Acoustic detections of minke whales in Northeast Scotland
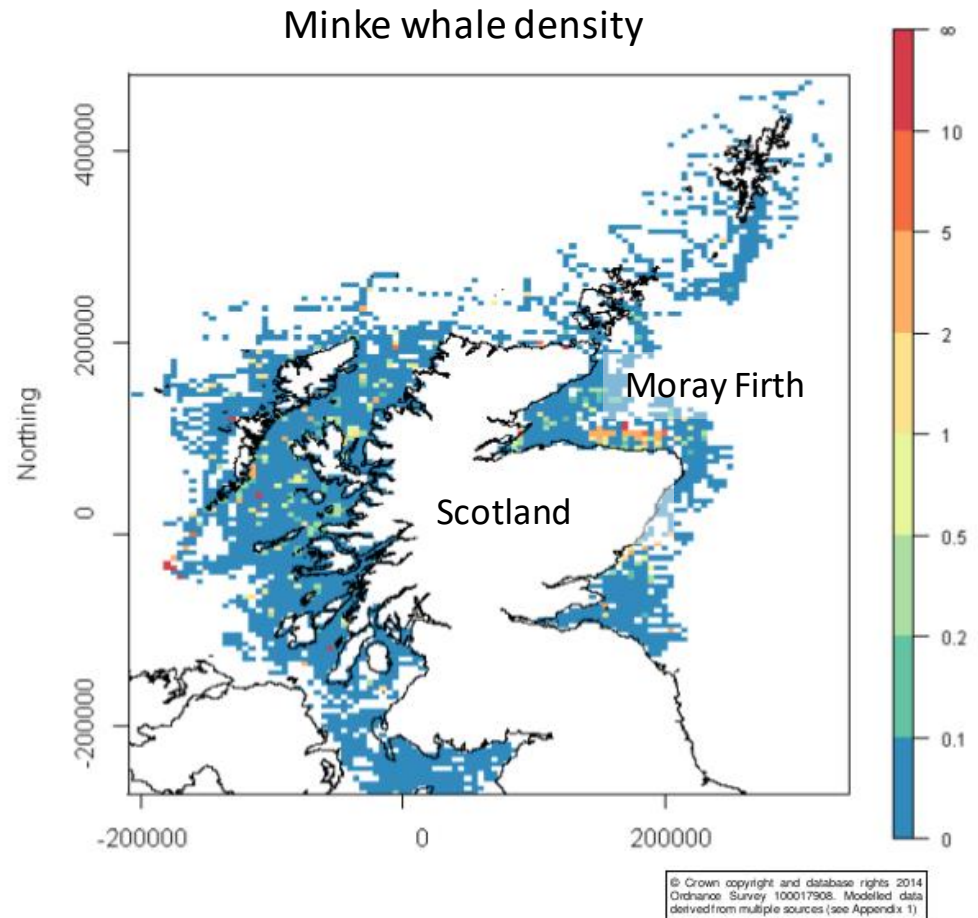
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Photo: David Gaspard

[1] Scottish Association for Marine Science (SAMS)
[2] Marine Scotland Science (MSS)

Background

- Minke whale presence in Scotland from **April to October**

- Visual sightings in the Moray Firth **peak** in **Summer** (July to August)

- **Winter** distribution data mostly **missing**

- Improved monitoring tools required, for example in the context of **MPA** designations and **Marine Renewable Energy** projects

Minke whale density


© Crown copyright and database rights 2014 Ordnance Survey 100017908. Modelled data derived from multiple sources (see Appendix 1)

Source: Paxton *et al.* (2014) SNH Commissioned Report No. 594

Source: SME

Background

- Most frequently recorded North Atlantic minke whale vocalizations: **low-frequency pulse trains**

- Peak frequency: **50-130 Hz**

- Duration: **10 – 45 sec**

- 3 main categories: slow-down (a-d), constant (e-f), speed-up (g)

- Most records from the **western North Atlantic** and mid-Atlantic ridge

- Only **one record from Scotland**, off the Isle of Mull (Swift et al. 1996)
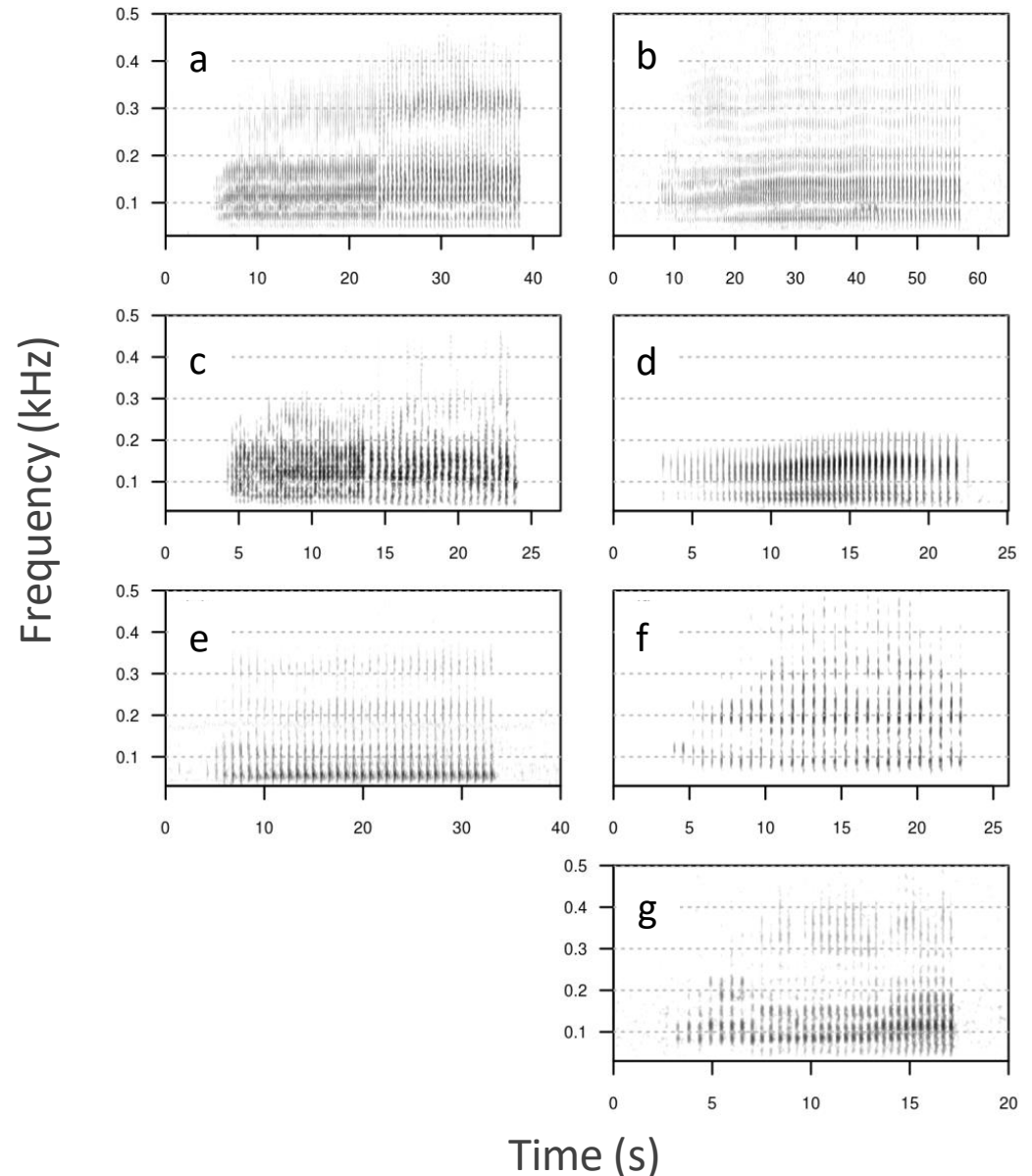
Questions

1. Can minke whales be acoustically detected in Scottish waters?

2. How does an existing minke whale pulse train detector perform in the Scottish context?

3. How do observed spatial, seasonal and diel patterns of minke whale occurrence compare to visual data?

Methods: Data collection

- East Coast Marine Mammal Acoustic Study (**ECOMMAS**): monitoring bottlenose dolphin movement and ambient noise since 2013

- **10 sites** close to shore (5 - 15 km)

Source: www.dolphincommunicationproject.org

- **SM2M** (Wildlife Acoustics) broadband recorders

- Sample Rate: **96 kHz**

- Duty cycle: **10/20 min** on/off

- 3 years of data analysed: **2015 - 2017**
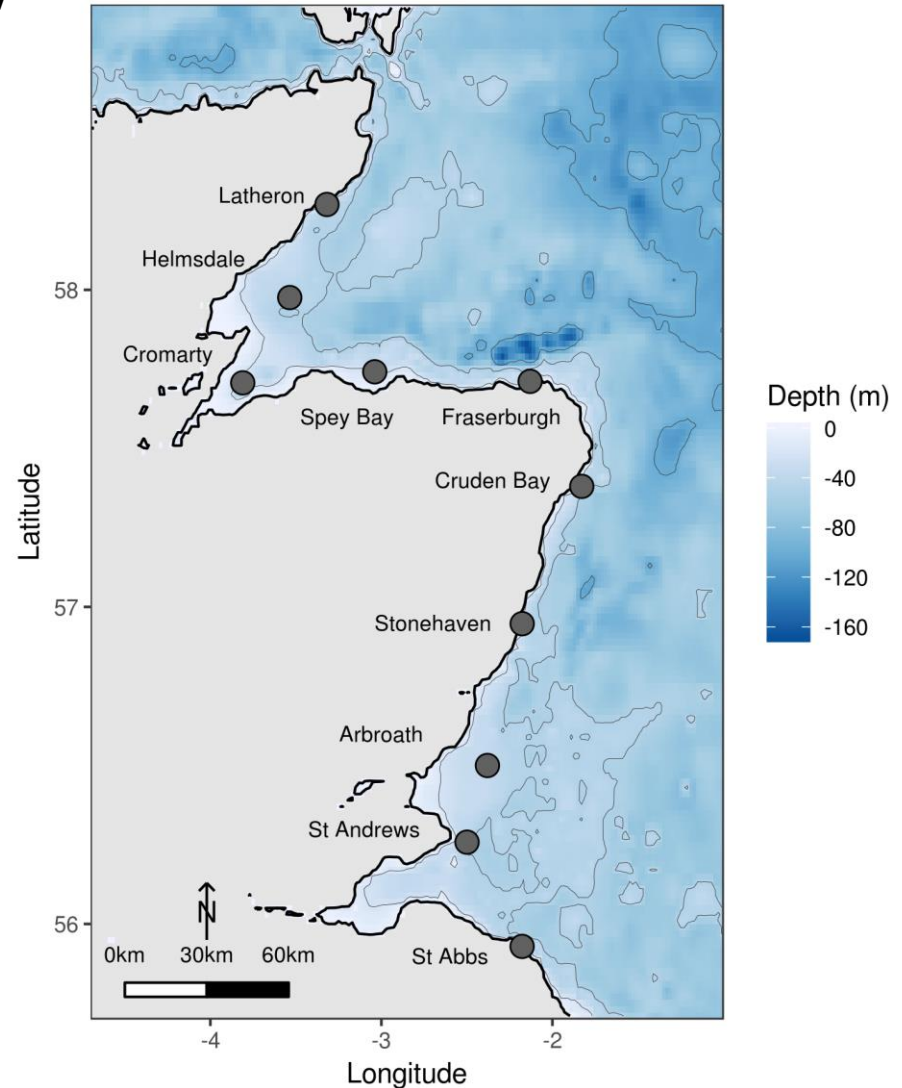
Methods: Pulse train detection & classification

1) **Spectrogram conditioning**
   - 75-300 Hz type II Chebyshev band pass filter
   - Spectrogram cropped to filter bounds

2) **Image processing**
   - Binarization based on image intensity

3) **Application of energy projection function and application of rules for pulse train detection**
   - local maxima above threshold
   - min and max number of local maxima above threshold
   - range of local maxima spacing (based on IPI)

4) **Feature extraction & rule-based classification**
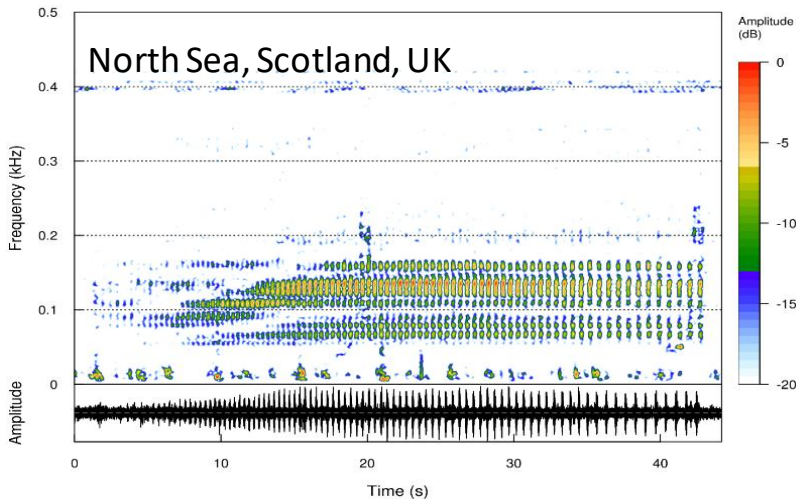   - duration, number of pulses, average and center bandwidth, mean, mode and max IPI, SNR etc.

Figure: Marian Popescu

Popescu *et al.* (2013) Bioacoustic Periodic Pulse Trains Signal Detection and Classification using Spectrogram Intensity Binarization and Energy Projection. *ICML Workshop on Machine Learning for Bioacoustics*, Atlanta, GA.
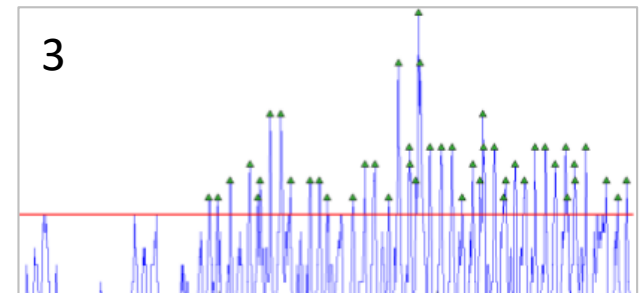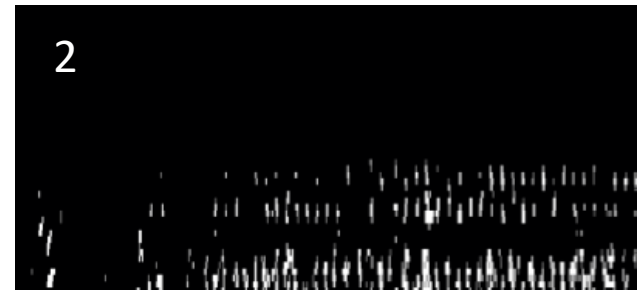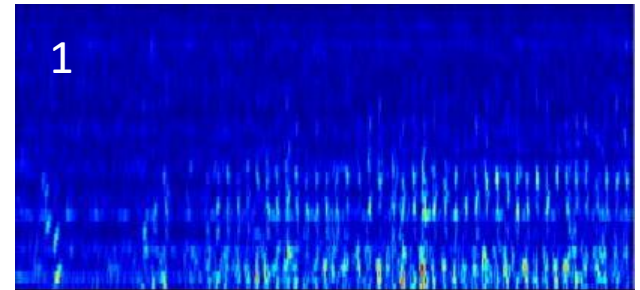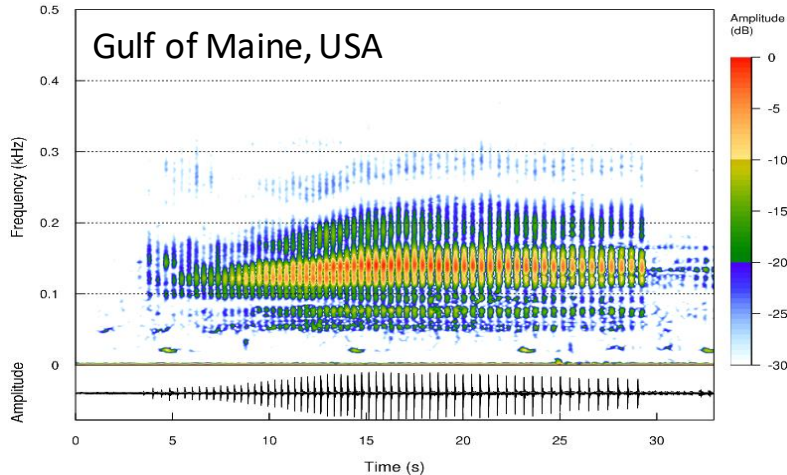
Results: Detections

1. Can minke whales be acoustically detected in Scottish waters? ✔
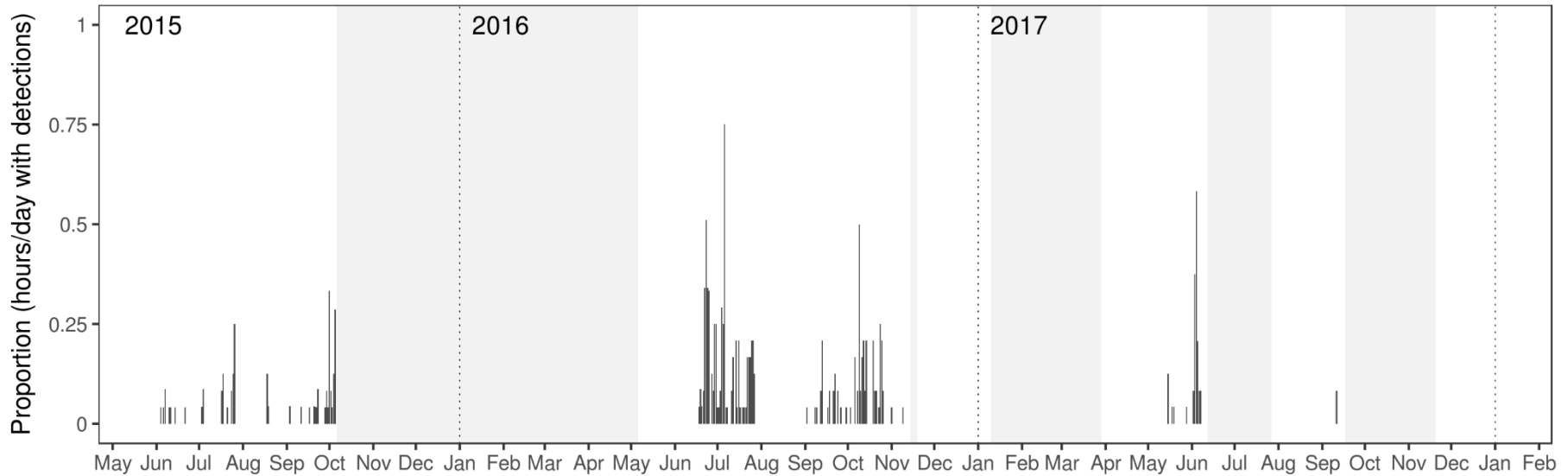

North Sea, Scotland, UK

- high miss rate of individual calls
- low precision due to prevalent seismic surveys & shipping noise
- but few (6%) detection positive hours missed

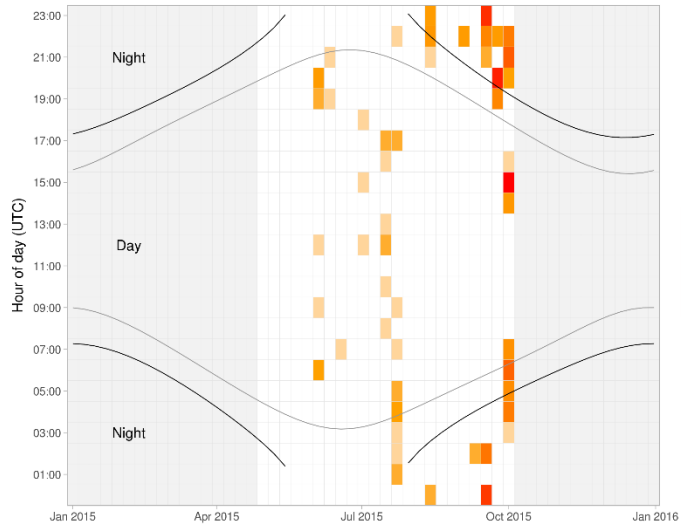Gulf of Maine, USA
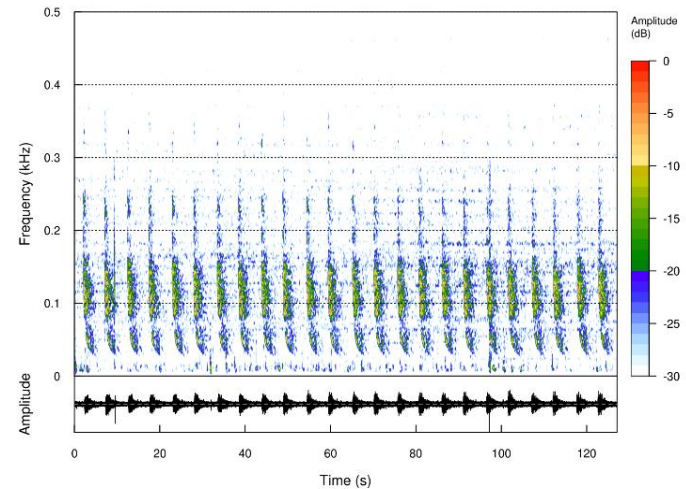
Results: Seasonal & spatial distribution
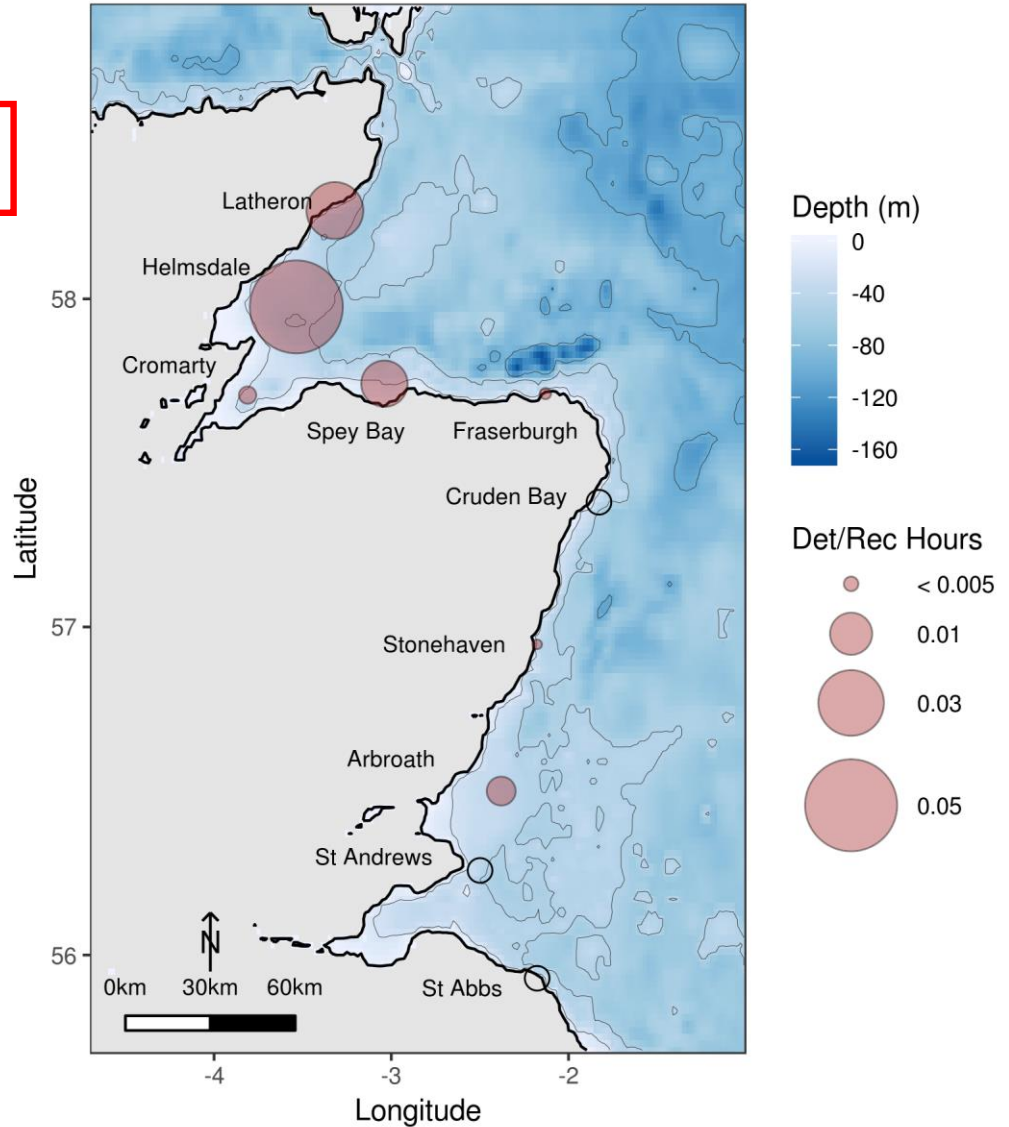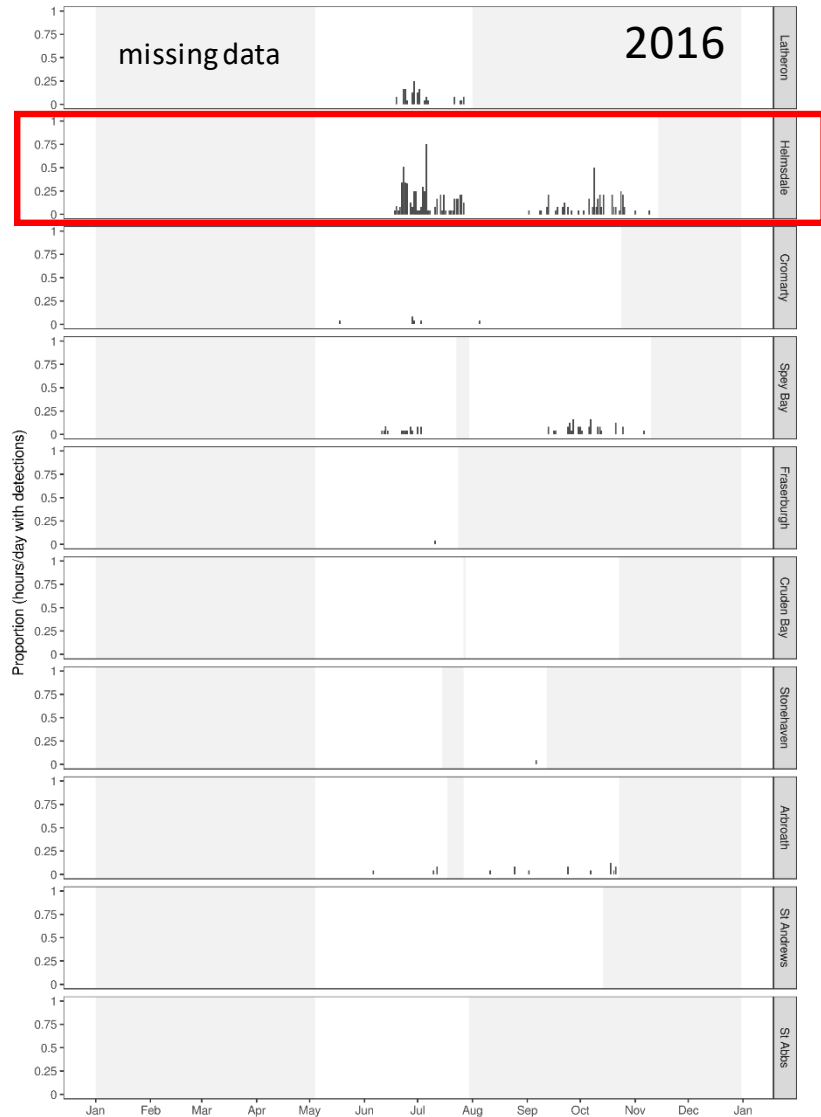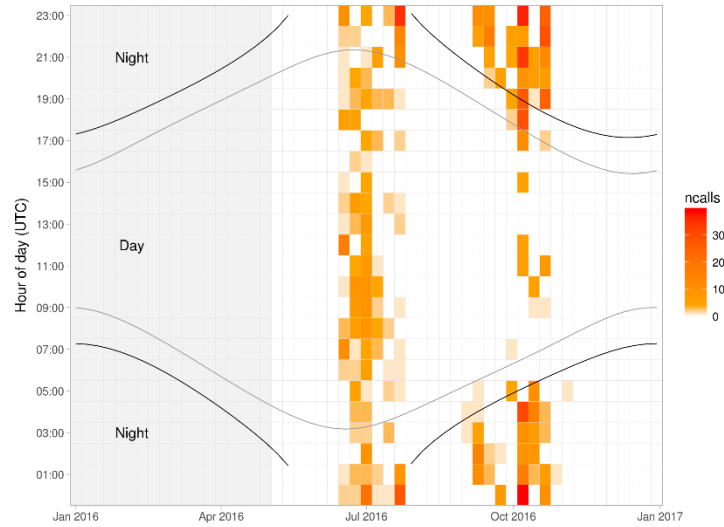
Results: Inter-annual variation

- Seasonal occupancy from May/June - October matches visual survey data for the Moray Firth (Robinson *et al.* 2007)
- No detections during winter (November - February)
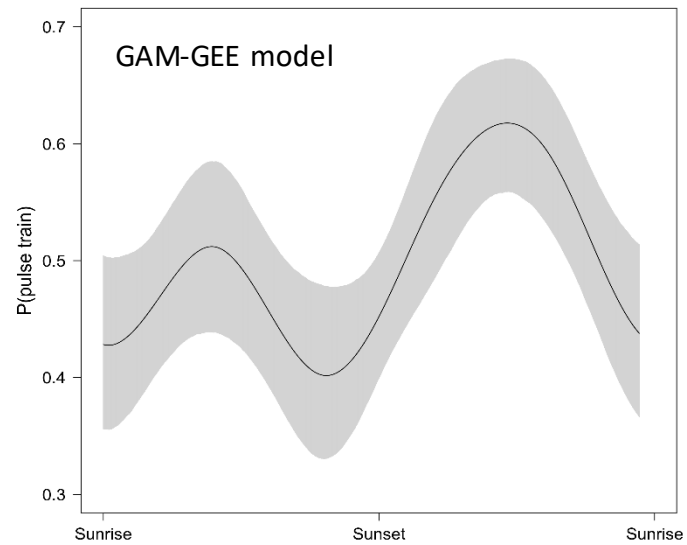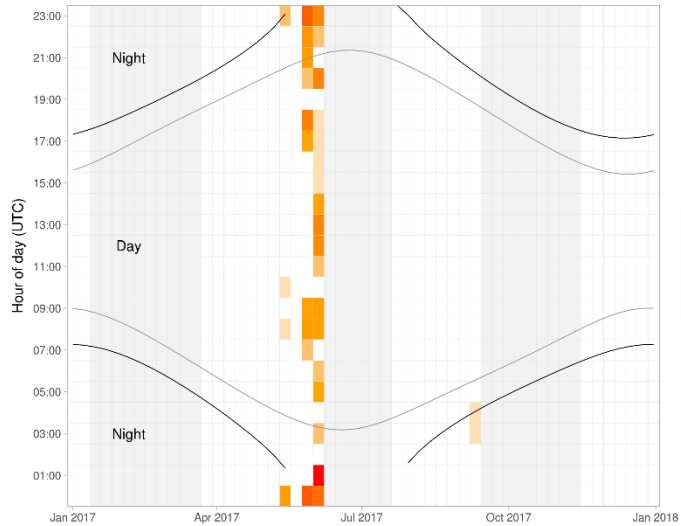
Results: Diel pattern

Summary

1. First description of minke whale pulse trains from the east coast of Scotland and North Sea

2. Current detector needs improvement to take account of local ambient noise conditions

3. Diel and seasonal patterns match visual sightings and vocal behaviour in other parts of the North Atlantic

Acknowledgements