



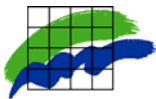
r/v Gunnar Thorson

# Monitoring Cruise Report

**Cruise no.: GT 250**

**Time: 17 - 21 August 2009**

**Area: The Sound, the Arkona Sea,  
the Belt Sea and the Kattegat**



National Environmental Research Institute

Aarhus University

Frederiksborgvej 399

DK-4000 Roskilde

Denmark

Tel.: +45 4630 1200 ◊ Fax: +45 4630 1114

[www.neri.dk](http://www.neri.dk)

## Data sheet

Title: Monitoring cruise report - Cruise no. GT 250, 17-21 August 2009

Author: Colin A. Stedmon  
Department: Department of Marine Ecology  
Serial title: Monitoring Cruise Report

Publisher: National Environmental Research Institute ©  
Aarhus University  
URL: <http://www.neri.dk>

Week/year of publication: 43/2009  
Please cite as: Stedmon, C.A. 2009: Monitoring cruise report - Cruise no. GT 250, 17-21 August 2009. National Environmental Research Institute, Aarhus University, Denmark. 16 pp. - Monitoring cruise report.

Reproduction is permitted, provided the source is explicitly acknowledged.

Keywords: Marine, monitoring, hydrography, eutrophication

Layout: Anne van Acker  
Drawings: Colin A. Stedmon

ISSN (electronic): 1600-1656

Number of pages: 16

Remark: The numbers of the monitoring cruises may not be successive, as the numbers also include other types of cruises.

Internet-version: The report is available in electronic format at NERI's website  
<http://www.dmu.dk/Vand/Havmiljoe/Togtrapper/>

Published by: National Environmental Research Institute  
Aarhus University  
Frederiksborgvej 399  
P.O. Box 358  
DK-4000 Roskilde  
Denmark  
Tel. +45 4630 1200  
E-mail: [dmu@dmu.dk](mailto:dmu@dmu.dk)  
[www.neri.dk](http://www.neri.dk)

# Monitoring Cruise Report - Cruise No. GT 250, 17-21 August 2009

Report author: Colin A. Stedmon

Cruise leader: Kjeld Sauerberg

Participants: Dorete W. Jensen  
Gitte Jacobsen  
Peter Kofoed  
Thomas Krogh

Vessel: R/V Gunnar Thorson

Sampling region: The Sound, the Arkona Sea, the Belt Sea and the Kattegat

Primary Aim: Monitoring of oxygen deficiency

This report is based on preliminary data, which might later be corrected. Citation permitted only when quoting is evident.

## Summary

Hydrographic, nutrient and oxygen conditions in the region are largely as they have been for last six years at this time of year. For many stations in the Kattegat and Great Belt, however, the thermocline was deeper than usual and surface water salinities were slightly higher. Inorganic nutrients were largely absent from surface waters and the majority of the nitrogen and phosphorus was therefore organically bound. The greatest nutrient concentrations were measured in the Southern Belt Sea in particular the Mecklenburg Bight. Oxygen depletion was present in the bottom waters of the Mecklenburg Bight and Arkona Sea.

## Introduction

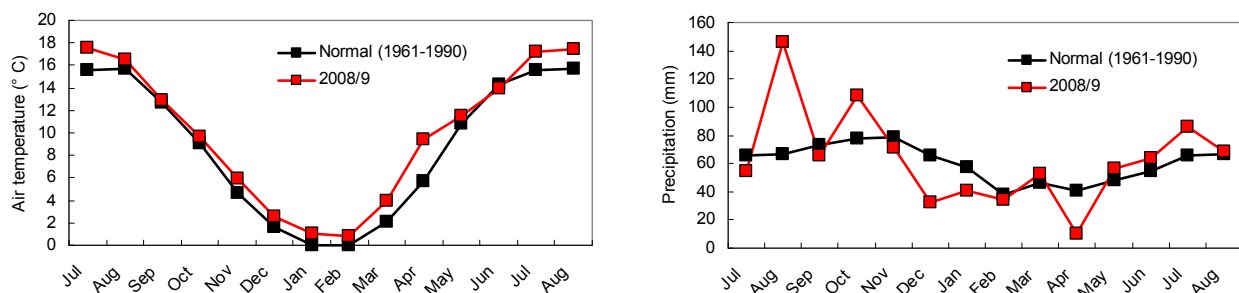
The cruise is part of the Danish national monitoring programme (NO-VANA), the HELCOM monitoring programme (COMBINE) for the Baltic Sea area, and the OSPARCOM monitoring programme (JAMP) for the Greater North Sea (the Kattegat). The primary aim of the cruise is to provide measurements of hydrography, nutrient concentrations and oxygen concentrations. *Figure 1* shows the locations of the monitoring sampling stations.



**Figure 1** Map showing the stations sampled by the monitoring cruise, region sea names and the location of the transects plotted in the following figures.

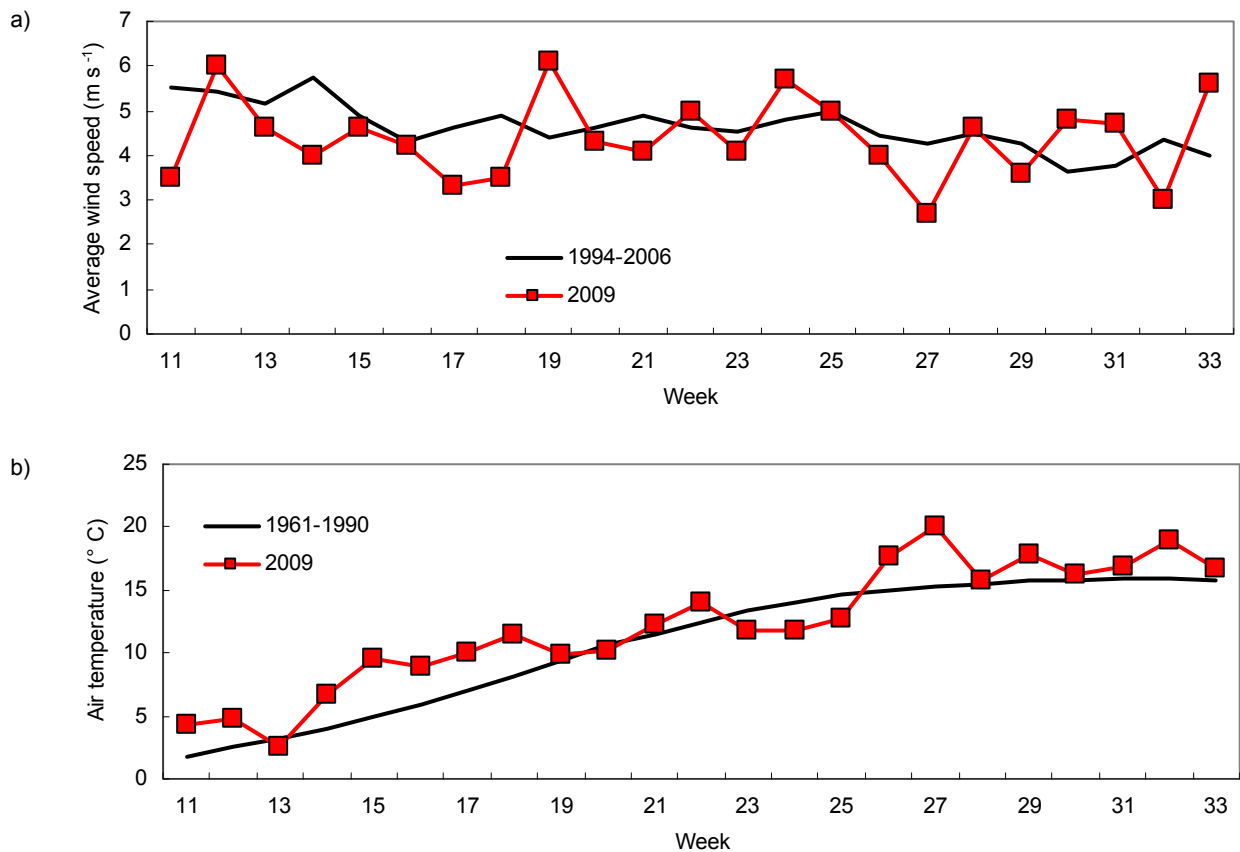
## Meteorology

In general the months preceding the cruise were warmer than average (*Figure 2*). May and June were, however, exceptions and their monthly average air temperature was similar to the long-term average. There was above average precipitation in the three months preceding the cruise (*Figure 2*). The period from December to April was dryer than normal.



**Figure 2** Monthly average air temperature and monthly total precipitation data for July 2008 to August 2009 compared with long-term averages (1961-1990). Data retrieved from the Danish Meteorological Institute ([www.DMI.dk](http://www.DMI.dk)).

The cruise was in week 34 and the four preceding weeks were characterised by slightly warmer temperatures and largely normal wind conditions (*Figure 3*).



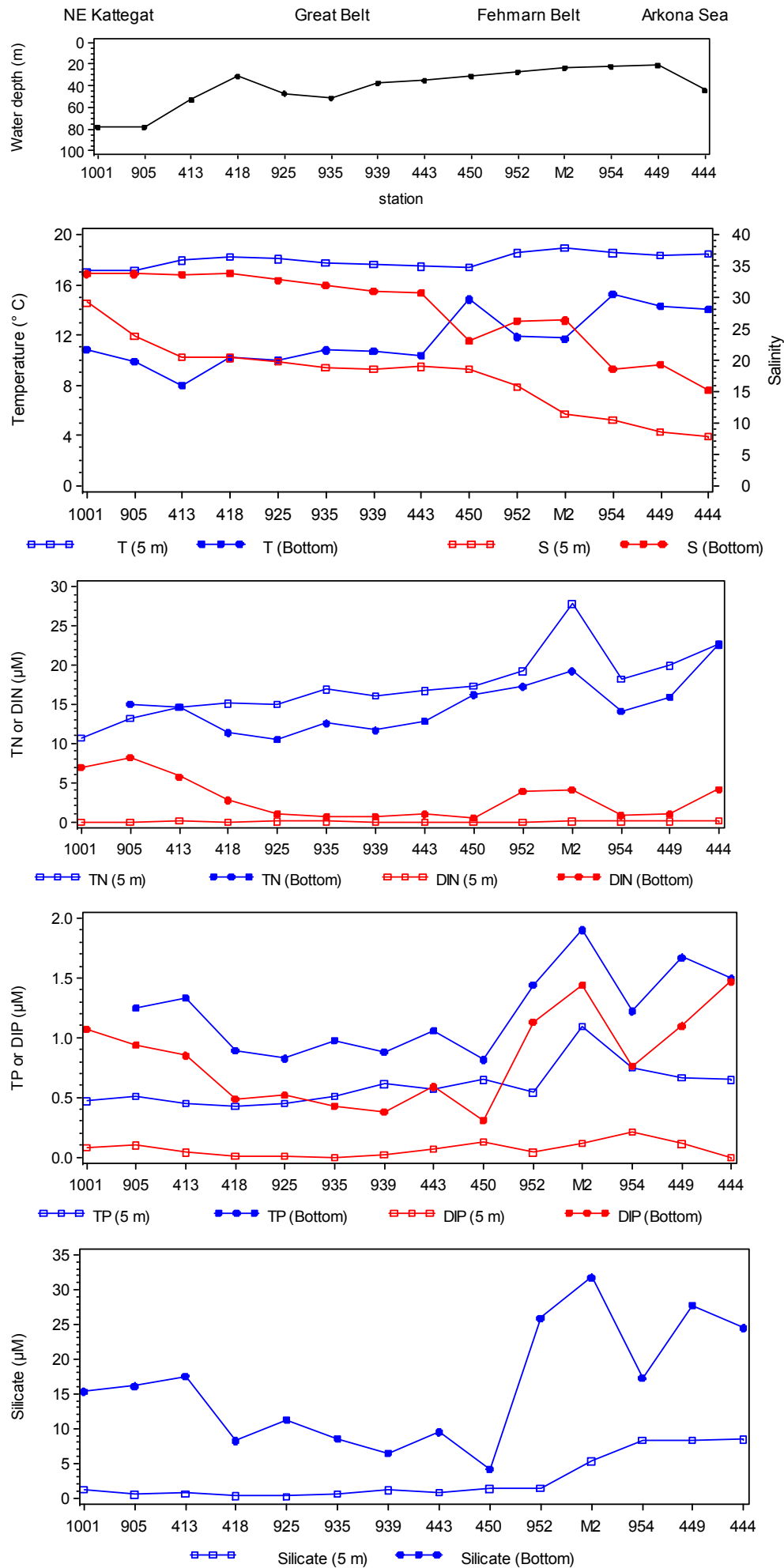
**Figure 3** a) Weekly average wind speed from mid-March to the week of the cruise compared with average values from 1994-2006. b) Weekly air temperature from the same period compared to average values from 1961-1990. This cruise was in week 34.

## Hydrography

A transect that summarises the horizontal gradients in the hydrographic and nutrient measurements is presented in *Figure 4* and the locations of the transect is marked on *Figure 1*.

The water column was stratified at most stations with surface and bottom waters differing in their salinity and temperature. Surface water temperatures ranged from 16.8 to 18.9° C. Bottom waters were generally cooler and ranged between 8.0 and 18.3° C with the warm bottom water temperatures arising from shallow stations such as St. 1728, St. N3 and St. 411. In general the temperature profiles resembled that expected for this time of year with the exception that there was a slightly deeper than usual thermocline in the Kattegat (see Appendix: St. 1001 and St. 413). Surface water salinities ranged from 7.8 (St. 444) in the East to 32.6 (St. 1008) in the West and bottom waters from 15.2 to 33.8. Salinity profiles and the depth of the halocline were in general very similar to that expected for this time of year. Though for some Kattegat and Great Belt stations surface water salinities were slightly higher than normal.

**Figure 4** Transects of surface and bottom water temperature, salinity and nutrient concentrations. Position of the transect is indicated in *Figure 1*. Note some silicate measurements are not shown as at the time of writing they were being re-analysed.



## Nutrients

Dissolved inorganic nitrogen (DIN) was largely absent from the surface waters ( $< 0.8 \mu\text{M}$ ). Concentrations in bottom waters were up to  $8.2 \mu\text{M}$ . Highest concentrations were measured in the bottom waters of the Northern Kattegat and Fehmarn Belt/Mecklenburg Bight region. Total nitrogen concentrations in surface waters generally decreased along the salinity gradient from East to West from  $22.6 \mu\text{M}$  to  $9.7 \mu\text{M}$ . Maximum concentrations were measured in the Mecklenburg Bight ( $27.8 \mu\text{M}$ ). Bottom water concentrations followed a similar trend only with slightly lower concentrations.

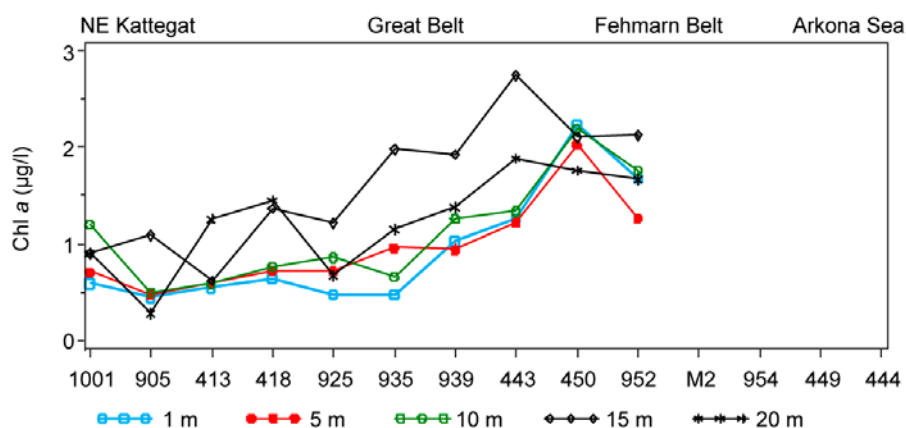
Dissolved inorganic phosphorus concentrations were low in the surface waters ( $< 0.29 \mu\text{M}$ ). Concentrations in the bottom waters were much higher and ranged up to  $1.47 \mu\text{M}$ . Total phosphorus concentrations in surface waters varied between  $0.4$  and  $1.1 \mu\text{M}$  and were relatively less variable than TN along the salinity gradient. Maximum values were measured in the Mecklenburg Bight. TP concentrations in the bottom waters were higher than the surface waters and greatest concentrations were measured in the Southern Belt Sea.

Silicate concentrations were low ( $< 1 \mu\text{M}$ ) in the surface waters of the Kattegat and Great Belt. In the surface waters of the Mecklenburg Bight and Arkona Sea, however, concentrations ranged between  $1.5$  and  $11.2 \mu\text{M}$ . Bottom water concentrations were considerably greater and more variable and exhibited a similar trend to bottom water TP and DIP concentrations.

## Chlorophyll a

Data for chlorophyll is unfortunately not available for the stations in the Arkona Sea and Mecklenburg Bight. For the remaining stations chlorophyll ranged between  $0.3$  and  $2.8 \mu\text{g/l}$ . The chlorophyll maximum for many stations was deeper than  $10$  m.

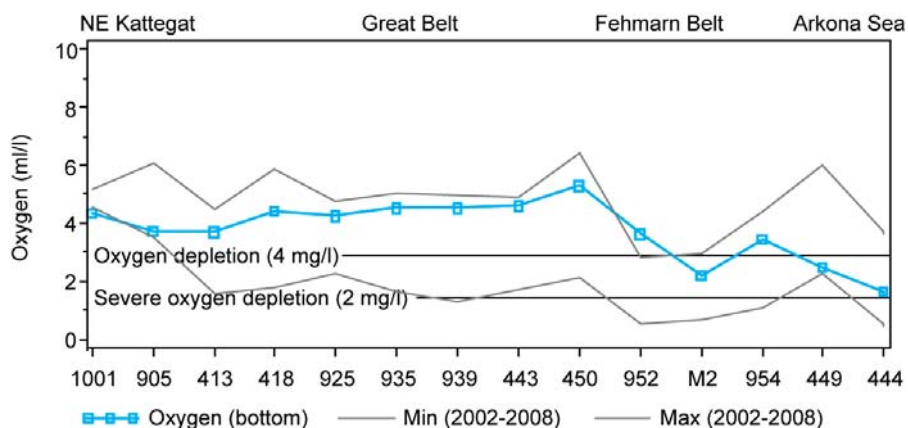
**Figure 5** Chlorophyll a concentrations in surface waters along the transect shown in Figure 1.



## Oxygen

Bottom water oxygen concentrations were typical for this time of year. *Figure 6* shows the values along the transect plotted together with the maximum and minimum values from the last six years. This years data generally follow the average trend seen previously for this time of year.

**Figure 6** Bottom water oxygen concentrations along the transect shown in *Figure 1*. Also shown are the concentrations which define oxygen depletion and severe oxygen depletion.

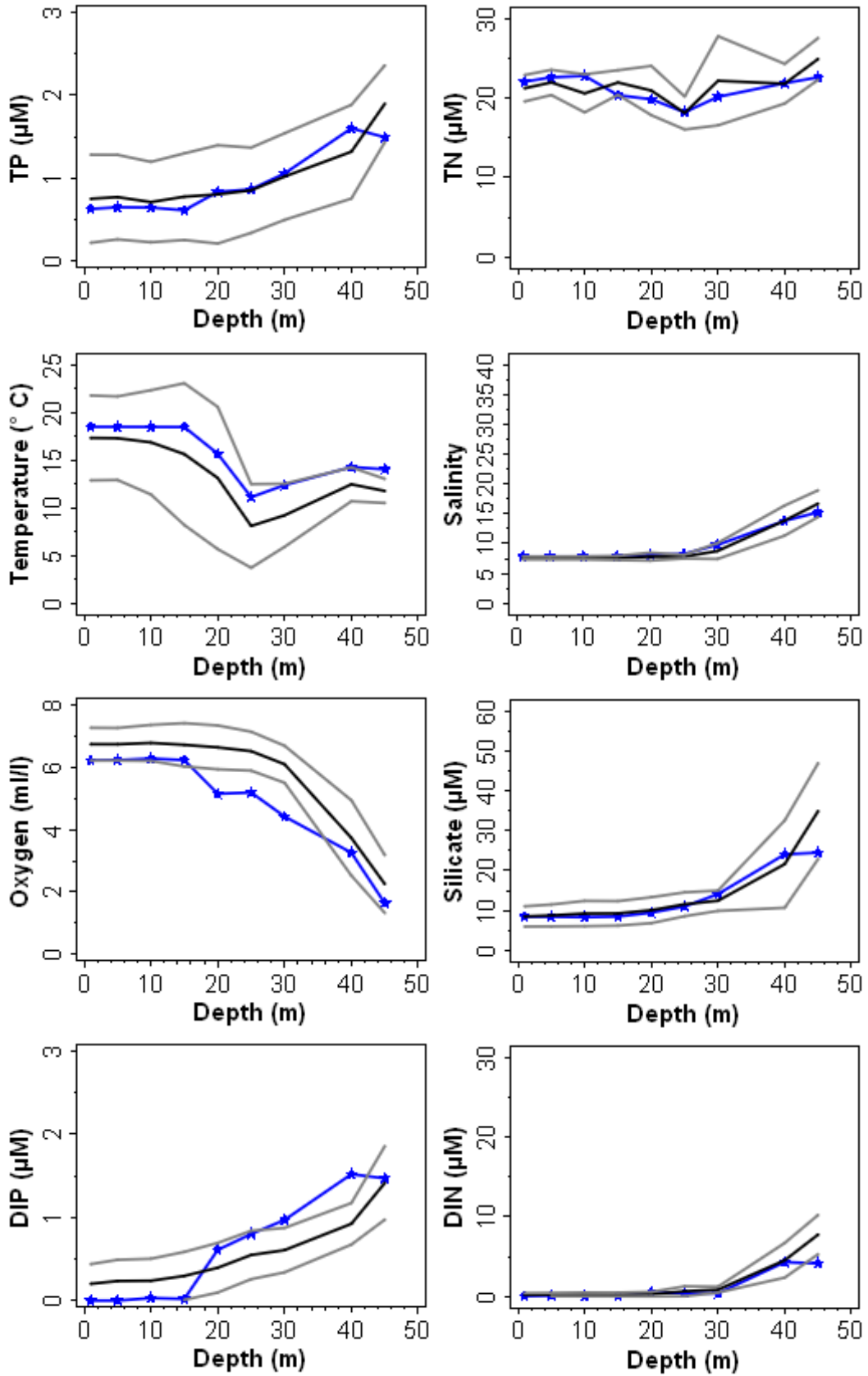




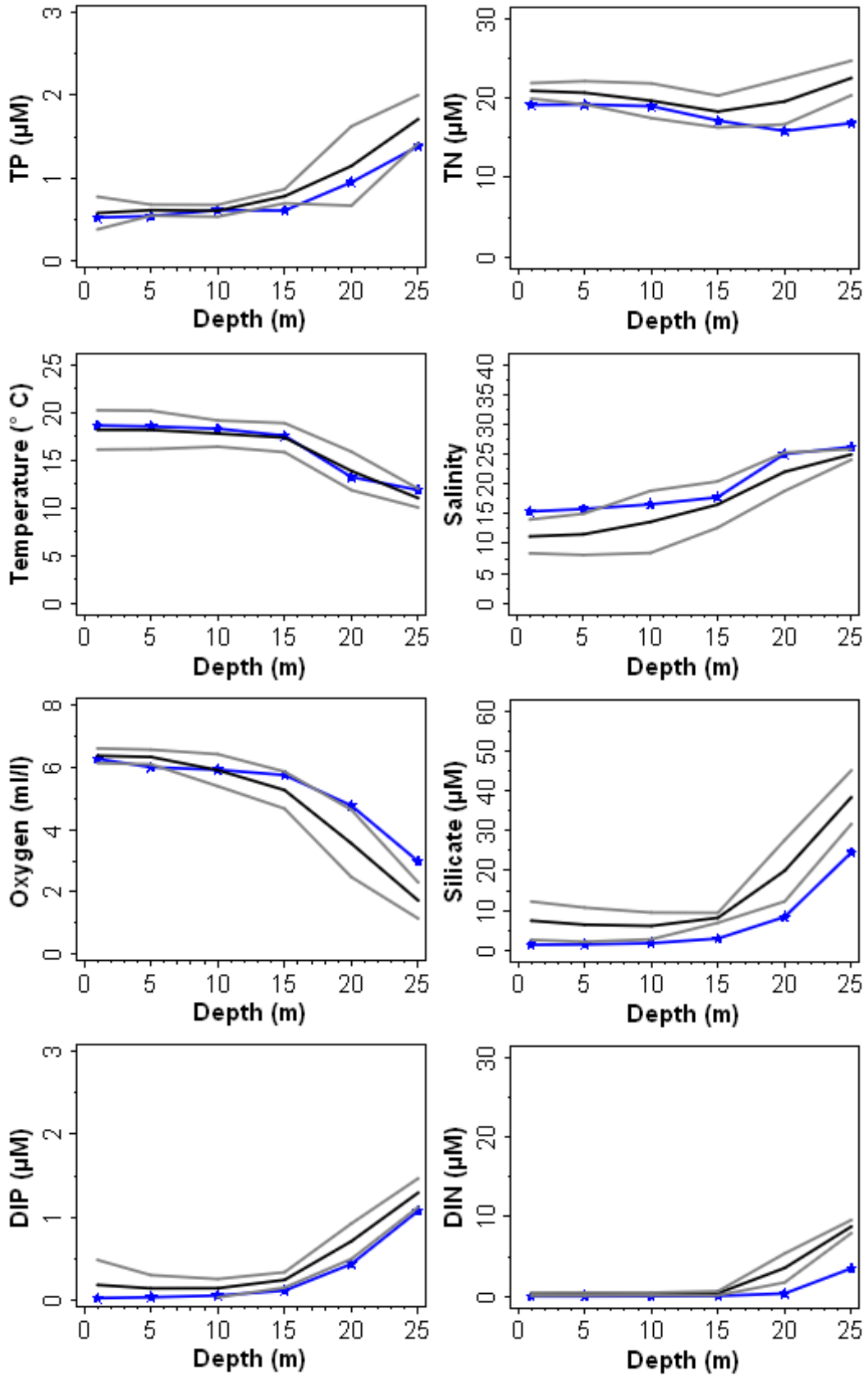
## **Appendix**

The following graphs show profiles of the measured parameters at seven chosen stations (blue lines). The mean profiles are also plotted for the station from the same cruise during the period 2002-2008 (black). The grey lines are the upper and lower 95% confidence limits for the mean.

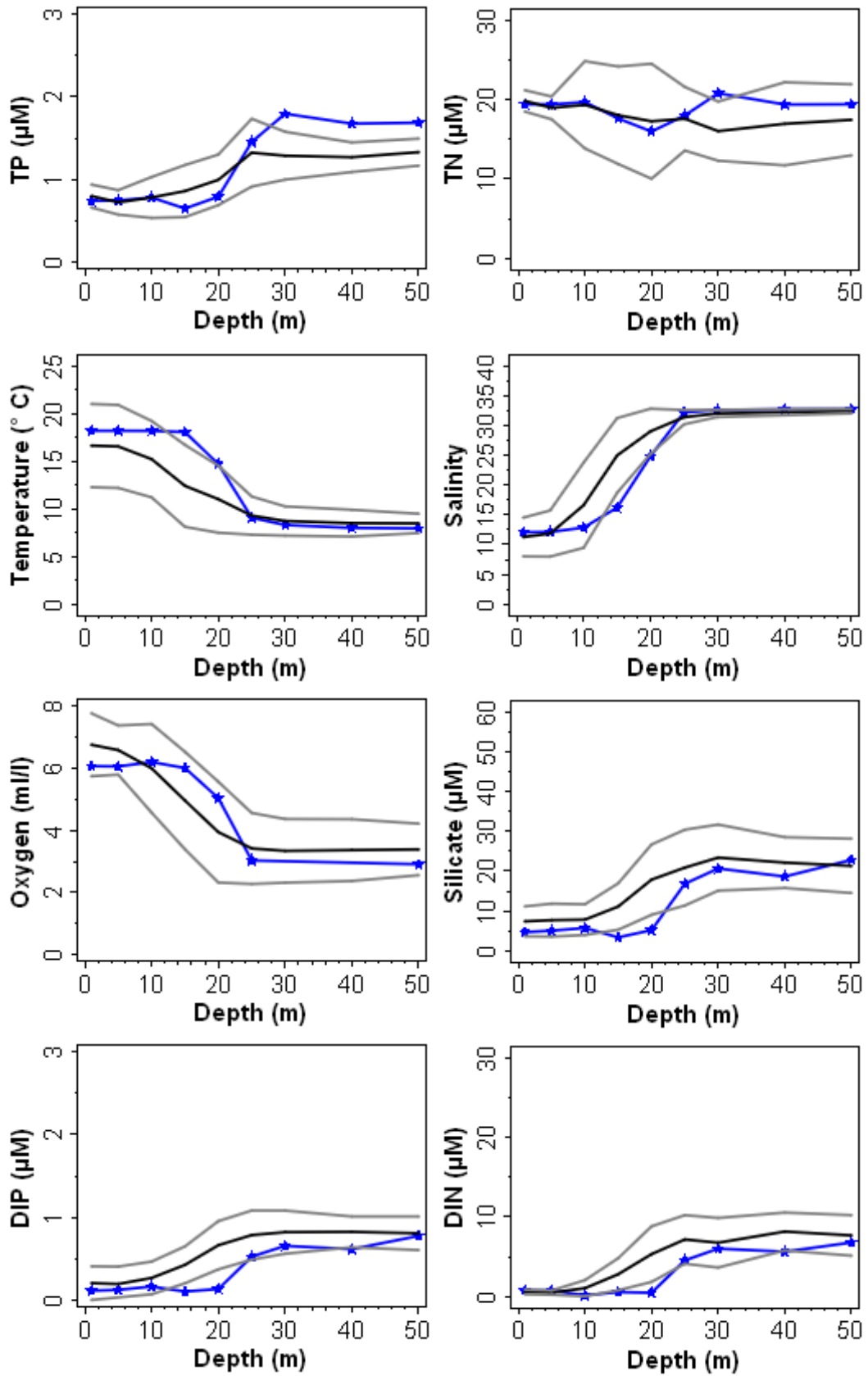
St. 444 - Arkona Sea



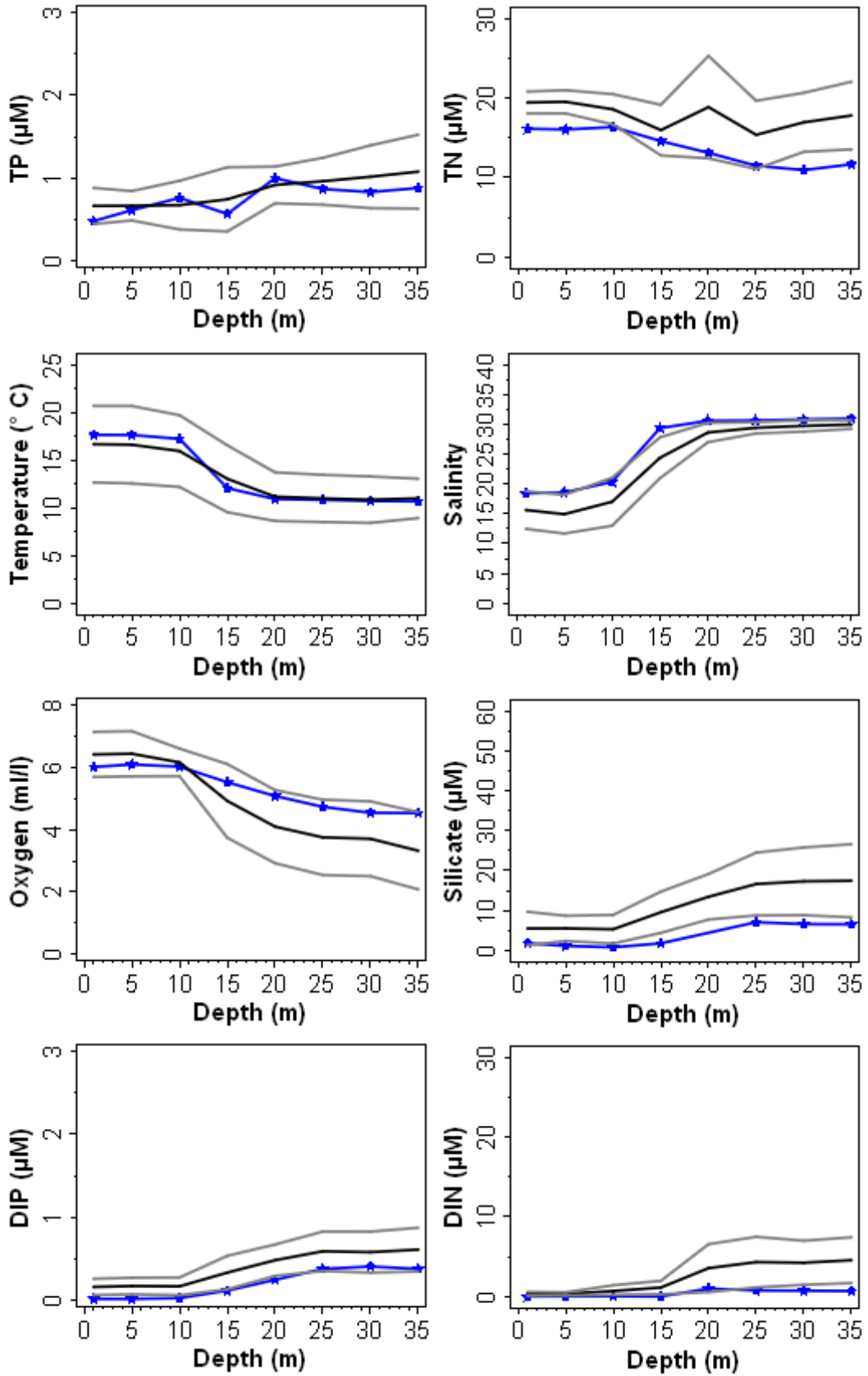
St. 952 - Fehmarn Belt



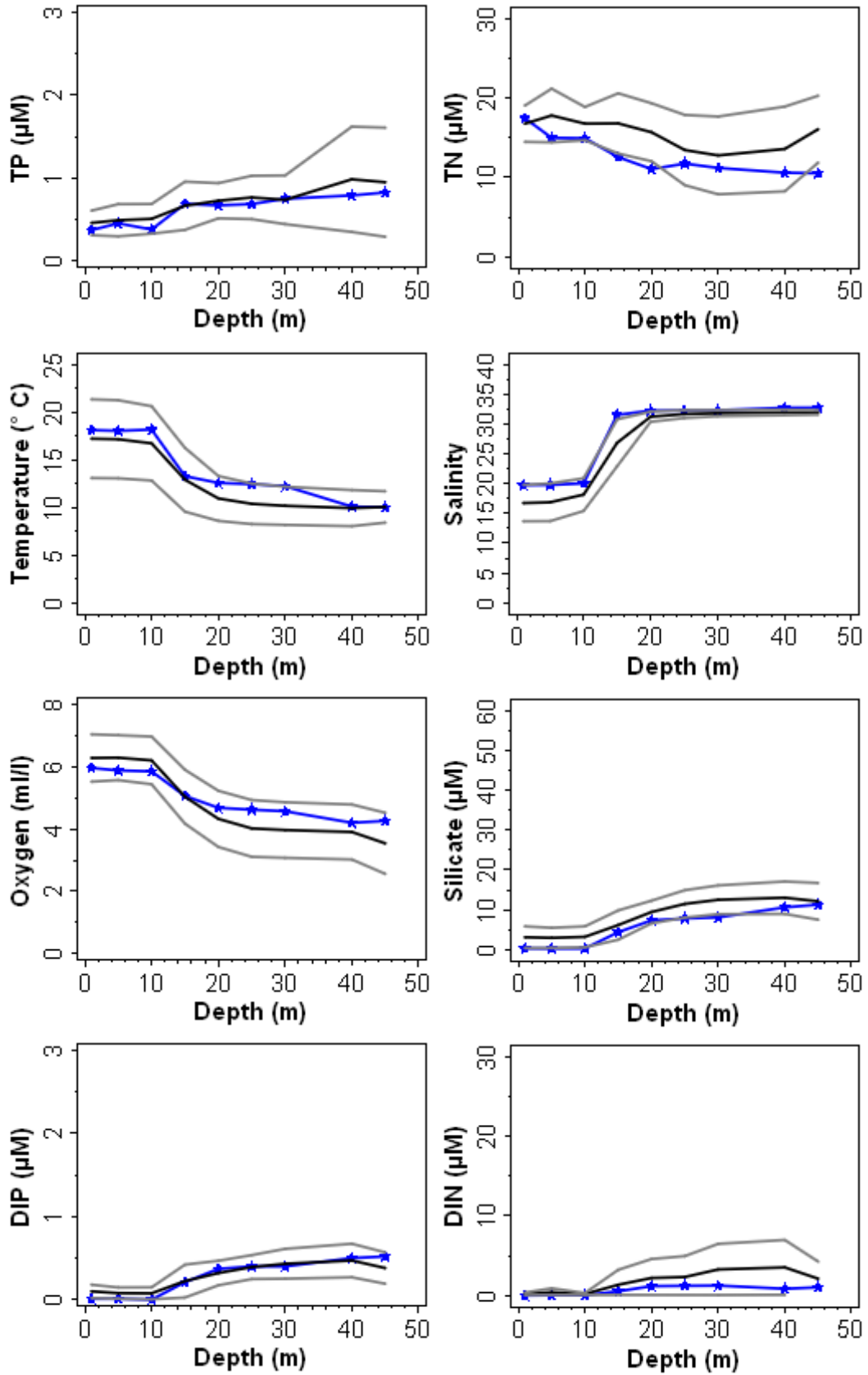
St. 431 - The Sound



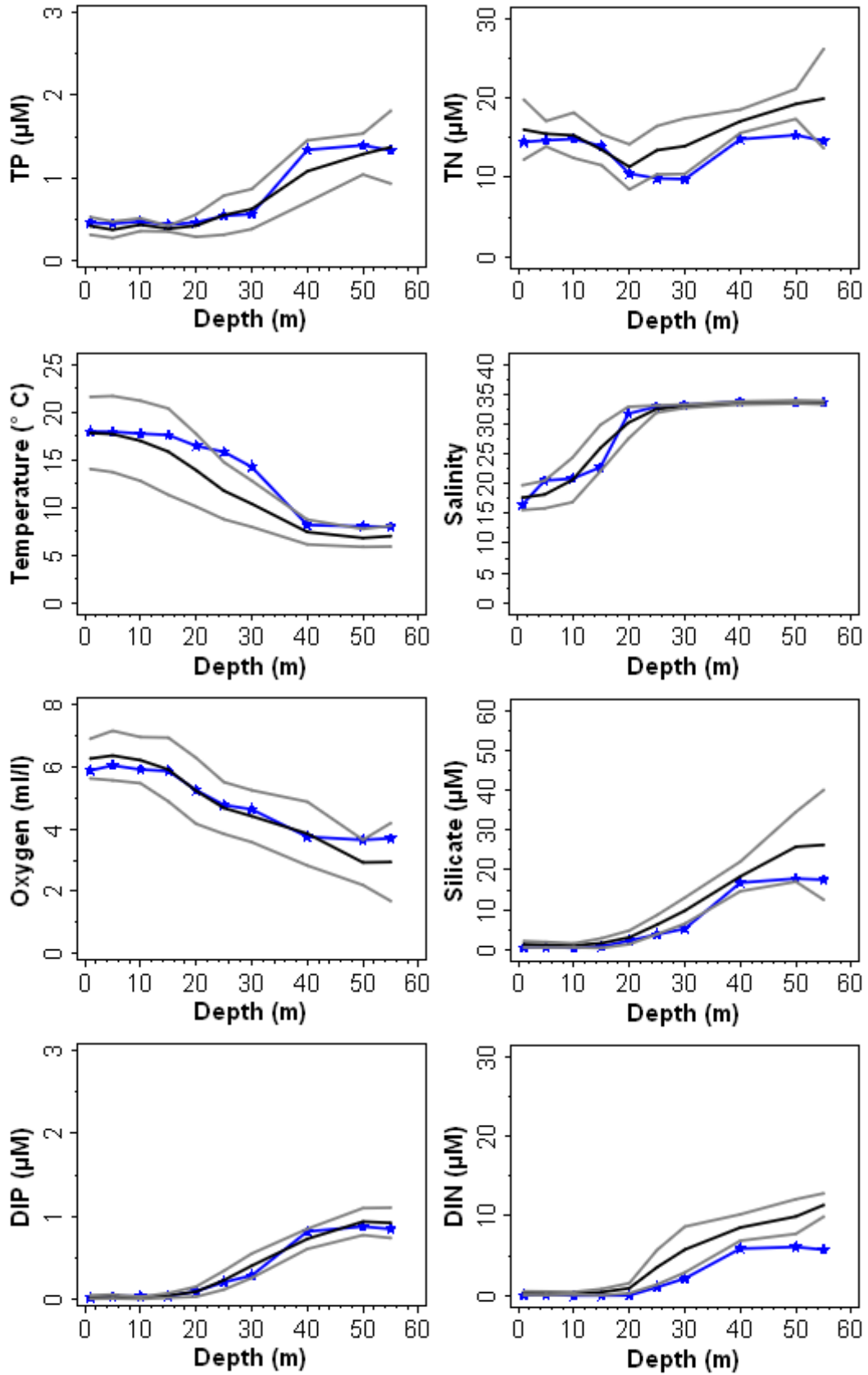
St. 939 - The Great Belt



St. 925 - Southern Kattegat



St. 413 - Central Kattegat



St. 1001 - Northern Kattegat

