CRUISE REPORT: 08.4.-21.4.2011

R.V. Alkor **Cruise No.:Al 371**

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

Port calls: Saßnitz

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

Chief Scientist: Hans-Harald Hinrichsen

Number of Scientists: 12

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), Helgoland Larvalnet (500 µm), IKS80 (300 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
- Svend Mees	IfM-Geomar Kiel	whole cruise
- Julian Döring	IfM-Geomar Kiel	whole cruise
- Enno Prigge	IfM-Geomar Kiel	whole cruise
- Lars Kruse	IfM-Geomar Kiel	whole cruise
- Burkhard v. Dewitz	IfM-Geomar Kiel	whole cruise
- Helena Hauss	IfM-Geomar Kiel	whole cruise
- Isabel Keller	IfM-Geomar Kiel	whole cruise
- Holger Haslob	IfM-Geomar Kiel	whole cruise
- Hilda Nurlaeli	IfM-Geomar Kiel	whole cruise
- Natascha Mortagli	IfM-Geomar Kiel	whole cruise
- Viola Neumann	DTU AQUA, Denmark	whole cruise

Report of cruise Al354 with technical details

Thursday 08/04/11	0800-1000	Loading of ship
	1000	Steaming to Arkona Basin
	1800	Prolongation of measurements due to bad weather conditions (up to 9 Bft.)
Friday 09/04/11	0000	Start with hydrographic, hydroaccoustic, plankton Sampling and pelagic fishery in the Arkona Basin (St. H23, H22, H21, H18 and H17)
Friday 09/04/11	2200	Start with hydrographic, hydroaccoustic and plankton sampling in the Bornholm Basin and in the Stolpe Trench (St. BB1-BB13, SF55, BB 23-26, BB14-16
Sunday 11/04/11	0600	Start with pelagic fishery in the northeast of the
	1800	Continuation with hydrographic, hydroaccoustic and plankton sampling in the Bornholm Basin (St.BB 23, 22, 17-21)
Monday 12/04/11	0600	Start with pelagic fishery in the northwest of the Bornholm Basin (6 hauls)

	1800	Continuation with hydrographic, hydroaccoustic and plankton sampling in the Bornholm Basin (St.BB 32, 31, 30, 34, 33, 42, 41, 40)
Tuesday 13/04/11	0600	Start with pelagic fishery in the southwest of the Bornholm Basin (6 hauls)
	1800	Continuation with hydrographic, hydroaccoustic and plankton sampling in the Bornholm Basin (St.BB 35, 39, 43-45, 38, 36-37, 28, 29)
Wednesday 14/04/11	0900	Start with pelagic fishery in the southeast of the Bornholm Basin (5 hauls)
	1900	Interruption of sampling and steaming to Saßnitz, consultation of hospital due to illness of a crew member, exchange of crew member
Friday 15/04/11	1400	Leaving Saßnitz into direction central Bornholm Basin
	2000	Continuation with hydrographic, hydroaccoustic and plankton sampling in the Bornholm Basin (small-scale resolution in vicinity of St. 23)
Saturday 16/04/11	0600	Start with small-scale pelagic fishery in vicinity of St. 23 Bornholm Basin (7 hauls)
	1700	Start with hydrographic, hydroaccoustic, plankton sampling and pelagic fishery in the Gdansk Deep (St. GB 59, 60, 60a, 63, 58, 57, 56)
Sunday 17/04/11	0600	Start with hydrographic, hydroaccoustic, plankton sampling and pelagic fishery in the Southern Gotland Basin and the Stolpe trench (St. GB 72, 73, 79, 80, 81, 82, SF 51, 50, 49, 52, 53, 48, 47, 54, 46)
Tuesday 19/04/11	1100	Continuation with hydrographic, hydroaccoustic and plankton sampling in the Bornholm Basin (St.BB 27 and 23)
Wednesday 20/05/10	0100	End of scientific program, Steaming to Kiel
	2000	End of cruise Al371 in Kiel

Summary of cruise

Despite of relatively bad weather conditions at the verya beginning of the cruise, sampling could be performed as scheduled.

The physical measurements of this cruise were designed to investigate the quasi-synoptic three-dimensional distribution of temperature, salinity, oxygen and pH within the Arkona- and Bornholm Basin. The station grid in the Bornholm Basin 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. Data of these physical observations will be used in future to analyse the three-dimensional distribution of biological parameters (e.g. zooplankton, fiah egg and larval abundance, fish abundance) with respect to variability of the physical environmental conditions.

The hydrographic measurements identified the permanent halocline in the Bornholm Basin in the depth range 45-55 meter increasing from east towards west. The water temperature of the mixed layer was around 2-3°C. In the more western part of the Bornholm Basin, below the halocline a very cold water body with temperatures was observed not exceeding 1.5°C. This relatively cold, well oxygenated water had a vertical extension down to the bottom. It originated from an inflow event of Kattegat and western Baltic water masses during winter 2010/2011. Within the deep water area of the eastern Bornholm Basin, oxygen values were below 2 ml/l with temperatures around 6°C and salinities not exceeding 17 psu. In comparison to hydrographic measurements available from previous cruises in 2010 within the central Baltic the hydrographic situation partly changed. The indication of newly inflowed water entering the Bornholm Basin, yields a relatively high probability of substantial water mass exchange between particular basins having an impact on environmental conditions in the Gdansk Deep and the southern Gotland Basin. Howeveer, at present, there is only low oxygen concentration in the near-bottom layers of the Gdansk Deep and the southern Gotland Basin, but parly above the required concentrations for successful cod spawning. The deep part of the southern Stolpe Trench has the most favourable spawning conditions from the halocline to the bottom, with oxygen concentrations larger than 2 ml/l.

The 500 µm samples from the Bongo have been checked for cod and sprat larvae on board. All fish larvae had been frozen at -80°C to enable evaluation of their nutritional status by RNA/DNA analysis in relation to otolith microstructure. The WP2 net was utilized 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).

43 pelagic fishery hauls were performed to determine the spatial distributions of sprat, cod and herring in the Bornholm Basin, the Gdansk Deep and the southern Gotland Basin. 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. For cod length and weight measurements were performed, maturation stages recorded and otoliths collected. Due to the relatively low water temperatures, the catch rates of cod were very low, indicating only low spawning migration from the winter feeding grounds towards the spawning ground in the deep Bornholm Basin. From the cruise it was recognized that the spawning activity of sprat had also not fully started.

Due to the peculiar hydrographical conditions in the Central Baltic Sea with oxygen minimum zones in higher saline bottom layers, pelagic fish eggs regularly face hypoxic conditions during their development. Thus, the determination of the specific buoyancy potential of the most important pelagic fish eggs (cod, sprat, flounder eggs) is an important issue to deal with and has been analyzed during this cruise using two independent methods to assess the vertical egg distribution.

Vertically towed Helgoländer Larvalnet (HLN) were used to integrate the near bottom to surface water column and alive, unharmed fish eggs (cod, sprat, flounder) have been picked out, determined to species level, staged and size measured under stereomicroscopes. The eggs were inserted into freshly prepared density gradient columns and the density was calculated after the eggs had obtained their neutral buoyancy within 60 minutes in the stratified column equipped with specific calibrated density floats.

The second method to determine egg density values (=egg neutral buoyancy) was the strip spawning of running ripe female fish and immediate fertilization with sperm collected from running ripe males. Eggs were decanted to separate dead from alive fertilized ones and after 30min incubation time kept cool and dark for about 20 hours before subsamples were checked for normal developmental progress, staged, size measured and put into gradient columns. 60

min past insertion, density potential of the batch could be read in conjunction with the calibrated density floats. The majority of measurements were made in the Bornholm Basin, followed by some batches in the southern Gotland Basin and in the Gdansk Deep.

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 AL371

Basin	Type	Number
Arkona Basin	CTD	5
	Watersampler	1
	Fishery trawls	5
	Helgoland Larvalnet	2
Bornholm Basin	CTD	60
	WP2	8
	Bongo/Babybongo	51
	Multinet	12
	Watersampler	2
	Helgoland Larvalnet	10
	Apstein net	6
	Fishery trawls	30
Stolpe Trench	CTD	9
	Bongo/Babybongo	6
	IKS80	4
	Helgoland Larvalnet	1
	WP2	1
Gdansk and Southern Gotland Basin	CTD	13
	IKS80	13
	WP2	2
	Helgoland Larvalnet	1
	Fishery trawls	8

Figures

Fig 1: Stations Arkona Basin

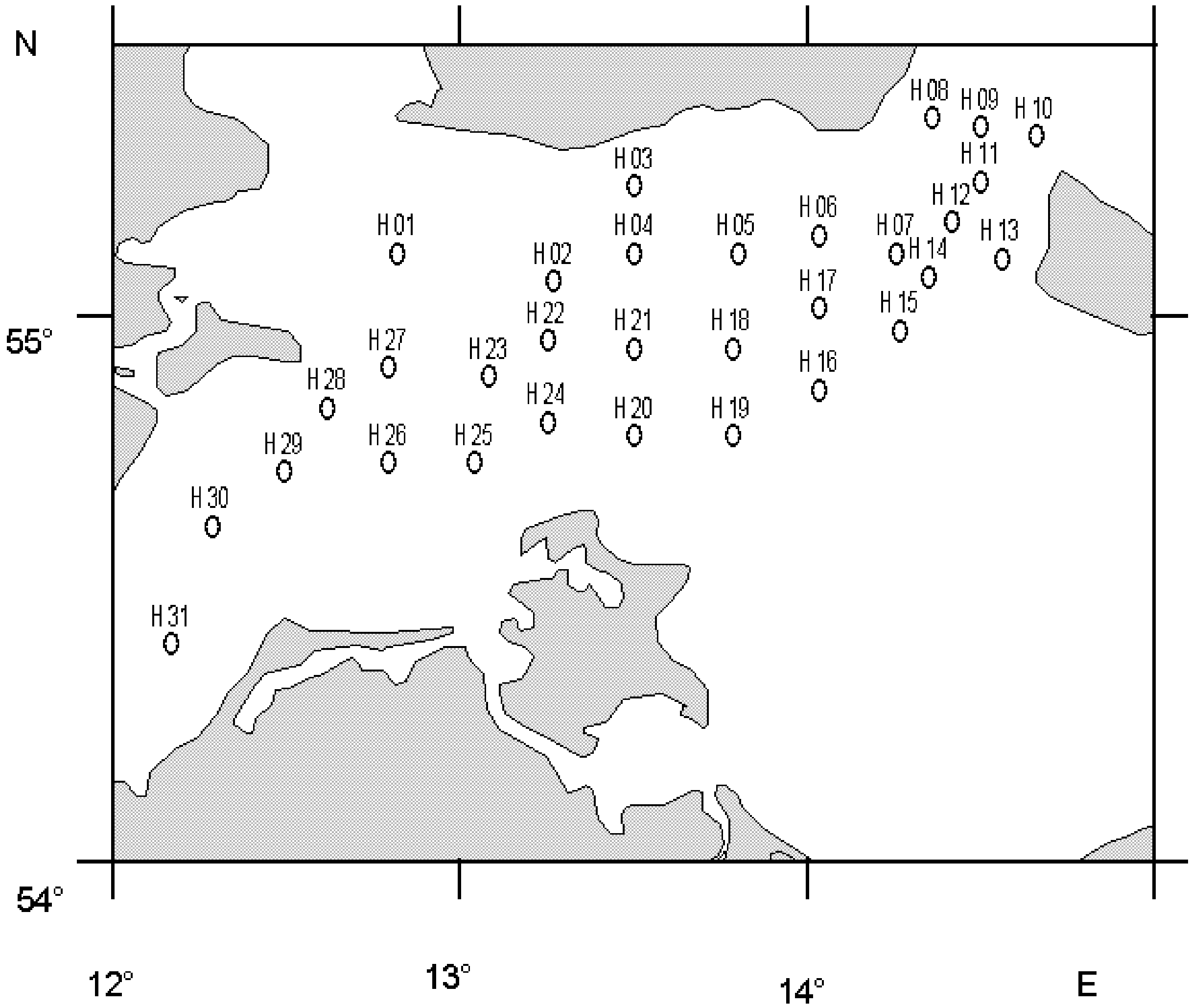

Fig 2: Stations Bornholm Basin and Stolpe Trench

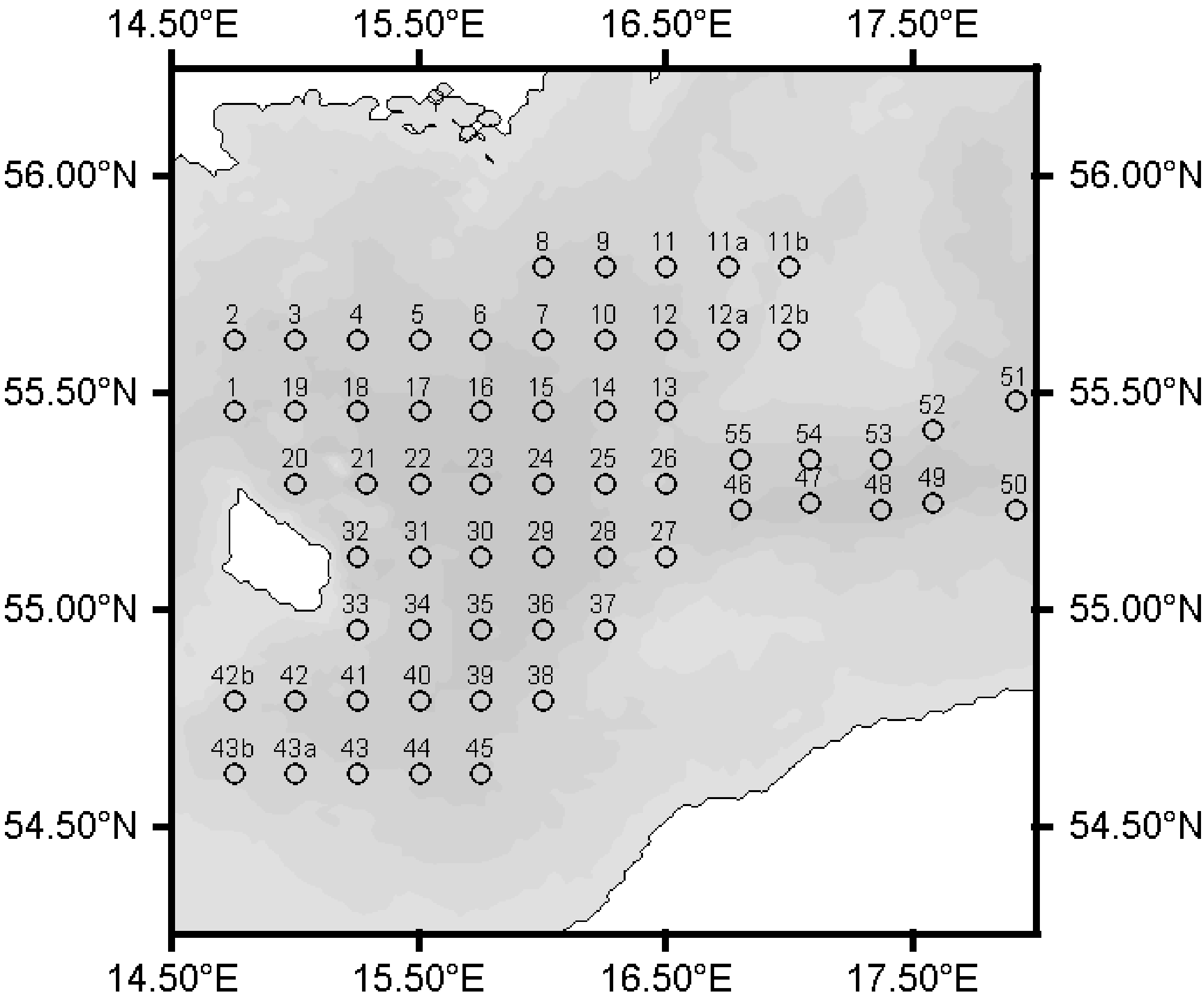

Fig 3: Stations Gdansk Deep and Gotland Basiin