

EFLSG9: Insights into marine vessel traffic and marine mammal usage of a busy urban waterway

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Project Rationale

Vessels are associated with several potential impacts to marine mammals, including underwater noise, strike, behavioural disturbance, entanglement and contaminant pollution. The type, size and behaviour of a vessel can be indicative of the type of impacts it may pose, for example, larger vessels tend to be slower and stay on a set course and speed, whilst smaller vessels, such as speed boats, tend to change course and alter speed more frequently and will often remain closer inshore in comparison to larger commercial shipping traffic. To quantify the amount and distribution of the different vessels, and explore any associated risks to marine mammals, information pertaining to vessel type, presence and movements is required. However, only larger vessels (>15m) or commercial vessels are required to have an automatic tracking system known as 'Automatic Identification System' (AIS) which records information on vessel type, vessel location and speed. In contrast, smaller non-commercial vessels do not have to broadcast their position via AIS, and therefore without targeted data collection it is extremely difficult to estimate the presence and distribution of these types of vessels, and therefore the potential overlap, and risk, to marine mammals. This gap in knowledge regarding the proportion of non-AIS vessels vs AIS vessels impacts the accuracy of quantifying risk from vessels, for example when modelling underwater noise only using AIS tracks will underestimate noise if non-AIS vessels are also present (Hermannsen et al., 2019) and mapping vessel traffic will underestimate presence if only AIS data is used. Non-inclusion of this common and pervasive smaller type of vessel may lead to underestimations of vessel presence and associated pressure in coastal areas by several orders of magnitude (Pine et al., 2016).

In recent times, COVID-related lockdown measures have resulted in reduced vessel traffic and consequently quieter seas (Thomson and Barclay, 2020; Pine et al., 2021). Furthermore, lockdowns and pandemic restrictions have contributed to many people emerging from these measures with a renewed sense of the importance of the time they spend outdoors for both wellbeing and recreation. The Firth of Forth (FoF) is a highly productive waterbody adjacent to a number of large coastal communities, and is increasingly becoming an important place to many for outdoor pursuits, including watching wildlife, such as whales, dolphins and seals, and for on water recreation, such as paddleboarding, sailing and recreational boating. The latter type of vessels are less likely to broadcast AIS, and so quantifying their presence, and inferring potential risk to marine mammals, is challenging.

With renewed public interest in coastal spaces, the funding provided by MASTS allowed the 'Scottish Vessel Project' to explore the potential of a number of different approaches to quantify non-AIS activity, and to explore the potential risk they pose to marine mammals in the Firth of

Forth. The funding provided has now been spent, as per the initial grant proposal. The following report provides an overview of the methodology, outputs and future of the project.

Project Aims

- 1.) Gain a better understanding of trends in marine mammal presence in the FoF through digitising and mapping citizen science data to identify potential 'high use' areas for cetaceans – a key first step to understanding where spatial conflict between vessels and cetaceans may be most likely to occur.
- 2.) Explore different techniques and technology for capturing non-AIS vessels and identify the advantages and challenges for each to inform future data collection efforts and provide the first insights into small boat area usage within the FoF.
- 3.) Determine the approximate proportion of vessel traffic not captured in AIS data collection and identify the types of vessels that are missing from AIS.

Methodology

- 1.) Forth Marine Mammals sighting's data has been digitised into an Excel spreadsheet, covering the study period. Continuation of this digitisation into the future, as per further funding, will provide a detailed long-term observation record, and maps (for example, Figure 1), of cetacean usage of the Forth. To date, 785 individual records have been digitised, covering 10 different marine mammal species, with reports from 253 different observers.

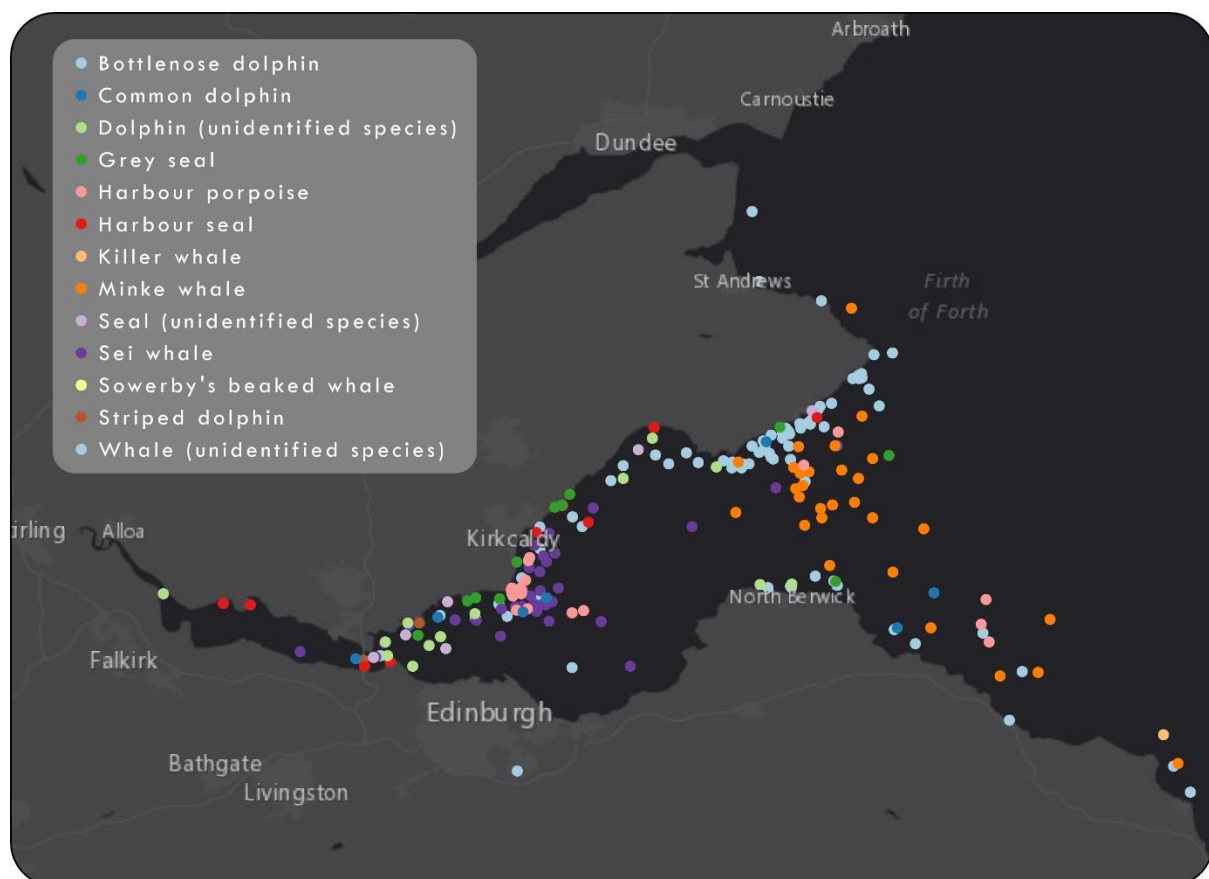


Figure 1 Forth Marine Mammals citizen science sightings data, May – October 2021

- 2.) A land based AIS receiver was installed in St Monans, Fife, and has been collecting data covering a large expanse of the Forth (Figure 2). Data collection is ongoing.

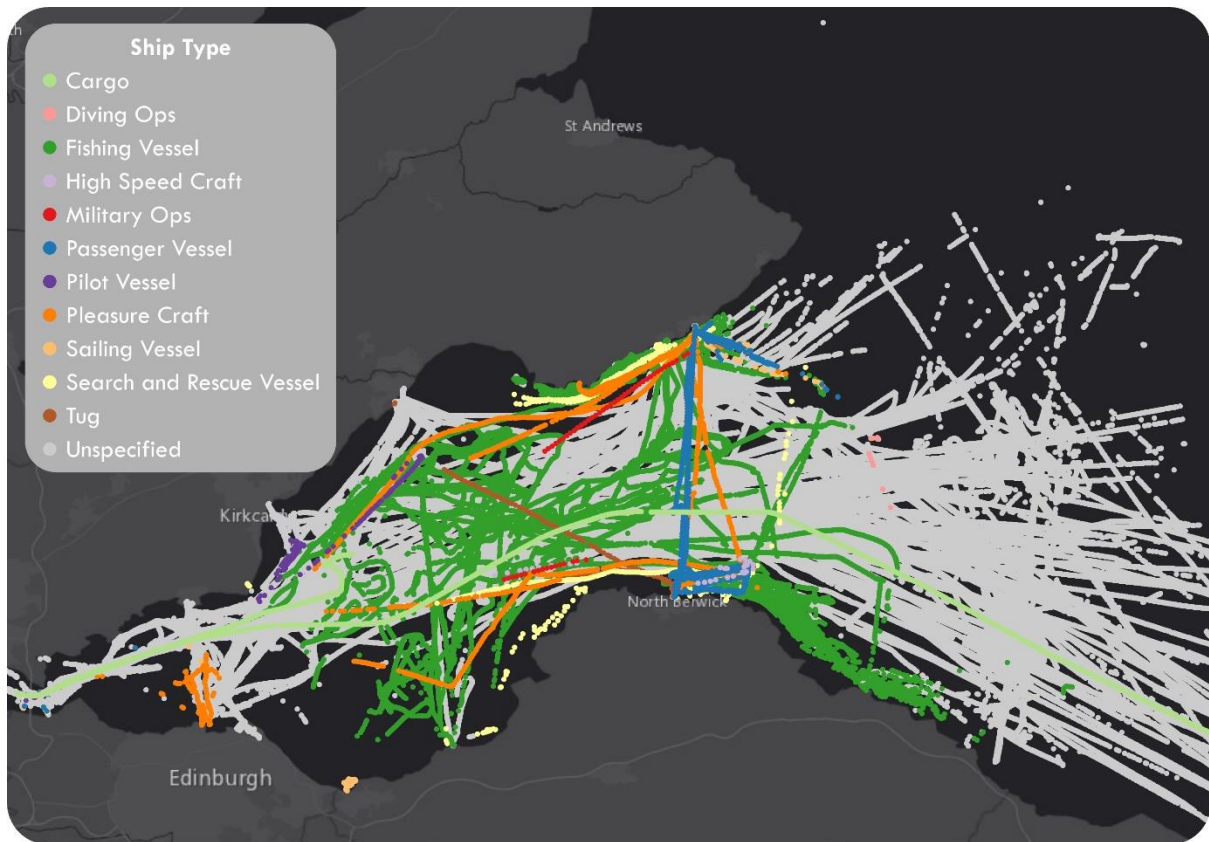


Figure 2 Example of AIS data collected by the land based AIS receiver. Data collected between 30 Aug and 9 Sept 2021, displayed by vessel type

- 3.) A time lapse camera has been trailed and subsequently permanently deployed, in collaboration with the West Braes project in Pittenweem (Figure 3). This is collecting time lapse footage (2 frames per minute) in day light hours. Information captured in the footage is being compared to data collected through the AIS receiver, to provide an estimate of how much, and what type, of vessel traffic is missing from the AIS data. Data collection, processing and analysis is ongoing. The potential to process files using movement detector algorithm is being explored. To date, 71 days of timelapse footage data have been collected at the Pittenweem site, equating to 6.25 hours of footage (for example, Figure 4).



Figure 3 Changing the camera batteries and memory card on the time-lapse camera




Figure 4 Example still images from timelapse camera footage

- 4.) A protocol, and data collection sheet, for land-based vessel watches has been developed in collaboration with WDC Shorewatch (Figure 5). Online and in-person training, in collaboration with Forth Marine Mammals, has also been provided to support volunteers and ensure understanding of the protocol (Figure 6). To date, there have been 31 watches carried out in the FoF, equating to 24.2 hours of effort, and 282 vessels recorded. 8 watches recorded vessels being sighted concurrently with marine mammals, with one interaction between marine mammals and vessels recorded. Data collection, processing and analysis is ongoing.

Initials of Observer [] Dedicated Vessel Watch – Data Sheet Page .. of ..

Location:..... Date:..... Observer(s):.....

Time vessel watch started..... Time vessel watch ended..... (please aim to do a vessel watch for at least 30 minutes. Ideally, longer watches (e.g. 2 hr +) would be fantastic)

Visibility Sea State..... Estimate of number of creel markers (e.g. buoys) visible from Shorewatch sitecreel markers 

Dedicated vessel watches are designed to be completed alongside (i.e. at the same time) as a Shorewatch. For example, you can arrive at your Shorewatch site and if you're planning to spend a few hours there, then you can start your vessel watch, briefly note the vessels you see at the start, and then move on and do your dedicated Shorewatch, before returning to your vessel watch. You can also do a dedicated vessel watch, without completing a Shorewatch, but we encourage you to do both if possible. The information you are helping us to collect on vessel activity, and number of creels, is important to help us gain an understanding of pressures around the Scottish coastline. For more information on how this data will contribute to the [Scottish Vessel Project](#), email emily.gill2001@hw.ac.uk

Vessel Information				Marine mammal sighting							
Use one row per vessel, recording when you first spot it, when it leaves your view, and its behaviour during that time. Note: vessels includes jet skis, kayakers, paddleboarders etc.				Note: if you witness disturbance that concerns you, please report this to the police on 101							
Time		Vessel type	Vessel name (If known)	Bearing °		Distance from Shorewatch site (km)		Speed and Vessel activity and behaviour e.g. moving, fishing, anchored, erratic <i>Circle all that apply and add extra notes, if required</i>	Vessel sited at the same time as marine mammals Yes or No Species?	Was there an interaction with the vessel Yes or No Was this initiated by the vessel or the animals? e.g. animals went to boat, or, boat went to animals	Did the marine mammals behaviour change? Yes or No How? e.g. bow-ride, changed direction, longer dives, no reaction
first seen	last seen	See boat codes sheet e.g. SV for sailing vessel	'MarineTraffic' is a helpful app for identifying vessels that are transmitting their location - if you use the app, please note whether the vessel was visible on there	when first seen	when last seen	when first seen	when last seen				
								Speed still - low - medium - high			
Activity / Behaviour Moving Idle Erratic Anchored Fishing Other (add more info)											

Figure 5 WDC Shorewatch Dedicated Vessel Watch Data Sheet, developed in collaboration with the Scottish Vessel Project



Figure 6 Volunteer training session for the WDC Shorewatch training

- 5.) An online StoryMap to advertise the project, and showcase updates and results has been developed: <https://bit.ly/ScottishVesselProject>

Divergence from initial grant proposal: The initial grant proposal stated that data from hydrophones deployed by collaborating partners Forth Marine Sounds would be processed using the Styles Group Ltd. small boat detector algorithm, who were donating their time to this processing, in kind, to the project. Unfortunately, the hydrophone deployment has been delayed until 2022 and so no processing has been possible within the project timeframe.

Outputs

Data collection, processing and analysis is ongoing, and results are expected to be written up into at least one peer review publication, where the funding and support provided by MASTS will be appropriately acknowledged. Preliminary results are expected to be presented at the UKIRSC conference in January 2022.

- Project Development Updates
 - 'Data Collection Protocol' developed and available for future AIS field sites.
 - WDC Shorewatch vessel categories updated in collaboration with the Scottish Vessel Project.
 - 'Dedicated Vessel' Watch protocol developed, trialed and then rolled out across the WDC Shorewatch programme.
 - WDC Shorewatch developed a new data entry portal to allow volunteers to submit vessel watch data online. Data is immediately digitised for volunteers to view in detail and download.
 - Training Events held:
 - Dedicated vessel watch training video developed: [Youtube](#)
 - Online with WDC Shorewatch: 26/08/21
 - In person with WDC Shorewatch and Forth Marine Mammals: 29/08/21
 - Online WDC Shorewatch Clinic to provide ongoing volunteer support: 06/10/21
- Project Outreach
 - Talk to the Shetland Community Wildlife Group, online, June 2021 and November 2021. *'Introducing the Scottish Vessel Project'*.
 - Invited speaker to the Scottish Seabird Centre: Meet the Scientist series, online, Sept 2021. [Meet the Scientist: Marine Mammals in the Firth of Forth](#).
 - Abstract submitted to give an 8-minute talk at the UK and Ireland Regional Student Chapter conference (scheduled January 2022): *'Sweating the small stuff: improving understanding of the presence of smaller vessels in regions of high marine mammal activity around Scotland's coast'*.
 - Scottish Vessel Project featured on [BBC Radio Shetland](#), June 2021 (19:50 onwards).

Benefit to students at MASTS institutes: The knowledge and experience gained as part of this project is already being utilised to support one student in the design of an AIS based Master's project in the south of England. Further, AIS data within the FoF collected as part of this project is also being provided to one undergraduate student to be analysed as part of an Honours project. The data will also contribute to the grant holders PhD thesis, as well as a number of peer review publications. Gaining the experience of building and leading a collaborative community project has been invaluable for the grant holder, a PhD student and early career researcher at a MASTS Higher Education institute.

Future of the Project

We are extremely grateful to MASTS for funding this work, which represented a fundamental first step in what will now be an ongoing program of study to better understand the impacts and potential risks of increasing vessel traffic on cetaceans in the FoF and other coastal waters and in particular, the behaviour of small boat traffic around Scotland's coastline. Since the project was funded, further collaborations have been developed with Dolphin View Cottages Hillockhead, the European Marine Energy Test Centre, Fife Weather, FleetMon, NatureScot, Orkney Marine Mammal Research Initiative, RSPB Scotland, Shetland UHI, Shetland Webcams, Sumburgh Head Lighthouse, Visitor Centre and Nature Reserve, the West Braes Project and the WDC Dolphin Centre. Subject to further funding and support, the outcomes of this continued program of collaborative work will provide data and recommendations that will help inform future governance and management of vessels, and support conservation objectives for marine mammals.

References

- Hermannsen, L., Mikkelsen, L., Tougaard, J., Beedholm, K., Johnson, M. and Madsen, P.T., (2019). Recreational vessels without Automatic Identification System (AIS) dominate anthropogenic noise contributions to a shallow water soundscape. *Scientific Reports*. **9**(1), pp.1-10.
- Thomson, D.J. and Barclay, D.R. (2020). Real-time observations of the impact of COVID-19 on underwater noise. *The Journal of the Acoustical Society of America*. **147**(5), pp.3390-3396.
- Pine, M.K., Jeffs, A.G., Wang, D. and Radford, C.A. (2016). The potential for vessel noise to mask biologically important sounds within ecologically significant embayments. *Ocean & Coastal Management*. **127**, pp.63-73.
- Pine, M.K., Wilson, L., Jeffs, A.G., McWhinnie, L., Juanes, F., Scuderi, A. and Radford, C.A., (2021). A Gulf in lockdown: How an enforced ban on recreational vessels increased dolphin and fish communication ranges. *Global Change Biology*. **27** (19), pp.4839-4848.