

**FRV Walther Herwig III
Cruise 469
10.08. – 24.08.2023**

**Integrated Monitoring of Contaminants and their
Biological Effects (INMON)**

Scientist in Charge: Dr. Klaus Wysujack

Summary

Within the framework of the monitoring programme of the Thünen Institute for Fisheries Ecology (FI) on the health status and contamination of fish in the North Sea and Baltic Sea with heavy metals and organic pollutants, investigations were carried out in six Baltic Sea and five North Sea areas as well as one station in the Skagerrak.

Macroscopically visible diseases and parasites were recorded onboard for all fish (dab *Limanda limanda* and cod *Gadus morhua*) used for further analyses (organic and inorganic pollutants, radioactivity). As part of a master's thesis, samples were taken to analyse the infestation of cod with two parasites (*Loma morhua* and *Contracaecum osculatum*) in relation to geographical location and water depth. Furthermore, in co-operation with the University of Hohenheim, tissue samples (liver, muscle, brain) of various fish species (including dab, mackerel, flounder and cod) were taken in the Baltic and North Sea for subsequent analysis of the levels of halogenated natural products (HNPs).

During the bottom trawl hauls, the marine litter caught was routinely recorded. A neuston catamaran (Hydro-Bios) was regularly used for the additional collection of litter floating on the water surface.

In addition, accompanying hydrographic investigations (water temperature, salinity, oxygen content) were carried out.

The following preliminary findings were noted:

Dab: Continued low infestation rates of "classical" externally visible infectious diseases (lymphocystis, epidermal hyperplasia/papillomas, skin ulcerations, fin rot); continued very high infestation rate of hyperpigmentation in North Sea dab.

Baltic cod: Overall, continued low prevalence of skin ulcerations and skeletal deformities; low infestation rates with nematodes in the body cavity in the Baltic Sea areas; again generally high prevalence of the gill parasite *Loma morhua*.

Participants:

Name	Function	Institution
Dr. Klaus Wysujack	Scientist in Charge	TI Fisheries Ecology
Alexandra Poell	Technician	TI Fisheries Ecology
Sarah-Jane Reyelt	Technician	TI Fisheries Ecology
Benita Möckel	Technician	TI Fisheries Ecology
Wojciech Wilczynski	Guest scientist/Observer	Warsaw University (Poland)
Hanna Robitschko	Student	TI Fisheries Ecology
Murielle Muesfeldt	Student	TI Fisheries Ecology
Elis Janssen	Student	TI Fisheries Ecology

Objectives of the Cruise

1. Studies on biological effects of contaminants;
2. Collection of fish samples for the analysis of radioactive substances, heavy metals and organic pollutants (within the framework of BLMP, Radiation Protection Act, OSPAR/HELCOM and research projects), as well as within the framework of a co-operation for the analysis of the contents of halogenated natural products (HNP's) in various organs;
3. Studies on the occurrence of fish diseases and parasites in the fish used for the abovementioned analyses and specific sampling for cod from the Baltic Sea (parasites *Loma morhua* and *Contracaecum osculatum*);
4. Assessment and documentation of litter items in the bottom trawls according to ICES protocol;
5. Sampling with a Neuston catamaran (Hydro-Bios) to collect (meso)-litter floating on the surface;
6. Hydrographical measurements (salinity, temperature, oxygen, turbidity).

Dates of the Cruise

On the morning of 10 August 2023, FFS Walther Herwig III left Bremerhaven and made its way around Skagen towards the Baltic Sea. On 12 August, the work began in area B01 in the Bay of Kiel. On 12 August, work began in area B01 (Bay of Kiel), followed on 13 August by B11 (Arkona Sea) and B10 (Adlergrund, neuston catamaran only). On the following days (14/15 August), three trawl stations were fished at approx. 90/60/40 m water depth near area B09 (Gdansk Bay) and from area B13 (Bornholm) in the direction of B10 for the special investigations on the infestation of cod with parasites depending on the water depth. After the trawl hauls, three hauls were carried out each day with the neuston catamaran. The last area in the Baltic Sea was B12 (Mecklenburg Bay) on 16 August.

On the following day, the ship set course for the Skagerrak, where one haul was made in area SK2 on 18 August.

The cruise then continued into the North Sea, where station GB3 (German Bight) was sampled on 19 August. In the following days, areas P02 (Ekofisk), GB4 (Entenschnabel) and GB1 (inner German Bight, buoy E3) were surveyed. The WH III had to leave area P02 after one haul, despite having the necessary permits, due to ongoing work in the area of the oil/gas platforms.

As in the previous year (WH459), sampling was carried out in area GB4 using radiation protection measures in relation to the Integrated Measurement and Information System for Monitoring Radioactivity in the Environment (IMIS) according to the Radiation Protection Act. These exercises are intended to help better protect the crew after a real release of radioactive substances.

On the morning of 23 August, the last North Sea station, N01 (former dumping area in the German Bight), was sampled. The WHIII then headed for Bremerhaven and arrived in the evening of 23 August. The cruise ended on 24 August with unloading the vessel.

The location of the study areas and the exact course of the journey can be seen in Figs. 1 and 2 as well as Table 1. In the 11 study areas (Figs. 1 and 2), a total of 21 fishing hauls (tow time mostly 30 minutes, 2 hauls of 25/26 minutes each, and the practice haul under radiation protection conditions of 15 minutes) were carried out (coordinates in Tab. 1, catch composition in Tab. 4).

In the Baltic Sea the 140 ft. bottom trawl was used, in the North Sea the GOV was used in standard configuration. Hydrographic measurements were carried out at almost all fishing stations with the exception of the haul during the IMIS exercise (coordinates in Table 2, results in Table 5).

Twenty-eight hauls with the neuston catamaran were conducted to collect litter floating on the surface (coordinates in Table 3).

Preliminary Results

Dab (*Limanda limanda*)

A total of 904 dab (total length ≥ 10 cm) from the Baltic Sea areas B01, B11 and B12 and from five North Sea areas (GB4, P02, GB1, N01 and GB3) were examined for externally visible diseases and parasites (Table 6). The occurrence of liver abnormalities was not investigated on this trip.

The findings and infestation rates as well as their regional infestation patterns largely corresponded to those of previous cruises. The general decreasing trend in the infestation rates of Lymphocystis in North Sea dab was confirmed. The current values (0.0-6.9 %) are in the range of the values from the last surveys in 2020 and 2022. The values for Baltic dab were even lower than in 2020 (currently 0.0-1.7 %). In comparison with the North Sea, Baltic dab show significantly lower infestation rates of externally visible parasites, with the exception of the trematode *Cryptocotyle lingua*, and the phenomenon of hyperpigmentation occurs extremely rarely in the Baltic Sea (see Table 6). However, the lower numbers of animals examined in this year's study should generally be noted.

Within the study areas in the German North Sea EEZ (GB1, N01, GB3, GB4), the distinct regional patterns of infestation rates already observed during previous cruises were largely confirmed. The infestation rates of Lymphocystis and in particular the parasite *Stephanostomum baccatum* (white cysts under the skin) are increasing in a north-westerly direction, while the rates of the parasite *Acanthochondria cornuta* (copepods) are decreasing. In contrast, the highest infestation rates with the copepod *Lepeophtheirus pectoralis* were recorded in the middle station (GB3) this year. However, also for this parasite, the infestation was lowest in the two stations furthest from the coast (GB4 and P02).

The infestation rate of hyperpigmentation remained high in the North Sea dab (Table 4); the highest value was recorded this year in area GB4, where 60.3 % of the dab were affected. However, the differences between the stations further from the coast are quite small (P02: 52.9 %, GB4: 60.3 % and GB3: 50.4 %). In contrast, the infestation rates are somewhat lower in the areas closer to the coast (N01: 48.7 %, GB1: 38.8 %). The causes of this phenomenon are still not understood.

Cod (*Gadus morhua*)

A total of 186 cod from five Baltic Sea areas (B01, B09, B10, B11, B13) and one station in the Skagerrak (SK2) were examined for externally visible diseases and parasites, of which 167 fish were also examined for nematode larvae (Anisakidae) in the abdominal cavity (Table 7). No cod were caught in the North Sea. However, only very few cod were caught in areas B01 (N = 7), B11 (n = 7) and SK2 (n = 5). Hence, the results for these areas are not strong and must be considered very careful.

There were only a few differences in the externally visible diseases compared to previous cruises. The infestation rates of acute/healing stages of skin ulceration in Baltic cod were again very low at mostly 0.0-2.4 %, with higher values only recorded for area B09 (8.9 %). Skeletal deformities were just as rare as the other diseases analysed, with a maximum value of 1.1 %.

Nematode larvae in the abdominal cavity were only detected in cod from area B13. However, in view of the generally lower sample sizes and the relatively low infestation rates in recent years, these findings should be evaluated with caution.

The gill parasite *Loma morhua* (Microspora) occurred quite frequently in almost all Baltic Sea areas and the Skagerrak with infestation rates of 24.4 - 71.4 % (areas with low sample numbers not included) and was generally in the same range as in previous years. Interestingly, however, in contrast to previous years, the lowest infestation rate was documented in the easternmost area B09.

Miscellaneous

Tab. 4 shows the mean catches of the most common fish species and Tab. 5 the results of the hydrographic surveys.

Acknowledgements

I would like to thank Captain Arne Schwegmann and his crew as well as the scientific cruise participants for the smooth and constructive cooperation and the very good atmosphere on board.

Dr. Klaus Wysujack

(Scientist in Charge)

Annex

3 Figures, 7 Tables

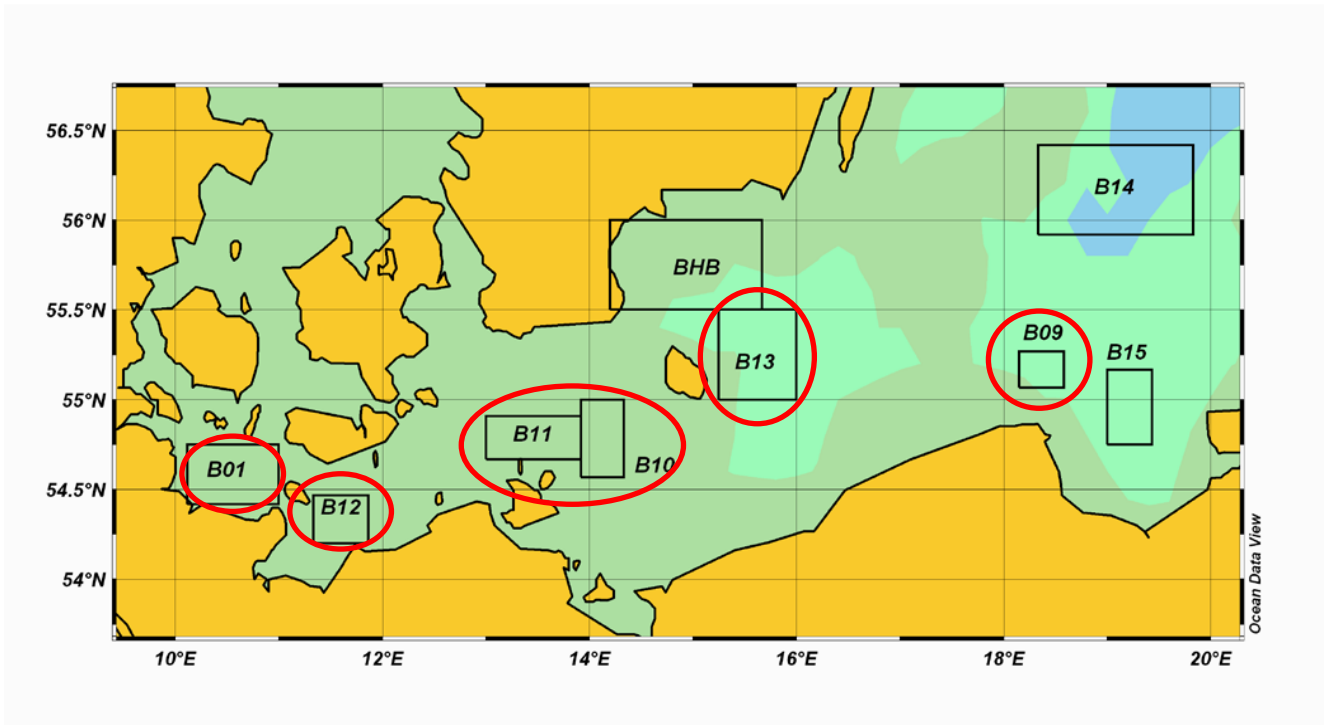


Fig. 1: Cruise 469 FRV 'Walther Herwig III', 10.08. - 24.08.2023: Location of sampling sites in the Baltic Sea.



Abb. 1a: Cruise 469 FRV 'Walther Herwig III', 10.08. - 24.08.2023: Location of the fisheries stations (bottom trawling) no. 6 – 11 in the Baltic Sea. Due to special requirements (water depths), most of these stations were not located in the standard areas B09, B13 and B10.

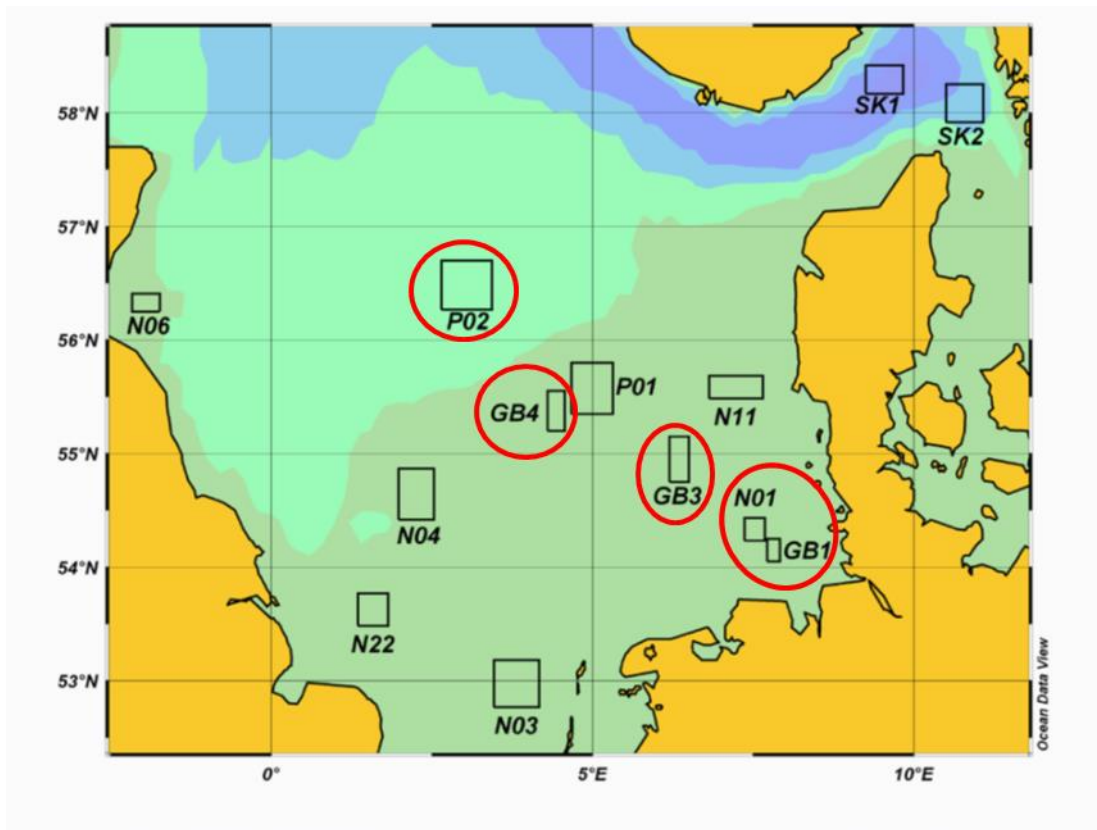


Fig. 2: Cruise 469 FRV 'Walther Herwig III', 10.08. – 24.08.2023: Location of sampling sites in the North Sea and in the Skagerrak

Tab. 1: Cruise 469 FRV 'Walther Herwig III', 10.08. – 24.08.2023: Geographical coordinates of trawling stations in the Baltic Sea and North Sea with trawling time and gear type.

DATE	STATION	AREA	LATITUDE	LONGITUDE	GEAR	TRAWLING TIME (min)
12.08.23	1	B01	54°32.961N	010°46.885E	140 Fuß-Netz	30
12.08.23	2	B01	54°31.705N	010°36.208E	140 Fuß-Netz	30
13.08.23	3	B11	54°47.849N	013°11.843E	140 Fuß-Netz	30
13.08.23	4	B11	54°52.158N	013°19.944E	140 Fuß-Netz	30
13.08.23	5	B11	54°44.067N	013°47.551E	140 Fuß-Netz	30
14.08.23	6	B09*	54°58.223N	018°41.717E	140 Fuß-Netz	30
14.08.23	7	B09*	55°02.609N	018°21.849E	140 Fuß-Netz	30
14.08.23	8	B09*	55°04.518N	018°03.441E	140 Fuß-Netz	30
15.08.23	9	B13	55°03.290N	015°45.511E	140 Fuß-Netz	30
15.08.23	10	B13*	54°53.749N	015°11.799E	140 Fuß-Netz	30
15.08.23	11	B10*	54°37.754N	014°41.986E	140 Fuß-Netz	30
16.08.23	12	B12	54°21.721N	011°22.770E	140 Fuß-Netz	30
16.08.23	13	B12	54°23.400N	011°25.527E	140 Fuß-Netz	30
16.08.23	14	B12	54°14.488N	011°25.487E	140 Fuß-Netz	30
18.08.23	15	SK2	57°57.470N	010°45.223E	GOV	25
19.08.23	16	GB3	55°00.859N	006°18.230E	GOV	30
20.08.23	17	P02	56°30.736N	002°54.327E	GOV	26
21.08.23	18	GB4	55°23.696N	004°26.978E	GOV	30
21.08.23	19	GB4	55°23.081N	004°30.011E	GOV	15 (*IMIS exercise)
22.08.23	20	GB1	54°04.504N	007°52.100E	GOV	30
23.08.23	21	N01	54°16.894N	007°39.153E	GOV	30

* Stations not located in the standard areas, see Fig. 1a.

Tab. 2: Cruise 469 FRV 'Walther Herwig III', 10.08. – 24.08.2023: Geographical coordinates of the hydrography stations in the Baltic Sea and North Sea.

DATE	STATION	FISHERY STATION	AREA	LATITUDE	LONGITUDE
12.08.23	1	1	B01	54°33.108N	010°47.728E
12.08.23	2	2	B01	54°31.489N	010°35.138E
13.08.23	3	3	B11	54°48.613N	013°10.463E
13.08.23	4	4	B11	54°52.012N	013°18.950E
13.08.23	5	5	B11	54°44.708N	013°47.623E
14.08.23	6	6	B09*	54°58.020N	018°41.441E
14.08.23	7	7	B09*	55°02.588N	018°23.208E
14.08.23	8	8	B09*	55°04.243N	018°04.542E
15.08.23	9	9	B13	55°03.696N	015°45.775E
15.08.23	10	10	B13	54°53.761N	015°11.367E
15.08.23	11	11	B10*	54°37.594N	014°43.082E
16.08.23	12	12	B12	54°21.340N	011°22.231E
16.08.23	13	13	B12	54°23.880N	011°25.358E
16.08.23	14	14	B12	54°15.025N	011°25.087E
18.08.23	15	15	SK2	57°55.718N	010°45.806E
19.08.23	16	16	GB3	55°01.759N	006°18.126E
20.08.23	17	17	P02	56°31.107N	002°52.500E
21.08.23	18	18	GB4	55°23.991N	004°25.633E
22.08.23	19	20	GB1	54°04.229N	007°53.716E
23.08.23	20	21	N01	54°16.938N	007°38.908E

* Stations not located in the standard areas.

Tab. 3: Cruise 469 FRV 'Walther Herwig III', 10.08. – 24.08.2023: Geographical coordinates of the neuston-catamaran stations in the Baltic Sea, North Sea and Skagerrak.

DATE	STATION	AREA	Start Haul		End Haul	
			LATITUDE	LONGITUDE	LATITUDE	LONGITUDE
12.08.23	1	B01	54°32.437N	010°44.631E	54°32.030N	010°46.207E
12.08.23	2	B01	54°31.765N	010°45.943E	54°31.747N	010°44.191E
12.08.23	3	B01	54°31.952N	010°44.377E	54°32.417N	010°45.910E
13.08.23	4	B10	54°37.802N	013°58.064E	54°37.614N	013°59.770E
14.08.23	5	B09*	55°05.171N	017°58.986E	55°06.142N	017°59.036E
14.08.23	6	B09*	55°06.344N	017°59.043E	55°07.315N	017°59.084E
14.08.23	7	B09*	55°07.500N	017°59.098E	55°08.469N	017°59.146E
15.08.23	8	B10*	54°37.799N	014°37.074E	54°37.799N	014°38.818E
15.08.23	9	B10*	54°37.803N	014°39.133E	54°37.802N	014°40.815E
15.08.23	10	B10*	54°37.796N	014°41.124E	54°37.744N	014°42.798E
16.08.23	11	B12	54°12.674N	011°36.838E	54°12.660N	011°38.561E
16.08.23	12	B12	54°12.657N	011°38.819E	54°12.625N	011°40.542E
16.08.23	13	B12	54°12.618N	011°40.855E	54°12.567N	011°42.605E
18.08.23	14	SK2	57°59.851N	010°43.240E	57°59.362N	010°42.008E
18.08.23	15	SK2	57°59.279N	010°41.784E	57°58.799N	010°40.477E
18.08.23	16	SK2	57°58.710N	010°40.241E	57°58.219N	010°38.945E
19.08.23	17	GB3	54°56.846N	006°17.583E	54°56.644N	006°19.452E
19.08.23	18	GB3	54°56.593N	006°19.868E	54°56.344N	006°21.883E
19.08.23	19	GB3	54°56.248N	006°22.395E	54°55.343N	006°23.457E
21.08.23	20	GB4	55°22.524N	004°30.995E	55°23.269N	004°29.700E
21.08.23	21	GB4	55°23.384N	004°29.476E	55°23.953N	004°27.934E
21.08.23	22	GB4	55°24.037N	004°27.698E	55°24.612N	004°26.201E
22.08.23	23	GB1	54°05.356N	007°49.725E	54°05.890N	007°48.262E
22.08.23	24	GB1	54°05.988N	007°48.003E	54°06.548N	007°46.575E
22.08.23	25	GB1	54°06.642N	007°46.329E	54°07.221N	007°44.887E
23.08.23	26	N01	54°17.879N	007°39.079E	54°17.120N	007°37.834E
23.08.23	27	N01	54°16.959N	007°37.604E	54°16.128N	007°36.605E
23.08.23	28	N01	54°15.983N	007°36.445E	54°15.093N	007°35.574E

* Stations not located in the standard areas.

Tab. 4: Cruise 469 FRV 'Walther Herwig III', 10.08. – 24.08.2023: Mean catches of selected abundant fish species in the Baltic Sea and North Sea (n = number, kg = weight per 1 h trawling)

AREA		Cod	Whiting	Haddock	Herring	Sprat	Mackerel	Dab	Plaice	Flounder
B01	n	16	6	5	20	31	102	720	479	---
	kg	0.8	0.5	0.3	0.5	0.4	19.8	60.2	46.5	---
B11	n	66	19	---	397	875	11	148	378	234
	kg	0.77	0.14	---	3.97	11.83	2.30	14.13	58.37	45.09
B09	n	1313	---	---	37	48	3	1	8	73
	kg	299.0	---	---	0.67	0.69	1.86	0.05	1.54	13.42
B13	n	81	---	---	79	3	---	---	1	5
	kg	19.26	---	---	6.53	0.04	---	---	0.14	0.71
B10	n	176	---	---	180	238	---	---	8	28
	kg	31.88	---	---	8.62	4.22	---	---	1.36	5.78
B12	n	1	7	---	86	326	33	512	309	2
	kg	0.0	0.45	---	0.98	4.34	5.7	54.05	38.67	0.4
SK2	n	12	4202	53	---	---	---	---	---	---
	kg	21.84	1202.4	11.86	---	---	---	---	---	---
GB3	n	---	4478	---	5364	30266	64	3818	---	---
	kg	---	275.12	---	43.82	255.14	14.82	170.26	---	---
P02	n	---	79	3627	---	---	---	1721	---	---
	kg	---	52.18	556.94	---	---	---	99.49	---	---
GB4*	n	---	54	2714	630	3158	5077	1850	---	---
	kg	---	26.36	329.92	9.4	37.04	29.5	112.82	---	---
GB1	N	---	8022	---	---	---	---	416	---	---
	kg	---	201.94	---	---	---	---	24.04	---	---
N01	n	---	8126	142	79166	348	48	396	---	---
	kg	---	232.38	5.62	402.32	1.74	8.54	26.64	---	---

* Haul 19 (IMIS-Exercise) not included.

Tab. 5: Cruise 469 FRV 'Walther Herwig III', 10.08. – 24.08.2023: Water depth, temperature (T), salinity (S), O₂ in mg/l and O₂ saturation (%) in Baltic Sea and North Sea

STATION	AREA	Total Depth	SURFACE					BOTTOM				
			Measuring	T	S	O ₂ (ml/l)	O ₂ (%)	Measuring	T	S	O ₂ (ml/l)	O ₂ (%)
1	B01	22	1	16.944	18.849	5.75	95.14	17	15.621	24.298	5.20	86.62
2	B01	16	1	17.278	18.574	5.75	95.68	11	16.676	19.026	5.36	88.39
3	B11	41	1	15.783	9.028	6.54	99.53	41	16.322	15.815	3.90	62.51
4	B11	44	1	13.628	7.872	6.89	99.55	43	15.608	16.318	2.27	36.05
5	B11	39	2	16.298	8.802	6.56	100.84	37	16.582	14.659	4.42	70.86
6	B09*	90	1	17.946	7.372	6.23	98.13	78**	7.411	11.613	0.07	0.89
7	B09*	69	1	18.098	7.399	6.38	100.88	67	6.620	10.843	0.78	9.82
8	B09*	45	1	17.985	7.411	6.43	101.40	43	7.941	7.842	5.78	73.25
9	B13	85	2	15.901	7.794	6.73	101.90	79**	8.142	14.603	0.08	1.05
10	B13*	58	1	16.167	8.010	6.68	101.93	57	9.617	10.370	4.70	62.95
11	B10*	45	2	17.324	7.593	6.37	99.30	44	6.757	10.895	3.40	42.70
12	B12	21	1	18.740	15.718	6.08	102.29	20	15.425	21.330	4.23	68.85
13	B12	22	1	18.586	15.719	6.12	102.60	21	15.160	22.274	4.20	68.42
14	B12	21	1	18.445	15.926	6.14	102.77	21	15.005	20.552	3.04	48.91
15	SK2	137	1	15.576	32.430	5.54	96.85	137	7.982	35.035	5.35	81.11
16	GB3	44	2	17.856	33.785	5.12	94.29	44	17.094	34.132	4.28	77.89
17	P02	72	2	15.994	34.505	5.36	95.68	71	7.781	34.964	4.29	64.71
18	GB4	44	2	16.924	34.627	5.24	95.37	42	9.655	34.539	4.65	72.84
19	GB1	39	1	19.029	30.953	5.65	104.66	38	18.118	32.395	4.13	75.83
20	N01	32	2	19.288	32.314	5.48	102.80	31	17.942	32.907	4.64	85.13

* Stations not located in the standard areas.

** Greatest depth at which values for dissolved oxygen were measured; at greater depth no values available.

Tab. 6: Cruise 469 FRV 'Walther Herwig III', 10.08. – 24.08.2023: Prevalences (%) of externally visible diseases and parasites in dab (*Limanda limanda*) from the Baltic Sea and North Sea

AREA	N unt	Ly	Ep Pap/Hyp	Ulc Ak/Hei	FloF Ak/Hei	KieHy	HypPig (Mel)	Skel	Steph	Acanth	Lepe	Cryp
B01	177	1.7	1.1	1.1	2.8	0.0	4.0	0.6	0.0	0.0	5.6	14.1
B12	114	0.9	0.0	0.0	0.0	0.0	0.0	0.9	0.0	0.0	3.5	38.6
B11	6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
GB4	116	6.9	3.4	0.9	0.0	0.0	60.3	0.9	70.7	0.9	14.7	0.0
P02	170	3.5	2.4	0.0	0.0	0.0	52.9	0.6	96.5	1.2	0.6	0.0
GB1	116	0.9	0.0	3.4	1.7	0.0	38.8	0.9	0.9	9.5	15.5	0.0
N01	76	0.0	7.9	3.9	5.3	0.0	48.7	0.0	5.6	3.9	25.0	0.0
GB3	129	3.9	4.7	5.4	1.6	0.0	50.4	0.8	0.8	1.6	26.4	4.7
SUM	904											

Tab. 7: Cruise 469 FRV 'Walther Herwig III'. 10.08. – 24.08.2023: Prevalences (%) of externally visible diseases and parasites in cod (*Gadus morhua*) from the Baltic Sea and the Skagerrak

AREA	N unt	Ulc Ak/Hei	Ulc Hae	FloF Ak/Hei	Ep Pap/Hyp	Skel	PBT	Cryp	Locera	Loma	N unt (Anis)	Anis
B01	7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7	0.0
B09*	90	8.9	0.0	0.0	1.1	1.1	0.0	0.0	0.0	24.4	90	0.0
B10*	35	0.0	0.0	0.0	0.0	0.0	0.0	2.9	0.0	71.4	20	0.0
B11	7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7	0.0
B13*	42	2.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	66.7	42	1.8
SK2	5	20.0	0.0	0.0	0.0	20.0	0.0	0.0	0.0	80.0	5	0.0
SUMME	186										167	

* Stations not located in the standard areas, see Fig. 1a.

Abbreviations:

N unt	: Number examined	Steph	: <i>Stephanostomum baccatum</i>
Ly	: Lymphocystis	Acanth	: <i>Acanthochondria cornuta</i>
Ep Hyp/Pap	: Epidermal hyperplasia/papilloma	Lepe	: <i>Lepeophtheirus pectoralis</i>
Ulc Ak/Hei	: Skin ulcerations. acute/healing	Locera	: <i>Lernaeocera branchialis</i>
Ulc Hae	: Skin ulcerations. haemorrhagic stage	Cryp	: <i>Cryptocotyle spp.</i>
Flo Ak/Hei	: Fin rot/erosion. acute/healing	Loma	: <i>Loma sp.</i>
Kie Hyp	: Gill hyperplasia. x-cell disease	Anis	: Nematodes in the body cavity
Hyp Pig	: Hyperpigmentation		
Skel Def	: Skeletal deformities		
PBT	: Pseudobranchial pseudotumour		