

# CLEAN AND SAFE : NOISE

## Continuous noise



Scottish Government  
Riaghaltas na h-Alba  
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### Key message

**This first continuous noise assessment used data collected at ten underwater recording stations during the summer months of 2013 and 2014. Averaged continuous noise levels were broadly similar between sites. Sound levels in the 125 Hz third-octave band were commonly between 84 and 95 dB re 1  $\mu$ Pa.**

### Background

Ambient noise is the background level of sound in the sea. Natural sources such as waves, rain, and marine life contribute to the level, as well as anthropogenic sources. Ambient noise is comprised of sound at a wide range of frequencies.

Continuous anthropogenic noise is primarily generated by shipping and increases the ambient noise level mainly at low frequencies. Sources are typically less intense than impulsive sources (e.g. explosions, seismic survey or piling). However, the pervasive presence of continuous noise from shipping could lead to significant and widespread effects to animals,

such as masking of sounds that animals use to communicate, forage or detect predators.

Policymakers are increasingly aware of the potential for ecological impact from underwater anthropogenic noise but are constrained by a lack of data on current and historic noise levels. International concern increasingly focuses on the potential negative effects of anthropogenic underwater noise on sensitive marine fauna, for example, reduction in reproductive rates due to behavioural disturbance, or reduced predator avoidance due to masking of natural sounds.



Shipping activity results in underwater noise  
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For this assessment, data were collected using underwater sound recorders deployed in the Moray Firth, North East and Forth and Tay Scottish Marine Regions (SMRs; Figure 1), as part of the East Coast Marine Mammal Acoustic Study (ECOMMAS). These data contributed to the first assessment of underwater noise levels in Scotland's seas and provide a baseline for tracking future trends.

For further information on this topic go to: <https://marine.gov.scot/sma/assessment/continuous-noise>

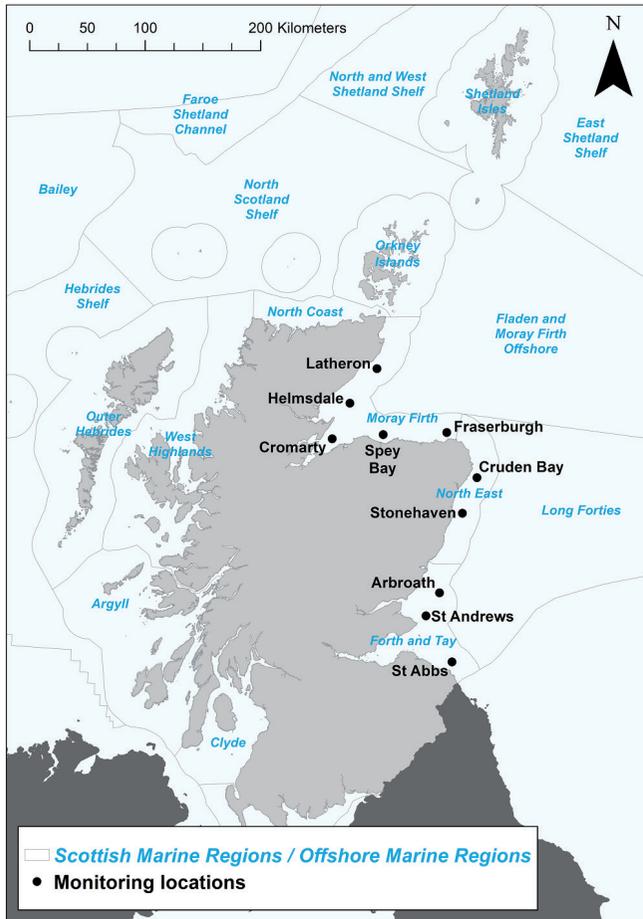


Figure 1:  
Map of East Coast Marine Mammal Acoustic Study (ECOMMAS) monitoring locations.

## Results

Although data were collected at all ten sites during 2013 and 2014, data from the Cruden Bay site were excluded from the assessment as they were contaminated by a loud pulsed sound originating nearby. Data from the St Andrews site in 2014 were also excluded due to problems with the data.

A range of noise conditions were observed at the ten monitoring sites off the east coast (Figure 1). The spectrogram from the Fraserburgh site is typical of a site where anthropogenic noise from shipping makes a substantial contribution to the low-frequency soundscape. The spectrogram (Figure 2) shows frequent vessel passages, which appear as intense vertical bands with peak frequencies at  $\sim 100$  Hz (Figure 2, one example of a vessel passing close to the recorder is labelled A), and a sustained period of high noise levels on 14 September, apparently due to a vessel moored near the monitoring location (Figure 2, labelled B).

Overall, the continuous noise levels at each site are broadly similar (Figure 3). Noise levels in the 125 Hz one-third octave band are predominantly within the range 80 – 120 dB re 1  $\mu$ Pa rms, and the modes of these distributions lie between 84 – 95 dB re 1  $\mu$ Pa rms.

An exception is the Cromarty site, which is located in the relatively sheltered waters of the inner Moray Firth. Here, the mode noise level in the 125 Hz one-third octave band was lower than at other sites (ca. 84 dB re 1  $\mu$ Pa rms) in both 2013 and 2014 (Figure 3). While the inner Moray Firth does sustain noise from shipping, levels of vessel traffic are relatively low compared to the main coastal shipping routes close to major ports such as Aberdeen and Peterhead. The shallower waters of the inner Moray Firth will also result in comparatively poor propagation of low-frequency sound, with the result that noise from shipping traffic in the wider Moray Firth SMR is not detectable at the monitoring location. This highlights how local oceanographic conditions can lead to deviations from wider trends in a monitoring region.

There are as yet no defined assessment criteria for continuous anthropogenic noise, so it is not possible to make an assessment of the status of the Scottish marine area. In addition, it is not clear at what level continuous anthropogenic noise will have a negative impact on marine life. However, these data provide a useful baseline for the North Sea for comparison in future assessments.

Continuous anthropogenic noise was not assessed in the 2011 Marine Atlas (Baxter *et al.*, 2011) and no assessment of trend can be made.

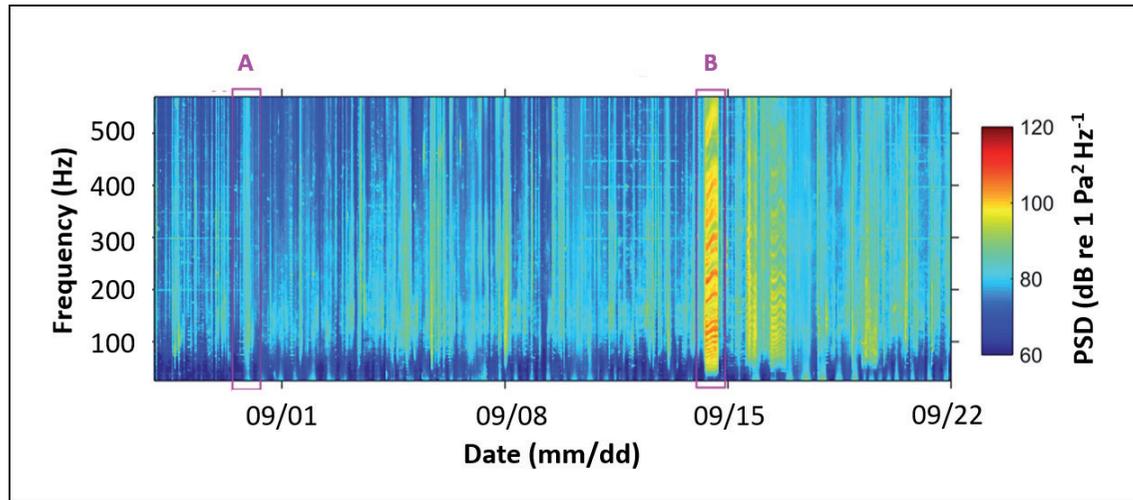


Figure 2:

Spectrogram showing data from the Fraserburgh monitoring site (referred to by Merchant *et al.* (2016) as NNS5) from a period during 2013.

The colour scale (Power Spectral Density; PSD) indicates noise level at a given time and frequency, with absolute noise levels as indicated by the colour bar.

The box labelled A indicates an example of a vessel passage close to the sound recorder; the box labelled B, indicates a sustained period of high noise levels on 14 September, appears to be a vessel moored near the monitoring location.

(Reproduced from Merchant *et al.* (2016), *Scientific Reports*).

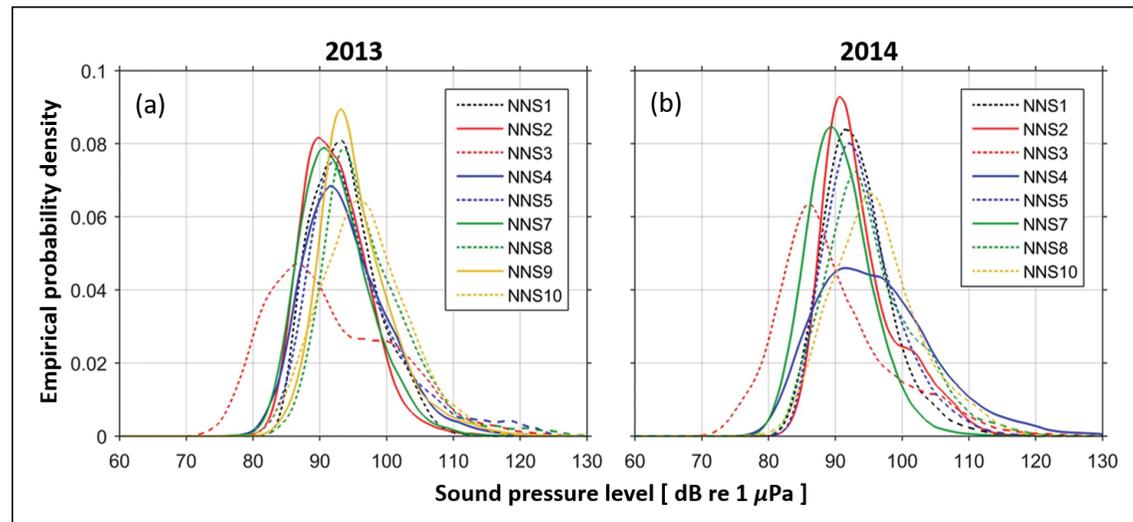


Figure 3:

Empirical probability densities of noise levels in the 125 Hz one-third octave band.

Site names in the figure legend come from Merchant *et al.* (2016), and represent the following locations illustrated in Figure 1: NNS1 Latheron; NNS2 Helmsdale; NNS3 Cromarty; NNS4 Spey Bay; NNS5 Fraserburgh; NNS6 Cruden Bay; NNS7 Stonehaven; NNS8 Arbroath; NNS9 St Andrews; NNS10 St Abbs.

(Reproduced from Merchant *et al.* (2016), *Scientific Reports*).

## Conclusion

This is the first reported assessment of continuous underwater noise in Scottish waters (as published in Merchant *et al.* 2016). No trend or inter-annual comparison is available and this assessment should be considered a report of baseline noise levels, in four one-third octave frequency bands, in the Scottish North Sea.

While data were only available during the summer months in 2013 and 2014, these data nonetheless provide a broad spatial coverage, at east coast sites ranging from the northern Moray Firth to the border with England.

The results show levels in Scottish North Sea waters that are broadly comparable with the rest of the UK (i.e. southern North Sea and Celtic Sea; Merchant *et al.*, 2016) and other studies internationally (Merchant *et al.*, 2013; Mustonen *et al.*, 2019).

At this stage there is little evidence of the level at which continuous anthropogenic noise could cause harm to marine species nor agreement on what constitutes a “safe” level of continuous anthropogenic noise. Further work is ongoing to attempt to quantify risk and identify an appropriate suite of indicators for north-east Atlantic waters.

## Knowledge gaps

A lack of reported data from northern and western Scotland and offshore regions constrains understanding in these regions. Marine Scotland is actively engaged in projects to address some of these gap in knowledge, i.e. the [COMPASS](#) and [MarPAMM](#) projects in west coast waters (West Highlands, Outer Hebrides and Argyll Scottish Marine Regions) and the [JONAS](#) project in offshore Atlantic waters.

Knowledge gaps still exist in terms of the thresholds of underwater noise which have deleterious impacts on marine species such as cetaceans, pinnipeds, fish and invertebrates.

The implications of masking, and an understanding of at what noise levels it occurs for different species, are highly uncertain.

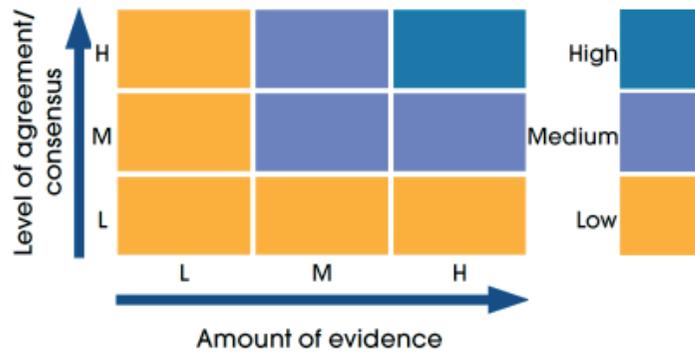
## Status and trend assessment

This assessment describes a baseline of continuous noise in the Scottish North Sea in 2013-2014. Since thresholds have not been determined for the effect of this pressure to marine species, and no previous assessment has been carried out, a traffic light assessment has not been recommended.

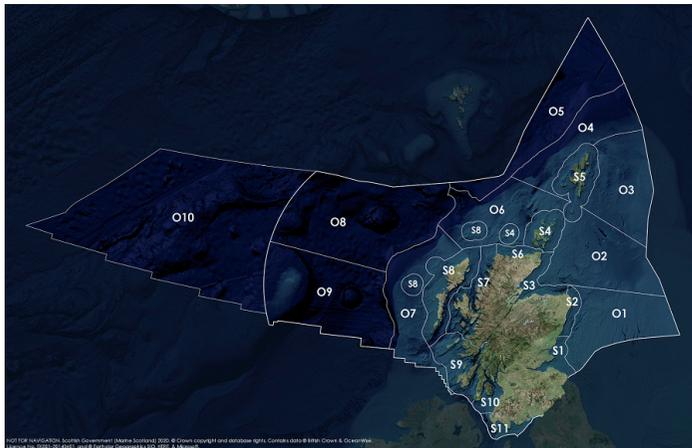
## Status and trend assessment legend

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	<b>Confidence assessment</b>	
	Lack of evidence / robust assessment criteria		
	Lack of regional evidence / robust assessment criteria, but no or few concerns for some local areas		Low
	Lack of regional evidence / robust assessment criteria, but some concerns for some local areas		Medium
	Lack of regional evidence / robust assessment criteria, but many concerns for some local areas		High

## Overall confidence



## Assessment regions

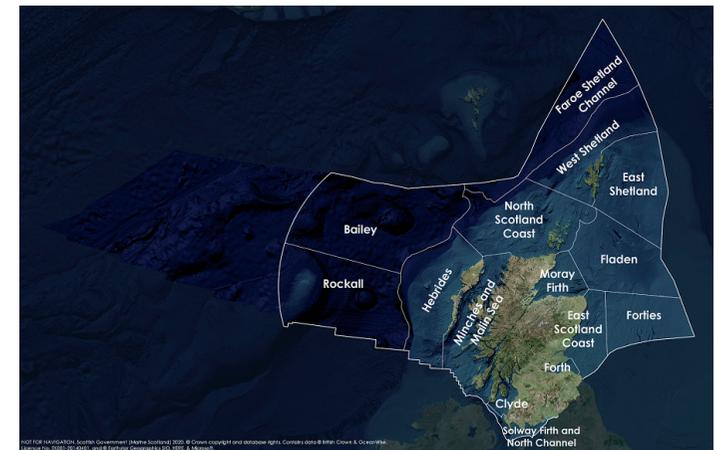


The Scottish Marine Regions (SMRs; S1 - S11) and the Scottish Offshore Marine Regions (OMRs, O1 - O10)

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.