CRUISE REPORT: 30.3.-18.4.2010

R.V. Alkor **Cruise No.:Al 353**

General subject of research: Physical, chemical, biological and fishery oceanography

Port calls: None

Leibniz-Institute-Department/CAU-Institute: Marine Ecology (Fishery Biology)/ Leibniz-Institute of Marine Sciences

Chief Scientist: Hans-Harald Hinrichsen

Number of Scientists: 11

Projects: AQUASHIFT, CAVIAR, EPOCA, DFG-Mnemiopsis-Project**,** CALMARO

Research programme

This multidisciplinary research cruise was conducted within the framework of different inter- and nationally funded projects:

The research focus in **AQUASHIFT** RECONN 2 is to develop a more general picture of the influence of climatic processes on Baltic sprat population development. This includes: (i) developing process models on adult sprat growth and reproduction based on available field data, and (ii) combining output from experiments, analyses of field data as well as modelling activities (RECONN 1) in a stage-based matrix population model (life table) approach in order to resolve the influence of climate processes on the overall stock dynamics of sprat.

CAVIAR is joint Danish/German research project which aims at a detailed analysis of the climate variability of the Baltic Sea area and to investigate its impact on bio/physical processes in the central Baltic Sea. Analysing the effect of regional climate variations on coupled bio/physical processes, past and future data sets will be utilized for coupled bio-physical modelling to investigate and compare the potential impact of future climate change, especially the effect of global warming on the spatial distribution, habitat utilisation and recruitment processes of central Baltic fish and zooplankton populations.

The overall goal of the EU FP7 Integrated Project **EPOCA** (European Project on OCean Acidification) is to advance our understanding of the biological, ecological, biogeochemical, and societal implications of ocean acidification. EPOCA aims to document the changes in ocean chemistry and biogeography across space and time and determine the sensitivity of marine organisms, communities and ecosystems to ocean acidification. The results of the impact of ocean acidification on marine ecosystems will be used to better understand and predict the responses of the Earth system to ocean acidification in order to assess uncertainties, risks and thresholds ("tipping points") related to ocean acidification at scales ranging from subcellular to ecosystem and local to global. Within EPOCA it is planned to investigate the impact of ocean acidification on the performance, reproduction and growth in marine organisms. One of the objectives is to identify the critical stages in the life cycle of functionally important marine organisms based on performance measures as indicators of sensitivity to ocean acidification. Furthermore, physiological mechanisms of performance, acclimation capacity and tipping points are to me analyzed. One of the key species in this study is the Baltic cod, *Gadus morhua*, which will be obtained during the cruises with the RV ALKOR. Results will be compared to other species and functional groups for quantification of the impact of ocean acidification.

The **DFG-Mnemiopsis-Project** focuses on the comb jelly *Mnemiopsis leidyi* (Ctenophora) which recently invaded North- and Baltic Sea. 18 mo after the first occurrence, populations frequently attain >500 individuals /m^3, suggesting profound consequences for the pelagic food chain. This project will study the *''paradox of invasions'*: how and why are supposedly genetically uniform colonizing populations so successful? - We first determine the source region(s) of *Mnemiopsis* populations invading North and Baltic Sea, using high-resolution genetic markers. We are then interested in processes enhancing adaptive evolution, which would exacerbate the impact that *M. leidyi* has on native fish populations. Taking advantage of genetic samples collected very early after first occurrence, we follow the level of genetic diversity displayed by *Mnemiopsis* populations across the study area over time. We test the hypothesis that the invading population is genetically less diverse than the source, while older invaded areas such as Caspian/Black Sea reveal intermediate levels. In order to address whether invading *Mnemiopsis* undergoes rapid evolutionary adaptation in its novel environment, genetic divergence among populations will be quantified temporally and spatially using gene-linked SNP loci in combination with genome scans.

Another focus is an additional cryptic invasion by another comb jelly, *Mertensia ovum*. This species co-occurs with *M.leidyi* in the Bornholm basin.

The EU project **CALMARO** involves initial Training Network aims at improving the career perspectives of early researchers by offering structured training in the field of Calcification by Marine Organisms as well as providing complementary skills and exposing the researchers to other sectors including private companies. CalMarO comprises investigation of calcareous structures as well as calcification processes and the sensitivities to changes in environmental conditions at all scales ranging from cellular, organism, population to ecosystem, and regional to global levels.

Gears used:

Hydrography: CTD, Water sample rosette

Zooplankton and jelly fish: Babybongo-Net (50 and 150 µm), Multinet (1/4 m^2; 50 µm), WP-2 (200 µm), Apstein (50 µm)

Ichthyoplankton: Bongo-Net (335 and 500 µm), Mulitnet (1/2 m^2; 335 µm),

Fish: Young fish trawl

Hydroaccoustic: 38 and 200 kHz-ecosounder

Scientific crew:

- Hans-Harald Hinrichsen (Chief Scientist)	IfM-Geomar Kiel	whole cruise
- Isabel Keller	IfM-Geomar Kiel	whole cruise
- Sören Bolte	IfM-Geomar Kiel	whole cruise
- Svend Mees	IfM-Geomar Kiel	whole cruise
- Martina Lohmann	IfM-Geomar Kiel	whole cruise
- Luise Töpfer	IfM-Geomar Kiel	whole cruise
- Lucia Lopez	IfM-Geomar Kiel	whole cruise
- Michael Swaat	IfM-Geomar Kiel	whole cruise
- Viola Neumann	DTU AQUA, Denmark	whole cruise
- Matthias Schaber	DTU AQUA, Denmark	whole cruise
- Robert Hagemann	University Munich	whole cruise

Report of cruise Al353 with technical details

Tuesday 30/03/10	0800-1200	Loading of ship and installation of echosounder Repair and test of vessels engine
Wednesday 31/03/10	1000 1200	Leaving in direction Western Baltic and Arkona Basin Start with hydrographic, hydroaccoustic and plankton sampling in the Kiel Bight area and in the Fehmarn Belt and in the Arkona Basin
Thursday 01/04/10	1700	Start with hydrographic, hydroaccoustic and plankton sampling in the Bornholm Basin and in the Stolpe Trench
Friday 02/04/10	1200	Start with hydrographic, hydroaccoustic and plankton sampling in the Gotland Basin
Saturday 03/04/10	1000	Interruption of sampling and steaming to Ventspils (Latvia) and consultation of hospital due to illness of a crew member
Sunday 04/04/10	0800	Leaving Ventspils and start with hydroaccoustic survey in the Gotland Basin

Monday 05/04/10	0600	Beginning of pelagic fishery in the Gotland Basin and hydroaccoustic survey in the Gdansk Deep
	2100	Start with hydrographic, hydroaccoustic and plankton sampling and pelagic fishery in the Gdansk Deep
Thursday 08/04/10	0000	Beginning of pelagic fishery and hydroaccoustic survey in the Bornholm Basin
Saturday 10/04/10	1900	Start with hydrographic, hydroaccoustic and plankton sampling in the Bornholm Basin
Tuesday 13/04/10	0600	Continue of pelagic fishery in the Bornholm Basin and in the Stolpe Trench
	2000	Continue with hydrographic, hydroacoustic and plankton sampling in the Bornholm Basin
Friday 16/04/10	1800	Continue with hydrographic, hydroaccoustic and plankton sampling in the Arkona Basin and in the Fehmarn Belt
Saturday 17/04/10	1200	End of scientific program, Steaming to Kiel
	1700	End of cruise Al353 in Kiel

Summary of cruise

With help of the almost perfect weather conditions and despite of some technical problems at the beginning of the cruise, sampling was very successful. As planned the extensive field sampling has been carried out during the cruise within the western and central Baltic Sea. A good coverage of hydrographic, plankton and fisheries data of the Bornholm Basin was obtained. In the Stolpe Trench, the Gdansk Deep and the Gotland Basin the data coverage was obtained on a larger spatial scale (see Table 4). In the Bornholm Basin and the Stolpe Trench ichthyo- and zooplankton was sampled with a Bongo/BabyBongo (equipped with 150, 335 and 500 µm nets) by means of double oblique hauls. The station grid covered the area enclosed by the 60 m isobath and was regularly spaced with a distance of 10 nm in N/S-and 8.5 nm in E/W-direction. The 500 µm samples from the Bongo have been checked for fish larvae on board. All larvae have been frozen for otolith microstructure analysis and RNA/DNA analysis to be conducted at the IfM-GEOMAR after the cruise.In the Gdansk Deep and Gotland Basin ichthyoplankton sampling was performed by IKS 80 net hauls. In order to investigate the spatial distribution and the genetic markers of *Mnemiopsis leydi* and *Mertensia ovum*., on several stations a WP2-net and vertical as well as towed multinet hauls were performed (see Table 4). The Bongo samples from the Bornholm Basin revealed that mainly due to the extremely cold temperatures of the previous winter only low abundances of fish eggs and larvae occurred. The IKS-80 samples from the Stolpe Trench, the Gdansk Deep and the Gotland Basin will be analysed by Andrej Makarchouk from LATFRA in Riga, Latvia.

Besides various samples on zoo- and ichthyplankton 28 pelagic fishery hauls were performed to determine the spatial distributions of sprat, cod and herring in the central Baltic. In order to collect adult sprat in spawning condition several fishery hauls were performed during night time. Length and weight distributions of sprat and herring were recorded as well as maturation stages on every fishery station. To describe the predation on ichthyoplankton by pelagic fish, herring and sprat stomachs have been sampled by pelagic trawling. Additionally, herring and sprat were frozen for bioenergetic analysis and frozen. For cod length and weight measurements were performed, maturation stages recorded and otoliths collected.

To describe the vertical as well as the horizontal conditions of the hydrographic parameters in the observation area CTD/O_2 casts were performed. For calibration purposes at some stations within the deep part of the basins water samples were taken using a 12 bottle rosette. During the cruise, on board measurements of sea surface temperature and salinity as well as additional meteorological variables were directly registered.

The hydrographic data recorded will be utilized to investigate the quasi-synoptic three-dimensional distribution of temperature, salinity and oxygen concentration. These data are planned to be used in future to analyse the three-dimensional distribution of physical parameters with respect to variability of the physical environmental conditions.

The hydrographic measurements in the Arkona Basin reflected new high saline inflowed water from the western Baltic, while in the Bornholm Basin the spatial distribution of water masses was different. Overall, due to the severe winter the water masses in the mixed layer showed temperatures down to less than 1°C. In the western deep water area of the basin extremely cold and well oxygenated water masses were transported from the western Baltic and the Arkona Basin during winter time. In the central and eastern parts of the Bornholm Basin below the halocline temperature increased to almost 10°C, but only low oxygen concentrations (< 2 ml/l) were found. Thus, the thickness of the spawning layer defining the vertical range with conditions allowing successful cod spawning conditions was low and mainly influenced by temperature. Generally, the deep water areas of Stolpen Trench revealed similar temperature driven cod spawning conditions as in the Bornholm Basin, while successful spawning of cod in the eastern basins was impossible due to only low oxygen concentrations in the spawning layer.

In comparison to hydrographic measurements available from cruises in 2009 within the central Baltic the hydrographic situation significantly changed due to the severe conditions of the previous winter.

Tables

Table1: Hydrographic stations Arkona Basin

Station	Breite	Länge
H01	55 7.0	12 49.0
H02	55 4.0	13 16.0
H03	55 14.5	13 30.0
H04	55 7.0	13 30.0
H05	55 7.0	13 48.0
H06	55 9.0	14 2.0
H07	55 7.0	14 15.5
H08	55 22.0	14 21.5
H09	55 21.0	14 30.0
H10	55 20.0	14 39.5
H11	55 15.0	14 30.0
H12	55 10.5	14 25.0
H13	55 6.5	14 33.5
H14	55 4.5	14 21.0
H15	54 58.5	14 16.0
H16	54 52.0	14 2.0
H17	55 1.0	14 2.0
H18	54 56.5	13 47.0
H19	54 47.0	13 47.0
H20	54 47.0	13 30.0
H21	54 56.5	13 30.0
H22	54 57.5	13 15.0
H23	54 53.5	13 5.0
H24	54 48.5	13 15.0
H25	54 44.0	13 2.5
H26	54 44.0	12 47.5
H27	54 54.5	12 47.5
H28	54 50.0	12 37.0
H29	54 43.0	12 29.5
H30	54 37.0	12 17.0
H31	54 24.0	12 10.0

Table 2: Hydrographic stations Bornholm Basin

station	latitude	longitude	Basin
1	55 27.5	14 45	BB
2	55 37.5	14 45	BB
3	55 37.5	15 00	BB
4	55 37.5	15 15	BB
5	55 37.5	15 30	BB
6	55 37.5	15 45	BB
7	55 37.5	16 00	BB
8	55 47.5	16 00	BB
9	55 47.5	16 15	BB
10	55 37.5	16 15	BB
11	55 47.5	16 30	BB
11a	55 47.5	16 45	BB
11b	55 47.5	17 00	BB
12	55 37.5	16 30	BB
12a	55 37.5	16 45	BB
12b	55 37.5	17 00	BB
13	55 27.5	16 30	BB
14	55 27.5	16 15	BB
15	55 27.5	16 00	BB
16	55 27.5	15 45	BB
17	55 27.5	15 30	BB
18	55 27.5	15 15	BB
19	55 27.5	15 00	BB
20	55 17.5	15 00	BB
21	55 17.5	15 17	BB
22	55 17.5	15 30	BB
23	55 17.5	15 45	BB
24	55 17.5	16 00	BB
25	55 17.5	16 15	BB
26	55 17.5	16 30	BB
27	55 07.5	16 30	BB
28	55 07.5	16 15	BB
29	55 07.5	16 00	BB
30	55 07.5	15 45	BB
31	55 07.5	15 30	BB
32	55 07.5	15 15	BB
33	54 57.5	15 15	BB
34	54 57.5	15 30	BB
35	54 57.5	15 45	BB
36	54 57.5	16 00	BB
37	54 57.5	16 15	BB
38	54 47.5	16 00	BB
39	54 47.5	15 45	BB
40	54 47.5	15 30	BB

41	54 47.5	15 15	BB
42	54 47.5	15 00	BB
42b	54 47.5	14 45	BB
43	54 37.5	15 15	BB
43a	54 37.5	15 00	BB
43b	54 37.5	14 45	BB
44	54 37.5	15 30	BB
45	54 37.5	15 45	BB

BB – Bornholm Basin

Table 3: Stolpe Trench, Gdansk Deep and Gotland Basin: **CTD and IKS-80**
At stations with * **CTD and Bongo/Babybongo**

Station	Breite	Länge	Becken
46*	55 14	16 48	SF
47*	55 15	17 05	SF
48*	55 14	17 22	SF
49	55 15	17 35	SF
50	55 14	17 55	SF
51	55 29	17 55	SF
52	55 25	17 35	SF
53*	55 21	17 22	SF
54*	55 21	17 05	SF
55*	55 21	16 48	SF
56	55 09	18 25	GD
57	55 10	18 49	GD
58	55 00	19 05	GD
59	54 54	18 54	GD
59a	55 00	18 41	GD
60	54 49	19 08	GD
60a	54 43	19 17	GD
61	54 48	19 25	GD
62	54 54	19 30	GD
62a	55 00	19 30	GD
63	54 54	19 12	GD
64	55 00	19 21	GD
65	55 10	19 16	GD
66	55 10	19 38	GD
67	55 19	19 42	GD
68	55 19	19 26	GD
69	55 18	19 06	GD
70	55 23	18 43	GD
71	55 23	18 19	GD
72	55 37	18 19	GB
73	55 37	18 43	GB
74	55 37	19 11	GB
75	55 37	19 26	GB
76	55 38	19 56	GB
76a	55 48	19 39	GB
77	55 39	20 11	GB
78	55 59	19 22	GB
79	55 57	19 03	GB
80	55 57	18 43	GB
81	55 55	18 29	GB

82	55 53	18 12	GB
82a	56 50	19 10	GB
83	55 15	18 37	GB
84	56 15	19 00	GB
85	56 15	19 30	GB
86	56 32	20 22	GB
86a	56 38	20 16	GB
87	56 34	20 01	GB
88	56 32	19 39	GB
89	56 32	19 23	GB
90	56 32	19 00	GB
90a	56 32	18 46	GB
91	56 42	19 00	GB
92	56 42	19 30	GB
93	56 42	20 00	GB
94	56 55	20 24	GB
95	56 55	19 54	GB
96	56 55	19 35	GB
97	56 55	19 14	GB
98	56 55	18 55	GB
99	57 10	19 25	GB
100	57 09	19 42	GB
101	57 09	20 00	GB
102	57 10	20 29	GB
102a	57 23	20 35	GB
103a	57 22	20 23	GB
104b	57 18	20 09	GB
105	57 23	19 58	GB
106a	57 22	19 28	GB
107	57 36	19 44	GB
108	57 54	19 50	GB
109	57 55	20 10	GB
110	57 45	20 30	GB
111	57 37	20 15	GB

SF: Stolper Trench; GD: Gdansk Deep; GB: Gotland Basin

Table 4. Number and type of samples taken during AL353

Basin	Type	Number
Arkona Basin	CTD	23
	WP2	12
	Bongo/Babybongo	6
	Multinet	5
	Helgoland Larvalnet	6
Bornholm Basin	CTD	68
	WP2	54
	Bongo/Babybongo	46
	Multinet	26
	Watersampler	1
	Helgoland Larvalnet	10
	Apstein net	7
	Fishery trawls	15
Stolpe Trench	CTD	14
	Bongo/Babybongo	14
	WP2	14
	IKS 80 net	4
	Fishery trawls	1
Gdank Deep and Gotland Basin	CTD	16
	Bongo/Babybongo	7
	WP2	21
	IKS80	7
	Multinet	2
	Watersampler	2
	Fishery trawls	8

Figures

Fig 1: Stations Arkona Basin

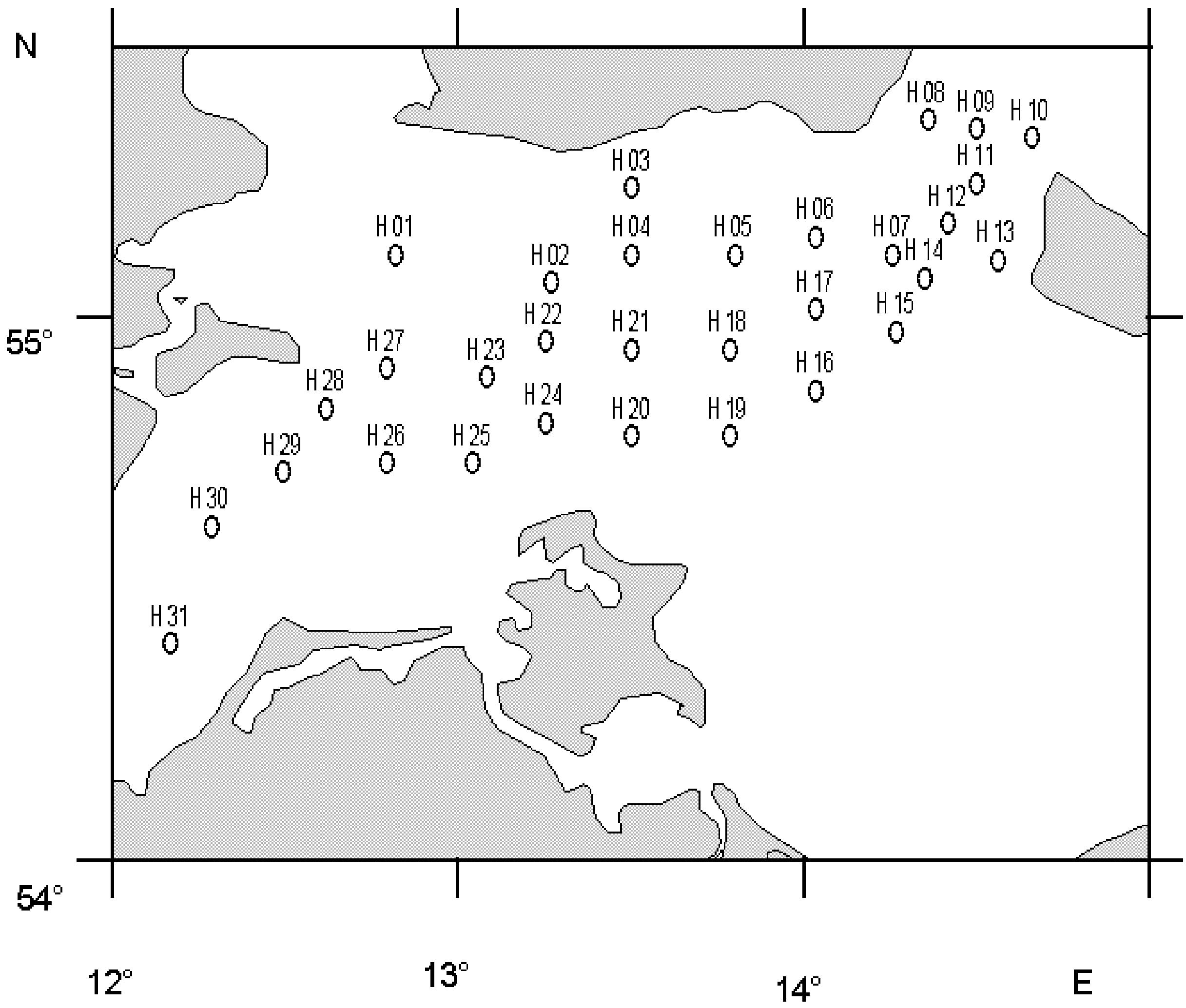

Fig 2: Stations Bornholm Basin and Stolpe Trench

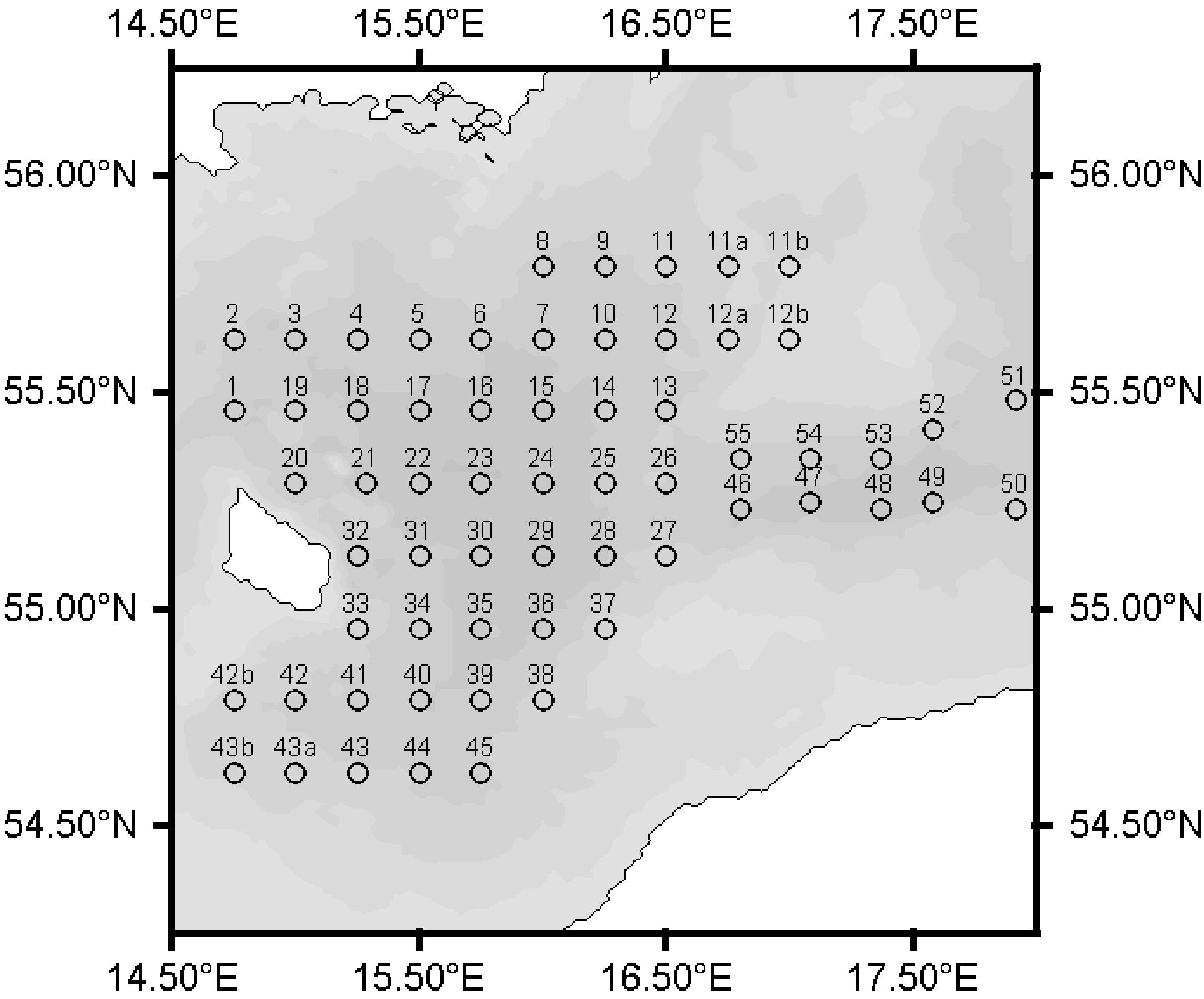

Fig 3: Stations Gdansk Deep and Gotland Basiin