

Key message

Activities generating impulsive noise occurred widely across the Scottish marine area during the years 2015-2017. There was a high degree of variability between years. 2015 had the highest number of noisy activity days. Across the three years, the vast majority of noisy activity is attributable to seismic (79%) and sub-bottom (17%) geophysical surveys.

Background

Impulsive noise is a pulsed sound that is often very loud and has a sudden onset. It is generated through activities such as acoustic surveys of seabed geology, pile-driving structures into the seabed (Figure 1), underwater explosions and various types of sonar (emitting sound pulses to detect underwater objects).

It is assessed because of its potential physiological and disturbance effects to marine organisms. Disturbance effects in particular can occur at large distances from the sound source, since sound travels approximately 4.5 times faster in water than in air. These effects have the potential to cause disruption to feeding,

socialising and reproduction in marine mammals and fish, which could have individual and population consequences for these species.

This assessment is a description of the impulsive noise pressure on the environment, using data reported to the [Marine Noise Registry](#) (MNR). The MNR is hosted and managed by [Joint Nature Conservation Committee](#) (JNCC) and collates UK wide data. Impulsive noise is reported as pulse block days (PBD): the number of days of impulsive noise generating activity per United Kingdom Continental Shelf (UKCS) licensing block (Figure 2).



The initial purpose of monitoring anthropogenic impulsive noise is to quantify the pressure on the environment by making available an overview of relevant impulsive sound sources throughout the year. This in turn will aid in the definition of a baseline level for impulsive noise in Scottish waters.

There is ongoing work by expert groups of the [OSPAR Convention](#) and the European Union (EU) to establish indicators of the risk of impact of the noise pressure on marine wildlife and the subsequent establishment of threshold values for that indicator.



Figure 1: A jack-up pile driving vessel installing wind turbine foundation piles in the Moray Firth, July 2019 © University of Aberdeen.

Results

Impulsive noise was not assessed in the 2011 Atlas (Baxter et al., 2011). This is the first assessment of impulsive noise in Scottish waters. The assessment covers the entire Scottish marine area, due to the coarse spatial scale of reporting of data to the MNR. It is also not appropriate to examine inter-annual variability or trends, as there is such a great degree of variability in location and intensity between years.

Preliminary results illustrate that across the Scottish marine area, the distribution of impulsive noise PBD was generally clustered. Some blocks had high numbers of PBD, some had very low numbers of PBD and a considerable proportion had no PBD at all.

2015 (Figure 2) had the highest percentage of blocks in the Scottish marine area with impulsive

noise activity (38% of all blocks). This was much lower in 2016 (8%) and 2017 (8%).

Across all years, the activity making the greatest contribution to PBD was seismic survey (78.9%), followed by sub-bottom profilers (16.8%) (Table 1). The remaining 4.3% of PBD were attributable to piling, explosives, Ministry of Defence activity, multi-beam echo-sounders and the use of acoustic deterrent devices (ADD) as a noise mitigation tool.

During the years 2015-2017, 88.7% of PBD across all UK waters occurred in the Scottish marine area. The dominant cause of PBD in Scottish waters was seismic survey activity, with 86.9% of UK seismic survey PBD taking place in Scottish waters.

The UKCS blocks with the highest rates of activity were generally concentrated in Scottish/Offshore Marine Regions where oil and gas exploration (e.g. Long Forties, Fladen and Moray Firth Offshore, East Shetland Shelf, North and West Shetland Shelf; seismic survey) and offshore renewable energy construction (e.g. Moray Firth; pile driving) was taking place (Figure 2). The majority of activity was clustered around oil and gas exploration prospects in the east of the Scottish North Sea area.

Off western Scotland, the majority of PBD were attributable to seismic surveys occurring in deeper offshore waters (Hebrides Shelf, Rockall, Bailey, North Scotland Shelf).

The large areas with small numbers of PBD in 2015 and 2016 were mainly related to three wide ranging seismic surveys commissioned by the UK Oil and Gas Authority.

As previously described, several types of activity contribute to the impulsive noise, but by far the most common was seismic surveys (using loud sounds generated by airguns to profile the rocks below the sea floor), followed by sub bottom profiling (using sound to survey seabed sediments). Both of these activities are primarily associated with the oil and gas industry.

Piling occurred at several sites, notably in the Clyde and Moray Firth SMRs. ADDs were used to mitigate risk of injury to marine mammals at these construction sites.

| | Acoustic deterrent devices | Explosives | Military | Multi-beam echo sounder | Piling | Seismic surveys | Sub-bottom profilers |
|------------------|----------------------------|------------|----------|-------------------------|--------|-----------------|----------------------|
| 2015 | 0.0 % | 0.0 % | 0.0 % | 0.0 % | 0.0 % | 83.3 % | 16.7 % |
| 2016 | 0.4 % | 0.0 % | 3.7 % | 0.0 % | 1.8 % | 77.5 % | 16.5 % |
| 2017 | 4.7 % | 0.6 % | 0.8 % | 0.3 % | 6.0 % | 70.4 % | 17.2 % |
| Total PBD | 1.1% | 0.1% | 1.2% | 0.1% | 1.8% | 78.9% | 16.8% |

Table 1: Percentage of pulse block days (PBD) for each impulsive noise generating activity type in 2015 to 2017 in Scottish waters. Source: Marine Noise Registry.

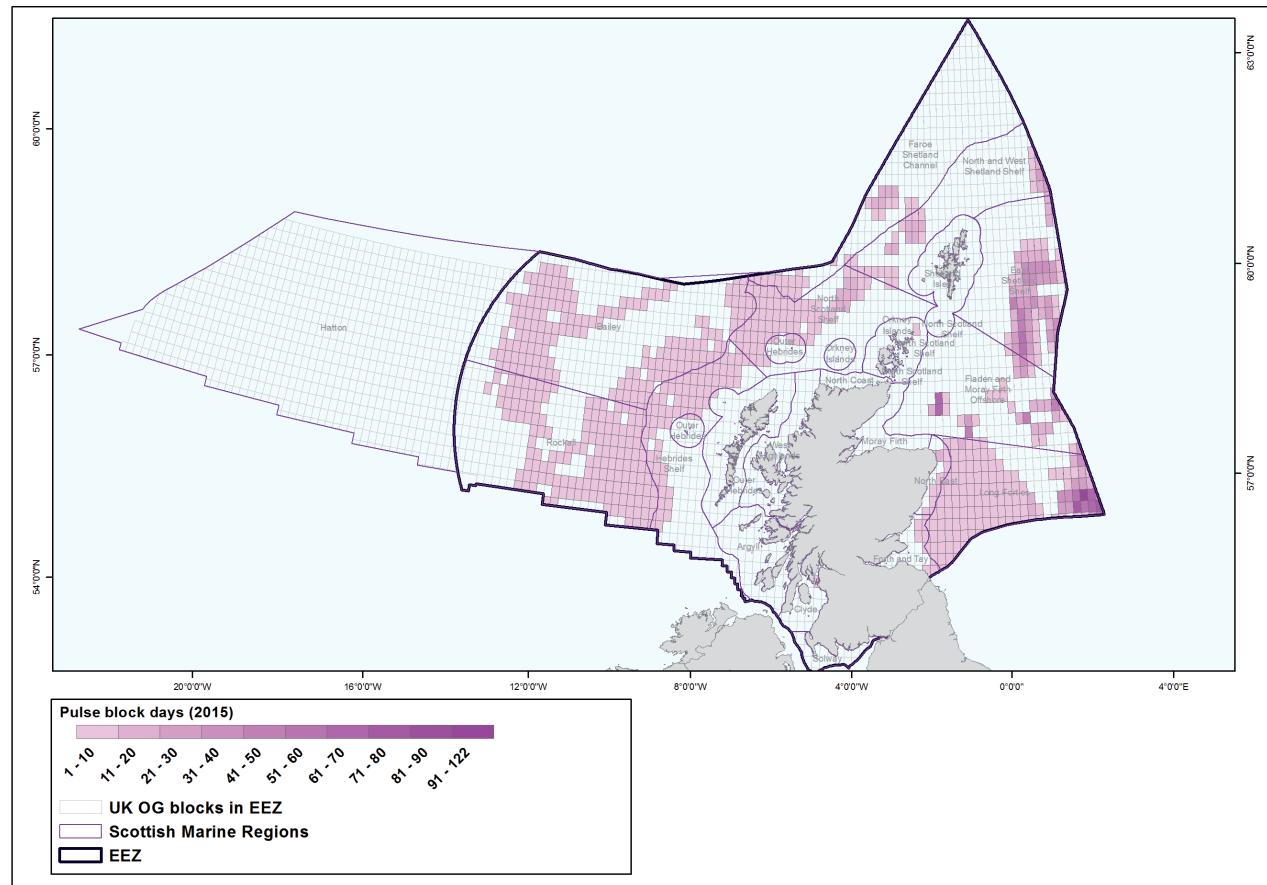


Figure 2: Distribution of pulse block days in each UKCS block in 2015. Scottish Marine Regions and Offshore Marine Regions also shown. Source: Marine Noise Registry.

Conclusion

This is the first Scottish assessment of impulsive noise. It provides a baseline for 2015 to 2017. It does not demonstrate a status or trend assessment.

This assessment illustrates that impulsive noise in the marine environment was highly variable both in location and between years. It depends largely on industrial developments and surveys that are taking place each year. There was a large proportion of UKCS blocks (spatial measuring unit) with no impulsive noise events, or a small number of days with impulsive noise. There were, however, clusters of activity in every year with a small number of blocks having had a relatively high number of days with impulsive noise.

Some activities were common in certain areas, e.g. seismic surveys in areas thought to host oil and gas reserves, and pile driving during the construction of offshore wind farms in the North Sea, but these activities are unlikely to be restricted to these areas in future years. In the five years 2019 to 2024, offshore wind farm construction is due to continue. Some of this construction work is likely to use impact pile driving, which will increase the levels of impulsive noise in regions such as the Moray Firth and Forth and Tay.

Knowledge gaps
















The coarse spatial scale of reporting of data to the MNR means that it has not been possible to assess spatio-temporal variability in impulsive noise.

There is a substantial knowledge gap surrounding impulsive noise for unlicensed activities. For example, there are some geophysical acoustic surveys which do not require licensing, so there is no regulatory control over whether data are submitted to the MNR.

Status and trend assessment

The assessment carried out is of the occurrence of the pressure from impulsive noise. Since thresholds have not been determined for the effect of this pressure to marine species, a traffic light assessment has not been carried out.

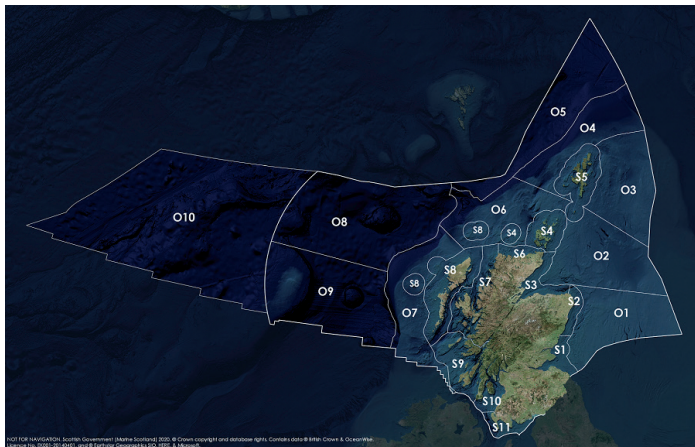
Status and trend assessment legend

| Status assessment (for Clean and safe, Healthy and biologically diverse assessments) | | Trend assessment (for Clean and safe, Healthy and biologically diverse and Productive assessments) | |
|---|---|---|--------------------------|
|  | Many concerns |  | No / little change |
|  | Some concerns |  | Increasing |
|  | Few or no concerns |  | Decreasing |
|  | Few or no concerns, but some local concerns |  | No trend discernible |
|  | Few or no concerns, but many local concerns |  | All trends |
|  | Some concerns, but many local concerns | Confidence assessment | |
|  | Lack of evidence / robust assessment criteria | | |
|  | Lack of regional evidence / robust assessment criteria, but no or few concerns for some local areas | Symbol | Confidence rating |
|  | Lack of regional evidence / robust assessment criteria, but some concerns for some local areas | ★ | Low |
|  | Lack of regional evidence / robust assessment criteria, but many concerns for some local areas | ★★ | Medium |
| | | ★★★ | High |

Overall confidence

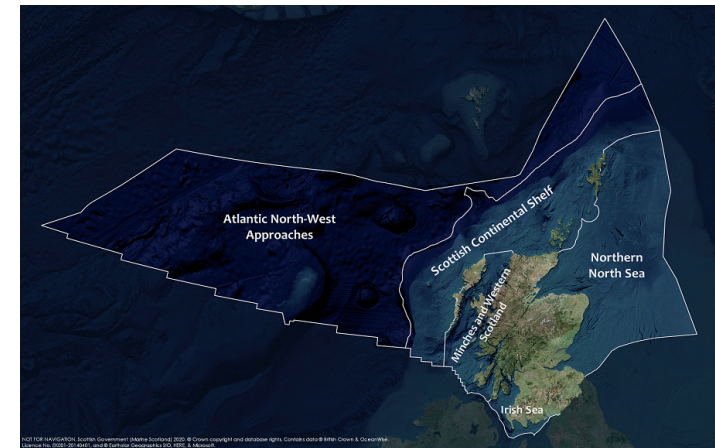


Assessment regions

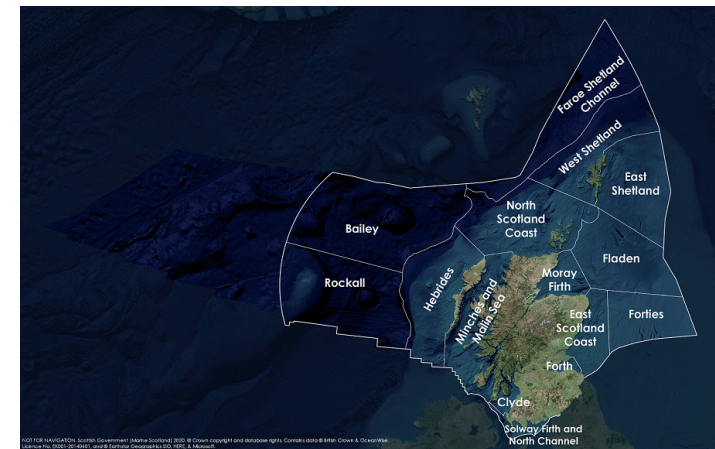


The Scottish Marine Regions (SMRs; S1 - S11) and the Scottish Offshore Marine Regions (OMRs, O1 - O10)

Key: S1, Forth and Tay; S2, North East; S3, Moray Firth; S4 Orkney Islands; S5, Shetland Isles; S6, North Coast; S7, West Highlands; S8, Outer Hebrides; S9, Argyll; S10, Clyde; S11, Solway; O1, Long Forties, O2, Fladen and Moray Firth Offshore; O3, East Shetland Shelf; O4, North and West Shetland Shelf; O5, Faroe-Shetland Channel; O6, North Scotland Shelf; O7, Hebrides Shelf; O8, Bailey; O9, Rockall; O10, Hatton.



Biogeographic, Charting Progress 2 (CP2) Regions. These have been used as the assessment areas for hazardous substances.



Scottish Sea Areas as used in Scotland's Marine Atlas 2011. These are sub divisions of the biogeographic, or Charting Progress 2 (CP2), Regions.