CRUISE REPORT: 10.5.-25.5.2010

R.V. Alkor **Cruise No.:Al 354**

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), 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
- Jörn Schmidt	University Kiel	Kiel-Saßnitz
- Max Stoeven	University Kiel	Kiel-Saßnitz
- Svend Mees	IfM-Geomar Kiel	whole cruise
- Martina Lohmann	IfM-Geomar Kiel	whole cruise
- Gregor Steffen	IfM-Geomar Kiel	whole cruise
- Franziska Heidemann	IfM-Geomar Kiel	whole cruise
- Cathrin Clemmesen	IfM-Geomar Kiel	whole cruise
- Marko Freese	IfM-Geomar Kiel	whole cruise
- Viola Neumann	DTU AQUA, Denmark	whole cruise
- Carolin Hauer	University Hamburg	whole cruise
- David Pena	University Kiel	Saßnitz-Kiel

Report of cruise Al354 with technical details

Monday 10/05/10	0800-1300	Loading of ship
	1300	Steamning to Bornholm Basin
Thursday 11/05/10	00800	Beginning of pelagic fishery and hydroaccoustic survey in the Bornholm Basin
Friday 14/05/10	1000	Interruption of sampling and steaming to Saßnitz because of engine repairment and exchange of scientific crew
	1400	Leaving Saßnitz into direction central Bornholm Basin
	2300	Continuation with pelagic fishery and hydroaccoustic survey in the Bornholm Basin
Tuesday 18/05/10	0000	Start with hydrographic, hydroaccoustic and plankton sampling in the Bornholm Basin and in the Stolpe Trench
Friday 21/05/10	1000	Interruption of sampling and steaming to Saßnitz, consultation of hospital due to illness of a crew member, exchange of crew member

Saturday 22/05/10	1000	Leaving Saßnitz into direction of the central Bornholm Basin
Sunday 23/05/10	0100	Continuation with station grid in the Bornholm Basin
Sunday 23/05/10	2100	Start with hydrographic, hydroaccoustic and plankton sampling in the Arkona Basin
Monday 24/05/10	0800	End of scientific program, Steaming to Kiel
	2000	End of cruise Al354 in Kiel

Summary of cruise

Due to the almost perfect weather conditions and despite of some technical problems of the vessels engine, sampling was very successful.

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. A total number of 87 CTD casts were performed on the survey, from which 6 were located Arkona Basin, 71 in the Bornholm Basin and 10 in the Stolpe Trench region (Table 3).

The mixed layer water masses in the observation area revealed temperatures of about 6°C and in the winter water body (between 35 and 45 m) temperatures down to less than 1°C were observed. 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 was low and mainly influenced by temperature. Generally, the deep water areas of Stolpe Trench revealed similar temperatures. In comparison to hydrographic measurements available from cruises in 2009 within the upper part of the Bornholm Basin the hydrographic situation significantly changed due to the severe conditions of the previous winter.

On 57 stations covered, ichthyo- and mesozooplankton was sampled with a Bongo and a Babybongo (equipped with 150, 335 and 500 µm nets) by means of double oblique hauls and on 15 stations with vertically resolving multinets. Compared to the cruise in April 2010, the Bongo samples from the Bornholm Basin revealed higher abundances of fish eggs and larvae. 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 3).

27 pelagic fishery hauls were performed to determine the spatial distributions of sprat, cod and herring in the Bornholm.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. The catch rates of cod were three times higher than in April, indicating an increase in spawning migration from the winter feeding grounds towards the spawning ground in the deep Bornholm Basin. From the cruise it was also obtained that compared to April 2010, the spawning activity of sprat had fully started, i.e., the catch rates of sprat was considerably higher than in preceding years. Hydroacoustic recordings did not reveal any different spatial distributions in abundance, indicating an overall relatively high abundance. Cod fertilisation success and egg development at different salinities was assessed using egg batches from different females and semem from different males. Furthermore, the impact of ocean acidification on the fertilisation success was evaluated by using different water with different pH values.

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. Number and type of samples taken during AL354

Basin	Type	Number
Arkona Basin	CTD	6
	WP2	6
	Multinet	6
Bornholm Basin	CTD	71
	WP2	50
	Bongo/Babybongo	41
	Multinet	28
	Watersampler	9
	Helgoland Larvalnet	11
	Apstein net	7
	Fishery trawls	27
Stolpe Trench	CTD	10
	Bongo/Babybongo	10
	WP2	10

Figures

Fig 1: Stations Arkona Basin

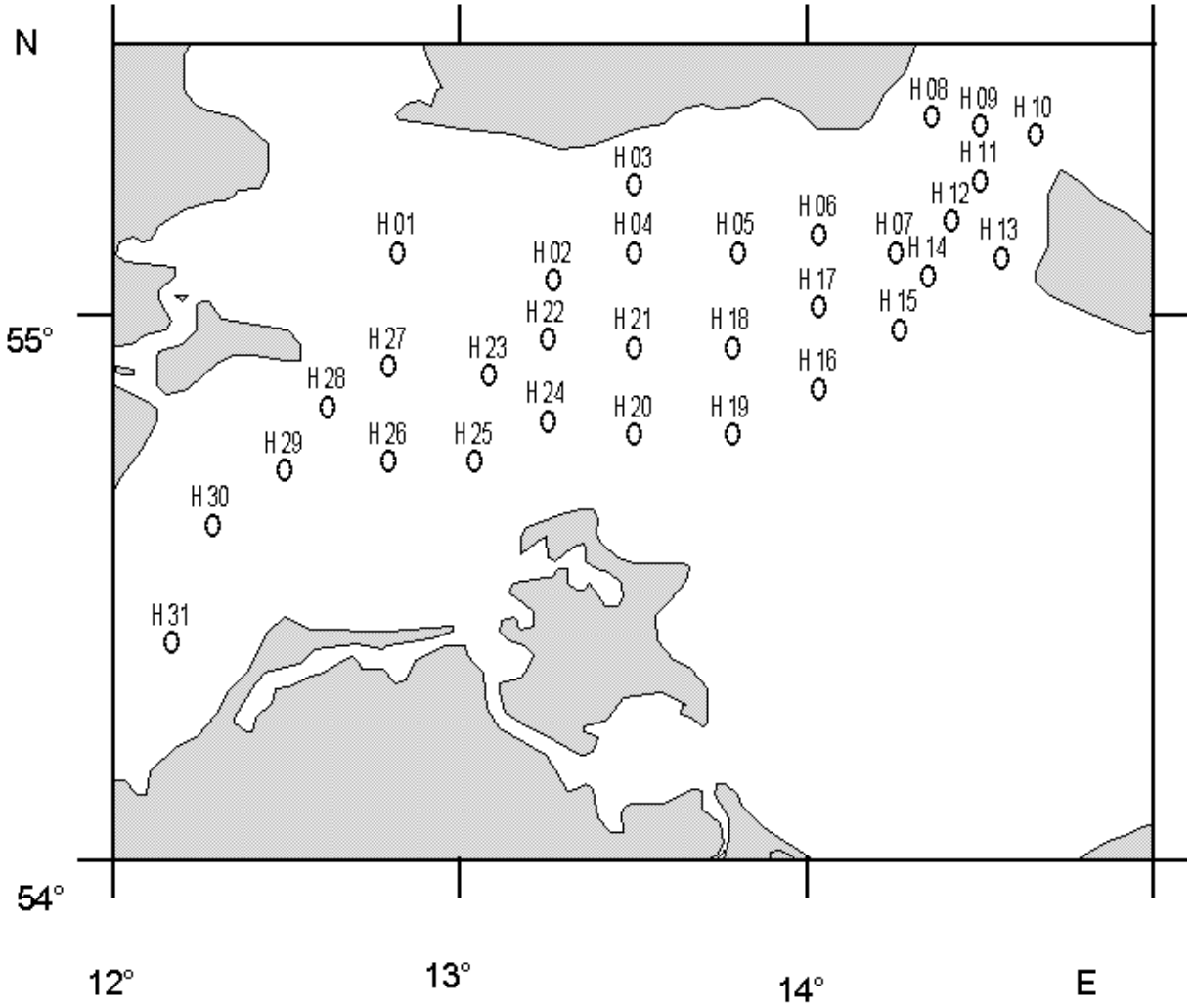

Fig 2: Stations Bornholm Basin and Stolpe Trench