FS Littorina 18-06

(28.05.-07.06.2018)

Fahrtbericht / Cruise Report

Der geologisch/ sedimentologische Aufbau und die Habitatverteilung im Übergangsbereich Watt – Schelf zwischen der Amrumbank und der Eiderrinne (Nordsee)

The geological / sedimentological built up and habitat distribution in the transition area Wadden Sea – Shelf between Amrum Bank and Eiderchannel – North Sea

„Nordfriesland Süd“

Institute of Geosciences
- Coastal Geology and Sedimentology -
Kiel University

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1. Objective of the cruise

The cruise L18-06 was carried out in the frame of the research project "Nordfriesland Süd – Der geologisch/sedimentologische Aufbau und die Habitatverteilung im Übergangsbereich Watt – Schelf zwischen der Amrumbank und der Eiderrinne - Nordsee". This project is a co-operation between the Agency for Coastal Protection, National Park and Marine Conservation of Schleswig-Holstein (LKN), the State office for Agriculture, Environment and Rural Areas Schleswig-Holstein (LLUR) and Kiel University (CAU). The investigation area is in the North Sea offshore the coast of Schleswig-Holstein (Figure 1).

Main objective of the cruise was the acquisition of high resolution hydroacoustic data for obtaining information about sediment distribution patterns, distribution of bedforms and the geological built up of the subsurface. As it is know from the northern area Amrum Bank that the geological built up of the subsurface influences the sediment distribution and geomorphological pattern of the seafloor (Schwarzer & Wittbrodt, 2016), it was the objective to prove if such an influence exists in this area as well. Information about the density and the diversity of the distributions of benthic organisms was collected as well. This information can improve the general understanding of the interrelation between water column, seafloor conditions and the distribution of organisms.

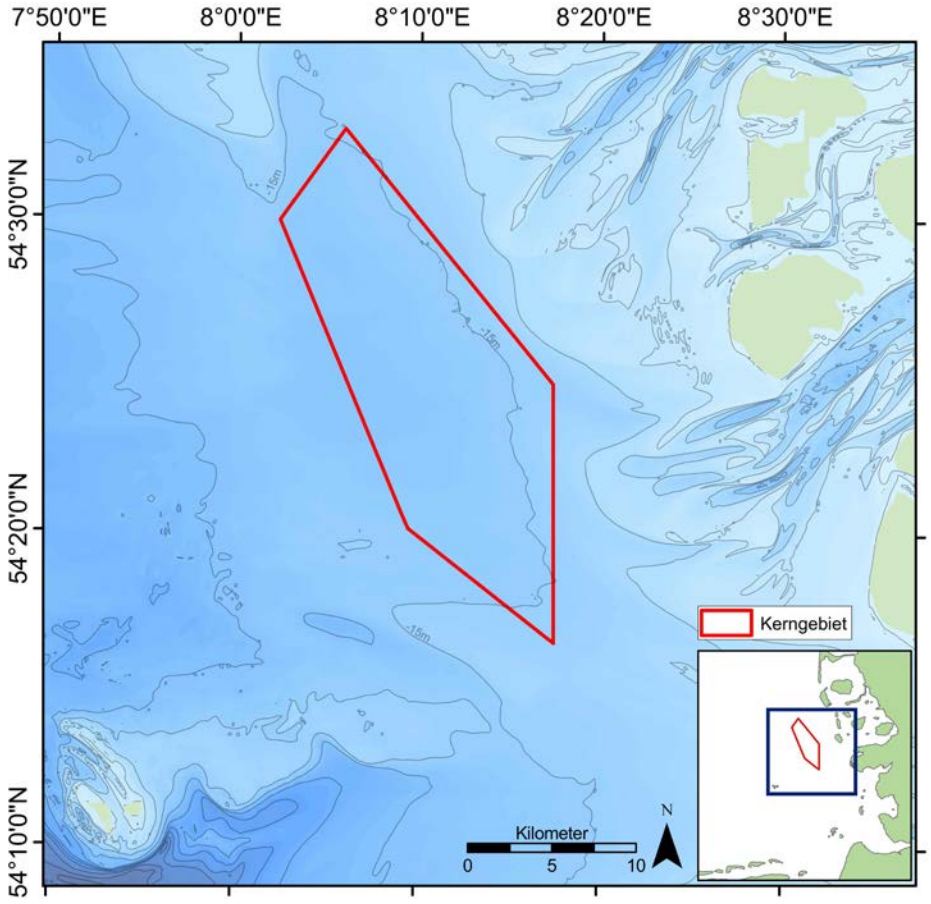

Figure 1: Investigation area.

2. Participants of the cruise:

1. **Dr. Klaus Schwarzer,** (chief scientist), Inst. of Geosciences, CAU
2. **Dr. Peter Richter,** (scientist), Inst. of Geosciences (from 28.05. – 30.05.2018), CAU
3. **Penele Borgeest,** (scientist, BSc student), Inst. of Geosciences, CAU
4. **Gianna Persichini,** **(**scientist, PhD student), Inst. of Geosciences, CAU

3. Cruise Narrative

Abbreviations used in this report:

1624- Sidescan Sonar (towed)	**SSS**
SES Innomar Subbottom Profiler	**SES**
Grab Sampler	**GS**
Conductivity – Temperature – Depth probe	**CTD**
Kiel University	**CAU**

Mo. 28.05.2018

Weather:	sunny
07:20	Departing Kiel, transit through Kiel Canal
19:00	Arrival working area
21:30	CTD station
22:03	Start profiling (SSS; SES)

Tu. 29.05.2018

Weather:	sunny
00:00-24:00	Profiling (SSS; SES)

We. 30.05.2018

Weather:	sunny
09:26	End of profiling (SSS; SES); Transit for crew change in Büsum
18:43	Start profiling (SSS; SES)

Th. 31.05.2018

Weather:	sunny
14:48	End of profiling (SSS; SES)
15:10	CTD station
15:43	Start of profiling (SSS; SES)

Fr. 01.06.2018

Weather:	sunny
00:00-24:00	Profiling (SSS; SES)

Sa. 02.06.2018

Weather:	sunny
00:00-24:00	Profiling (SSS; SES)

Su. 03.06.2018

Weather:	sunny
00:00-24:00	Profiling (SSS; SES)

Mo. 04.06.2018

Weather:	sunny
11:20	End of profiling
11:40	CTD station

Tu. 05.06.2018
Weather: sunny
08:11-17:26 GS

We. 06.06.2018
Weather: sunny
07:48-16:42 GS
16:59 CTD station
17:14 Start of profiling (SSS; SES)
17:47 End of profiling (SSS; SES) due to technical malfunction (SSS)
17:47-19:00 Attempt of fixing technical malfunction
19:10 Transit to Kiel

Th. 07.06.2018
Weather: sunny
14:30 Arrival in Kiel

4. Methods

To obtain information about the composition of the seafloor, hydroacoustic data was acquired by using a towed Dual Frequency Teledyne Benthos SIS 1624 Sidescan Sonar System (SSS) which is operating with the frequencies 200 and 400 kHz. For towing the SSS-System a McArtney Cormac 4 winch was used. By measuring the intensities of the backscatter from the seafloor, it is possible to draw conclusions about its morphology, the material properties and sometimes the distribution of certain benthic species (Blondel & Murton, 1997; Lurton, 2002; Blondel, 2009). A range of 100 m on each side was set for the measurements. Line spacing between the profiles was 0.1 nautical mile (nm) which results in an overlap of about 20 m. After post-processing the data, high resolving acoustic images of the SSS will be used to elaborate geological facies of the seafloor (see Lurton, 2002). A high resolution parametric sediment echosounder (INNOMAR SES-2000 compact) was applied to obtain further information about the subsurface built-up and to identify the geological architecture in the investigation area. During hydroacoustic profiling the vessel speed did not exceed 4.5 knots.

For ground truthing, grab samples were collected with a Van-Veen-Grab Sampler. Additionally an underwater video system (Mariscope) was applied (see Figure 2).

Figure 3 shows the tracklines of hydroacoustic profiles and in figure 4 the position of sampling stations are shown. In table 1 - 3 all stations and performed profiles of the cruise are listed.

Figure 2: Van-Veen-Grab-Sampler (left), sidescan sonar and underwater video system (right).

5. Preliminary scientific results

By profiling 56 lines with a length between 11 and 14 nm an area of about 230 km² was full coverage mapped. Based on the SSS mosaic, which was processed on board, it was possible to get first impressions of the distribution of sediment properties of the sea floor. Due to the large data load splitting of processing project files was necessary. Thus, in the draft version of the SSS mosaic (Figure 4), absolute grey levels are varying for subsections (green arrows). Based on the mosaic, 58 stations for sediment sampling were selected.

The eastern part of the mosaic shows relatively homogeneous and low backscatter intensities. A slight variance can be seen in NW-SE-striking segments of higher and lower backscatter intensities which might be connected to the orientation of tidal channels (black arrows in Figure 4). The grab samples in this area contain primarily fine sand. An obvious difference in sediment sizes in the segments of slightly varying backscatter intensities was not determined. The western part of the mapped area shows (especially in the south) very heterogeneous backscatter intensities. Ground truthing confirmed coarser sediment (up to gravel) inside the dark coloured sections (compare position of sample L18_06_20180606_39 (orange arrow in Figure 4) with picture of the sample itself (Figure 5)).

Several grab samples contain the polychaete *Lanice conchilega*. *Lanice conchilega* is a tube building worm using sand grains and shell fragments as construction element. Due to its habitat structuring effect it is referred as bioengineer (Jones et al. 1994). Normally, those worms use middle to fine sand for their tubes (Van Hoey et al., 2008). In grab sample L18_06_20180606_32, one tube was found that even included gravel in its structure (see Figure 6). Since *Lanice conchilega* colonies have an impact on the roughness of the sea floor, it is possible to detect those areas by applying hydroacoustic methods (Heinrich et al., 2017).

In order to connect information about the properties of the sea floor with geological structures in the subsurface SES-data was collected. Figure 7 (upper figure) shows a SES profile located in the SW of the investigation area. In this area subsections with high backscatter intensities are linked to the morphology. As shown in the example, coarser material is often located in depressions, showing sharp borders to surrounding sectors with finer sediment. Those structures might be explained by the theories of sorted bedforms (Murray & Thieler, 2004, Diesing et al., 2006).

The SES data show several subsurficial and filled channels. Some of them are more than 7 m (see Figure 7). The orientation and lengths of the channel system will be evaluated in further work.

6. References

Blondel, P. & Murton, B.-J., 1997. Handbook of seafloor imagery. - 314 pp. (Springer)

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Diesing, M., Kubicki, A., Winter, C., Schwarzer, K., 2006. Decadal scale stability of sorted bedforms, German Bight, southeastern North Sea. Continental Shelf Res., 26 (8), 902-916.

Heinrich, C., Feldens, P., Schwarzer, K., 2016. Highly dynamic biological seabed alterations revealed by side scan sonar tracking of Lanice conchilega beds offshore the island of Sylt (German Bight). Geo-Mar Lett., doi: 10.1007/s00367-016-0477-z

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7. Appendices

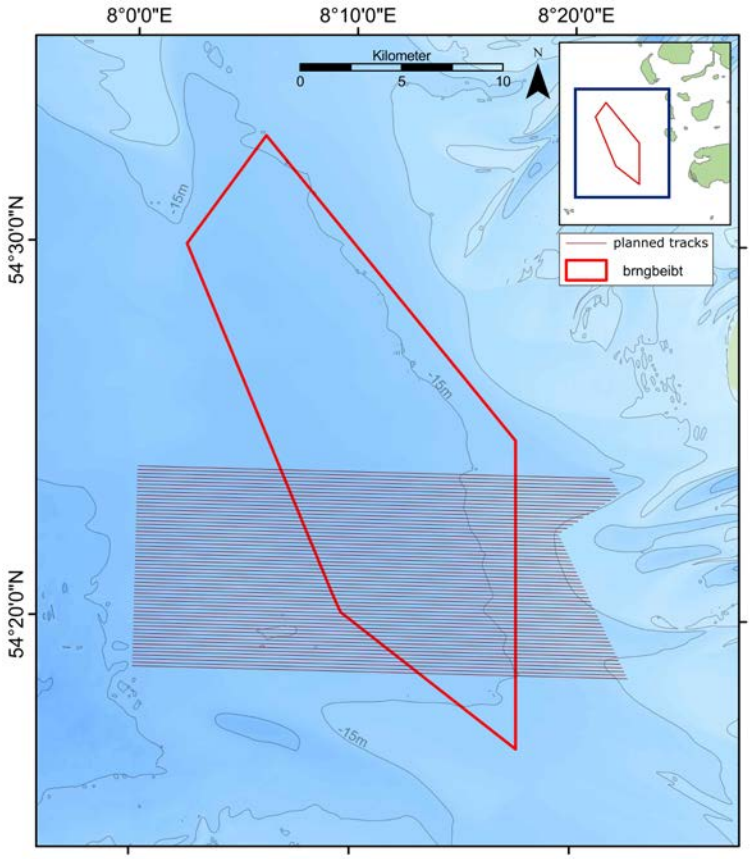

Figure 3: Realized tracks of hydroacoustic measurements

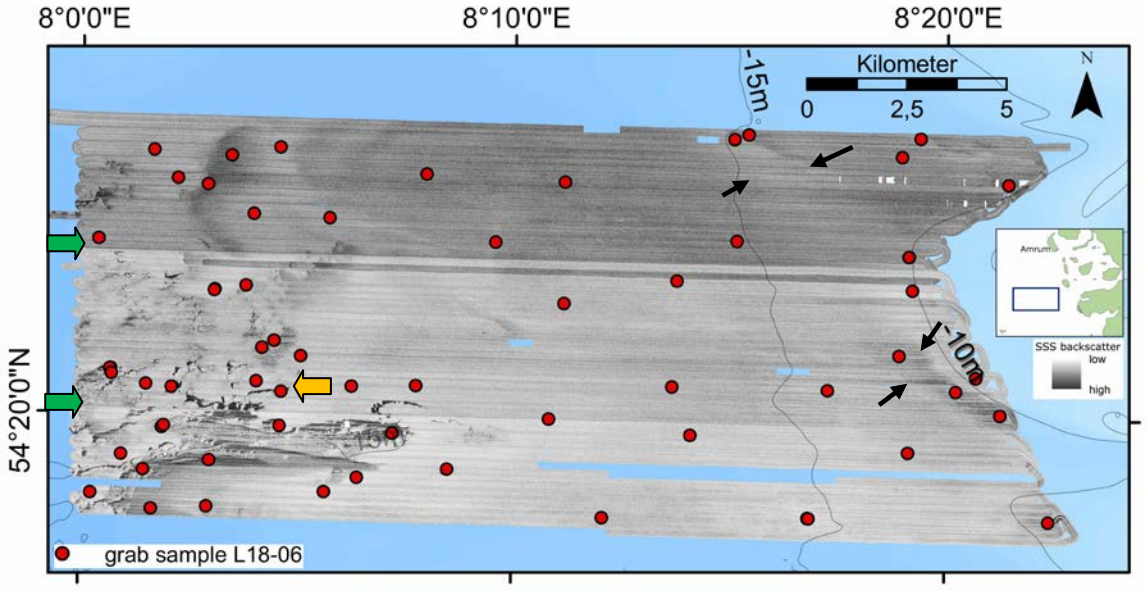

Figure 4: Resulting SSS mosaic. Black arrows show backscatter differences in the eastern part which might be connected to tidal channels. Orange arrow shows the position of sample L18_06_20180606_39, which contains coarse material, which might be connected to “Sorted Bedforms”.

Figure 5: Photo of grab-sample with coarse material.

Figure 6: *Lanice conchilega* sediment tube, containing gravel

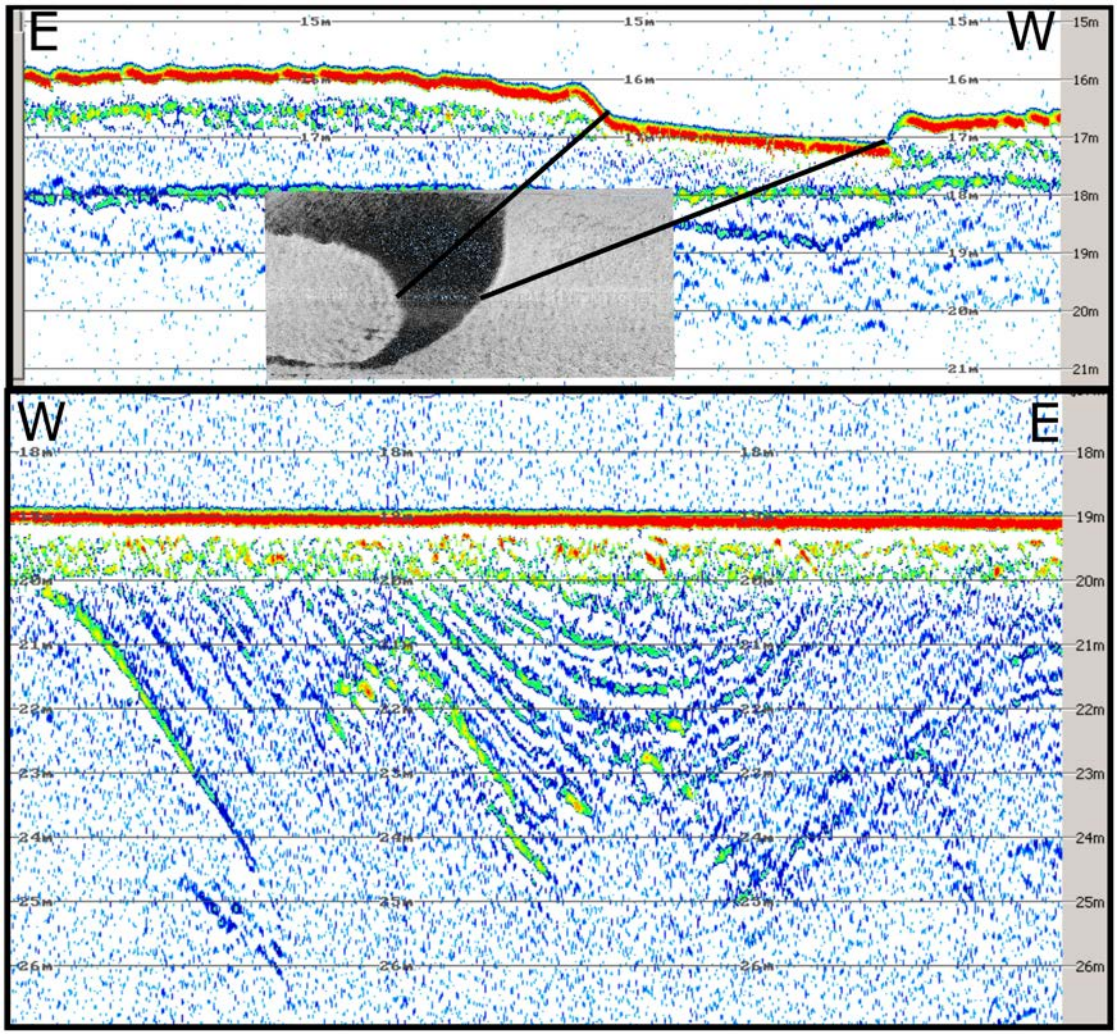

Figure 7: The upper figure shows a morphology which is connected to high backscatter intensities. Figure below: A sediment layer with a thickness of about 1 m unconformably overlies deep channels (more than 7 meters deep).

Tab 1.: Hydroacoustic profiling SSS

No.	Date	Time[UTC]	Latitude	Longitute	Remark
1	28.05.2018	20:03	54° 23.741'	8° 17.974'	start profile; SSS
1		22:26	54° 23.003'	8° 0.153'	end profile; SSS
2		22:40	54° 23.994'	8° 0.223'	start profile; SSS
2	29.05.2018	01:17	54° 23.801'	8° 21.75'	end profile; SSS
3		01:22	54° 23.5043'	8° 21.8291'	start profile; SSS
3		03:54	54° 23.697'	8° 0.196'	end profile; SSS
4		03:59	54° 23.809'	8° 0.196'	start profile; SSS
4		06:27	54° 23.608'	8° 21.945'	end profile; SSS
5		06:32	54° 23.314'	8° 22.052'	start profile; SSS
5		09:03	54° 23.512'	8° 0.063'	end profile; SSS
6		09:07	54° 23.612'	8° 0.169'	start profile; SSS
6		11:43	54° 23.412'	8° 22.177'	end profile; SSS
7		11:49	54° 23.131'	8° 21.483'	start profile; SSS
7		14:10	54° 23.331'	8° 0.174'	end profile; SSS
8		14:16	54° 23.406'	8° 0.193'	start profile; SSS
8		16:44	54° 23.216'	8° 21.684'	end profile; SSS
9		16:52	54° 22.936'	8° 21.014'	start profile; SSS
9		19:18	54° 23.124'	8° 0.227'	end profile; SSS
10		19:21	54° 23.222'	8° 0.154'	start profile; SSS
10		21:48	54° 23.036'	8° 21.235'	end profile; SSS
11		21:57	54° 22.742'	8° 20.55'	start profile; SSS
11	30.05.2018	00:18	54° 22.944'	8° 0.147'	end profile; SSS
12		00:24	54° 23.031'	8° 0.199'	start profile; SSS
12		02:50	54° 22.841'	8° 20.79'	end profile; SSS
13		02:57	54° 22.557'	8° 19.996'	start profile; SSS
13		05:10	54° 22.737'	8° 0.146'	end profile; SSS
14		05:16	54° 22.835'	8° 0.16'	start profile; SSS
14		07:26	54° 22.056'	8° 20.32'	end profile; SSS
15		16:43	54° 22.649'	8° 0.18'	start profile; SSS
15		19:06	54° 22.469'	8° 19.823'	end profile; SSS
16		19:10	54° 22.248'	8° 19.448'	start profile; SSS
16		21:38	54° 22.443'	8° 0.159'	end profile; SSS
17		21:41	54° 22.541'	8° 0.158'	start profile; SSS
17	31.05.2018	00:10	54° 22.378'	8° 19.559'	end profile; SSS
18		00:20	54° 22.075'	8° 19.546'	start profile; SSS
18		02:44	54° 22.252'	8° 0.159'	end profile; SSS
19		02:50	54° 22.351'	8° 0.179'	start profile; SSS
19		05:11	54° 22.177'	8° 19.501'	end profile; SSS
20		05:17	54° 21.883'	8° 19.673'	start profile; SSS
20		07:42	54° 22.056'	8° 0.095'	end profile; SSS
21		07:42	54° 22.081'	8° 0.006'	start profile; SSS

No.	Date	Time[UTC]	Latitude	Longitute	Remark
22		10:18	54° 21.693'	8° 19.889'	start profile; SSS
22		12:48	54° 21.866'	8° 0.146'	end profile; SSS
23		13:43	54° 21.968'	8° 0.121'	start profile; SSS
23		16:14	54° 21.787'	8° 19.857'	end profile; SSS
24		16:21	54° 21.494'	8° 19.992'	start profile; SSS
24		18:45	54° 21.671'	8° 0.034'	end profile; SSS
25		18:46	54° 21.677'	7° 59.96'	start profile; SSS
25		21:15	54° 21.587'	8° 19.987'	end profile; SSS
26		21:26	54° 21.297'	8° 19.691'	start profile; SSS
26		23:55	54° 21.474'	8° 0.143'	end profile; SSS
27		23:55	54° 21.773'	8° 0.134'	start profile; SSS
27	01.06.2018	02:30	54° 21.398'	8° 20.163'	end profile; SSS
28		02:36	54° 21.096'	8° 20.334'	start profile; SSS
28		05:05	54° 21.285'	8° 0.001'	end profile; SSS
29		05:15	54° 21.372'	8° 0.86'	start profile; SSS
29		07:39	54° 21.195'	8° 20.386'	end profile; SSS
30		07:44	54° 21.902'	8° 20.559'	start profile; SSS
30		10:21	54° 21.089'	8° 0.153'	end profile; SSS
31		10:31	54° 21.189'	8° 0.159'	start profile; SSS
31		13:06	54° 20.999'	8° 20.474'	end profile; SSS
32		13:14	54° 20.713'	8° 20.724'	start profile; SSS
32		15:40	54° 20.889'	8° 0.127'	end profile; SSS
33		15:44	54° 21.004'	8° 0.126'	start profile; SSS
33		18:18	54° 20.806'	8° 20.688'	end profile; SSS
34		18:18	54° 20.755'	8° 20.765'	start profile; SSS
34		20:59	54° 20.699'	8° 0.116'	end profile; SSS
35		21:03	54° 20.793'	8° 0.087'	start profile; SSS
35		23:33	54° 20.612'	8° 20.774'	end profile; SSS
36		23:36	54° 20.102'	8° 21.007'	start profile; SSS
36	02.06.2018	02:20	54° 20.49'	8° 0.109'	end profile; SSS
37		02:23	54° 20.599'	8° 0.193'	start profile; SSS
37		05:03	54° 20.403'	8° 21.027'	end profile; SSS
38		05:04	54° 20.401'	8° 21.104'	start profile; SSS
38		07:41	54° 20.311'	8° 0.072'	end profile; SSS
39		07:42	54° 20.311'	8° 0.024'	start profile; SSS
39		10:09	54° 20.219'	8° 21.115'	end profile; SSS
40		10:17	54° 19.927'	8° 21.382'	start profile; SSS
40		12:56	54° 20.107'	8° 0.108'	end profile; SSS
41		13:01	54° 20.225'	8° 0.124'	start profile; SSS
41		15:41	54° 20.02'	8° 21.305'	end profile; SSS
42		15:46	54° 19.747'	8° 21.55'	start profile; SSS
42		18:14	54° 19.933'	8° 0.053'	end profile; SSS
43		18:18	54° 20.022'	8° 0.089'	start profile; SSS

No.	Date	Time[UTC]	Latitude	Longitute	Remark
44		20:57	54° 19.534'	8° 21.738'	start profile; SSS
44		23:44	54° 19.727'	8° 0.132'	end profile; SSS
45		23:48	54° 19.821'	8° 0.092'	start profile; SSS
45	03.06.2018	02:34	54° 19.622'	8° 21.643'	end profile; SSS
46		02:42	54° 19.335'	8° 21.854'	start profile; SSS
46		05:15	54° 19.53'	8° 0.074'	end profile; SSS
47		05:16	54° 19.531'	8° 0.026'	start profile; SSS
47		08:11	54° 19.443'	8° 21.79'	end profile; SSS
48		08:17	54° 19.137'	8° 22.053'	start profile; SSS
48		11:14	54° 19.338'	8° 0.128'	end profile; SSS
49		11:17	54° 19.423'	8° 0.069'	start profile; SSS
49		14:08	54° 19.228'	8° 22.07'	end profile; SSS
50		14:15	54° 18.959'	8° 22.17'	start profile; SSS
50		16:55	54° 19.147'	8° 0.039'	end profile; SSS
51		16:56	54° 19.147'	7° 59.997'	start profile; SSS
51		19:42	54° 19.042'	8° 22.151'	end profile; SSS
52		19:43	54° 19.032'	8° 22.211'	start profile; SSS
52		22:30	54° 18.951'	8° 0.121'	end profile; SSS
53		22:47	54° 19.033'	8° 1.918'	start profile; SSS
53	04.06.2018	01:08	54° 18.858'	8° 22.276'	end profile; SSS
54		01:17	54° 18.548'	8° 22.521'	start profile; SSS
54		03:58	54° 18.768'	8° 0.054'	end profile; SSS
55		04:02	54° 18.853'	8° 0.094'	start profile; SSS
55		06:45	54° 18.647'	8° 22.447'	end profile; SSS
56		06:45	54° 18.64'	8° 22.533'	start profile; SSS
56		09:20	54° 18.663'	8° 0.005'	end profile; SSS

Tab 2.: Hydroacoustic profiling SES

No.	Date	Time[UTC]	Latitude	Longitude	Remarks
1	28.05.2018	20:28	54° 23.741'	8° 17.974'	start profile; SES
1		22:26	54° 23.9031'	8° 0.132'	end profile; SES
2		22:40	54° 23.994'	8° 0.2961'	start profile; SES
2	29.05.2018	01:17	54° 23.801'	8° 21.75'	end profile; SES
3		01:23	54° 23.5043'	8° 21.8291'	start profile; SES
3		03:50	54° 23.7009'	8° 0.0607'	end profile; SES
4		03:59	54° 23.7966'	8° 0.2253'	start profile; SES
4		06:27	54° 23.608'	8° 21.945'	end profile; SES
5		06:32	54° 23.314'	8° 22.052'	start profile; SES
5		09:03	54° 23.514'	8° 0.002'	end profile; SES
6		09:07	54° 23.613'	8° 0.218'	start profile; SES
6		11:43	54° 23.404'	8° 22.23'	end profile; SES

No.	Date	Time[UTC]	Latitude	Longitude	Remarks
7		11:49	54° 23.1289'	8° 21.424'	start profile; SES
7		14:10	54° 23.3252'	8° 0.1626'	end profile; SES
8		14:16	54° 23.4148'	8° 0.197'	start profile; SES
8		16:45	54° 23.216'	8° 21.757'	end profile; SES
9		16:52	54° 22.9346'	8° 20.9543'	start profile; SES
9		19:18	54° 23.124'	8° 0.227'	end profile; SES
10		19:21	54° 23.222'	8° 0.154'	start profile; SES
10		21:48	54° 23.036'	8° 21.235'	end profile; SES
11		21:57	54° 22.742'	8° 20.55'	start profile; SES
11	30.05.2018	00:18	54° 22.944'	8° 0.147'	end profile; SES
12		00:24	54° 23.031'	8° 0.199'	start profile; SES
12		02:50	54° 22.841'	8° 20.79'	end profile; SES
13		02:57	54° 22.557'	8° 19.996'	start profile; SES
13		05:10	54° 22.737'	8° 0.146'	end profile; SES
14		05:16	54° 22.835'	8° 0.16'	start profile; SES
14		07:26	54° 22.556'	8° 20.32'	end profile; SES
15		16:43	54° 22.6387'	8° 0.175'	start profile; SES
15		19:05	54° 22.4651'	8° 19.8115'	end profile; SES
16		19:10	54° 22.2688'	8° 19.4389'	start profile; SES
16		21:39	54° 22.4375'	8° 0.0439'	end profile; SES
17		21:42	54° 22.5428'	8° 0.2013'	start profile; SES
17		00:10	54° 22.3792'	8° 19.5464'	end profile; SES
18	31.05.2018	00:19	54° 22.0796'	8° 19.5504'	start profile; SES
18		02:44	54° 22.252'	8° 0.159'	end profile; SES
19		02:50	54° 22.351'	8° 0.179'	start profile; SES
19		05:11	54° 22.16'	8° 19.55'	end profile; SES
20		05:17	54° 21.88'	8° 19.43'	start profile; SES
20		07:42	54° 22.0562'	8° 0.1133'	end profile; SES
21		07:45	54° 22.1564'	8° 0.1386'	start profile; SES
21		10:09	54° 21.9892'	8° 19.6326'	end profile; SES
22		10:17	54° 21.6868'	8° 19.8714'	start profile; SES
23		13:43	54° 21.9634'	8° 0.1149'	start profile; SES
23		16:08	54° 21.7863'	8° 19.8503'	end profile; SES
24		16:21	54° 21.494'	8° 19.992'	start profile; SES
24		18:46	54° 21.098'	7° 59.912'	end profile; SES
25		18:47	54° 21.74'	7° 59.895'	start profile; SES
25		21:16	54° 21.5802'	8° 20.0925'	end profile; SES
26		21:27	54° 21.2986'	8° 19.5982'	start profile; SES
26		23:55	54° 21.4742'	8° 0.0884'	end profile; SES
27		23:58	54° 21.5747'	8° 0.1707'	start profile; SES
27	01.06.2018	02:30	54° 21.398'	8° 20.163'	end profile; SES
28		02:36	54° 21.096'	8° 20.334'	start profile; SES
28		05:06	54° 21.316'	7° 59.885'	end profile; SES

No.	Date	Time[UTC]	Latitude	Longitude	Remarks
29		05:07	54° 21.346'	7° 59.869'	start profile; SES
29		07:39	54° 21.1966'	8° 20.3539'	end profile; SES
30		07:44	54° 20.9022'	8° 29.5593'	start profile; SES
30		10:22	54° 21.0889'	8° 0.0956'	end profile; SES
31		10:30	54° 21.196'	8° 0.2574'	start profile; SES
31		13:06	54° 20.999'	8° 20.474'	end profile; SES
32		13:14	54° 20.7147'	8° 20.6687'	start profile; SES
32		15:40	54° 20.8938'	8° 0.0557'	end profile; SES
33		15:44	54° 20.9924'	8° 0.1799'	start profile; SES
33		15:46	54° 20.9'	8° 0.19'	end profile; SES
34		18:18	54° 20.787'	8° 20.741'	start profile; SES
34		21:00	54° 20.6996'	8° 0.0515'	end profile; SES
36		23:43	54° 20.3201'	8° 20.9755'	start profile; SES
36	02.06.2018	02:20	54° 20.5116'	7° 59.95'	end profile; SES
38		05:08	54° 20.12'	8° 21.127'	start profile; SES
38		07:41	54° 20.3103'	8° 0.096'	end profile; SES
40		10:17	54° 19.9258'	8° 21.353'	start profile; SES
40		12:57	54° 20.1189'	8° 0.1101'	end profile; SES
42		15:46	54° 19.7394'	8° 21.526'	start profile; SES
42		18:14	54° 19.9242'	8° 0.0033'	end profile; SES
43		18:18	54° 20.0213'	8° 0.138'	start profile; SES
43		20:52	54° 19.8051'	8° 21.5919'	end profile; SES
44		20:58	54° 19.5293'	8° 21.6617'	start profile; SES
44		23:44	54° 19.729'	8° 0.0275'	end profile; SES
45		23:48	54° 19.826'	8° 0.211'	start profile; SES
45	03.06.2018	02:34	54° 19.6301'	8° 21.689'	end profile; SES
46		02:42	54° 19.3406'	8° 21.7722'	start profile; SES
46		05:17	54° 19.59'	8° 59.86'	end profile; SES
47		05:18	54° 19.61'	8° 59.91'	start profile; SES
47		08:12	54° 19.4315'	8° 21.8786'	end profile; SES
48		08:18	54° 19.135'	8° 21.9691'	start profile; SES
49		11:18	54° 19.4293'	8° 0.1772'	start profile; SES
49		14:00	54° 19.233'	8° 22.033'	end profile; SES
50		14:15	54° 18.958'	8° 22.086'	start profile; SES
50		16:56	54° 19.166'	7° 59.9'	end profile; SES
51		16:57	54° 19.199'	7° 59.873'	start profile; SES
51		19:43	54° 19.0426'	8° 22.1133'	end profile; SES
52		19:47	54° 18.745'	8° 22.3147'	start profile; SES
52		22:30	54° 18.9562'	8° 0.0219'	end profile; SES
53		22:34	54° 19.0458'	8° 0.2491'	start profile; SES
53	04.06.2018	01:08	54° 18.855'	8° 22.363'	end profile; SES
54		01:17	54° 18.559'	8° 22.414'	start profile; SES
54		03:59	54° 18.704'	7° 59.93'	end profile; SES

No.	Date	Time[UTC]	Latitude	Longitude	Remarks
55		04:00	54° 18.809'	8° 59.878'	start profile; SES
55		06:47	54° 19.487'	8° 22.51'	end profile; SES
56		06:49	54° 18.45'	8° 22.47'	start profile; SES
56		09:20	54° 18.6611'	8° 0.0721'	end profile; SES

Tab 3.: Stations Grab Sampling

Sample	Date	Time[UTC]	Waterdepth[m]	Latitude	Longitute
1	5.6.18	6:11	19.0	54°22.346'	8°0.393'
2		6:35	18.3	54°23.554'	8°1.656'
3		6:49	17.9	54°23.176'	8°2.213'
4		6:59	17.9	54°23.094'	8°2.906'
5		7:13	18.3	54°23.489'	8°3.451'
6		7:25	18.9	54°23.604'	8°4.576'
7		7:40	17.3	54°22.702'	8°3.976'
8		7:55	17.6	54°22.658'	8°5.729'
9		8:15	18.5	54°23.262'	8°7.961'
10		8:35	17.2	54°22.356'	8°9.57'
11		8:51	17.4	54°23.174'	8°11.169'
12		9:14	13.8	54°23.775'	8°15.083'
13		9:23	14.5	54°23.84'	8°15.412'
14		10:20	13.2	54°23.806'	8°19.389'
15		10:30	13.0	54°23.555'	8°18.962'
16		10:47	10.6	54°23.187'	8°21.43'
17		11:04	9.9	54°22.204'	8°19.14'
18		11:14	10.1	54°21.75'	8°19.222'
19		11:37	15.6	54°22.398'	8°15.152'
20		11:53	16.8	54°21.854'	8°13.772'
21		12:12	18.0	54°21.854'	8°11.129'
22		12:24	18.1	54°21.854'	8°11.168'
23		13:00	18.0	54°21.733'	8°3.809'
24		13:11	18.5	54°21.675'	8°3.089'
25		13:21	18.8	54°21.663'	8°3.078'
26		13:43	20.2	54°20.593'	8°0.702'
27		13:54	19.8	54°20.593'	8°0.683'
28		14:19	19.9	54°20.527'	8°0.716'
29		14:40	21.2	54°18.909'	8°0.258'
30		14:55	20.5	54°19.438'	8°0.962'
31		15:05	19.9	54°19.231'	8°1.472'
32		15:26	20.0	54°18.701'	8°1.666'
33	6.6.18	6:48	18.5	54°20.389'	8°1.515'

Sample	Date	Time[UTC]	Waterdepth[m]	Latitude	Longitute
34		6:57	18.1	54°20.35'	8°2.109'
35		7:18	18.0	54°19.807'	8°1.892'
36		7:27	17.8	54°19.829'	8°1.942'
37		7:41	17.6	54°18.742'	8°2.942'
38		7:52	16.3	54°19.365'	8°2.996'
39		8:05	16.1	54°20.442'	8°4.069'
40		8:14	15.9	54°20.896'	8°4.193'
41		8:34	15.8	54°20.989'	8°4.474'
42	6.6.18	8:43	15.5	54°20.788'	8°5.094'
43		8:52	15.6	54°20.303'	8°4.64'
44		9:02	15.5	54°19.837'	8°4.616'
45		9:14	15.7	54°18.952'	8°5.658'
46		9:22	14.8	54°19.152'	8°6.413'
47		9:35	15.2	54°20.383'	8°6.271'
48		10:31	15.3	54°20.402'	8°7.763'
49		10:43	14.3	54°19.756'	8°7.221'
50		10:54	14.8	54°19.277'	8°8.497'
51		11:12	15.3	54°18.644'	8°12.081'
52		11:38	15.9	54°19.97'	8°10.84'
53		11:53	16.0	54°20.42'	8°13.676'
54		12:03	16.6	54°19.77'	8°14.11'
55		12:18	15.5	54°18.664'	8°16.832'
56		12:30	15.7	54°18.658'	8°16.853'
57		12:57	15.2	54°20.395'	8°17.278'
58		13:18	13.5	54°20.866'	8°18.925'
59		13:36	14.0	54°19.556'	8°19.144'
60		13:47	12.0	54°20.385'	8°20.237'
61		14:05	9.6	54°20.572'	8°20.7'
62		14:14	12.2	54°20.071'	8°21.27'
63		14:42	11.1	54°18.629'	8°22.397'