Federal Research Institute for Rural Areas, Forestry and Fisheries
Institute of Fisheries Ecology

THÜNEN

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FRV Walther Herwig III
Cruise 401
30.11. – 20.12.2016

Studies on Fish Diseases and Biological Effects of Contaminants in the North Sea and Baltic Sea

DAIMON project

Scientist in Charge: Dr. Marc-Oliver Aust

Summary

As part of the fish health monitoring programme of the Thünen Institute of Fisheries Ecology (FI), studies were carried out in four Baltic Sea and four North Sea areas plus two areas in the Skagerrak. In addition to the onboard examination of dab (*Limanda limanda*) and cod (*Gadus morhua*) for externally visible diseases and parasites, a large range of fish samples were taken for a subsequent analysis of contaminants (incl. radioactive substances) and their biological effects. As part of the DAIMON project, extensive studies were carried out on the health status of cod in dumping areas for chemical munitions and reference areas. Furthermore, hydrographical measurements were carried out (water temperature, salinity, oxygen content, turbidity).

The following preliminary findings were noted:

Dab: Comparatively high prevalence of lymphocystis in Kiel Bight, Baltic Sea; markedly higher than in the four areas in the German EEZ of the North Sea. In the North Sea higher prevalence of grossly visible parasites and especially of hyperpigmentation compared to the Baltic Sea.

Baltic cod: Low prevalence of acute/healing skin ulcerations and skeletal deformities; nematodes in the body cavity in all Baltic Sea areas except Kiel Bight; repeatedly generally high prevalence of the gill parasite *Loma branchialis*.

Participants:

Name	Function	Institution
Dr. Marc-Oliver Aust	Scientist in Charge	TI FI Hamburg
Dr. Thomas Lang	Scientist	TI FI Cuxhaven
Jennifer Ipse	Technician	TI FI Cuxhaven
Maike Siegmund	Technician	TI FI Cuxhaven
Katharina Straumer	Scientist	TI FI Cuxhaven
Alexander Schulz	Technician	TI FI Hamburg
Nadine Dichte	Technician	TI FI Hamburg
Michael Drenckow	Technician	TI FI Hamburg
Dr. Matthias Brenner	Guest Scientist	AWI Bremerhaven
Melina Mader	Student	University Hamburg
Christin Mantel	Student	University Hamburg
Lena Soumpasis	Volunteer	University Kiel

Objectives of the Cruise

1. Studies on the occurrence of fish diseases and parasites in the North Sea and Baltic Sea;
2. Studies on biological effects of contaminants;
3. Sampling of fish for chemical analysis of contaminants;
4. Studies and sampling for the DAIMON project
5. Hydrographical measurements (salinity, temperature, oxygen, turbidity);
6. Recording of marine litter in trawls after ICES-Protocol;
7. Test if the modified multi-closing device of the Isaacs-Kidd Midwater Trawl (IKMT).

Dates of the Cruise

FRV Walther Herwig III left Bremerhaven around noon of 30.11. After the passage of Kiel Channel on 01.12., the vessel sailed to the first sampling area in the Baltic Sea, B11, where work started in the morning of 02.12. The next day, a Polish observer came aboard and joined the cruise during the project studies and sampling in area B09 outside Gdansk Bay (03.-04.12.). Afterwards, project sampling was continued in the munitions dumpsite for chemical warfare agents (area B13) east of the island of Bornholm on 06th and 07th of December. On 08.12., work was conducted in area B11. On 09.12., WHIII arrived in Warnemünde, where technical problems had to be fixed and an exchange of scientific crew members took place. During the following day, a test of the modification of the Isaacs-Kidd Midwater Trawl was carried out by colleagues of the Thünen-Institutes of Fisheries Ecology and Baltic Sea Fisheries before the use on the cruise to the Sargasso Sea (in March 2017). On 11.12., work was resumed in area B01 and in the evening WHIII arrived Kiel, where one scientist left the ship.

Then, Walther Herwig III headed towards two new research areas in the Skagerrak (SK1 + SK2, both major dumpsites of chemical munitions after WW II), where fishing was carried out on 13.12. In the afternoon of 14.12., WHIII arrived in area GB4. In the following days, work was continued in the other three North Sea areas, GB3, N01 and GB1. In the late afternoon of 19.12., WHIII arrived in Bremerhaven, where the cruise ended in the morning of 20.12.

The location of the sampling areas and the cruise dates are shown in Fig. 1 and 2 and Tab. 1. A total of 39 fishing hauls (towing time 30–60 min. each) was performed in 10 sampling areas (Fig. 1; geographical coordinates in Tab. 1, catch composition in Tab. 2). In the Baltic Sea, a 140 ft bottom trawl and a pelagic PSN 205 net (the latter also in the Skagerrak areas) were used, in the North Sea a GOV net, all with standard configuration. Hydrographical measurements were made at all fishery stations (geographical coordinates in Tab. 1a, results in Tab. 3).

Preliminary Results

1 Dab (*Limanda limanda*)

In total, 2715 dab from one Baltic Sea area (B01) and four North Sea areas in the German EEZ (GB1, N01, GB3, GB4) were examined for the occurrence of externally visible diseases and parasites (Tab. 4) and 419 dab for the occurrence of liver anomalies (Tab. 5).

The prevalence of the diseases recorded largely corresponded to findings from previous surveys. The decreasing trend in lymphocystis prevalence of North Sea dab apparently continues (current values 1.4-9.4 %). Currently, Baltic Sea dab display a higher prevalence (14.8 %). In contrast, the prevalence of grossly visible parasites is lower in the Baltic Sea, and the phenomenon of hyperpigmentation is lacking completely (see Tab. 4).

In the four areas of the German North Sea EEZ, the marked spatial patterns in disease prevalence already identified during previous cruises were confirmed. The prevalence of lymphocystis, x-cell gill disease and in particular of the parasite *Stephanostomum baccatum* (white cysts under the skin) increases in northwesterly direction, while the prevalence of the parasites *Acanthochondria cornuta* and *Lepeophtheirus pectoralis* (both copepods, crustaceans) decreased.

There were no new findings regarding the prevalence of liver tumours; again, dab from the outermost area in the German North Sea EEZ (GB4) showed the highest values (size group 20-24 cm: 13.5 %; size group ≥25 cm: 10.6 %) (see Tab. 5).

2 Cod (*Gadus morhua*)

In total, 768 cod from four Baltic Sea areas were examined for externally visible diseases and parasites, and 255 specimens were inspected for nematodes in the body cavity (Tab. 6). The prevalence of externally visible diseases largely corresponded to previous cruises. The prevalence of acute/healing skin ulcerations ranged from 1.9 % to 4.5 %. Skeletal deformities were rare, too, with values in the range of 0.0 % to 4.5 %.

Larval nematodes in the body cavity were recorded in cod from all sampling areas except for area B01 (Kiel Bight). A comparison to data from the 1980s/1990s reveals that the prevalence has clearly increased since then. In Kiel Bight, the parasite *Cryptocotyle lingua* (black trematode cysts in the skin) was again prevalent with a value of 40.9 %. The gill parasite *Loma branchialis* was again very prevalent in all areas.

3 Miscellaneous

The mean catch data of the most frequent fish species are provided in Tab. 2; Tab. 3 gives results of the hydrographical measurements.

Acknowledgements

Thanks are due to Captain Janßen and his crew and to the scientific staff for constructive and hard work and a very good atmosphere on board.

Dr. Marc-Oliver Aust

(Scientist in Charge)

Annex

2 Figures, 7 Tables

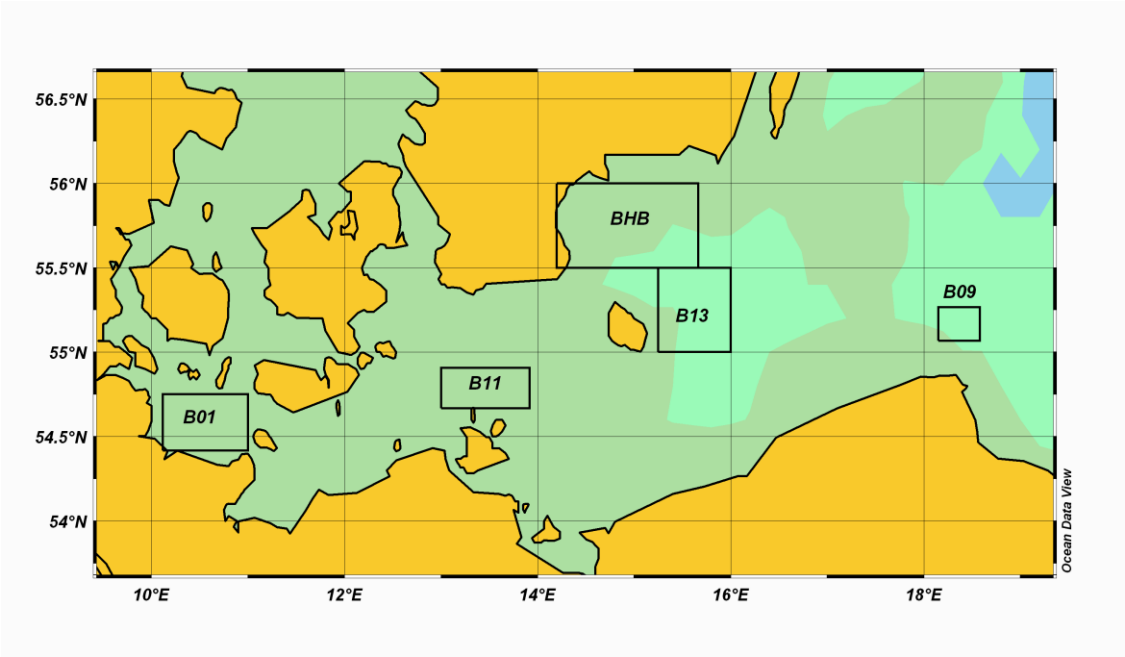

Fig. 1: Cruise 401 RV 'Walther Herwig III', 30.11. – 20.12.2016*:*
Location of sampling sites in the Baltic Sea

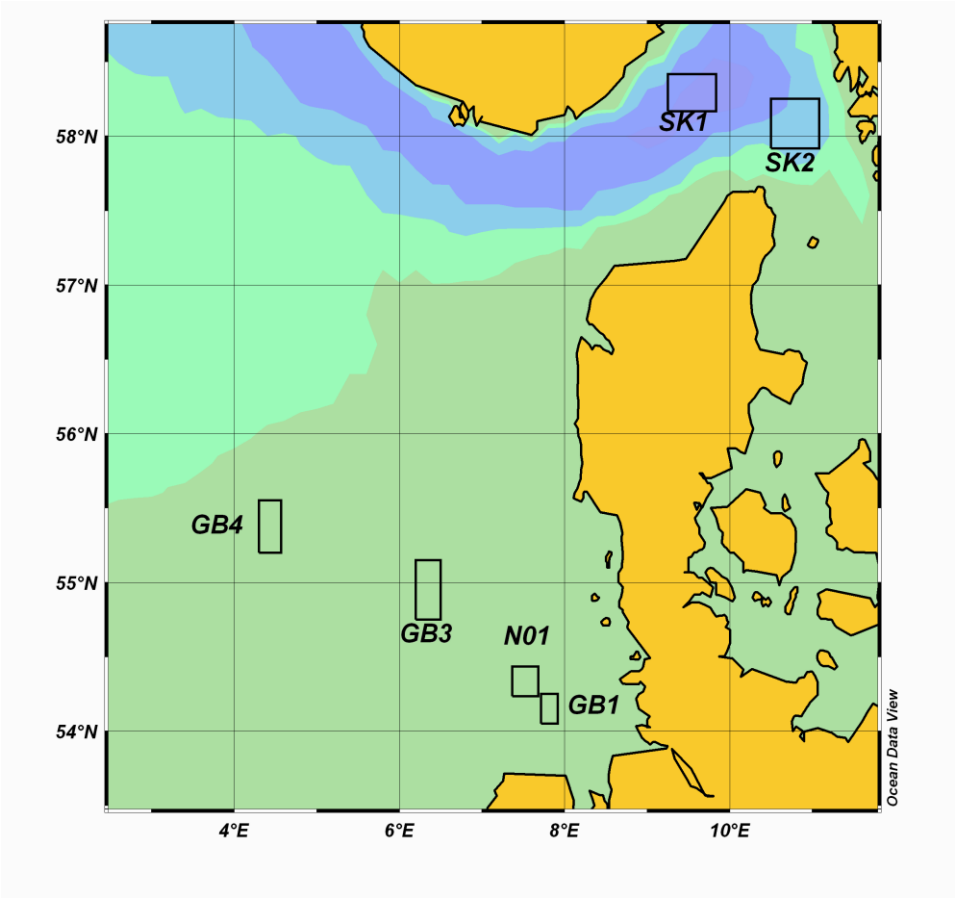

Fig. 2: Cruise 401 RV 'Walther Herwig III', 30.11. – 20.12.2016:
Location of sampling sites in the North Sea and Skagerrak

Tab. 1: Cruise 401 RV 'Walther Herwig III', 30.11. – 20.12.2016:
Geographical coordinates of trawling stations in the Baltic Sea and North Sea

DATE	STATION	Area	ICES-RECTANGLE	Latitude	Longitude
02.12.16	001	B11	38G3	54°43.34N	13°39.11E
03.12.16	002	B09	39G8	55°11.12N	18°30.37E
04.12.16	003	B09	39G8	55°12.86N	18°17.11E
04.12.16	004	B09	39G8	55°13.28N	18°10.89E
04.12.16	005	B09	39G8	55°08.13N	18°10.84E
06.12.16	006	B13	39G5	55°18.79N	15°36.28E
06.12.16	007	B13	39G5	55°22.65N	15°35.18E
06.12.16	008	B13	39G5	55°18.88N	15°38.54E
06.12.16	009	B13	39G5	55°22.23N	15°40.81E
06.12.16	010	B13	39G5	55°19.15N	15°36.07E
07.12.16	011	B13	39G5	55°22.37N	15°40.83E
07.12.16	012	B13	39G5	55°13.79N	15°43.32E
07.12.16	013	B13	39G5	55°13.40N	15°35.62E
07.12.16	014	B13	39G5	55°18.76N	15°34.48E
08.12.16	015	B11	38G3	54°47.21N	13°51.33E
08.12.16	016	B11	38G3	54°47.16N	13°48.88E
08.12.16	017	B11	38G3	54°45.71N	13°29.58E
08.12.16	018	B11	38G3	54°43.63N	13°19.71E
11.12.16	019	B01	38G0	54°33.17N	10°48.47E
11.12.16	020	B01	38G0	54°32.40N	10°45.73E
11.12.16	021	B01	38G0	54°33.94N	10°30.40E
13.12.16	022	SK2	45G0	58°07.99N	10°43.71E
13.12.16	023	SK2	45G0	58°10.47N	10°37.96E
13.12.16	024	SK1	45F9	58°11.53N	09°40.37E
13.12.16	025	SK1	45F9	58°11.33N	09°34.70E
14.12.16	026	GB4	39F4	55°23.14N	04°33.15E
14.12.16	027	GB4	39F4	55°22.94N	04°25.88E
15.12.16	028	GB4	39F4	55°23.67N	04°25.85E
15.12.16	029	GB4	39F4	55°23.12N	04°32.60E
15.12.16	030	GB3	38F6	54°56.49N	06°16.81E
16.12.16	031	GB3	38F6	54°58.75N	06°23.03E
16.12.16	032	GB3	38F6	54°55.86N	06°16.53E
17.12.16	033	N01	37F7	54°15.46N	07°29.81E
17.12.16	034	N01	37F7	54°20.69N	07°28.49E
17.12.16	035	N01	37F7	54°19.43N	07°30.36E
18.12.16	036	GB1	37F7	54°07.51N	07°44.87E
18.12.16	037	GB1	37F7	54°04.39N	07°52.50E
18.12.16	038	GB1	37F7	54°07.42N	07°45.24E
18.12.16	039	GB1	37F7	54°04.47N	07°52.60E

Tab. 1a: Cruise 401 RV 'Walther Herwig III', 30.11. – 20.12.2016:
Geographical coordinates of hydrography stations in the Baltic Sea and North Sea

DATE	STATION	FISHING STATION	AREA	ICES-RECTANGLE	LATITUDE	LONGITUDE
02.12.16	001	001	B11	38G3	54°45.24N	013°46.49E
03.12.16	002	002	B09	39G8	55°10.43N	018°32.160E
04.12.16	003	003	B09	39G8	55°13.14N	018°17.32E
04.12.16	004	004	B09	39G8	55°14.29N	018°10.42E
04.12.16	005	005	B09	39G8	55°08.22N	018°09.77E
06.12.16	006	006	B13	39G5	55°18.02N	015°36.63E
06.12.16	008	008	B13	39G5	55°18.09N	015°38.747E
06.12.16	009	009	B13	39G5	55°22.27N	015°41.93E
07.12.16	011	011	B13	39G5	55°22.99N	015°41.20E
07.12.16	012	012	B13	39G5	55°14.29N	015°44.12E
07.12.16	013	013	B13	39G5	55°18.05N	015°34.79E
08.12.16	015	015	B11	38G3	54°47.03N	013°50.62E
08.12.16	016	016	B11	38G3	54°47.45N	013°49.92E
08.12.16	017	017	B11	38G3	54°45.74N	013°30.58E
08.12.16	018	018	B11	38G3	54°43.76N	013°20.59E
11.12.16	019	019	B01	38G0	54°33.16N	010°48.29E
11.12.16	020	020	B01	38G0	54°32.47N	010°46.49E
11.12.16	021	021	B01	38G0	54°33.55N	010°31.05E
13.12.16	022	022	SK2	45G0	58°07.26N	010°46.51E
13.12.16	023	023	SK2	45G0	58°11.58N	010°38.04E
13.12.16	024	024	SK1	45F9	58°12.70N	009°41.91E
13.12.16	025	025	SK1	45F9	58°10.88N	009°32.54E
14.12.16	026	026	GB4	39F4	55°23.08N	004°33.76E
14.12.16	027	027	GB4	39F4	55°22.99N	004°25.45E
15.12.16	028	028	GB4	39F4	55°23.15N	004°26.28E
15.12.16	029	029	GB4	39F4	55°23.22N	004°33.39E
15.12.16	030	030	GB3	38F6	54°55.92N	006°15.87E
16.12.16	031	031	GB3	38F6	54°58.48N	006°23.54E
16.12.16	032	032	GB3	38F6	54°55.78N	006°15.31E
17.12.16	033	033	N01	37F7	54°14.94N	007°30.30E
17.12.16	034	034	N01	37F7	54°20.36N	007°27.08E
17.12.16	035	035	N01	37F7	54°20.16N	007°30.49E
18.12.16	036	036	GB1	37F7	54°07.29N	007°45.01E
18.12.16	037	037	GB1	37F7	54°04.18N	007°53.65E
18.12.16	038	38	GB1	37F7	54°08.04N	007°44.15E

Tab. 2: Cruise 401 RV 'Walther Herwig III', 30.11. – 20.12.2016:
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	Herring	Sprat	Mackerel	Dab	Plaice	Flounder
B11	n	106	271	139	3307		7	13	441
	kg	59	25	11	35		1	2	104
B09	n	105	< 1	27	101			1	13
	kg	50	< 0.5	1	1			< 0.5	3
B13	n	3		157	671			6	1
	kg	1		6	9			1	<0.5
B01	n	9	132	224	255		991	117	12
	kg	8	4	3	2		114	42	5
SK2	n		4	8					
	kg		1	<0.5					
GB4	n	< 1	226	7183	2687		1697	13	
	kg	< 0.5	8	152	29		102	3	
GB3	n	2	3285	12117	14409		1245	80	
	kg	< 0.5	83	121	79		54	15	
N01	n	2	19945	5952	4481		722	7	< 1
	kg	< 0.5	640	43	40		35	< 0.5	< 0.5
GB1	n		19088	5616	1017		182		
	kg		629	89	4		12		

Tab. 3: Cruise 401 RV 'Walther Herwig III', 30.11. – 20.12.2016:
Water depth, temperature (T), salinity (S), O_2 in mg/l and O_2 saturation (%),
Baltic Sea and North Sea

DATE	STATION	AREA	DEPTH (m)	S (PSU)	T (°C)	O2 (mg/L)	O2-SATURATION (%)
02.12.2016	001	B11	3	9.57	6.85	7.76	96.92
			35	10.90	6.67	7.71	96.72
03.12.2016	002	B09	7	7.28	6.50	7.70	93.92
			79	10.74	6.88	1.98	24.94
04.12.2016	003	B09	3	7.24	6.64	7.67	93.89
			54	8.23	8.31	6.63	84.96
	004	B09	4	7.22	6.57	7.70	94.07
			57	9.27	7.15	4.21	52.84
	005	B09	5	7.30	7.10	7.70	95.38
			67	7.46	7.93	7.56	95.60
06.12.2016	006	B09	3	7.73	8.20	7.59	96.76
			93	18.27	6.72	0.13	1.72
	008	B13	4	7.71	8.14	7.61	96.92
			91	18.26	6.72	0.19	2.57
	009	B13	6	7.68	8.20	7.59	96.67
			90	18.17	6.78	0.16	2.07

Tab. 3: cont.

DATE	STATION	AREA	DEPTH (m)	S (PSU)	T (°C)	O2 (mg/L)	O2-SATURATION (%)
07.12.2016	011	B13	12	7.67	8.03	7.60	96.43
			88	18.23	6.73	0.14	1.87
	012	B13	4	7.60	7.73	7.70	97.03
			89	18.26	6.74	0.15	1.96
	013	B13	4	7.81	8.02	7.60	96.54
			89	18.21	6.80	0.15	1.96
08.12.2016	015	B11	3	8.86	6.65	7.95	98.37
			36	14.11	7.93	6.41	84.63
	016	B11	3	8.99	6.58	7.95	98.23
			38	16.33	7.67	6.31	84.04
	017	B11	8	8.90	6.67	7.93	98.22
			37	14.76	6.58	7.42	95.30
	018	B11	6	9.24	6.27	7.83	96.21
			33	14.26	6.18	7.52	95.32
11.12.2016	019	B01	2	16.77	6.09	7.71	99.11
			19	23.96	6.48	6.96	94.65
	020	B01	3	16.76	6.12	7.70	99.02
			18	24.08	6.47	6.90	93.94
	021	B01	6	16.82	6.38	7.71	99.90
			14	17.77	6.68	7.50	98.42
13.12.2016	022	SK2	4	32.31	6.73	6.73	97.39
			207	35.05	9.09	5.21	80.96
	023	SK2	4	32.73	7.01	6.66	97.16
			237	35.11	9.15	5.24	81.48
	024	SK1	4	32.74	6.99	6.67	97.38
			522	35.18	6.90	5.13	75.90
	025	SK1	5	32.98	7.11	6.63	97.11
			293	35.17	7.20	5.66	84.37
14.12.2016	026	GB4	5	34.78	9.62	6.13	96.12
			43	34.78	9.61	6.16	96.65
	027	GB4	4	34.79	9.83	6.12	96.45
			42	34.79	9.79	6.14	96.66
15.12.2016	028	GB4	3	34.78	9.81	6.13	96.61
			42	34.81	9.42	6.18	96.48
	029	GB4	5	34.80	9.76	6.15	96.75
			42	34.84	9.13	6.24	96.85
	030	GB3	3	34.40	10.50	6.05	96.41
			39	34.40	10.50	6.06	96.66
16.12.2016	031	GB3	3	34.34	10.42	6.06	96.40
			41	34.34	10.42	6.07	96.54
	032	GB3	4	34.42	10.45	6.05	96.38
			39	34.44	10.46	6.06	96.58

Tab. 3: cont.

DATE	STATION	AREA	DEPTH (m)	S (PSU)	T (°C)	O2 (mg/L)	O2-SATURATION (%)
17.12.2016	033	N01	3	33.62	9.43	6.21	96.29
			38	33.62	9.46	6.22	96.45
	034	N01	4	33.70	9.52	6.23	96.75
			25	33.71	9.51	6.23	96.75
	035	N01	5	33.73	9.47	6.20	96.31
			27	33.73	9.47	6.25	96.97
18.12.2016	036	GB1	3	33.51	9.31	6.22	96.08
			39	33.54	9.34	6.24	96.44
	037	GB1	3	33.29	9.04	6.27	96.14
			36	33.32	9.13	6.26	96.28
	038	GB1	5	33.48	9.23	6.24	96.33
			37	33.50	9.32	6.24	96.35

Tab. 4: Cruise 401 RV 'Walther Herwig III', 30.11. – 20.12.2016:
Prevalences (%) of externally visible diseases and parasites in dab (*Limanda limanda*) from the Baltic Sea and North Sea

Area	N unt	Ly	Ep Hyp/Pap	Ulc Ak/Hei	Flo Ak/Hei	KieHy	Skel Def	Hyp Pig	*Steph*	*Acanth*	*Lepe*
B01	534	14.8	1.7	0.7	0.0	2.6	0.2	0.0	0.9	0.9	0.9
GB1	495	1.4	8.1	1.2	1.0	0.0	0.4	44.8	8.1	5.1	14.1
GB3	560	5.7	2.1	0.2	0.5	0.4	0.2	27.5	22.7	2.0	5.4
GB4	524	9.4	2.9	0.8	0.4	1.1	0.2	50.0	80.3	2.3	5.7
N01	602	4.3	7.3	1.3	0.8	0.0	0.5	42.2	6.8	3.2	8.0
Summe	**2715**										

Tab. 5: Cruise 401 RV 'Walther Herwig III', 30.11. – 20.12.2016: Prevalences (%) of liver anomalies in dab (*Limanda limanda*) from the Baltic Sea and North Sea

Area	Lenght (cm)		N unt	Liver nodules (mm)			Green Livers	Nema-todes	Acantho-ceph.
	from	to		≥ 2	≥ 5	≥ 10			
B01	20	24	51	3.9	0	0	2.0	0	0
	25	40	52	3.8	0	1.9	1.9	0	0
GB1	20	24	52	5.8	0	0	0	0	0
	25	40	33	3.0	0	0	0	3.0	0
GB3	20	24	51	2.0	5.9	0	2.0	0	0
	25	40	12	0	0	8.3	0	0	0
GB4	20	24	52	13.5	0	1.9	5.8	5.8	0
	25	40	47	10.6	2.1	4.3	8.5	10.6	4.3
N01	20	24	52	5.8	0	1.9	0	0	0
	25	40	17	0	0	0	0	0	0
Sum			**419**						

Tab. 6: Cruise 401 RV 'Walther Herwig III', 30.11. – 20.12.2016: Prevalences (%) of externally visible diseases and parasites in cod (*Gadus morhua)* from the Baltic Sea

Area	N unt	Ulc Ak/Hei	Skel Def	PBT	*Locera*	*Cryp*	*Loma*	N	Anis
B01	22	4.5	4.5	0.0	9.1	40.9	22.7	0	0
B09	196	3.6	0.5	0.0	0.0	5.1	79.6	98	80.6
B11	528	1.9	2.3	5.7	1.9	9.1	74.4	107	59.8
B13	22	4.5	0.0	0.0	0.0	4.5	59.1	20	60.0
Summe	**768**							**225**	

Abbreviations:

N unt	:	Number examined	**Acanthoceph.**	:	Acanthocephaleans, liver
Ly	:	Lymphocystis	***Steph***	:	*Stephanostomum baccatum*
Ep Hyp/Pap	:	Epidermal hyperplasia/papilloma	***Acanth***	:	*Acanthochondria cornuta*
Ulc Ak/Hei	:	Skin ulcerationen, acute/healing	***Lepe***	:	*Lepeophtheirus pectoralis*
Flo Ak/Hei	:	Fin rot/erosion, acute/healing	***Locera***	:	*Lernaeocera branchialis*
KieHy	:	Gill hyperplasia, x-cell disease	**Clav**	:	*Clavella adunca*
Hyp Pig	:	Hyperpigmentation	***Cryp***	:	*Cryptocotyle spp.*
Skel Def	:	Skeletal deformities	***Loma***	:	*Loma sp.*
PBT	:	Pseudobranchial pseudotumour	**Nemato**	:	Nematodes in the body cavity
LK >2 mm	:	Liver nodules > 2 mm in diameter	***Cryp***	:	*Cryptocotyle spp.*