



# Leibniz Institute for Baltic Sea Research Warnemünde

## Monitoring cruise

FS „Elisabeth Mann Borgese“

Cruise- No. EMB-069

30<sup>th</sup> April – 9<sup>th</sup> May 2014

Western and Central Baltic Sea

This report is based on preliminary data

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1. **Cruise No.:** EMB-069
2. **Dates of the cruise:** from 30.04.2014 to 09.05.2014
3. **Particulars of the research vessel:**
  - Name: FS Elisabeth Mann Borgese
  - Nationality: Germany
  - Operating Authority: Baltic Sea Research Institute Warnemünde (IOW)
4. **Geographical area in which ship has operated:**  
western and central Baltic Sea
5. **Purpose of the cruise**  
Monitoring cruise in the framework of HELCOM programme
6. **Crew:**
  - Name of master: Uwe Scholz
  - Number of crew: 11
7. **Research staff:**
  - Chief scientist: Dr. Michael Naumann
  - Engineers: Peter Wlost, Robert Mars
  - Technicians: Andrea Tschakste, Lars Kreuzer, Christian Burmeister, Stefan Bücker
  - Students: Diane Enkelmann, Lotta Flaig
8. **Scientific equipment:**  
CTD + Rosette water sampler, Phytoplankton net (Apstein), Zooplankton net (WP2), Secchi disk, Spectrophotometric pH determination (Agilent) based on the use of m-cresol purple as indicator dye, Coulometric SOMMA system using an UIC coulometer, Combination of equilibrator and CO<sub>2</sub> IR-detection (Li-COR), Paramatric Sediment Echosounder (SES2000)
9. **General remarks and preliminary result:**

The third monitoring cruise of the Leibniz Institute for Baltic Sea Research Warnemünde in 2014 was carried out with FS “Elisabeth Mann Borgese“ between April 30<sup>th</sup> and May 9<sup>th</sup> 2014. The cruise is part of the German contribution to the HELCOM COMBINE program and contributes to IOW’s long term data series in the central Baltic Sea.

The area under investigation covered the Baltic Sea between Kiel Bight and the northern Gotland Sea. Marine meteorological, hydrographic, hydrochemical and hydrobiological investigations were performed according to the COMBINE program of HELCOM. The station map is attached to this report.

The **weather situation** during the cruise was mainly sunny and calm, influenced by the high pressure cell “Reinhold” moving from the north Atlantic Ocean over middle Europe and to Northeast. Air pressure ranged between 1005 and 1020 hPa. The Wind speed mostly ranged between 1 and 4 Bft. Wind directions changed between NW and SSW as well as SSE to E in a short period. Air temperature ranged between 5 °C to 7 °C in the northern Gotland Sea up to 11 °C in the western Baltic Sea. Only the last two days the low pressure “Vicky” brought cloudy, sometimes rainy weather with winds up 6 Bft from SSW direction. Weather conditions did not hamper the station work.

The following hydrographical and hydrochemical characteristics have been observed during the cruise (cf. Tables 1 and 2, Figures 4 to 6):

- **Surface temperatures** varied between 4.99 °C (Farö Deep) and 11.55 °C (Lübeck Bight). In all investigated areas of the Baltic Sea, temperatures are well above the long-term mean. The reason is the mild winter 2013/2014. The water column is stratified down to the halocline in the western and southern Baltic. In the northern Gotland Sea the process of annual temperature stratification starts to build (see fig. 5). On the tour back home from the central Baltic the more windy weather of low pressure “Vicky” mixed the upper water column up to depths of 20 m in the western Baltic Sea. Some additional CTD stations from Bornholm into the Lübeck Bight are measured to get a second cross section of the area which mirrors this situation (see fig. 6).
- **Deep water layer temperatures** (bottom near depths) decreased slightly in the central Baltic Proper during the last years due to the absence of major barotropic inflow events. But they are still higher as the long-term mean. Repeated inflow events during last summer resulted in high deep water temperatures in the Bornholm Basin during the winter time, but are actual decreasing. However, these inflows are too weak and could not proceed further east.

	May 2013	Aug. 2013	Febr. 2014	May 2014	Mean 1971/90
Bornholm D.	5.12 °C	4.88 °C	8.65 °C	5.60 °C	6.1 °C
Gotland Deep	6.41 °C	6.40 °C	6.36 °C	6.62 °C	5.6 °C
Farö Deep	5.94 °C	5.90 °C	5.76 °C	5.71 °C	5.2 °C
Landsort D.	5.39 °C	5.39 °C	5.34 °C	5.32 °C	4.8 °C
Karlsö Deep	5.33 °C	5.24 °C	5.08 °C	4.99 °C	4.2 °C

- The major Baltic inflow from January 2003 was the last strong inflow event into the Baltic Sea. Inflows in 2012 and 2013 could not influence the deep basins around

Gotland. Thus, the stagnation period continues there, documented by further slightly decreasing **salinity in the bottom layer** in the central Baltic Proper:

	Feb. 2013	August 2013	May 2014
Gotland Deep	12.12	12.10	12.21
Farö Deep	11.45	11.49	11.42
Landsort Deep	10.40	10.50	10.32
Karlsö Deep	9.80	9.77	9.48

- Thus, the **oxygen situation in the deep water** of central basins (>100 m water depth) documents the long-lasting stagnation period. Hydrogen sulphide concentrations (expressed as negative oxygen equivalents) in the near-bottom layer remained high, and increased further in the northeastern Gotland Basin (Landsort Deep). Also the vertical extension of hydrogen sulphide is remarkable. At stations 271 (Gotland Deep), 286 (Farö Deep), 284 (Landsort Deep) and station 245 (Karlsö Deep) hydrogen sulphide was found from 100 m downwards. A slightly improvement of the situation was found at the southeastern margin of the eastern Gotland Basin, where at the bottom (between 100 m and 130 m) oxygen contents of up to 4 ml/l are measured (see fig. 5).

	May 2013	Feb. 2014	May 2014
Gotland Deep	-7.59 ml/l	-6.74 ml/l	-6.03 ml/l
Farö Deep	-3.57 ml/l	-3.46 ml/l	-3.58 ml/l
Landsort Deep	-0.78 ml/l	-2.09 ml/l	-3.13 ml/l
Karlsö Deep	-0.70 ml/l	-2.10 ml/l	-0.74 ml/l

In contrast to that, storm events in autumn and early winter 2013 ventilated the western Baltic Sea as well as the Arkona Basin and Bornholm Basin down to the bottom. Thus, high oxygen concentrations were measured in the bottom near layer (see fig. 4).

- The **nutrient situation** in the surface layer is typical for the season. Nitrate concentrations are close to the detection limit and depleted by the spring bloom, but higher phosphate contents remaining for the summer bloom (table 1).
- In the deep waters of the **central basins** (>100 m water depth), the hydrographic situation is mirrored. Continued oxygenation of the Bornholm Basin deep water caused low phosphate and ammonium concentrations and high nitrate values. The permanent stagnation caused the absence of nitrate and very high phosphate and ammonium concentrations in the eastern and western Gotland Basin (table 2). Also silicate concentrations have increased further, reaching more than 100  $\mu\text{mol/l}$  in the bottom layer of the Gotland Basin.

- Samples for **phyto- and zooplankton** were collected for later analysis in the laboratory.
- **Additional program:**

Spectrophotometric pH determination and CO<sub>2</sub> measurements by water sampling tracks of surface water across all areas of the cruise. Additional water samples in different water depths at selected stations like 213, 271, 284 (responsible scientist: Dr. B. Schneider, Prof. G. Rehder)

At 16 stations located from Kiel Bight to the Pomeranian Bight 16 samples of the surface water are taken to analyze polar pollutants (responsible scientist: Dr. A. Orlikowska).

In the Pomeranian Bight these additional sampling stations were connected by geophysical measurements (Parametric Sediment Echosounder) of the geological subsurface up to 10 m below seafloor. The profile complements earlier measurements in this area taken in 2007-2008 for the SINCOS-II project to detect the palaeo outflow system of the Oder river and former coastlines (responsible scientist: Dr. M. Naumann, Prof. R. Lampe – Greifswald University).

At station 213 (Bornholm Basin) are additional phyto- and microzooplankton samples taken by WP2 and Apstein nets as well as water samples (responsible scientist: Dr. J. Dutz).

In the Gotland Deep (station 271) are water samples from the oxic and anoxic water layer taken for a BSc thesis of the topic “Validation and optimization of a spectrophotometric method for the determination of Mn(II) in seawater” (responsible scientist: Dr. D. Meyer).

For demonstration issues of the oxygen content at deep basins of the Baltic Sea we took at the same station 12 samples of different depths for the open science day called “Ostseetag” 23.05.2014 (responsible scientist: Dr. G. Nausch, Dr. M. Naumann).

#### Attachments:

Tables 1 and 2: Preliminary results of selected parameters in the surface layer and the near bottom water layer - (unvalidated results)

Figs. 1-3: Track charts

Fig. 4: Oxygen/hydrogen sulphide in the bottom near layer for selected stations

Fig. 5: Transect from the Kiel Bight to the northern Gotland Basin for temperature, salinity and oxygen (unvalidated data), measured 30<sup>th</sup> April – 5<sup>th</sup> May 2014

Fig. 6: Transect from the Lübeck Bight to the Bornholm Basin for temperature, salinity and oxygen (unvalidated data), measured 7<sup>th</sup>-8<sup>th</sup> May 2014

Warnemünde 14<sup>th</sup> May 2014

Dr. Michael Naumann  
(scientist in charge)

Table 1: Surface water layer (about 1 m depth)

Area Date	Station Name /No.*	Temp. °C	Sal. psu	O <sub>2</sub> ml/l	PO <sub>4</sub> μM	NO <sub>3</sub> μM	SiO <sub>4</sub> μM
Kiel Bight 30.04.2014	TFO360/05	9.4	11.15	7.96	0.05	0.86	4.4
Meckl.Bight 1.05.2014	TFO012/08	7.37	22.04	7.89	0.5	0.01	10.8
Lübeck Bight 01.05.2014	TFO022/07	11.55	11.52	7.69	0.12	0.01	3.8
Darss Sill 01.05.2014	TFO030/14	7.86	8.31	8.31	0.51	0.04	11.4
Arkona Basin 01.05.2014	TFO113/18	7.14	7.93	8.52	0.69	0.01	14.1
Bornholm Deep 03.05.2014	TFO213/40	7.86	7.75	9.93	0.48	0	14.1
Stolpe Channel 04.05.2014	TFO222/43	6.75	7.41	9.60	0.46	0.02	12.4
SE Gotland Basin 04.05.2014	TFO259/45	5.96	7.30	10.38	0.41	0.03	12.4
Gotland Deep 04.05.2014	TFO271/52	5.2	7.06	10.20	0.25	0.07	12.5
Farö Deep 05.05.2014	TFO286/54	4.99	6.89	9.76	0.16	0.08	11.8
Landsort Deep 06.05.2014	TFO284/57	6.05	6.73	9.52	0.6	3.35	15
Karlsö Deep 06.05.2014	TFO245/59	6.42	7.15	8.98	0.54	0.46	11.5

\* see attached map

Table 2: Deep water layer (bottom near layer depths)

Area Date	Station Name /No.*	Temp. °C	Sal. psu	O <sub>2</sub> ml/l	PO <sub>4</sub> µM	NO <sub>3</sub> µM	SiO <sub>4</sub> µM
Kiel Bight 30.04.2014	TFO360/05	6.67	20.84	6.01	0.28	1.48	9.9
Meckl.Bight 1.05.2014	TFO012/08	9.95	22.59	4.60	0.35	0	12.5
Lübeck Bight 01.05.2014	TFO022/07	6.09	21.73	4.91	0.07	0.03	3.1
Darss Sill 01.05.2014	TFO030/14	7.56	18.29	7.24	0.55	0.03	12.1
Arkona Basin 01.05.2014	TFO113/18	5.42	19.65	2.97	0.77	0.09	29.2
Bornholm Deep 03.05.2014	TFO213/40	5.60	16.63	3.46	1.48	9.35	39.8
Stolpe Channel 04.05.2014	TFO222/43	6.46	14.17	3.09	2.18	8.34	48.6
SE Gotland Basin 04.05.2014	TFO259/45	5.41	11.46	4.1	0.72	0.56	13.8
Gotland Deep 04.05.2014	TFO271/52	6.62	12.21	-6.03	6.45	0	106.5
Farö Deep 05.05.2014	TFO286/54	5.71	11.42	-3.58	5.15	0	94.3
Landsort Deep 06.05.2014	TFO284/57	5.32	10.32	-3.13	3.08	n.d.	50.1
Karlsö Deep 06.05.2014	TFO245/59	4.99	9.48	-0.74	4.55	0	60.4

\* see attached map

\*\* hydrogen sulphide was converted into negative oxygen equivalent

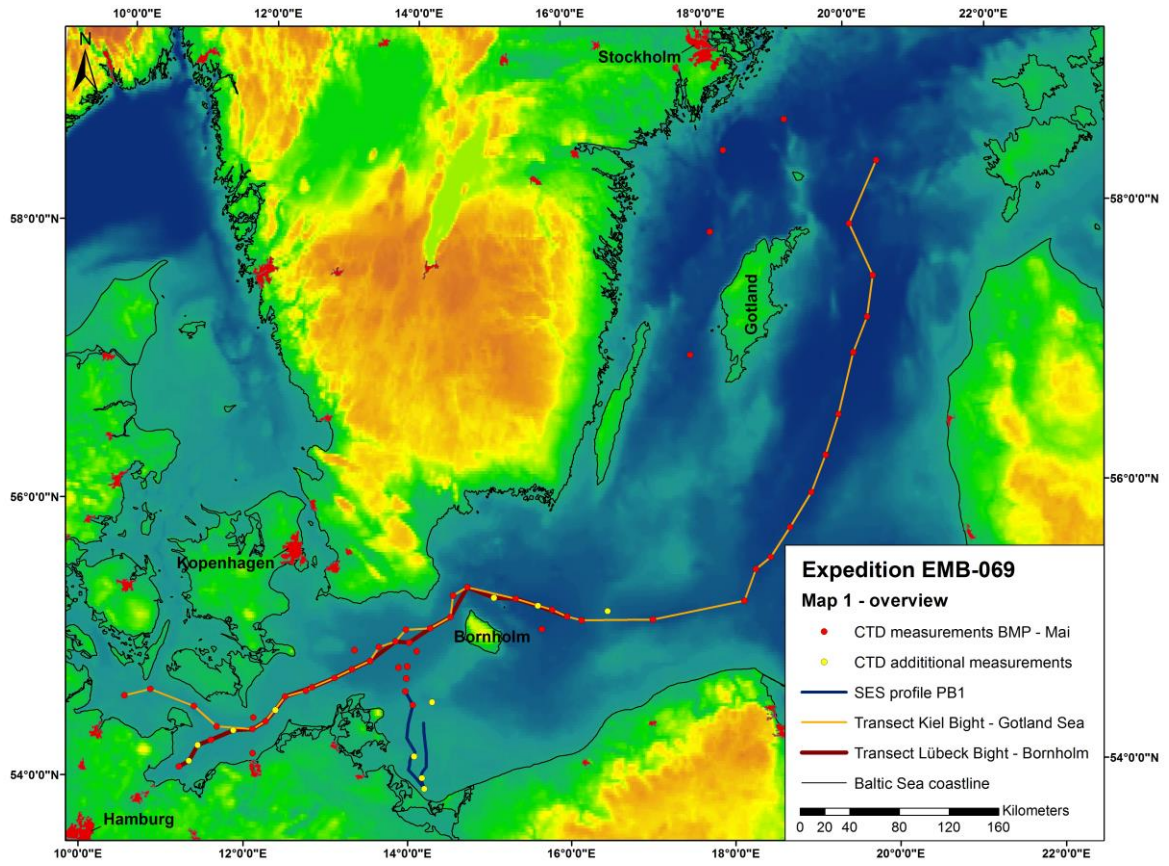


Fig. 1: Track chart - overview

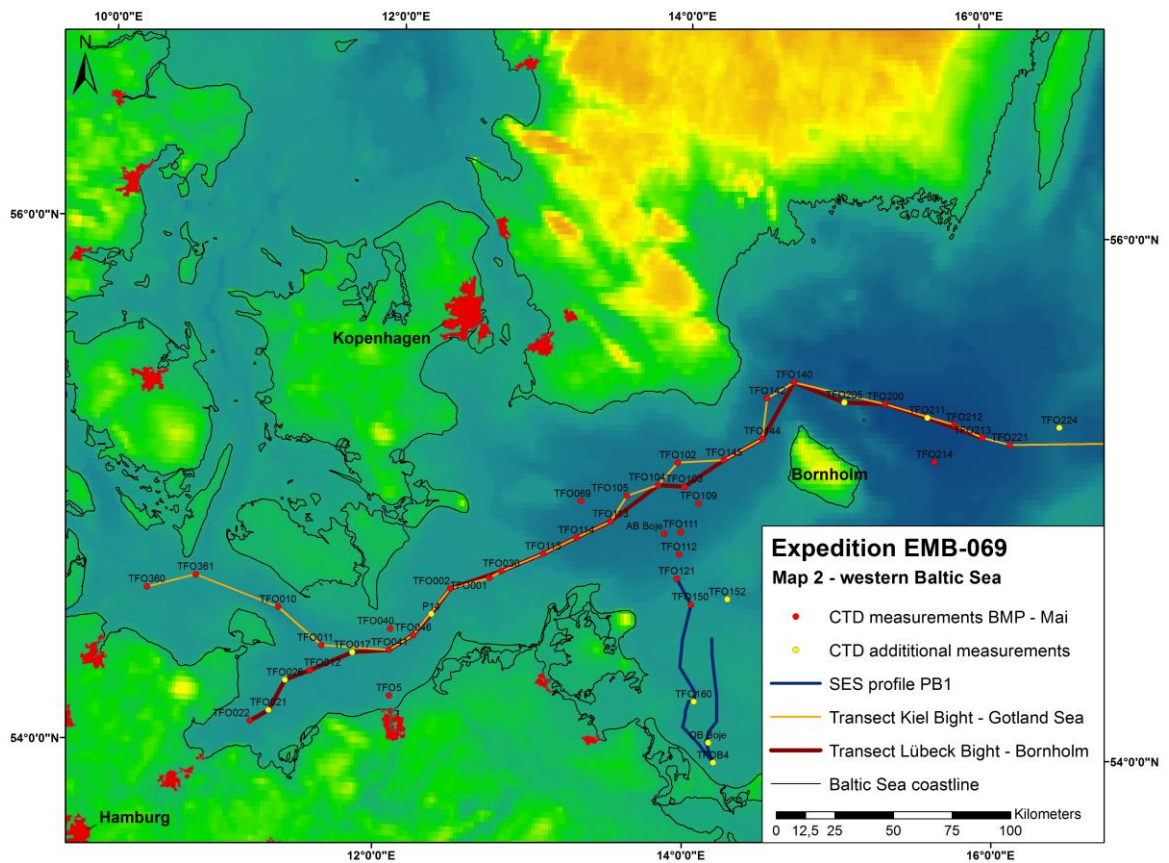


Fig. 2: Track chart – western Baltic Sea



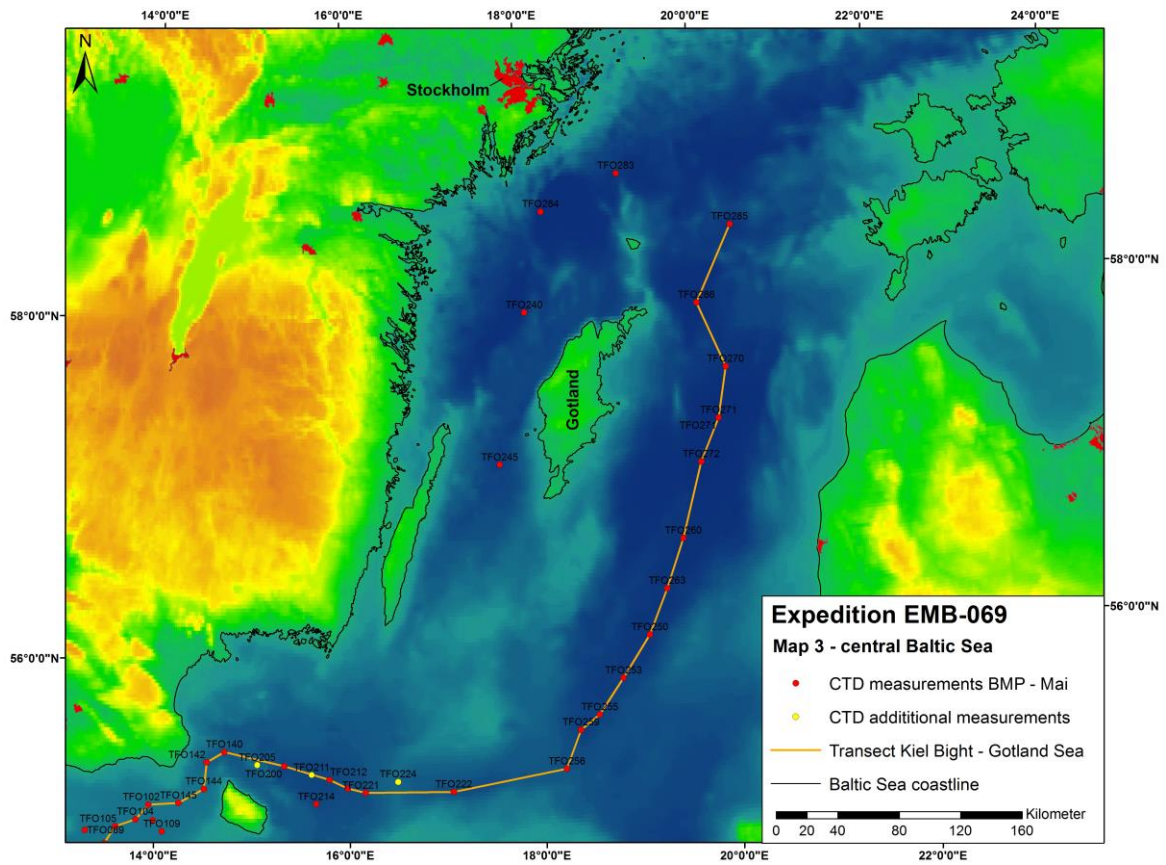


Fig. 3: Track chart – central Baltic Sea

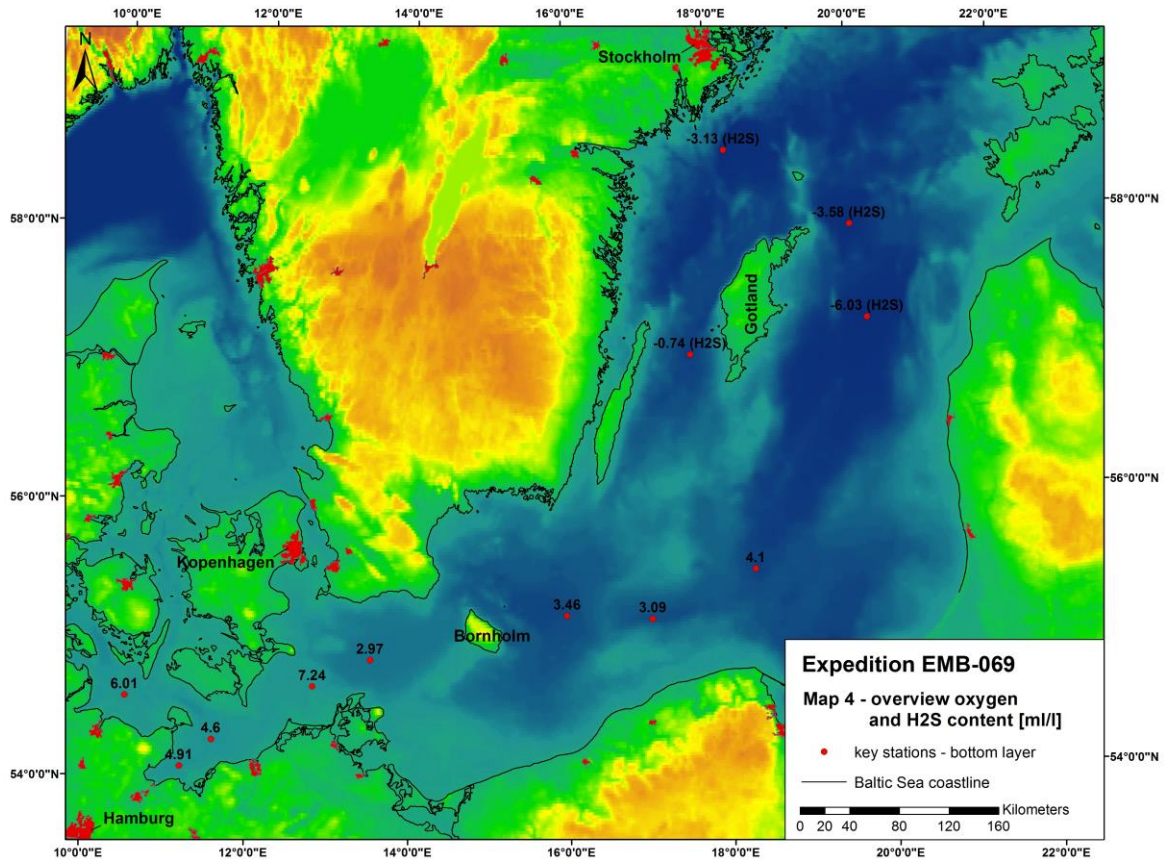


Fig. 4: Oxygen/hydrogen sulphide in the bottom near layer for selected stations

# Monitoring EMB069

Kiel Bight - Gotland Sea

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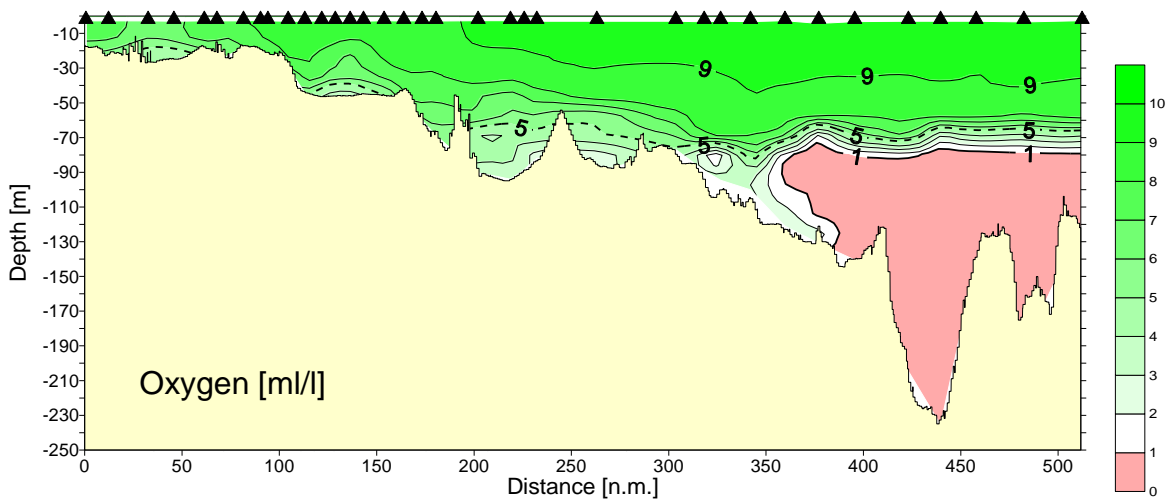
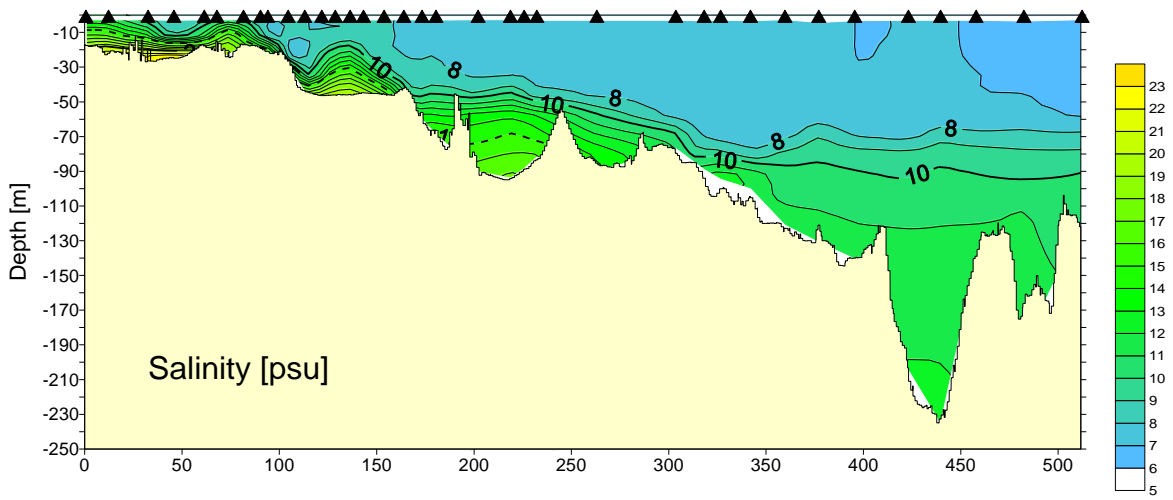
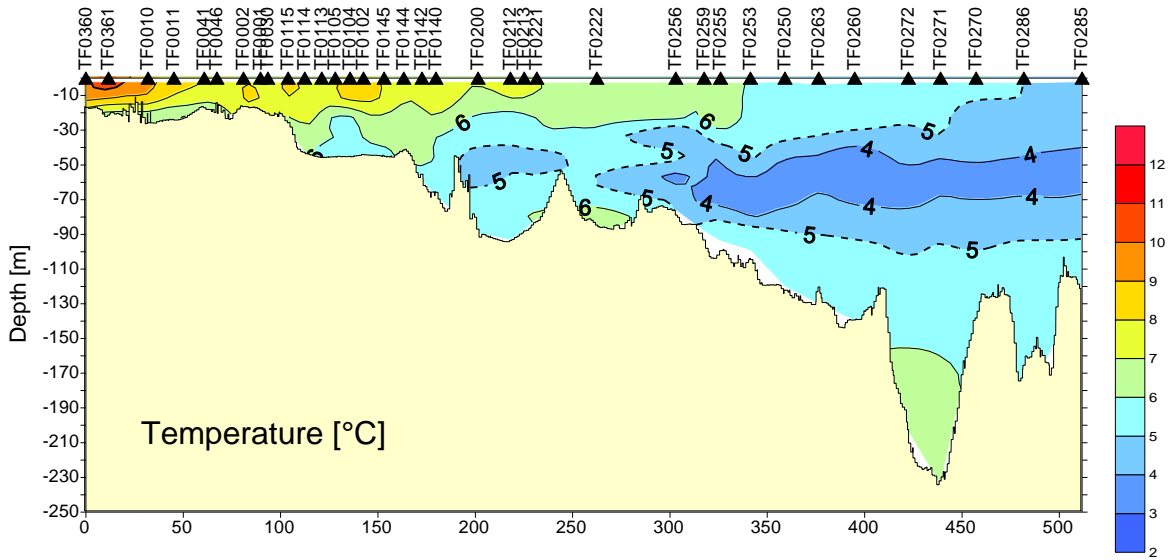


Fig. 5: Transect from the Kiel Bight to the northern Gotland Basin

# Monitoring EMB069

Lübecker Bucht - Bornholm

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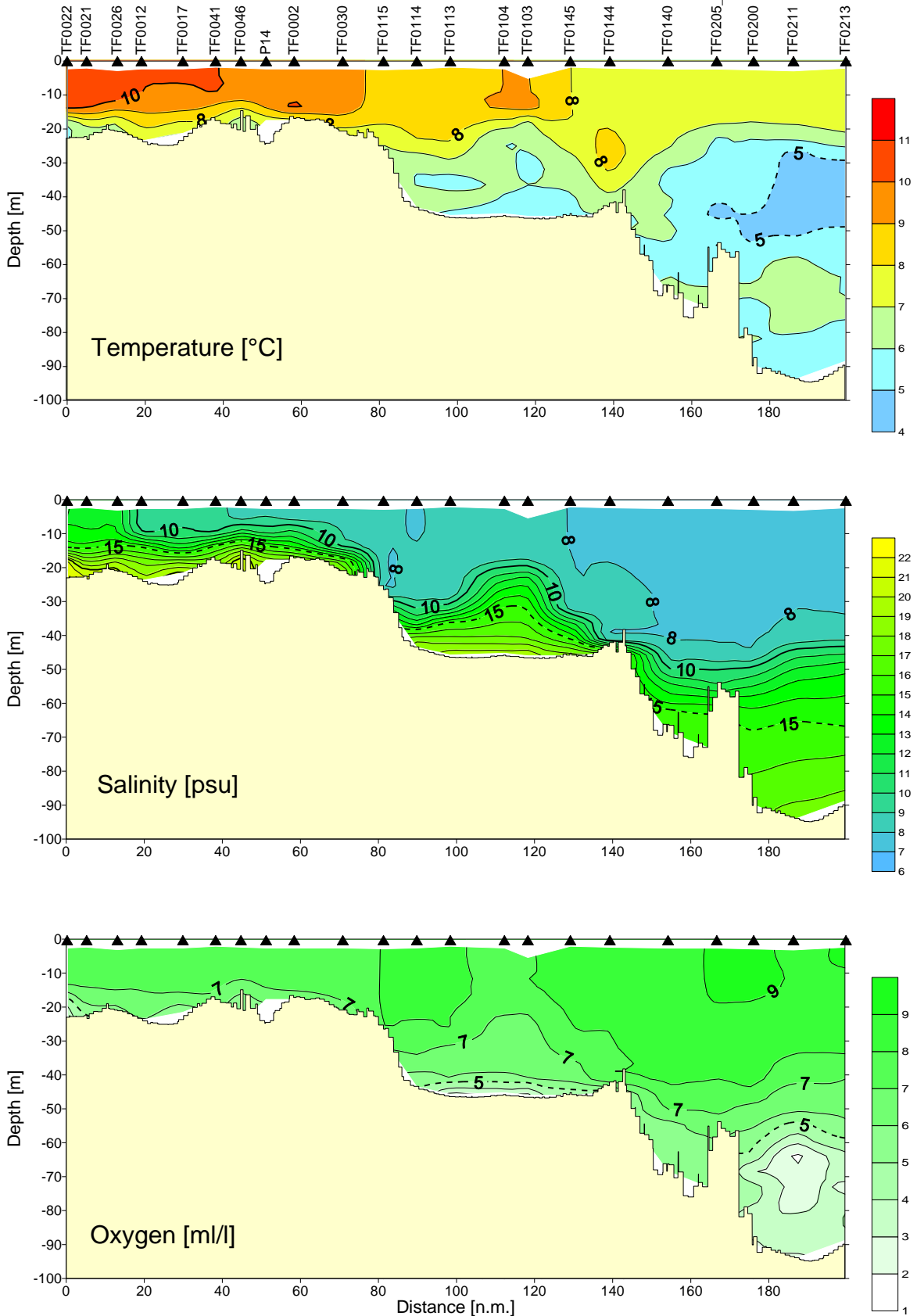


Fig. 6: Transect from the Lübeck Bight to the Bornholm Basin