An Overview of the East Coast Marine Mammal Acoustic Study (ECOMMAS)

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Ross Culloch, Ewan Edwards, Ian Davies & Kate Brookes

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science

Outline

1. Background
2. East Coast Marine Mammal Acoustic Studies (ECOMMAS)
    - Cetacean presence (e.g. diurnal, seasonal, inter-annual variation)
    - Noise monitoring (e.g. Marine Strategy Framework Directive)
3. Acoustic monitoring projects

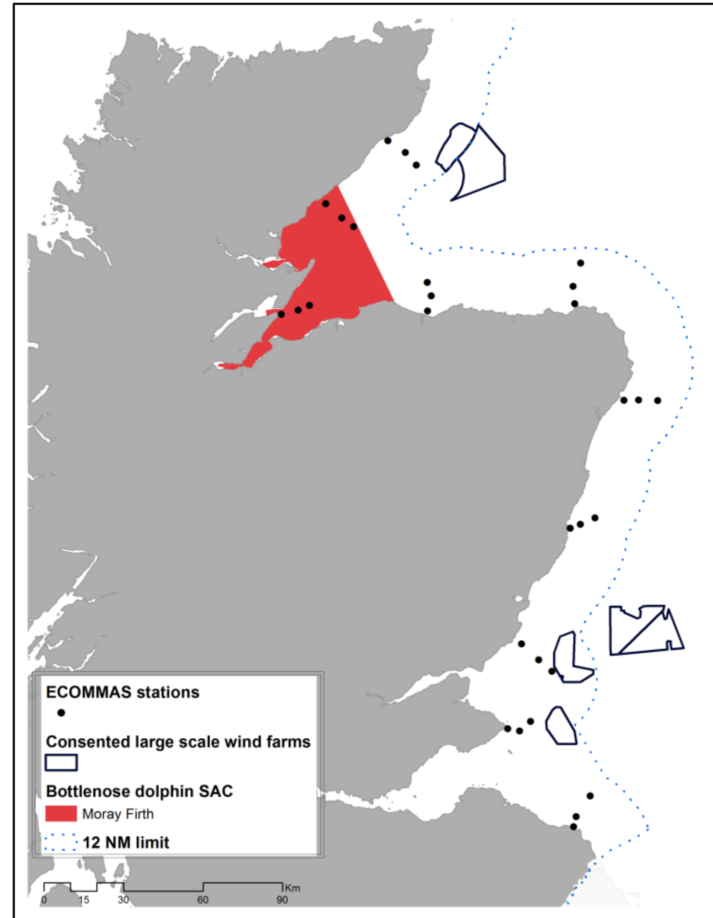
Background

Timelines

- **2012-13:** five companies submitted applications for offshore wind farms
- **2013:** ECOMMAS started
- **2014:** Consent for offshore wind farms granted
- **2017-19:** Construction at the BOWL site

Concerns and Legislation

- Potential impacts to areas within the range of bottlenose dolphins and harbour porpoise
  - Pile driving (impulsive noise)
  - Disturbance
  - Physiological injury
- Legislation protects all cetaceans from killing, injury and disturbance
  - European Protected Species
  - Special Areas of Conservation



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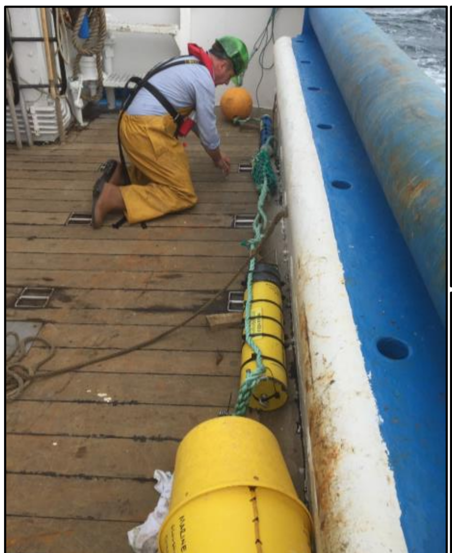
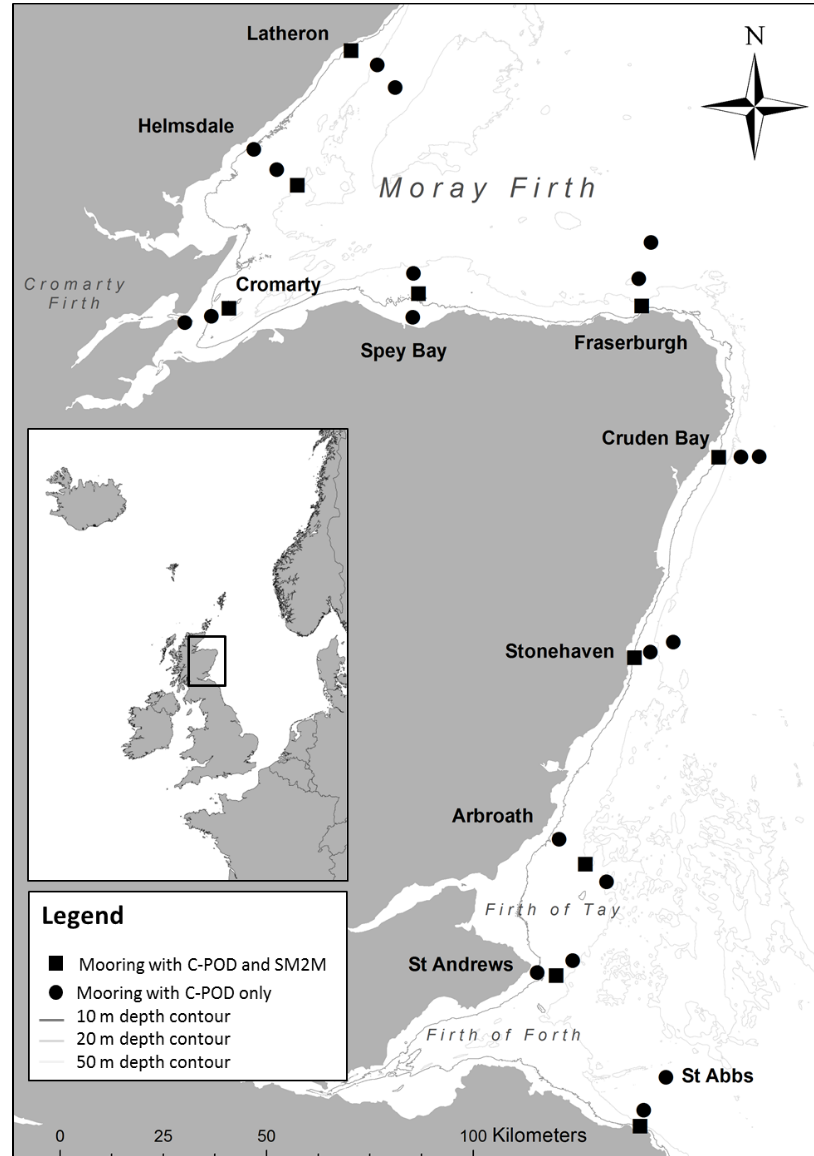
ECOMMAS

- 3-4 months of data collection (July - October) in 2013 and 2014
- 8 months of data collection (April - November) in 2015 - 2018
- Winter data collection at two sites





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ECOMMAS: Peer-review outputs

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Underwater noise levels in UK waters

Nathan D. Merchant[1], Kate L. Brookes[2], Rebecca C. Faulkner[1], Anthony W. J. Bicknell[3,4], Brendan J. Godley[3,4] & Matthew J. Witt[3]

Received: 09 May 2016
Accepted: 24 October 2016
Published: 10 November 2016

Underwater noise from human activities appears to be rising, with ramifications for acoustically sensitive marine organisms and the functioning of marine ecosystems. Policymakers are beginning to address the risk of ecological impact, but are constrained by a lack of data on current and historic noise levels. Here, we present the first nationally coordinated effort to quantify underwater noise levels, in support of UK policy objectives under the EU Marine Strategy Framework Directive (MSFD). Field measurements were made during 2013–2014 at twelve sites around the UK. Median noise levels ranged from 81.5–95.5 dB re 1 μPa for one-third octave bands from 63–500 Hz. Noise exposure varied considerably, with little anthropogenic influence at the Celtic Sea site, to several North Sea sites with persistent vessel noise. Comparison of acoustic metrics found that the RMS level (conventionally used to represent the mean) was highly skewed by outliers, exceeding the 97th percentile at some frequencies. We conclude that environmental indicators of anthropogenic noise should instead use percentiles, to ensure statistical robustness. Power analysis indicated that at least three decades of continuous monitoring would be required to detect trends of similar magnitude to historic rises in noise levels observed in the Northeast Pacific.

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Diurnal variation in harbour porpoise detection — potential implications for management

L. D. Williamson[1,2,3,*], K. L. Brookes[2], B. E. Scott[1], I. M. Graham[3], P. M. Thompson[3]

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[2]Marine Scotland Science, Marine Laboratory, 375 Victoria Road, Aberdeen, AB11 9DB, UK
[3]Institute of Biological and Environmental Sciences, Lighthouse Field Station, University of Aberdeen, Cromarty, IV11 8YJ, UK

ABSTRACT: Robust information on animal distributions and foraging behaviour is required to target management and conservation measures for protected species and populations. Visual survey data are commonly used to model these distributions. However, because visual data can only be collected in daylight, modelled distributions and consequent management actions may fail to identify or protect important nocturnal habitats. We explored this issue using data from the Moray Firth, Scotland, where visual survey data have previously been used to characterise habitat use and distribution patterns of harbour porpoises *Phocoena phocoena*. Marine predators such as harbour porpoises have a widespread distribution, are highly mobile and are known to exhibit behavioural variation in relation to diel cycles. Here, we used long-term passive acoustic data which revealed habitat-specific differences in diel patterns of detection. Harbour porpoises were detected consistently during night and day in sandy areas, with peaks in detection around sunrise and sunset, and at night in muddy areas. Detections also varied with depth, with the greatest proportion of daytime detections recorded in shallower sandy areas, and the most nighttime detections recorded in deeper muddy areas. The proportion of detections with foraging buzzes increased slightly during the night and in muddy habitats. These findings suggest that the importance of muddy habitats could be underestimated when using visual survey data alone. This highlights the value of using a combination of visual and acoustic methods both to characterise species distribution and to support efforts to develop appropriate spatio-temporal management of key habitats.

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Seals and shipping: quantifying population risk and individual exposure to vessel noise

Esther L. Jones*[1,2], Gordon D. Hastie[2], Sophie Smout[1,2], Joseph Onoufriou[2], Nathan D. Merchant[3], Kate L. Brookes[4] and David Thompson[2]

[1]Centre for Research into Ecological and Environmental Modelling, The Observatory, Buchanan Gardens, University of St Andrews, St Andrews KY16 9LZ, UK; [2]Sea Mammal Research Unit, Scottish Oceans Institute, University of St Andrews, St Andrews KY16 8LB, UK; [3]Centre for Environment, Fisheries & Aquaculture Science, Lowestoft, Suffolk NR33 0HT, UK; and [4]Marine Scotland Science, 375 Victoria Road, Aberdeen AB11 9DB, UK

Summary

1. Vessels can have acute and chronic impacts on marine species. The rate of increase in commercial shipping is accelerating, and there is a need to quantify and potentially manage the risk of these impacts.
2. Usage maps characterising densities of grey and harbour seals and ships around the British Isles were used to produce risk maps of seal co-occurrence with shipping traffic. Acoustic exposure to individual harbour seals was modelled in a study area using contemporaneous movement data from 28 animals fitted with UHF global positioning satellite telemetry tags and automatic identification system data from all ships during 2014 and 2015. Data from four acoustic recorders were used to validate sound exposure predictions.
3. Across the British Isles, rates of co-occurrence were highest within 50 km of the coast, close to seal haul-outs. Areas identified with high risk of exposure included 11 Special Areas of Conservation (SAC; from a possible 25). Risk to harbour seal populations was highest, affecting half of all SACs associated with the species.
4. Predicted cumulative sound exposure level, cSELs(M_{pw}), over all seals was 176·8 dB re 1 μPa^2 s (95% CI 163·3–190·4), ranging from 170·2 dB re 1μPa^2 s (95% CI 168·4–171·9) to 189·3 dB re 1 μPa^2 s (95% CI 172·6–206·0) for individuals. This represented an increase in 28·3 dB re 1 μPa^2 s over measured ambient noise. For 20 of 28 animals in the study, 95% CI for cSELs(M_{pw}) had upper bounds above levels known to induce temporary threshold shift. Predictions of broadband received sound pressure levels were underestimated on average by 0·7 dB re 1 µPa (±3·3).
5. *Synthesis and applications.* We present a framework to allow shipping noise, an important marine anthropogenic stressor, to be explicitly incorporated into spatial planning. Potentially sensitive areas are identified through quantifying risk to marine species of exposure to shipping traffic, and individual noise exposure is predicted with associated uncertainty in an area with varying rates of co-occurrence. The detailed approach taken here facilitates spatial planning with regard to underwater noise within areas protected through the Habitats Directive, and could be used to provide evidence for further designations. This framework may have utility in assessing whether underwater noise levels are at Good Environmental Status under the Marine Strategy Framework Directive.

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Categorizing click trains to increase taxonomic precision in echolocation click loggers

K. J. Palmer,[1,a)] Kate Brookes,[2] and Luke Rendell[1]
[1]*School of Biology, University of St. Andrews, Sir Harold Mitchell Building, St. Andrews, Fife KY16 9TH, United Kingdom*
[2]*Marine Laboratory, Marine Scotland Science, PO Box 101, 375 Victoria Road, Aberdeen AB11 9DB, United Kingdom*

(Received 9 January 2017; revised 27 June 2017; accepted 7 July 2017; published online 14 August 2017)

Passive acoustic monitoring is an efficient way to study acoustically active animals but species identification remains a major challenge. C-PODs are popular logging devices that automatically detect odontocete echolocation clicks. However, the accompanying analysis software does not distinguish between delphinid species. Click train features logged by C-PODs were compared to frequency spectra from adjacently deployed continuous recorders. A generalized additive model was then used to categorize C-POD click trains into three groups: broadband click trains, produced by bottlenose dolphin (*Tursiops truncatus*) or common dolphin (*Delphinus delphis*), frequency-banded click trains, produced by Risso's (*Grampus griseus*) or white beaked dolphins (*Lagenorhynchus albirostris*), and unknown click trains. Incorrect categorization rates for broadband and frequency banded clicks were 0.02 (SD 0.01), but only 30% of the click trains met the categorization threshold. To increase the proportion of categorized click trains, model predictions were pooled within acoustic encounters and a likelihood ratio threshold was used to categorize encounters. This increased the proportion of the click trains meeting either the broadband or frequency banded categorization threshold to 98%. Predicted species distribution at the 30 study sites matched well to visual sighting records from the region. © *2017 Acoustical Society of America.*

[http://dx.doi.org/10.1121/1.4996000]

[JFL] Pages: 863–877

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Seasonal and diel acoustic presence of North Atlantic minke whales in the North Sea

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Denise Risch[1], Samuel C. Wilson[1], Mathilde Hoogerwerf[1], Nienke C. F. van Geel[1], Ewan W. J. Edwards[2] & Kate L. Brookes[2]

Despite frequent records from other parts of the North Atlantic, minke whales have never been acoustically recorded in the North Sea. This study investigated the detectability of pulse trains previously associated with this species in other regions, in acoustic data from ten sites along the east coast of Scotland. Since preliminary results confirmed pulse train presence, subsequently, an automated detector was applied to these data to record the seasonal and diel presence of minke whale pulse trains. Minke whales were detected from May to November, with most detections occurring in June, July and October. No acoustic detections were made in December, January or in the month of April, whilst no data were available for February and March. This pattern of acoustic presence supports available visual data and suggested an absence of minke whales from the study area during winter. Minke whale acoustic presence showed a statistically significant diel pattern, with a detection peak during night time. This study established the acoustic detectability of minke whales in the North Sea and highlights the potential of using passive acoustic monitoring to study the seasonal presence and spatial distribution of minke whales in the North Sea and wider Northeast Atlantic.

Categorizing click trains to increase taxonomic precision in echolocation click loggers

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Acoustic Monitoring Projects

- Joint Monitoring Programme for Ambient Noise North Sea (JOMOPANS) project
- Collaborative Oceanography and Monitoring for Protected Areas and Species (COMPASS) project
- Marine Protected Area Management and Monitoring (MarPAMM) project
- Joint Framework for Ocean Noise in the Atlantic Seas (JONAS) project

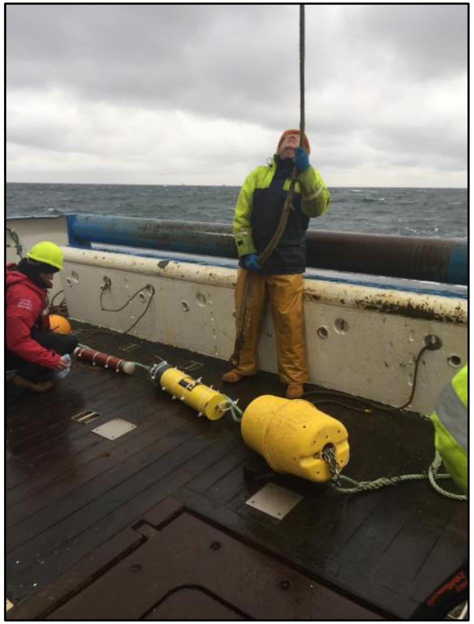
Interreg North Sea Region Jomopans European Regional Development Fund EUROPEAN UNION

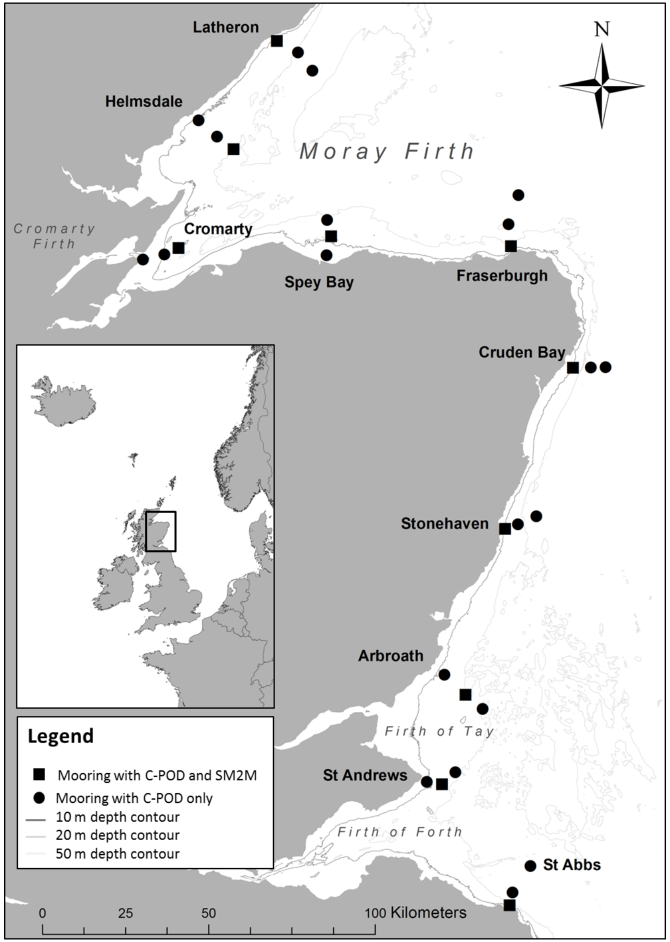
COMPASS COLLABORATIVE OCEANOGRAPHY AND MONITORING FOR PROTECTED AREAS AND SPECIES

Interreg EUROPEAN UNION Northern Ireland - Ireland - Scotland European Regional Development Fund

The future of ECOMMAS

- Regularly review ECOMMAS
  - Outputs and deliverables
- How to progress, and improve on ECOMMAS
  - Align with ScotMER
- Q&A sessions give you the opportunity to feed in to this process





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- The crew of the RV Alba Na Mara
- The staff within the Renewable and Energy Programme at Marine Scotland Science
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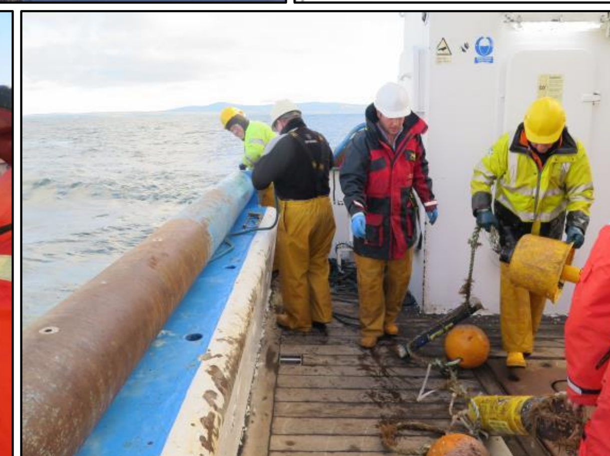
- Moray First Marine
- Collaborative partners: University of Aberdeen, University of St. Andrews, SAMS and Cefas



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