



# IMPULSIVE NOISE SOURCES (D11.1)

Activities in the Danish EEZ reported for 2016 to the ICES impulsive noise register

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Technical Report from DCE – Danish Centre for Environment and Energy

No. 113

2018



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DCE – DANISH CENTRE FOR ENVIRONMENT AND ENERGY

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# 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 2016.
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# 1 Foreword

This report presents the data reported by Denmark to the ICES impulsive noise registry for the calendar year 2016. 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). This report covers the indicator 11.1, impulsive noise.

The purpose of the report is to present the data in summary form, including comments not passed on to the ICES registry. It 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, i.e. the possible effects of the reported activities on the environmental status of the Danish waters have not been assessed.

## 2 Indicator 11.1 in Danish waters

The Marine Strategy Framework Directive requires reporting of impulsive noise sources that a) are below 10 kHz in frequency and b) possibly detrimentally affect marine life (European Commission 2008). Selection and classification of impulsive noise sources in Danish waters have been conducted in accordance with the guidelines 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).

<b>Magnitude</b>	<b>Source level (zero-to-peak pressure)</b>
very_low	209-233 dB re 1 $\mu$ Pa·m
low	234-243 dB re 1 $\mu$ Pa·m
medium	244-253 dB re 1 $\mu$ Pa·m
high	> 253 dB re 1 $\mu$ Pa·m

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

Four surveys (DUC16, PGS-NS, Finke16 and ALCOR) were conducted by moving sources covering large-sized areas (conventional 2D, 3D and 4D seismic surveys). The activities are reported at the level of ICES-subrectangles for each active day. No information is available about the magnitude (number of shots) fired per subrectangle per day.

One survey (Bassin Refleks 2016) used stationary air guns. The activities are reported as positions. At least one shot was thus fired at each particular position on that particular day. No information is available on the number of shots fired and, accordingly, multiple shots may have been fired at each position.

Two surveys (DONG-HA, HAD-19) were also stationary and presumably undertaken in connection with oil and gas installations (well testing or similar). The position and date of each test are supplied, but no information about the number of shots at each position is available.

### 2.2 Explosions

Underwater explosions are classified into five different magnitude classes.

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

<b>Magnitude</b>	<b>Equivalent TNT mass</b>
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



No explosions were reported to the registry for 2016. This only reflects that no information about explosions was supplied by the Danish Navy or other relevant bodies. It is very likely that numerous underwater explosions occurred in 2016 in connection with UXO (unexploded ordnance) clearance, navy training and civilian construction activities.

## 2.3 Impact pile driving

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 three activities: Tyra SE (conductor pipe piling) and Nakskov and Nyborg harbours (piling of concrete piles). None of these activities were reported to employ bubble curtains or other sound reduction measures.

## 2.4 Sonar and acoustic deterrents

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

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

Magnitude	Source level (zero to peak pressure) <sup>1</sup>
very_low	176-200 dB re 1 $\mu$ Pa·m
low	201-210 dB re 1 $\mu$ Pa·m
medium	211-220 dB re 1 $\mu$ Pa·m
high	> 220 dB re 1 $\mu$ Pa·m

One activity reported the use of sonars below 10 kHz: ALCOR.

## 2.5 Other impulsive noise sources

Impulsive sound sources not covered by 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.

<sup>1</sup> The unit is not stated in Dekeling et al. (2014) but is presumed to be zero-to-peak pressure to preserve consistency with the other categories.

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

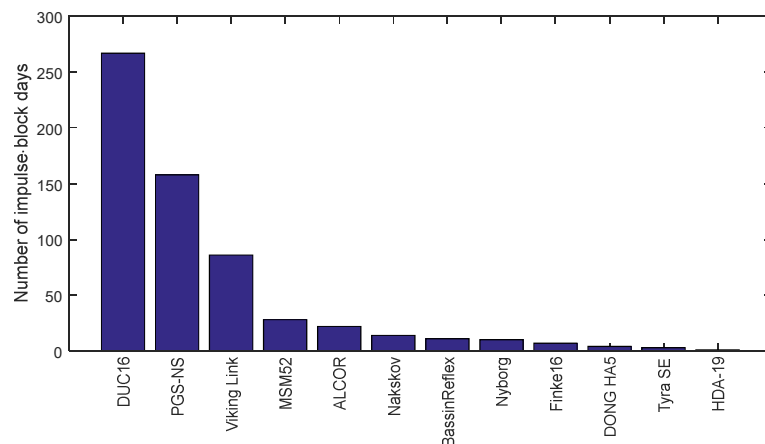
Magnitude	Source level (energy flux density)
very_low	186-210 dB re 1 $\mu\text{Pa}^2\text{m}^2\text{s}$
low	211-220 dB re 1 $\mu\text{Pa}^2\text{m}^2\text{s}$
medium	221-230 dB re 1 $\mu\text{Pa}^2\text{m}^2\text{s}$
high	> 230 dB re 1 $\mu\text{Pa}^2\text{m}^2\text{s}$

One activity, Viking Link, used other impulsive noise sources: pingers and sparkers.

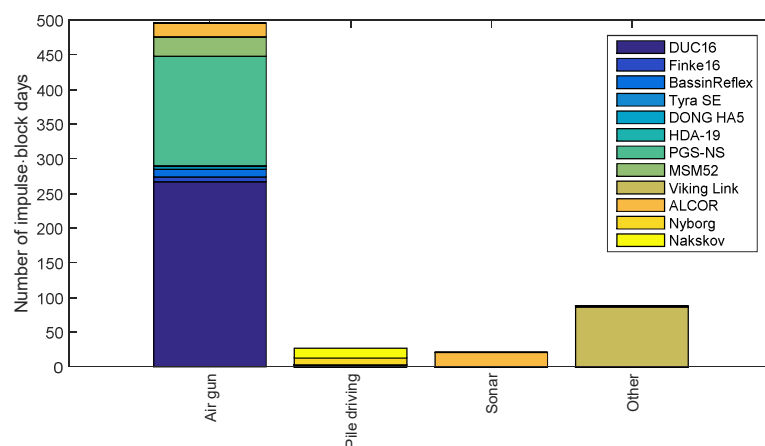
## 2.6 Overview of reported data

The total contribution of impulse-block days (one day with activity in one ICES-subrectangle) reported is illustrated in figures 2.1-2.3. Note that some activities reported several types of activities or magnitudes on the same day and in the same area and that different activities may have occurred in the same block on the same date. This means that the number of total impulse-block days may be smaller than the grand sum of 611 impulse-block days.

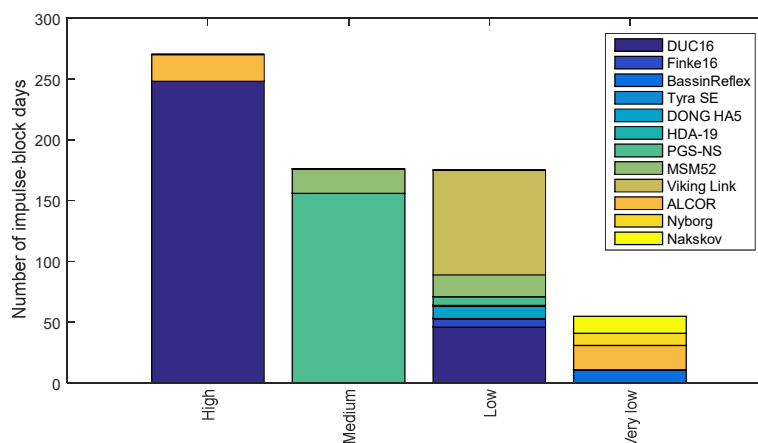
**Figure 2.1.** Overview of the impulse-block days reported from the Danish EEZ in 2016. Note that some activities may have occurred on the same day in the same block, which means that the number of total impulse-block days for the Danish EEZ could be smaller than the sum of all entries.



**Figure 2.2.** Overview of the types of impulsive noise sources reported in the Danish EEZ in 2016 separated into activities. Note that no underwater explosions or military sonars were reported. This does not mean that such activities did not take place, only that they were not reported.



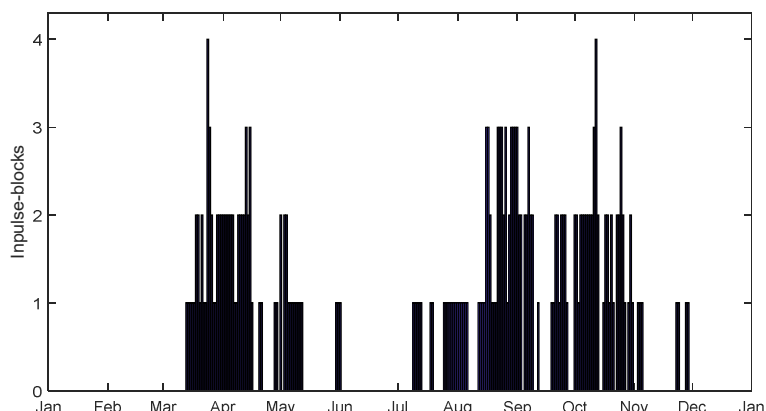
**Figure 2.3.** Overview of the magnitude of impulsive noise sources reported for the Danish EEZ in 2016 separated into sources. Note that some activities reported sources of different magnitude on the same days and in the same area, which means that the total number of impulse block-days is smaller than the sum of the individual contributions.



The by far largest contribution to the reported impulse-block days in 2016 was that of seismic surveys with towed airgun arrays. The two largest surveys, DUC16 and PGS-NS, were both conducted in the North Sea.

Figure 2.4 shows the distribution of impulse-block days by date, and the two clusters of activity in late spring and autumn also reflect the two seismic surveys.

**Figure 2.4.** Distribution of impulse-block days by date in 2016.



## 2.7 Registered activities not reported to the registry

A few activities were reported to the Environmental Protection Agency but were considered to be outside the requirements of the MSFD reporting, and they were thus not passed on to the ICES registry. These were:

Nyborg Havn: 22 days of sheet piling with a vibrator.

Nakskov Havn: Seven days of sheet piling with a vibrator.

Mya16: Four days of survey in Listerdyb with single-beam, multi-beam and side-scan sonars (SeaBeam 1185, Roxann, Biosonics, Yellowfin and Starfish), all with a signal frequency from 24 kHz and up to 1 MHz, i.e. well above the 10 kHz limit of the MSFD requirements.

## 2.8 Possible underreporting

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

The reported figures for air gun impulsive sound are considered to be an accurate reflection of the actual activities in 2016, in particular regarding the large surveys, as a permit is required to conduct seismic surveys in the Danish EEZ. Smaller surveys conducted with single airguns or very small arrays for short periods without a permit are not included as no mechanism ensuring the reporting of these activities exists.

The reported figures for impact pile driving are considered accurate for pile driving of large diameter piles (such as offshore wind turbine foundations). For smaller diameter piles, in particular in connection with small construction works on harbour piers etc., permitting and reporting mechanisms are under development but very difficult to implement in an efficient way. A significant underreporting of smaller pile drivings on or close to the coast is thus unavoidable.

The fact that no underwater explosions have been reported is most certainly incorrect. There is at present no permitting procedure for civilian underwater explosions that can serve as a source of information, and according to the MSFD the Navy is not obliged to and has not reported any activities for 2016.

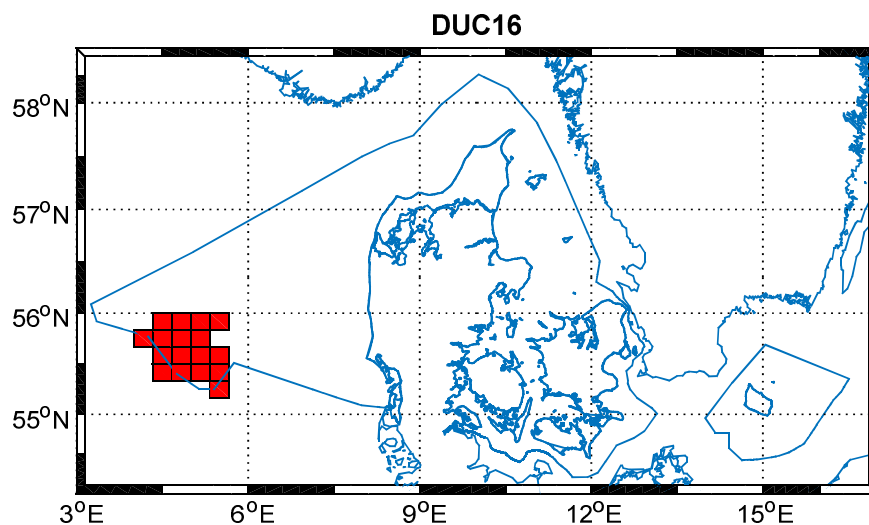
The reported figures for sonars and acoustic deterrents are likely too low. The Danish Navy possesses sonars that are covered by the MSFD (frequency below 10 kHz), but as for explosions, military activities are granted an exception from the reporting requirements of the MSFD and are presently not reported. Acoustic deterrents (seal scarers etc.) covered by the MSFD (frequency below 10 kHz) are not considered to be used in the Danish EEZ.

The reported figures for other impulsive sources are subject to uncertainty. The primarily relevant sources for this category are considered to be various equipment for sub-bottom profiling such as pingers, sparkers and boomers. As there is a permitting procedure for such surveys, the reported figures likely reflect the actual activities in 2016, although some non-permitted activities might have gone unreported.

### 3 Reported activities

#### 3.1 DUC16

Seismic survey with airgun array of magnitude **high**. Conducted between 25.7.2016 and 5.11.2016.



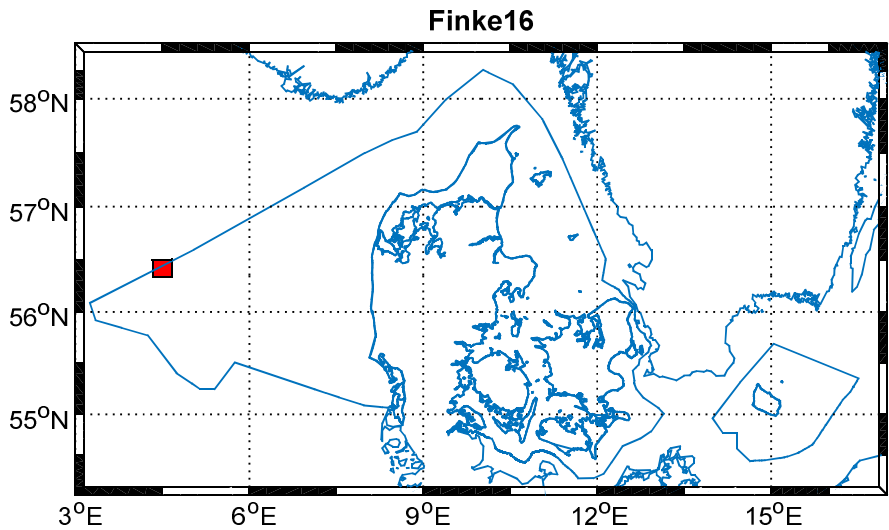
**Table 3.1.** Summary of impulse-block days.

ICES subrectangle	Impulse-block days
39F44	3
39F47	35
39F51	31
39F54	2
39F55	1
40F42	1
40F44	7
40F45	21
40F46	23
40F47	9
40F48	21
40F49	45
40F51	2
40F52	8
40F53	51
40F54	1
40F56	6
<b>Grand Total</b>	<b>267</b>

Notes: Coding for ICES-subrectangles was changed in the QA as they were reported in a wrong format (numbering started in SW corner, not NW corner).

### 3.2 Finke Geophysical

Seismic survey with airguns of magnitude **low**. Conducted between 9.7.2016 and 19.7. 2016.

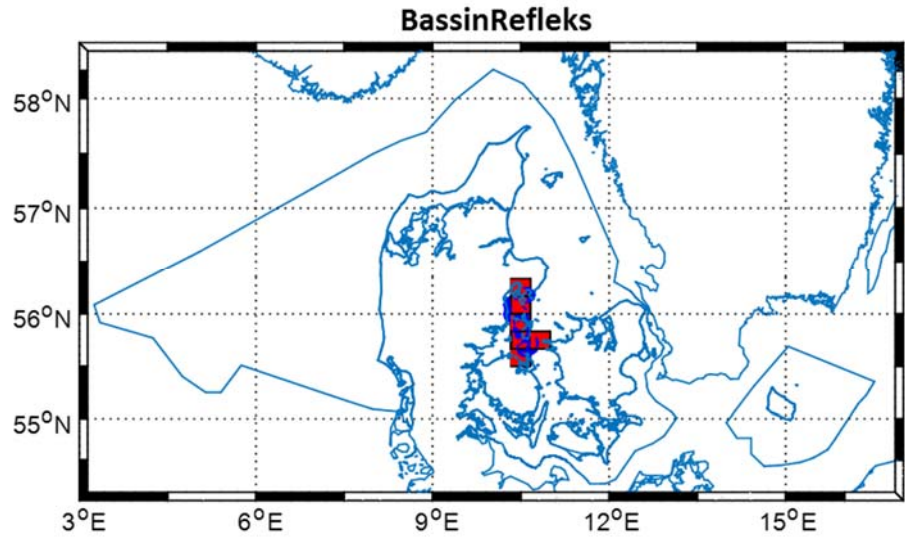


**Table 3.2.** Summary of impulse-block days.

ICES subrectangle	Impulse-block days
41F44	7
<b>Grand Total</b>	<b>7</b>

### 3.3 Bassin Refleks

Seismic study with 105 cu-Inch  
airgun of magnitude **very low**.  
Conducted between 24.10.2016  
and 26.10.2016.



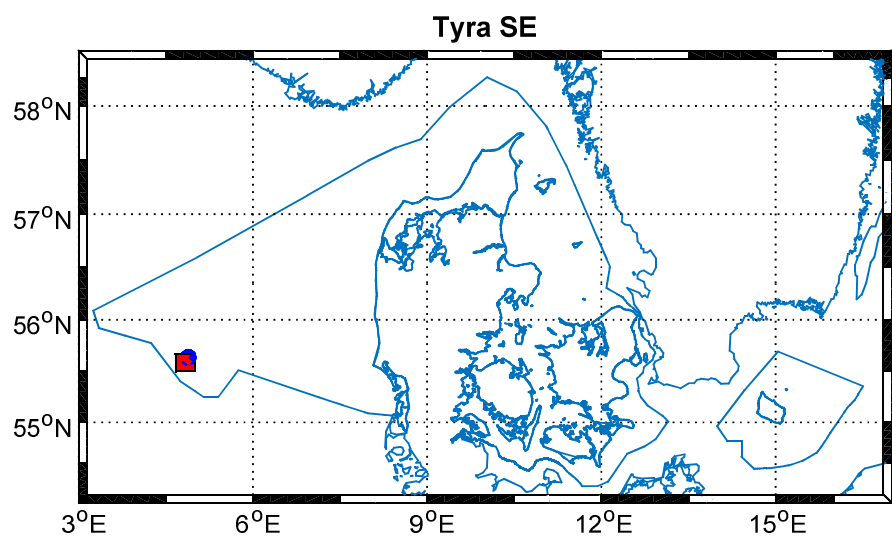
**Table 3.3.** Summary of impulse-block days.

ICES subrectangle	Impulse-block days
40G04	2
40G05	3
40G06	1
40G08	2
41G05	1
41G06	2
<b>Grand Total</b>	<b>11</b>

Notes: One position was not supplied as point but only as ICES-subrectangle.

3.4 Tyra

Pile driving (conductor pipe) of magnitude **very low**. Conducted between 30.5.2016 and 1.6.2016.



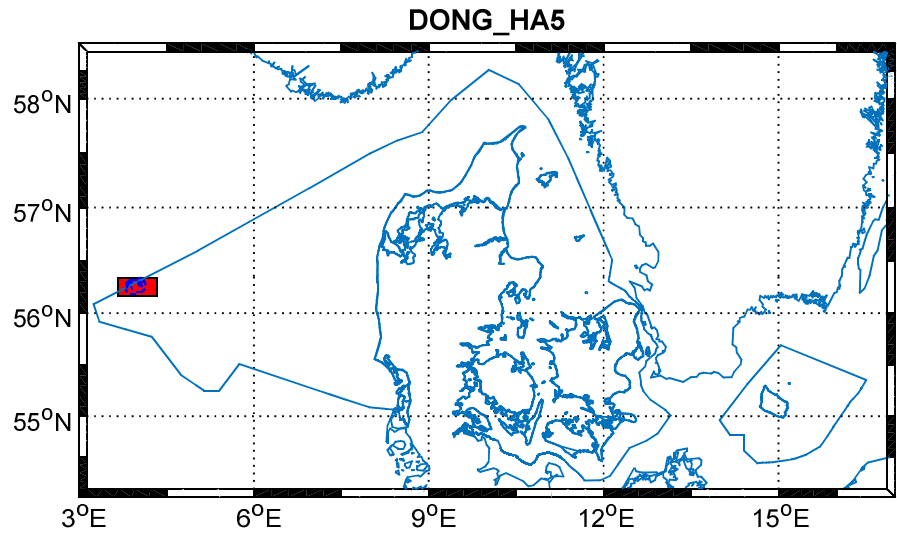
**Table 3.4.** Summary of impulse-block days.

ICES subrectangle	Impulse-block days
40F49	3
Grand Total	3



### 3.5 DONG HA-5

Seismic survey with airgun array of magnitude **low**. Conducted between 16.8.2016 and 17.8.2016.

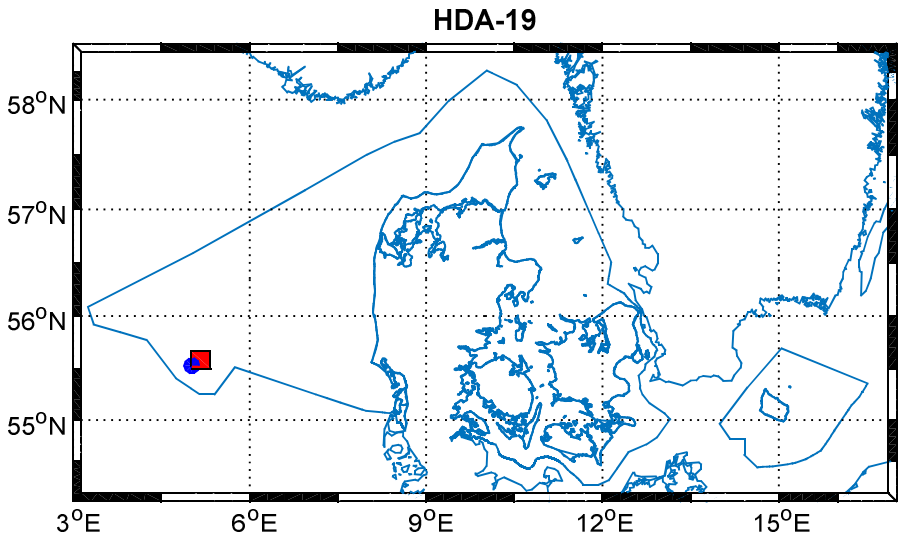


**Table 3.5.** Summary of impulse-block days.

ICES subrectangle	Impulse-block days
41F39	2
41F43	2
<b>Grand Total</b>	<b>4</b>

3.6 HDA-19A

Seismic survey with airgun of magnitude **low**. Conducted on 11.10.2016.

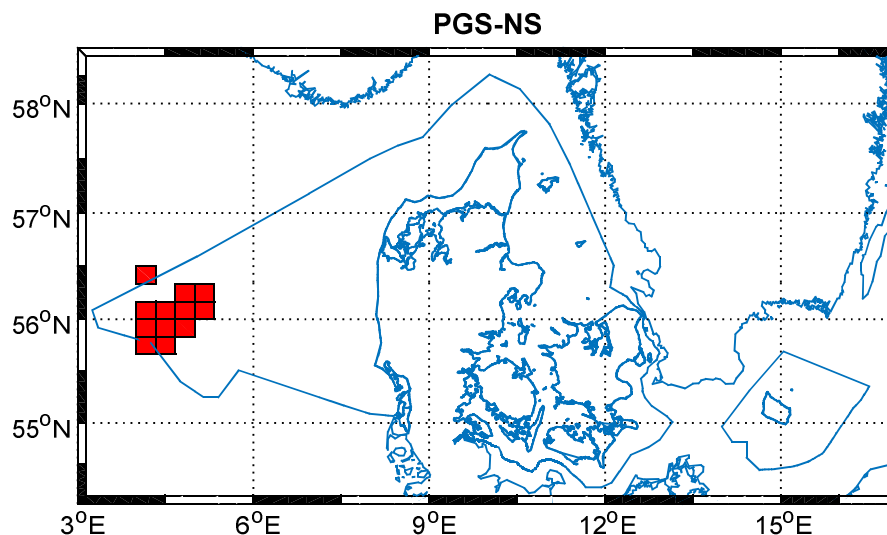


**Table 3.6.** Summary of impulse-block days.

ICES subrectangle	Impulse-block days
40F53	1
<b>Grand Total</b>	<b>1</b>

### 3.7 PGS-NS

Seismic survey with airgun array of magnitude **medium**. Conducted between 18.03.2016 and 16.04.2016.



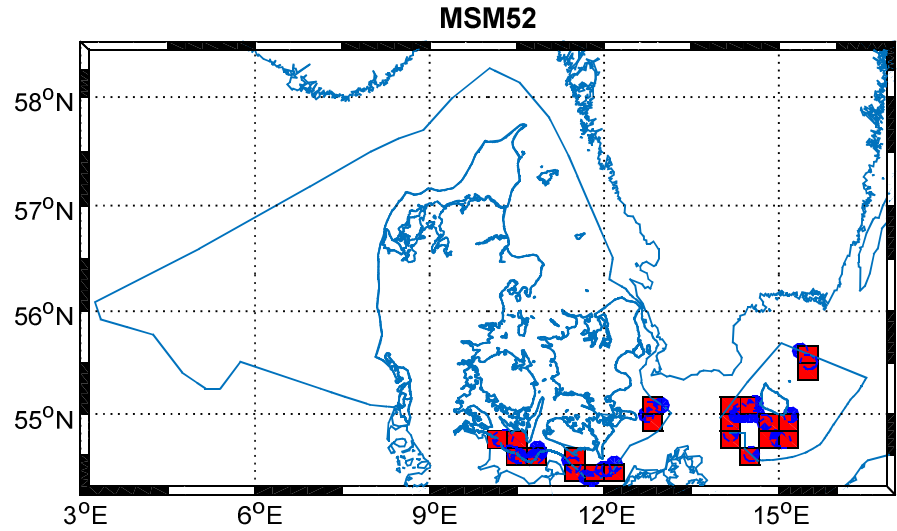
**Table 3.7.** Summary of impulse-block days.

ICES subrectangle	Impulse-block days
40F41	26
40F42	10
40F44	29
40F45	9
40F47	2
41F41	1
41F43	10
41F46	20
41F48	10
41F49	19
41F52	11
41F53	11
<b>Grand Total</b>	<b>158</b>

Notes: Several dates were apparently wrong, off by one or more years. All years were changed to 2016 in the QA.

### 3.8 MSM-52

Seismic survey with airgun array of magnitude **medium**. Conducted between 13.03.2016 and 23.03.2016.



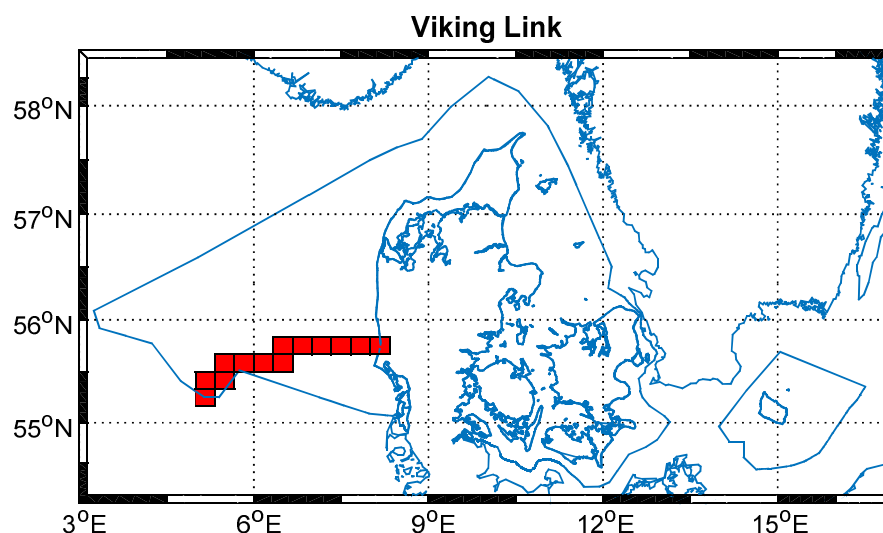
**Table 3.8.** Summary of impulse-block days.

ICES subrectangle	Impulse-block days
37G14	1
37G17	2
37G21	1
38G02	2
38G05	1
38G06	2
38G09	3
38G16	1
38G27	1
38G41	1
38G42	1
38G46	1
38G47	1
38G48	2
38G51	1
38G52	1
39G29	1
39G43	1
39G46	2
39G54	1
40G56	1
<b>Grand Total</b>	<b>28</b>

Notes: Activities were also reported as GPS points, with the survey line starting point coordinates given as latitude and longitude. GPS coordinates for both start and endpoints are provided in the comments column.

### 3.9 Viking Link

Seismic survey conducted with pingers (SES-2000 medium-100, 5 kHz and 3.5 kHz; Massa TQ-1075 pinger, 600 Watt) and sparker (Geo-Spark 200, 200 Hz – 2kHz, 50 - 300 J) of magnitude **low**. Survey conducted between 24.03.2016 and 12.05.2016.



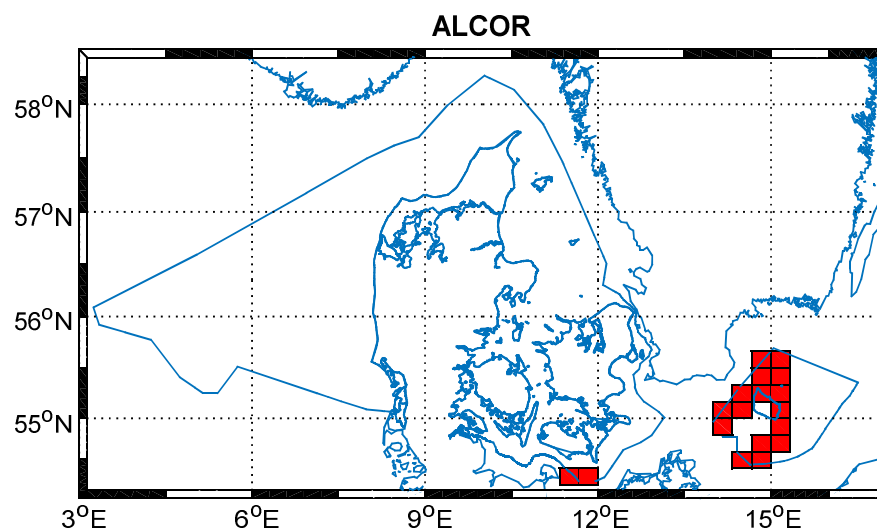
**Table 3.9.** Summary of impulse-block day.

ICES subrectangle	Impulse-block days
39F51	6
39F52	3
39F54	6
40F56	5
40F59	7
40F63	7
40F65	6
40F66	6
40F68	11
40F72	5
40F75	5
40F78	7
40F82	12
<b>Grand Total</b>	<b>86</b>

Notes: Entries were changed from category *sonar* to *generic impulsive* in the QA.

### 3.10 ALCOR

Seismic survey conducted with airgun array (SERCEL Mini GI) of magnitude **very low** and other source (NAUTIK NORD Boomer, 300 Hz - 22 kHz; SIMRAD EK60 Echo Sounder, 2 – 22 kHz; INNOMAR SES-2000 medium) of magnitude **high**. Conducted between 01.10.2016 and 13.10.2016.



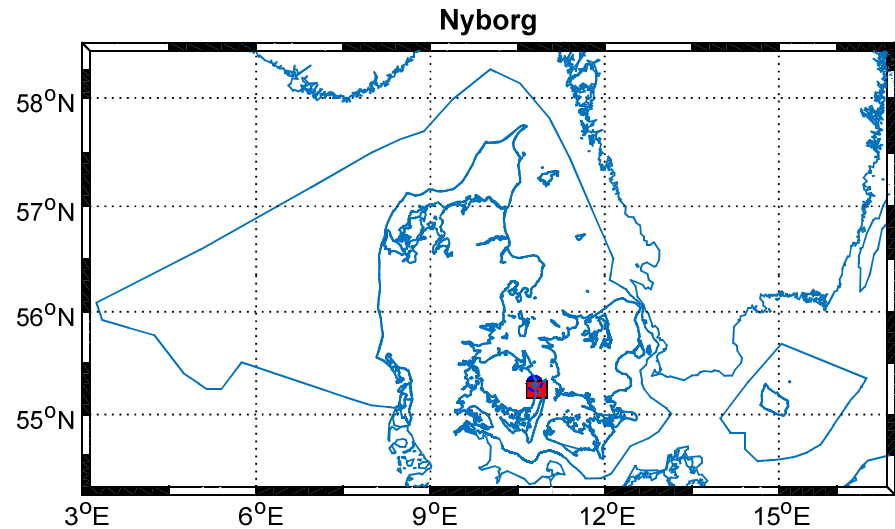
**Table 3.10.** Summary of impulse-block days.

ICES subrectangle	Impulse-block days
37G14	1
37G17	2
38G41	1
38G46	1
38G48	1
38G49	1
38G51	1
38G52	1
39G43	1
39G45	1
39G46	1
39G47	2
39G48	1
39G51	2
39G52	1
39G53	1
40G49	2
40G53	1
<b>Grand Total</b>	<b>22</b>

Notes: Entries of Nautik Nord Boomer were separated from the seismic activities and included as separate entries of category *generic impulsive* in the QA.

### 3.11 Nyborg Havn

Pile driving and vibration of sheet piles and concrete piles of magnitude **very low**.



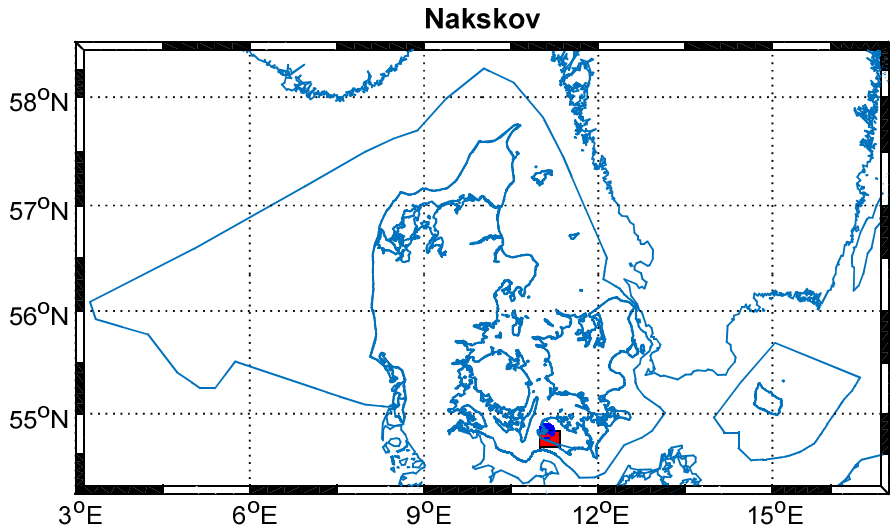
**Table 3.11.** Summary of impulse-block days.

ICES subrectangle	Impulse-block days
39G08	10
<b>Grand Total</b>	<b>10</b>

Notes: Vibratory sheet piling was not included in the report to the ICES registry as this is not considered to be an impulsive source. As pile driving activities were provided as a period only, it was assumed that pile driving had taken place every day in the specified period.

### 3.12 Nakskov Havn

Pile driving of sheet piles and concrete piles of magnitude **very low**.



**Table 3.12.** Summary of impulse-block days.

ICES subrectangle	Impulse-block days
38G12	14
<b>Grand Total</b>	<b>14</b>

Notes: Vibratory sheet piling is not included. Several piles were installed each day. The number of piles installed per day is specified in the comments column.



## 4 References

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