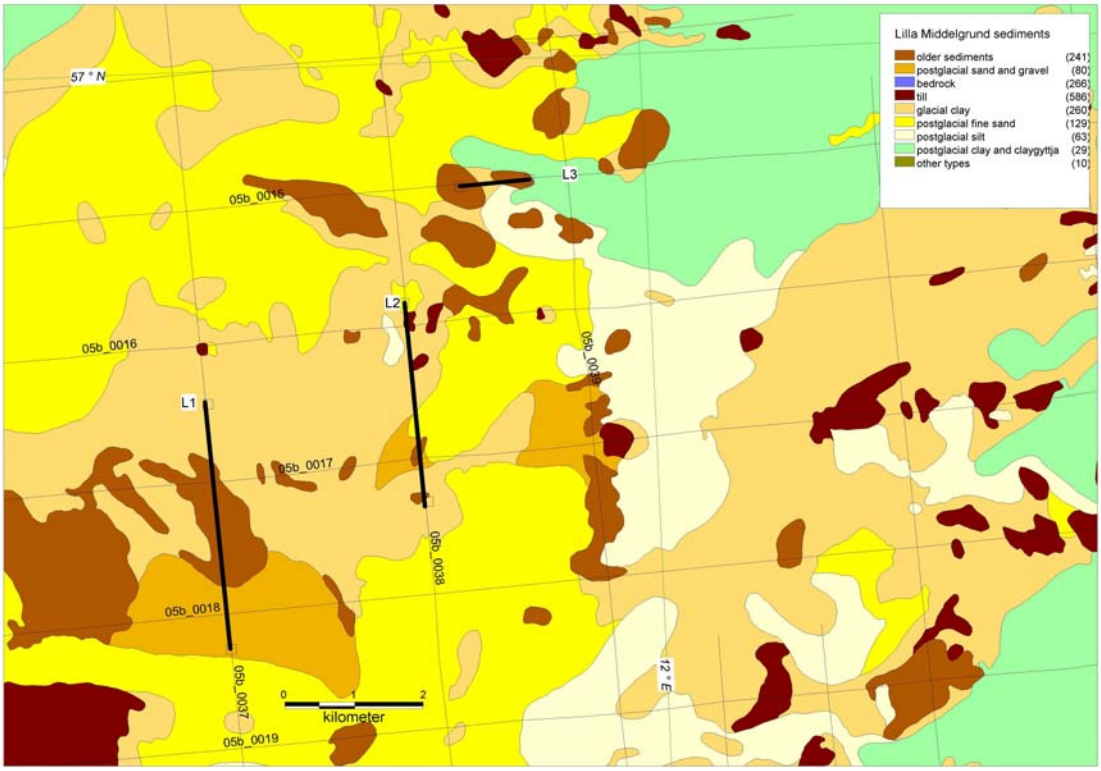

Figure 2b. Investigations in the Swedish part of the case study area in pilot 1at Lille Middelgrund. The base map is the SGU sediment distribution map.

2.2 Positioning

DGPS-satellite positioning took place next to the winch of the core sampler on R/S 'Gunnar Thorson' and the underwater video camera was handled a few meter from the GPS antenna onboard the R/S 'Havternen'. Some deviation between the actual sampling location at the seabed and the position is expected due to drifting of the ship and changing currents in the water column.

During the acoustic survey the positioning was managed by the NaviPac® software. The offset of the sidescan fish in relation to the DGPS antenna position was set in the set-up file [(x,y,z) = (5,-20, 0)]. I.e. the position stored in the navigation file has been corrected to the real position of the fish.

2.3 Underwater video inspection with focus on hard bottom

An underwater video system including light mounted on an aluminum frame were used from 5-8 sub-transect along the main hard bottom transects and all sequences are saved on DVD's (figure 3).

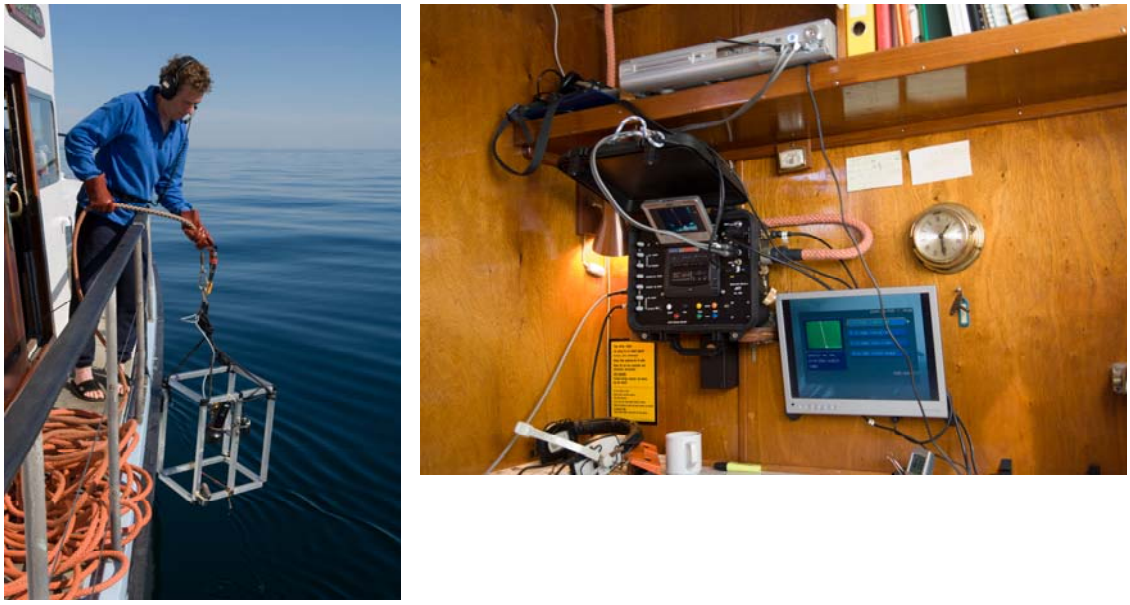

Figure 3. An underwater video system with monitor and hard disk/DVD recorder

The underwater inspection focused on a rough description on the average sediment structure between obviously changing types of seabeds as well as the general vegetation cover, cover of red and brown algal species and cover of larger recognizable algal and epifauna species. The chosen 9 transects were split on 60 sub-transects. On each sub-transect the seabed were observed during drifting of the vessel of in average 100 m. Positions were taken when the seabed changed during the sub transect (figure 4). 100 different seabeds are described from the sub-transects. In addition 7 points along the soft-bottom transects were inspected as well as two other points chosen due to interesting features.

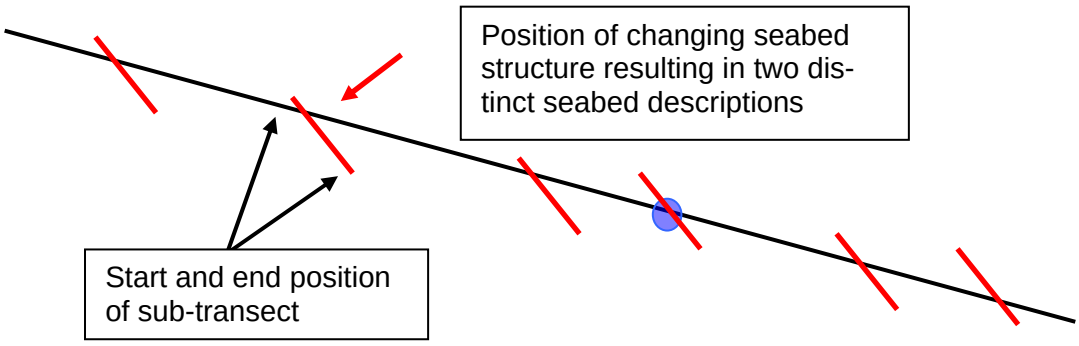

Figure 4. Example on transect with 6 sub-transects were television inspection took place (red color) and a dive investigation indicated by a blue point.

2.4 Dive inspection

Diving was done by experienced divers to describe the species composition of epifauna and macroalgal vegetation in more detail. Diving was carried out on 5 locations from 11 to 27 meter waterdepth. DVD recording of benthic flora and epifauna were done during diving as well as photo documentation with a NIKON D2X camera in a Subal underwater housing using a SB-800 flashlight.

2.5 Sampling sediment and softbottom fauna

ll sampling were done with a “haps” core sampler (figure 5) (Kanneworf & Nicolaisen 1973) The “Habs” core cover 142 cm^2 seabed surface and sample to a sediment depth of 10 to 24 cm depending of the structure of the soft sediment. The samples can not operate probably on hard sandy seabed or when the sediment include even smaller stones.

Figure 5. Emptying a core from a "Haps" core sampler Foto: NERI

If the first attempt to sample was not successful at a given location it was repeated 2 times,. If still not successful the station was left assuming that the seabed was too rough for the coresampler. Samples were taken on 157 stations out of 276 along the 5 transects. The distribution of successful and not successful sampling along the five transects is visualized in figure 6.

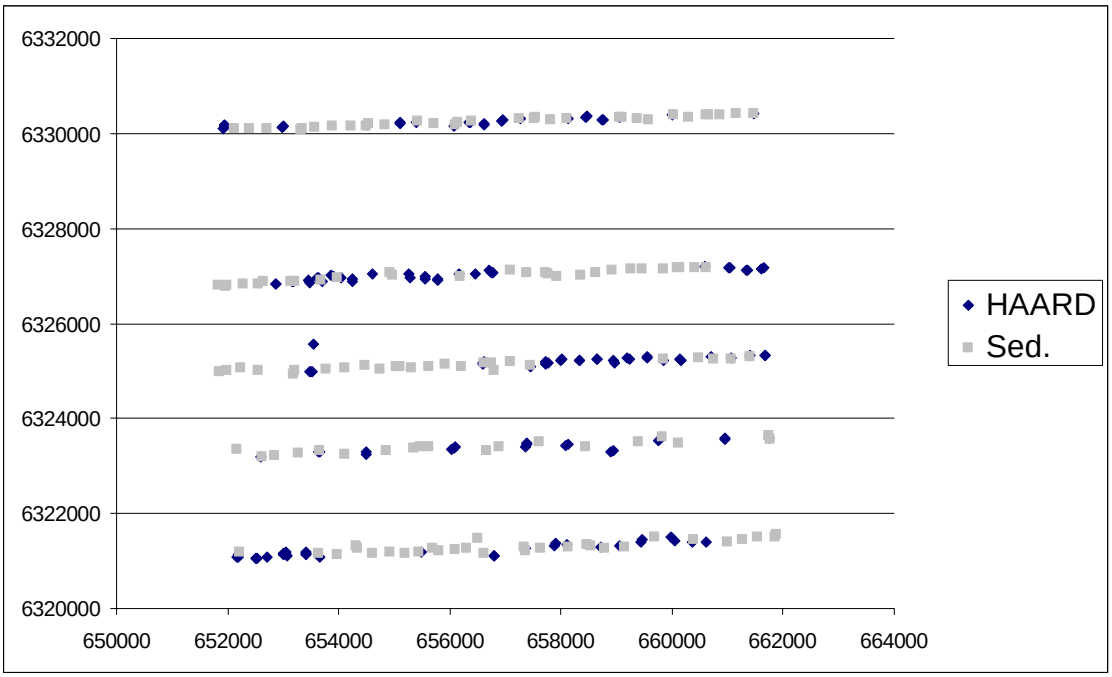

Figure 6. Haps core samples along 5 transects in the case study area in Kattegat. "HAARD" indicate that the sampling was not successful and "sed" indicate that sampling took place. numbers in X and Y axes are UTM coordinates (zone 32)

Subsamples of 60 ml were taken for sediment analysis at GEUS. The rest of the sample was sieved onboard with a 1,0 mm sieve. and preserved in formalin buffered with borax for further analysis of fauna biomass and abundance in laboratory. In addition to the sampling inside the pilot area, 21 extra large sediment samples (2 liter) were sampled from the pilot area and further some 15 locations were sampled outside the pilot area covering the Kattegat. The purpose of the large samples were to verify sediment-fauna relationships outside the pilot areas and as a supplement to sediment description based on the 60ml sediment samples.

2.6 Sea grass survey

A long transect at the shallow water south of Læsø was surveyed with the purpose to find patches ore larger meadows with sea grass beds. Ecco sounder, direct visual sighting and underwater television system were used in combination. Location of sea grass meadows should be used as reference points in an image analysis of satellite photos. Unfortunately only very small patches were found.

2.7 The Sidescan Sonar survey

The system used is the Benthos SIS - 1624 dual frequency digital side scan sonar (figure 7a). It's towed behind the survey boat at a safe distance. For the configuration see figure 7b. The system operates at two sweeped frequencies simultaneously: 110 - 130 kHz and 370 - 390 kHz corresponding to a standard and high-resolution operation respectively. The system generates a fan shape beam in the cross track direction. The transducer radiation is 0.5° horizontal/55°vertical for the 110 – 130 kHz band; 0.5° horizontal/35° vertical for the 370 - 390 kHz band. A 1 - 8 knots towing speed is given in the manual, but a survey speed of 4 knots was found to be adequate for the survey in hand.

Figure 7a. Benthos Side Scan Sonar fish.

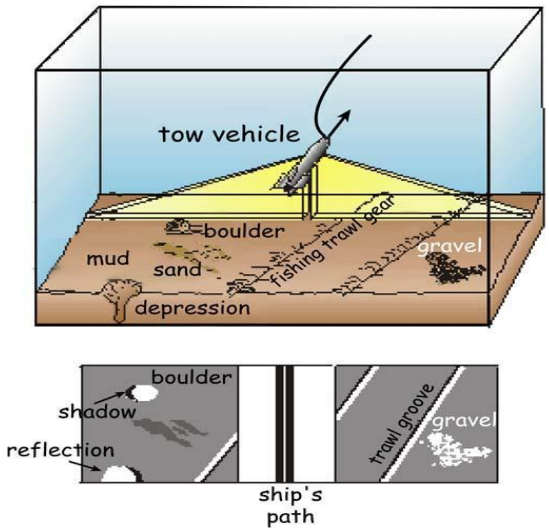

Figure 7b. Schematic diagram of the side scan sonar operation.

The Triton Elics ISIS Sonar software was used for collecting side scan data. The data was recorded digitally in *.XTF format. Important targets were noticed online and delineated for further inspection. The processing software is also the ISIS Suite where data can be corrected for range and grey tone to enhance its quality for interpretation.

For technical details on the sidescan sonar system see appendix 1.

3 CONCLUSIONS

The purpose of the cruises was fulfilled, i.e. to sample data within the case study area in the central Kattegat for verifying marine landscapes and habitat modelling, although the second cruise was affected by very bad weather conditions resulting in a smaller number of transects investigated than originally planned. The fieldwork area was delimited based on available multibeam data and geological information from Denmark and Sweden. During the fieldwork the applicability of the combined use of multibeam sonar and sidescan sonar systems was tested as a tool for mapping of marine habitats. A huge number of core samples were taken and 60 sub-transects of approximately 100 m length were inspected using the underwater television system. In addition 5 dives were carried out for detailed taxonomic investigations of biota on boulder reefs. Side scan sonar data has been acquired covering parts of the sampling stations as well as the transects inspected by video and divers.

4 ACKNOWLEDGEMENT

Previous studies in the pilot area 1 and the performed field work has been based on multibeam echosounder maps made available for the BALANCE project by Dennis Anthony from The Royal Danish Administration Navigation and Hydrography who is gratefully acknowledged.

5 APPENDIX 1: THE SIDESCAN SONAR SYSTEM

The Benthos SIS-1600 Series Side Scan Sonar is a fully integrated system that uses both advanced Chirp and conventional continuous wave (CW) technologies—single frequency or dual frequency—and an advanced high-speed communications link to acquire high resolution side scan sonar images.
The Benthos SIS-1600 is a complete side scan sonar survey system that includes a topside acquisition system and software, a 100-meter tow cable, the CL-160 Communications Link, and one of two available tow vehicles: the TTV-196 Tow Vehicle, which acquires long range, high resolution Chirp side scan sonar images in a single frequency band; and the TTV-196D Tow Vehicle, which acquires long range, high resolution Chirp side scan sonar images in two frequency bands simultaneously.

System Highlights

▲ CL-160 Communications Link
▲ 100 kHz, 100 meter range
▲ 400 kHz, 100 meter range
▲ Topside sonar processor

System Features

The TTV-196D Tow Vehicle includes the transceiver electronics, the processing and communications electronics, the port and starboard side scan transducer arrays, the pitch, roll and heading sensors, and the optional sensors. The optional sensors include a water temperature sensor, a pressure sensor, a magnetometer, and a responder. Hydro dynamically stable tow vehicle with operating depth up to 1,750 meters.

Features
■ Dynamic range - high frequency data up to 150 meters
■ Enhanced resolution
■ Repeatable transmitted waveforms
■ Constant temporal resolution
■ The pulse characteristics are programmable
■ Stainless steel construction
■ Seaconnet shipwreck, 400 kHz, 75 meter range

SYSTEM SPECIFICATIONS

Software
Application: Third party data acquisition and display (i.e.TEI “Isis Lite”, Chesapeake, “Sonarmap”)
Operating System: Microsoft® Windows® XP Professional

Hardware
Processor CPU: Intel® Pentium® 4 processor
Memory: 512 DDR SDRAM
I/O Ports: Wireless keyboard/mouse
RS-232 serial
Parallel
Ethernet 10/100 BaseT
Graphics Processor: Integrated high resolution graphics
Data Sorage: High capacity hard drive, CD/DVD-RW drive
CL-160 Communications Link

Physical Characteristics
Construction: 316 stainless steel
Dimensions: 11.4 cm (4.5 in.) outside diameter by 177.8 cm (70 in.) long
Weight in Air: 34 Kg (75 pounds)
Weight in Water: 25 Kg (55 pounds), approx.
Operating Depth: 1,750 meters
Towing Speed: 1 to 8 knots operational
Input Power: 144 VDC, 32 watts nominal

Side Scan Sonar
Acoustic Source Level: +225 dB re 1uPa @ 1 meter
Range: 25 to 500 meters each channel

Frequency Range
Chirp Frequency Range:
(TTV-196D): Simultaneously sweeps in the 110 kHz to 130 kHz and 370 kHz to 390 kHz bands
CW Frequency
(TTV-196D): Simultaneous 123 kHz and 383kHz
Transducer Radiation(TTV-196D): 0.5 degrees horizontal, 55 degrees vertical (110 kHz to 130 kHz band), 0.5 degrees horizontal, 35 degrees vertical (370 kHz to 390 kHz band)

About the BALANCE project:

This report is a product of the BSR INTERREG IIIB project "BALANCE".

The BALANCE project aims to provide a transnational marine management template based on zoning, which can assist stakeholders in planning and implementing effective management solutions for sustainable use and protection of our valuable marine landscapes and unique natural heritage. The template will be based on data sharing, mapping of marine landscapes and habitats, development of the blue corridor concept, information on key stakeholder interests and development of a cross-sectoral and transnational Baltic zoning approach. BALANCE thus provides a transnational solution to a transnational problem.

The BALANCE partnership is composed of the following institutions based in 10 countries: The Danish Forest and Nature Agency (Lead), The Geological Survey of Denmark and Greenland, The National Environmental Research Institute, The Danish Institute for Fisheries Research, WWF Denmark, WWF Germany, Institute of Aquatic Ecology at University of Latvia, Estonian Marine Institute at University of Tartu, Coastal Research and Planning Institute at Klaipeda University, Metsähallitus Natural Heritage Service, The Finnish Environment Institute, The Geological Survey of Finland, WWF Finland, The Swedish Environmental Protection Agency, The National Board of Fisheries – Department of Research and Development, The Geological Survey of Sweden, County Administrative Board of Stockholm, Department of Marine Ecology at Gothenburg University and WWF Sweden.

The following institutes contribute as consultants to the partnership: The Geological Survey of Norway, Norwegian Institute for Water Research, DHI Water and Environment, The Leibniz Institute of Marine Sciences, The Sea Fisheries Institute, The Finnish Game and Fisheries Research Institute, Metria Miljöanalys and The Nature Conservancy.

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BALANCE Interim Report No. 6 "BALANCE Cruise Report – The Archipelago Sea".
BALANCE Interim Report No. 7 "BALANCE Cruise Report – The Kattegat"
BALANCE Interim Report No. 8 "BALANCE Stakeholder Communication Guide".

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