



IMPULSIVE NOISE SOURCES (D11.1)

Activities in the Danish EEZ reported for 2018 to the ICES impulsive noise register

Technical Report from DCE – Danish Centre for Environment and Energy

No. 179

2020



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DCE – DANISH CENTRE FOR ENVIRONMENT AND ENERGY

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Activities in the Danish EEZ reported for 2018 to the ICES impulsive noise register

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DCE – DANISH CENTRE FOR ENVIRONMENT AND ENERGY

Data sheet

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Abstract: EU member states are required to record and report impulsive underwater noise sources according to the Marine Strategy Framework Directive. Denmark fulfils this obligation through reporting of activities to the joint impulsive noise register, maintained by ICES. This report describes the activities reported for Danish marine waters in the calendar year 2017.

Keywords: Marine Strategy Framework Directive, Descriptor 11, underwater noise, impulsive noise, pile driving, air guns, sonar.

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1 Foreword

This report presents the data reported by Denmark to the ICES impulsive noise registry for the calendar year 2018. This reporting is part of the obligations of the EU Marine Strategy Framework Directive, which requires the member states to report and assess the environmental status with respect to emission of energy, including underwater noise, to the marine environment (MSFD descriptor 11). The report covers criterion D11C1, impulsive noise. The reporting is also part of the reporting to HELCOM and OSPAR, as part of their monitoring programs for the Baltic and the North Sea, respectively.

The purpose of the report is to present the data in summary form passed on to the ICES registry, including comments not otherwise reported together with the data. The report thus serves as a background reference to the data in the ICES registry. The ICES registry should be consulted directly for access to the submitted data. No evaluation of the data has been performed beyond quality control, meaning that the possible effects of the reported activities on the environmental status of the Danish waters have not been assessed.

A draft of this report was submitted to the Environmental Protection Agency (Miljøstyrelsen) for comments before finalisation, but none was received.

2 Indicator D11C1 in Danish waters

The Marine Strategy Framework Directive requires reporting of impulsive noise sources, which fulfil the criteria of being a) below 10 kHz in frequency and b) have the possibility to detrimentally affect marine life (European Commission, 2008). Selection and classification of impulsive sources in Danish waters has been conducted in accordance with the guidance provided in Dekeling et al. (2014). These guidelines operate with five different categories of impulsive noise. The data collection procedure for each of the categories is outlined below.

2.1 Airgun arrays

Seismic surveys with airgun arrays are classified into four different magnitude classes.

Table 2.1. Classification of seismic air gun surveys according to Dekeling et al. (2014).

Magnitude	Source level (zero-to-peak pressure)
Very_low	209-233 dB re 1 μ Pa·m
Low	234-243 dB re 1 μ Pa·m
Medium	244-253 dB re 1 μ Pa·m
High	> 253 dB re 1 μ Pa·m

Information about seismic surveys in the Danish EEZ was obtained from the competent authorities: the Danish Energy Agency and the Danish Ministry of Foreign Affairs.

One survey was conducted with a single, moving airgun (AL518). The activity is reported at the level of ICES-subrectangles for each active day. No information is available about the number of shots fired per square per day.

2.2 Explosions

Underwater explosions are classified into five different magnitude classes.

Table 2.2. Classification of explosions according to Dekeling et al. (2014).

Magnitude	Equivalent TNT mass
Very low	8 g to 210 g
Low	220 g - 2.1 kg
Medium	2.11 kg - 21 kg
High	22 kg - 210 kg
Very high	> 210 kg

Fifteen underwater explosions were reported to the registry for 2018, all conducted by the Danish Navy, in connection with clearing of unexploded ordnance (UXO) and training/exercises. No explosions were reported for civilian purposes.

2.3 Impact pile driver

Impact pile driving is classified into four different magnitude classes, based on the hammer energy. Furthermore, it is noted whether mitigation measures in the form of sound reduction (air bubble curtains or other) were used.

Table 2.3. Classification of impact pile driving according to Dekeling et al. (2014).

Magnitude	Hammer impact energy
Very low	< 280 kJ
Low	290 kJ - 2.80 MJ
Medium	2.81 - 28 MJ
High	> 28 MJ

Impact pile driving was reported from one activity: construction of a new harbour pier in Rønne, Bornholm. A large number of sheet piles were installed over a period of many months.

2.4 Sonar and acoustic deterrents

Sonars (under 10 kHz) and acoustic deterrent devices (for example seal scarers) are classified into four different magnitude classes, based on the energy source level.

Table 2.4. Classification of sonars and acoustic deterrents according to Dekeling et al. (2014).

Magnitude	Source level (zero to peak pressure) ¹
Very_low	176-200 dB re 1 µPa·m
Low	201-210 dB re 1 µPa·m
Medium	211-220 dB re 1 µPa·m
High	> 220 dB re 1 µPa·m

One activity reported the use of sonars below 10 kHz: HE507 of magnitude **high**, but no additional details were provided. Upon request (see Appendix 2), the responsible acoustician on the cruise, T. Lüdmann, reported that the equipment used was an EM710 multibeam sonar from Kongsberg. This sonar operates with signals between 40 kHz and 100 kHz, i.e. above 10 kHz and therefore does not require reporting.

It was reported that a seal scarer was used in connection with the sheet piling at Rønne Havn. No further details were given, but it is presumed that this seal scarer had a frequency above 10 kHz. It is therefore not covered by the obligation to report under the MSFD.

2.5 Other impulsive noise sources

Impulsive sound sources not covered under the four categories above are reported under the category *Generic impulsive sources* and classified into four magnitude classes based on the source energy flux density.

¹ The unit is not stated in Dekeling et al. (2014), but presumed to be zero-to-peak pressure to be consistent with the other categories.

Table 2.5. Classification of other impulsive sources according to Dekeling et al. (2014).

Magnitude	Source level (energy flux density)
very_low	186-210 dB re 1 $\mu\text{Pa}^2\text{m}^2\text{s}$
Low	211-220 dB re 1 $\mu\text{Pa}^2\text{m}^2\text{s}$
medium	221-230 dB re 1 $\mu\text{Pa}^2\text{m}^2\text{s}$
High	> 230 dB re 1 $\mu\text{Pa}^2\text{m}^2\text{s}$

One activity reported the use of other impulsive sources: AL518 (subbottom profiler) no further details are given).

2.6 Overview of reported data

The total contribution of impulse-block days (one day with activity in one ICES subsquare) reported is illustrated in figure 2.1. Note that some operators reported several types of activities or magnitudes on the same day and same area, and different operators may have operated in the same block on the same date. This means that the total impulse block-days (123) is smaller than the grand sum of all contributions (162 impulse block-days).

Figure 2.1. Overview of the impulse-block days reported from the Danish EEZ in 2018, divided on activities. Note that some activities may have occurred on the same day in the same block, which means that the total impulse-block days for the Danish EEZ is smaller than the sum of all entries.

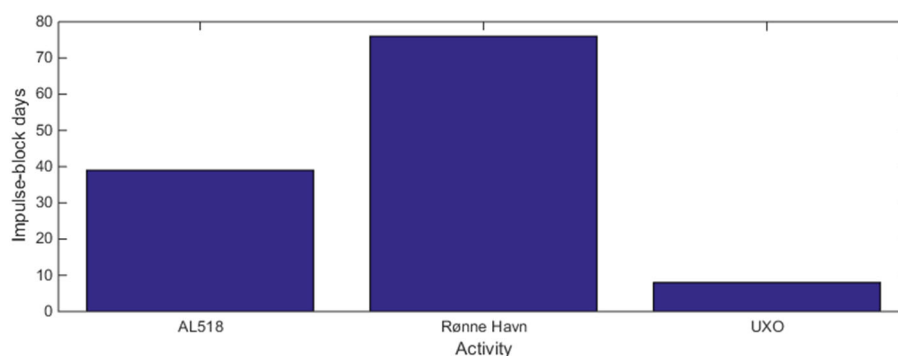


Figure 2.2 shows the distribution of impulse block-days with date. The peak in beginning of October corresponds to the AL518 survey around Bornholm.

Figure 2.2. Distribution of impulse block-days by date in 2018.

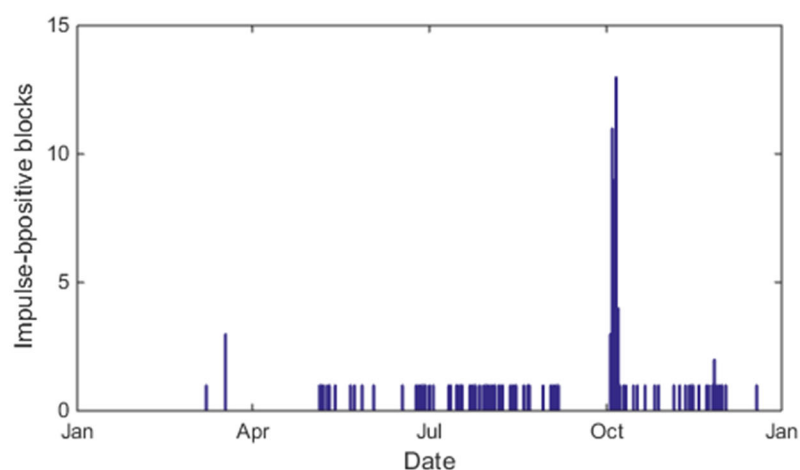
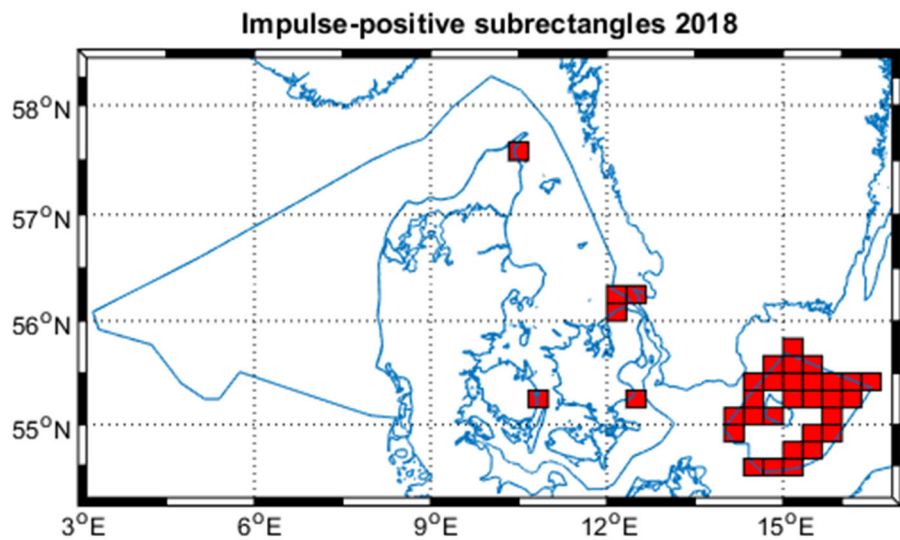


Figure 2.3 shows the 34 ICES subrectangles where activities were recorded in 2018.

Figure 2.3. Map showing ICES subrectangles in the Danish EEZ, where impulsive noise events were recorded in 2018.



2.7 Possible underreporting

The registry relies on submission of accurate information from permit holders (seismic operators, offshore contractors, etc.) to permitting agencies and that this information is passed on to the Environmental Protection Agency. The procedures for this reporting is still under development and some underreporting is unavoidable.

No large-scale seismic surveys with large airgun arrays were reported from the Danish EEZ in 2018. Some activities in neighbouring EEZs may have passed briefly through Danish EEZ (during line turns), but not likely. Smaller surveys conducted with single airguns or very small arrays for short periods without a permit are not included, as there is no mechanism to secure reporting of these activities. It is known that such activities took place in 2018, but no details are available.

No offshore wind turbine foundations were installed in 2018, and thus no large percussive pile drivings were reported. A smaller number of isolated pile drivings of for example conductor pipes for oil and gas wells may have been conducted without reporting, but there are no indications that such activities took place. Permitting and reporting mechanisms for smaller pile drivings, in particular in connection to small construction works on harbour piers etc., are under development and very difficult to implement in an efficient way. Only one activity, Rønne Harbour, was reported for 2018. It is very likely that other, unreported construction work of similar nature (but smaller scale) took place and escaped reporting.

Fifteen cases of military explosions were reported. It is believed that they were all related to clearance of unexploded ordnance (UXO) or training of personnel for UXO clearance. It is therefore likely that several smaller explosions in connection with training and exercises of the Navy in general are unreported. It should be noted that military activities are exempted from the reporting obligations of the MSFD and that the reporting of explosions received is a highly welcomed courtesy of the Danish Navy. No civilian explosions were reported, which may reflect the actual absence of such activities in 2018. There is no mechanism in place to ensure civilian explosions are reported.

The reported figures for sonars and acoustic deterrents is likely too low. The Danish Navy possess sonars that are covered by the MSFD (frequency below 10 kHz), but as for explosions, military activities are granted an exception from reporting requirements in the MSFD and are presently not reported. Acoustic deterrents (seal scarers etc.) covered by the MSFD (frequency below 10 kHz) are not considered to be used in the Danish EEZ, besides when used as mitigation devices for pile driving. In such cases the pile driving is the primary activity and the activity, which is reported to the registry.

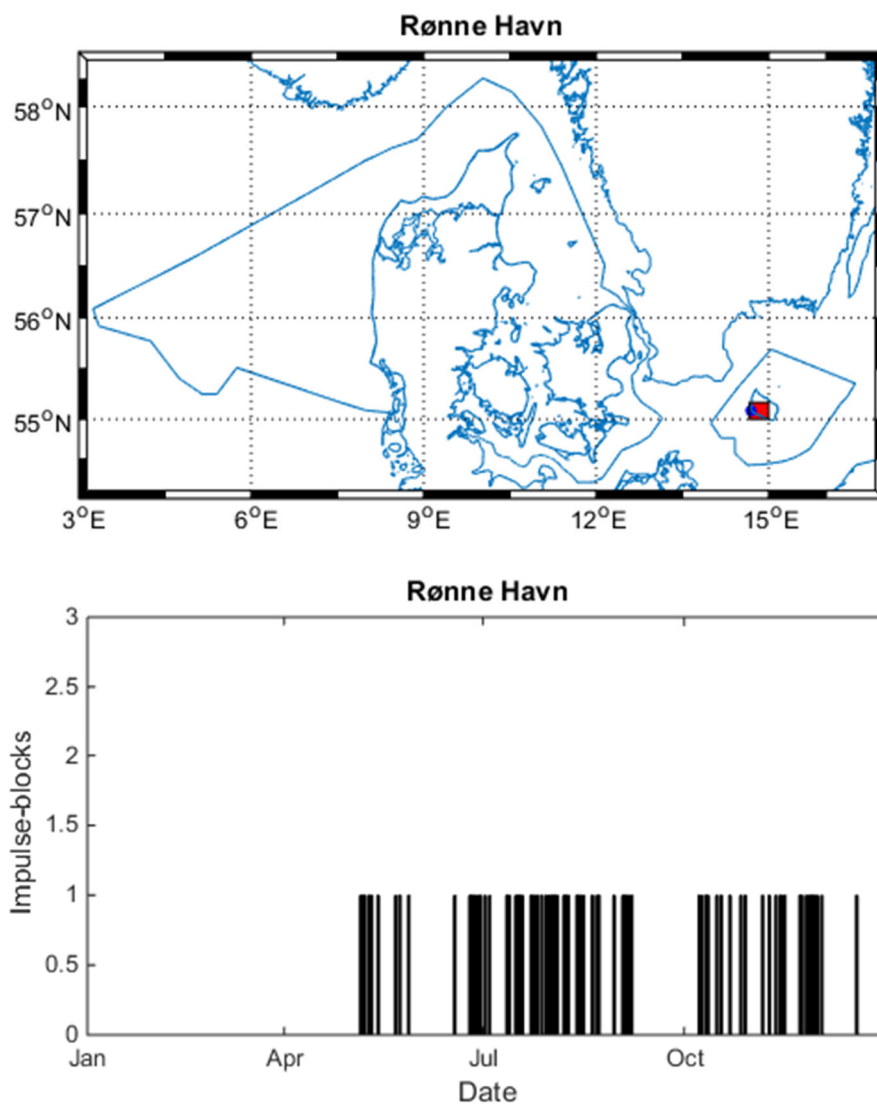
The reported figures for other impulsive sources are subject to uncertainty. The primarily relevant sources for this category are various equipment for sub-bottom profiling, such as pingers, sparkers and boomers. Although there are permitting procedures in place for these activities, it is believed that there is a substantial underreporting, in particular of smaller activities.

2.8 Registered, but not reported activities

A number of activities were registered by the responsible agencies, but do not fall under the categories of activities, which must be reported and data was therefore not uploaded to the ICES database. These data include APB44 (sidescan survey at Bornholm), MSM74 + MSM76 (surveys in Greenlandic waters, apparently not involving impulsive hydroacoustic sources) and HE507 (Kongsberg EM710 multibeam sonar survey in the North Sea). See appendix 1 for a complete list of reports received and data submitted.

3 Reported activities

3.1 Rønne Havn

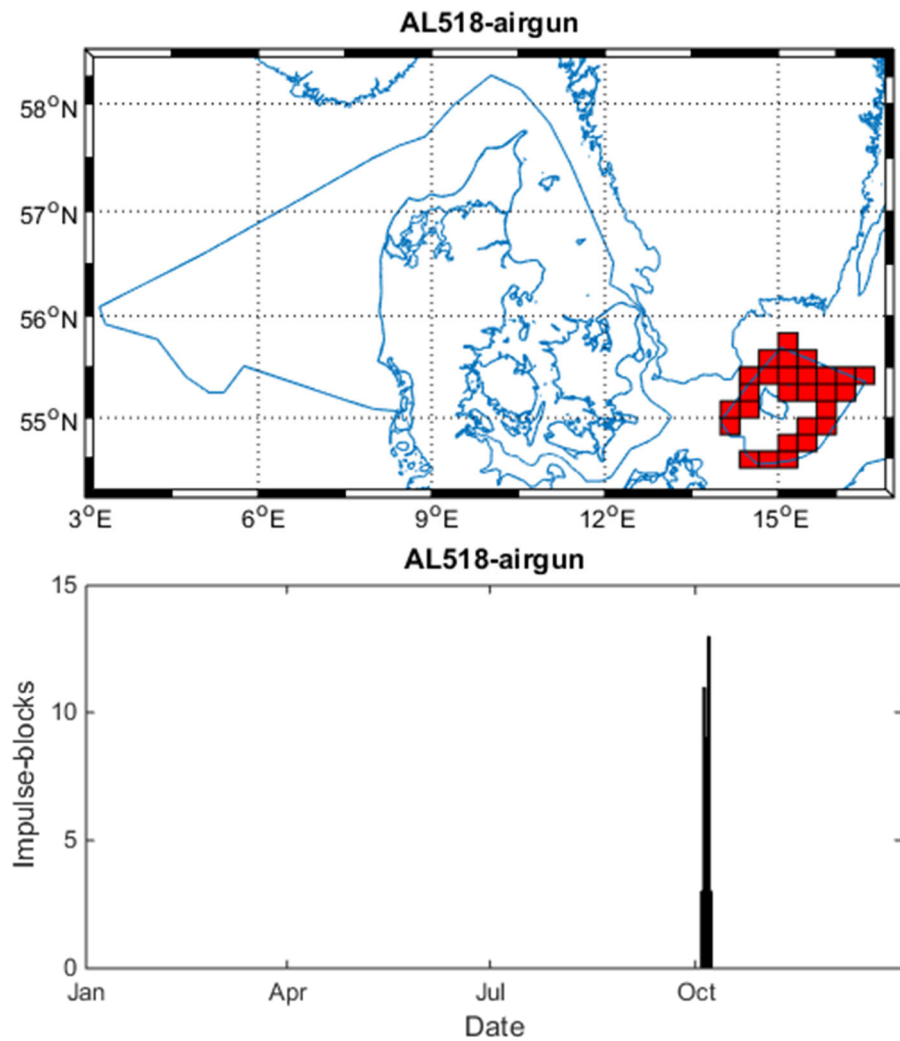


Sheet pile driving in connection to harbour wall construction with magnitude **very low**. Junttan HHK14T (165 kJ) and IHC S90 pile drivers used. Conducted between 6.5.2018 and 19.12.2018. Ramp up and seal scarers used as mitigation prior to each pile driving. Total 671 sheet piles.

Table 3.1. Summary of impulse-block days

ICES subrectangle	Impulse-block days
39G49	76
Grand Total	76

3.2 ALKOR – airgun



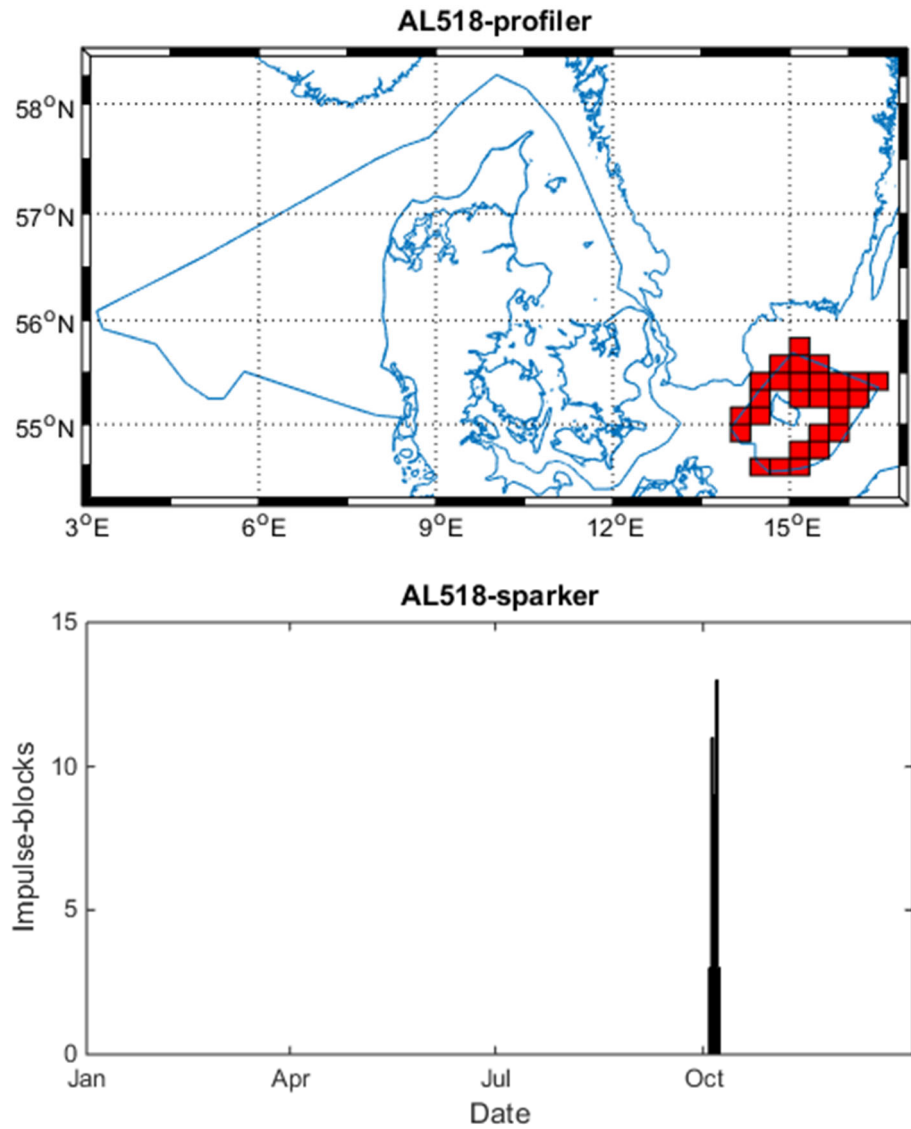
Subbottom profiling with single small airgun (ERCEL miniGI) of magnitude very low. Conducted between 4.10.2018 and 8.10.2018 with total of 39 impulse-block days. Ship RV Alkor. Ship speed 4-6 knots. Source depth 1 m. Shot interval 6 s.

Notes: Entry no. 2 – ICES rectangle changed from 29G43 to 39G43.

Table 3.2. Summary of impulse-block days

ICES subrectangle	Impulse-block days
38G41	1
38G46	1
38G49	1
38G52	1
38G53	2
38G54	1
38G55	1
38G57	1
39G43	1
39G44	3
39G45	1
39G46	2
39G47	3
39G51	2
39G52	2
39G54	1
39G55	1
39G57	3
39G58	2
39G59	1
39G61	1
39G62	1
39G64	1
40G49	1
40G52	1
40G53	2
40G56	1
Grand total	39

3.3 ALKOR – subbottom profiler



Subbottom profiling with Innomar SES-2000 medium profiler of magnitude high. Bandwidth 2-22 kHz (secondary frequencies). Source depth 4 m, tow speed 4-6 knots. Impulse interval 0.07-0.15 s. Also Simrad EK60 echosounder (85-115 kHz). Conducted simultaneously with airgun survey between 4.10.2018 and 8.10.2018 with a total of 39 impulse-block days.

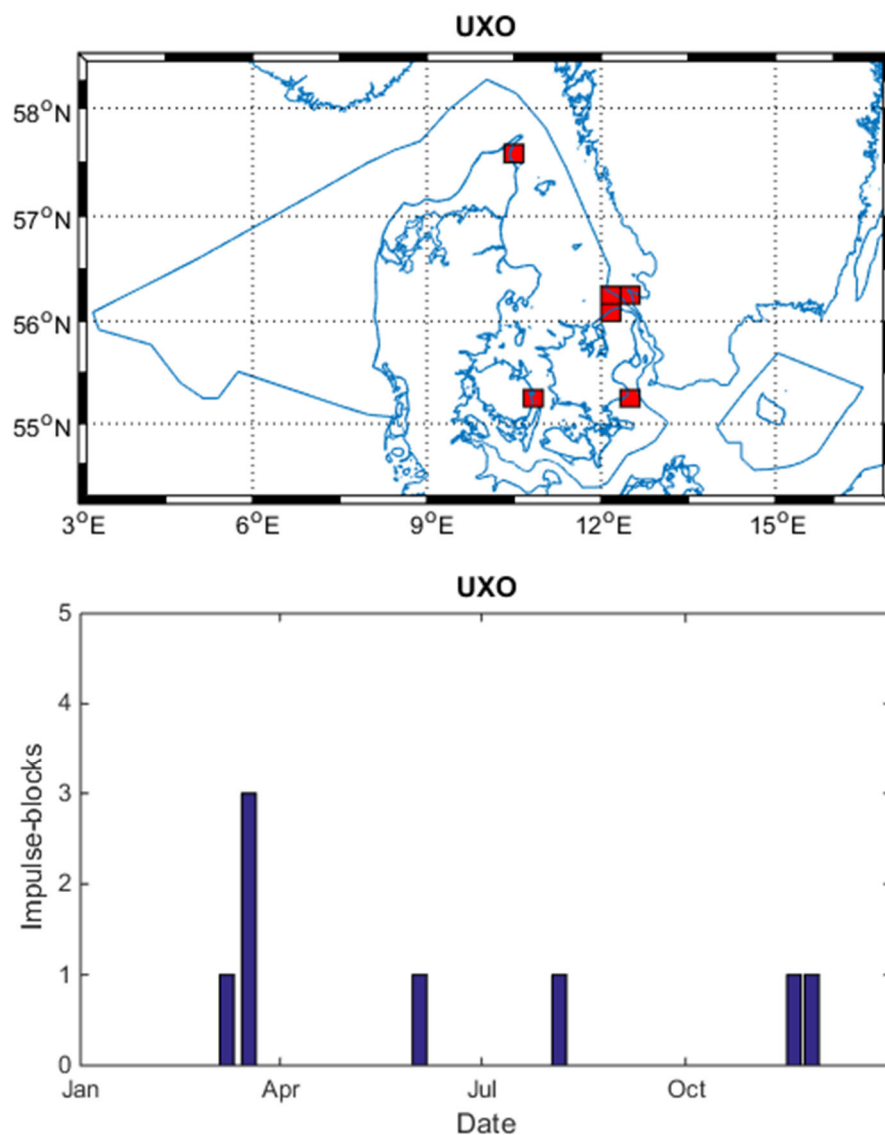
Notes: ICES rectangle ID scrambled in original file. Assumed to map airgun use 1:1, as number of entries and dates correspond 1:1.

Table 3.3- Summary of impulse-block days

ICES subrectangle	Impulse-block days
38G41	1
38G46	1
38G49	1
38G52	1
38G53	2
38G54	1
38G55	1
38G57	1
39G43	1
39G44	3
39G45	1
39G46	2
39G47	3
39G51	2
39G52	2
39G54	1
39G55	1
39G57	3
39G58	2
39G59	1
39G61	1
39G62	1
39G64	1
40G49	1
40G52	1
40G53	2
40G56	1
Grand total	39

3.4 UXO 2018

Figure 3.1.



Clearing of unexploded ordnance (UXO) and other explosions conducted by the Danish Navy. Total 17 explosions reported, constituting 8 impulse-block days. Magnitude high and very high.

Table 3.4. Summary of impulse-block days in 2017 and January 2018.

ICES subrectangle	Impulse-block days
39G08	2
39G25	1
41G22	2
41G23	1
41G25	1
44G06	1
Grand Total	8

Notes: One explosion reported from ICES subrectangle 41G24, entirely in Swedish waters, was omitted from the reporting to the database.

4 References

Dekeling, R.P.A., M.L. Tasker, A.J. Van der Graaf, M.A. Ainslie, M.H. Anderson, M. André, J.F. Borsani, K. Brensing, M. Castellote, D. Cronin, J. Dalen, T. Folegot, R. Leaper, J. Pajala, P. Redman, S.P. Robinson, P. Sigray, G. Sutton, F. Thomsen, S. Werner, D. Wittekind, and J.V. Young. 2014. Monitoring Guidance for Underwater Noise in European Seas, Part I: Executive Summary, JRC Scientific and Policy Report EUR 26557 EN, Publications Office of the European Union, Luxembourg.

European Commission. 2008. Directive 2008/56/EC of the European Parliament and of the Council of 17 June 2008 establishing a framework for community action in the field of marine environmental policy (Marine Strategy Framework Directive).

Appendix 1 – Submitted data

Name	Original file name	XML-file	Processed	Submitted	Comments
Rønne Havn	Registreringskema-Impulsstøj fra ramning_Rønne Havn_Etape 1.xlsx	DK_2018_Roenne.xml	03-04-2020	03-04-2020	Sheet pile driving
AL518	AL518_NoiseRegisterTemplate.18_mod	DK_2018_AL518.xml	03-04-2020	03-04-2020	Airgun+subbottom profiler
MSM76	NoiseRegister_2018_MSM76.xlsx	NA	04-04-2020	Not submitted	No reportable activities
HE507	NoiseRegister_HE507.xlsx	NA	04-04-2020	Not submitted	No reportable activities (multibeam sonar)
FES2018	Indberetning af marin støj - FES - 2018.xlsx	DK_2018_UXO.xml	04-04-2020	04042020	Explosions
	071235Z NOV 18 - MCM DNK-SPRAENGNINGSTILLADELSE 26 -29 NOV- UKL.docx	DK_2018_UXO.xml	04-04-2020	04042020	Explosions, included in FES2018
MSM74	NoiseRegisterTemplate 2018_MSM74.xlsx	NA	04-04-2020	Not submitted	No reportable activities
ABP44	Noise register ABP44	NA	03-04-2020	Not submitted	No reportable activities

Appendix 2 – cruise reports

Source: [BSH](#).

Alkor AL518

Deutsches Ozeanographisches Datenzentrum Inventur der Alkor-Reise AL518
(DOD-Ref-No.20180022)

Inventory of Alkor Cruise AL518 (DOD-Ref-No.20180022)

Plattform Platform	Reise-Nr. Cruise-No.	Zeitraum Period	Projekt Project	Arbeitsgebiet Working area
Alkor	AL518	30.09.2018 - 13.10.2018		Bornholm Basin Mecklenburg Bight Baltic Sea Arkona Basin

Fahrtleiter Chief Scientist	Institut Institute	Auslaufhafen Port of departure	Einlaufhafen Port of return	Stations- karte Station map	Schiffs- route Trackchart
Spieß Volkhardt	Fachbereich Geowissenschaften der Universität Bremen	Kiel	Kiel		

Ziel der Reise / Objectives of Cruise:

Cruise AL518 was dedicated to students training and education as marine geophysical field exercise. This Course was offered to students in the Bachelor Program "Geosciences" at the end of the 2./beginning of the 3. year of study, and to students in the Master Programs "Geosciences" and "Marine Geosciences" at the end of their first academic year. During this cruise, glacial and tectonic structures, Holocene sedimentation, shallow gas occurrences as well as human-made structures (pipelines, cables) was studied by means of seismic, hydroacoustic, CTD and magnetics. Additional Information.

Messungen / Measurements

Institut Institute	Wissenschaftler Scientist	Anzahl Number	Einheit Unit	Typ der Messungen Type of measurements	Kommentar Comments	Daten im DOD Data in DOD
GEOUNB	Frederichs Thomas	73	profiles	G28 Magnetic measurements	-	no
GEOUNB	Spiess Volkhardt	128	profiles	G73 Single-beam echosounding	SES2000, EK60	no
GEOUNB	Spiess Volkhardt	121	profiles	G74 Multi-beam echosounding	-	no
GEOUNB	Spiess Volkhardt	121	profiles	G76 Multichannel seismic reflection	-	no
GEOUNB	Spiess Volkhardt	8	stations	H10 CTD-Stations	-	no

Heincke HE507

Deutsches Ozeanographisches Datenzentrum Inventur der Heincke-Reise
HE507 (DOD-Ref-No.20180057)
Inventory of Heincke Cruise HE507 (DOD-Ref-No.20180057)

Plattform Platform	Reise-Nr. Cruise-No.	Zeitraum Period	Projekt Project	Arbeitsgebiet Working area
Heincke	HE507	06.04.2018 - 12.04.2018		North Sea

Fahrtleiter Chief Scientist	Institut Institute	Auslaufhafen Port of departure	Einlaufhafen Port of return	Stations- karte Station map	Schiffsrouten Trackchart
Lahajnar Niko	Institut für Geologie der Universität Hamburg	Bremerhaven	Bremerhaven		

Ziel der Reise / Objectives of Cruise:

The cruise HE 507 served two purposes: Firstly, it is part of the curriculum in Geology at Universität Hamburg as a practical exercise for students at the M.Sc. level (lecture number 63-345). The goals of the master course are (1) to learn ship-based operations at sea, (2) to apply and to use techniques to collect surface sediment and suspended matter samples, (3) to obtain water samples for biogeochemical measurements, (4) to obtain profiles of water column structure and water properties by CTD profiling, and (5) to get a first insight to acoustic techniques for the investigation of sediment layering and structure. At each evening of the cruise, students give seminars on topics related to geology and environment in the North Sea or on measurement and sampling techniques. The course also gives an introduction to the software OceanDataView for data evaluation and visualisation. In addition to the purpose of student training, a second objective was to obtain samples of surface sediment for granulometric measurements and biogeochemical properties, such as the content of organic carbon, nitrogen, and for mapping the distribution of stable isotope ratios of nitrogen ($^{15}\text{N}/^{14}\text{N}$) in water-column particulate matter and surface sediments in the Danish Exclusive Economic Zone. This work is performed under research project "North Sea – Assessment of Habitats" (NOAH). The present set of samples will be analyzed in the near future in the frame of B.Sc and M.Sc. theses.

Messungen / Measurements

Institut Institute	Wissenschaftler Scientist	Anzahl Number	Einheit Unit	Typ der Messungen Type of measurements	Kommentar Comments	Daten im DOD Data in DOD
IFGEO	Lahajnar Niko	22	hauls	B08 Phytoplankton	Phytoplankton Hand-Net 25?m. 12.04.2018	no
IBGMHH	Ludmann T.	2	profiles	D90 Other physical oceanographic measurements	Sound velocity profiles. 12.04.2018	no
IFGEO	Lahajnar Niko	22	stations	G02 Grab	van Veen Grab. 12.04.2018	no
IFGEO	Lahajnar Niko	22	stations	G04 Core-soft bottom (no. of cores)	Multicorer Octopus. 12.04.2018	no
IBGMHH	Ludmann T.	4	survey	G74 Multi-beam echosounding	Seismic Surveys. 12.04.2018	no
IBGMHH	Lahajnar Niko	26	stations	H00 Stations	-	yes
IFGEO	Lahajnar Niko	22	stations	H09 Water bottle stations	Bottom Water Sampler (25-125 cm off bottom). 12.04.2018	no
IFGEO	Lahajnar Niko	22	stations	H09 Water bottle stations	CTD Rosette. 12.04.2018	no
IFGEO	Lahajnar Niko	22	stations	H10 CTD-Stations	CTD Seabird . 12.04.2018	no

From: Thomas Lüdmann <thomas.luedmann@uni-hamburg.de>
Sent: 6. april 2020 13:13
To: Jakob Tougaard <jat@bios.au.dk>
Subject: AW: Questions about cruises HE507 and HE532

Dear Mr. Tougaard,
I am wondering because we submitted all detailed information about the used hydroacoustics to Danish Ministry of Foreign Affairs.
On both RV Heincke cruises we used a shipboard EM710 multibeam from Kongsberg.
Best Regards,
T. Lüdmann

Dr. Thomas Lüdmann
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Center for Earth System Research and Sustainability - CEN
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Von: Jakob Tougaard <jat@bios.au.dk>
Gesendet: Sonntag, 5. April 2020 12:31
An: thomas.luedmann@uni-hamburg.de
Betreff: Questions about cruises HE507 and HE532

Dear Dr. Lüdmann

I am responsible for quality assurance and reporting of data from Danish waters to the ICES impulsive noise register. For this, I have reports from the HE507 and HE532 cruises with R/V Heincke in the Danish North Sea.

My question is simply whether you can tell me the types of hydroacoustic equipment used during these two surveys. Relevant types are multibeam sonars and any kind of subbottom profilers (air guns, boomers, sparkers etc). Echosounders, ADCPs etc. are not relevant.

Any help much appreciated.

Sincerely

Jakob Tougaard

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