

MORAY FIRTH RENEWABLES ADVISORY GROUP (MFRAG) MEETING NOTES

Meeting	MFRAG Marine Mammals Subgroup	
Date	22 nd September 2022 13:00 – 16:00	
Location	Teams Call	
Invitees	Marine Scotland Science (MSS)	Jared Wilson (JW), Kate Brookes (KB) Hannah Millar (HM)
	Marine Scotland - Policy	
	Marine Scotland Licensing and Operations Team (MS-LOT)	Gayle Holland (GH)
	NatureScot (NS)	Erica Knott (EK), Chris Eastham (CE), Caroline Carter (CC),
	Joint Nature Conservation Committee (JNCC)	
	University of Aberdeen	Paul Thompson (PT), Isla Graham (IG),
	Whale and Dolphin Conservation (WDC)	
	BOWL	Joe Deimel (JD), Heather Shaw (HS)
	Moray East	Eliana Araujo (EA), Mary Adejoh (MA)
	Moray West	Nuria Abad Oliva (NAO), Chris Newman (CN)
Apologies	Barbara Cheney (UoA), Debbie England (MS-LOT), Stephanie Sweeting (MS-LOT), Sue O'Brien (MSS), Jack Lucas (MSS), Fiona Manson (NS), Fiona Read (WDC), Sarah Canning (JNCC), Janelle Braithwaite (MS-Policy)	

Action Number	Action	Completion Date
1	PrePARED team to liaise with developers to avoid interactions with major O&M activities	On-going
2	Action for MFRAG-MM to review reports: <ul style="list-style-type: none"> • Porpoise occurrence prior to pile-driving at two offshore wind farms (circulated 5/9/22) • Comparison of piling noise and porpoise responses at Beatrice and Moray East offshore wind farms (Circulated 27/7/22) 	17th October
3	Action for MFRAG-MM to discuss if it might be possible to take advantage of vessel time and deployments that might be happening. Action for discussions to take place amongst the projects that are	Originally set for 17th October,

	deploying monitoring equipment, to identify if there are opportunities to coordinate deployments, to make best use of Moray First Marine vessel time.	action on-going
4	Action for MFRAG-MM members to feed back comments (if any) to PT on proposed design for a PAM array to monitor responses of porpoises to piling at Moray West (incorporating receivers in Moray West, Moray East and BOWL, to enable monitoring along distance gradients).	17th October, action now ongoing
5	CC and HM to discuss precedents for noise monitoring at 750m distance from pile driving and feed back to NAO. Action completed – NatureScot emails to NAO 28/09/22 and 26/10/22	17 th October
6	Action for developers, NatureScot and UoA to discuss progress on approaches to future co-ordination and management of WP1 and WP2, and to feed back to group.	On-going
7	Action on JW to provide summary of PrePARED progress to date to this group.	On-going
8	PrePARED team to offer presentations to developers in Moray Firth on update.	On-going

1 Introductions & Meeting Objectives
Introductions not required
2 Review actions from last meeting (9 February 2022)
<ol style="list-style-type: none"> 1. MSS to provide feedback and comments on the Addendum MMMP <ul style="list-style-type: none"> • KB is not certain written comments were made but confirmed MSS content with Addendum MMMP. Action completed 2. NatureScot to confirm acceptance of agreement with the Addendum to the MMMP <ul style="list-style-type: none"> • EK confirmed this has been completed. Agreement made during meeting with CC and PT. 3. MSS to provide written response on Addendum to MMMP <ul style="list-style-type: none"> • No action required

4. Developers to agree cost sharing to deliver 2022 MMMP work
 - Completed in April
5. Prepared team to liaise with developers to avoid interactions with major O&M activities
 - On-going
6. Developers to update MFRAG-MM of any other plans for related research at Moray Firth sites.
 - To be discussed at this meeting
7. Developers to set up a doodle poll to identify date for next MFRAG-MM
 - Completed

3 MMMP Update

3.1 Progress on WP1, WP2, WP3 & WP 4 during summer 2022

PT provided a progress update on work packages

- This year is pre-construction monitoring for Moray West and post-construction for Moray East and Beatrice.
- This monitoring includes elements of harbour seal monitoring, bottlenose dolphin monitoring, minke whale monitoring in Moray West and marine mammal responses to windfarm operations linking in with the PrePARED work.
- Planned work for 2023, number of elements same except Moray West moving into construction, and potentially taking the lead for 2023 monitoring (to include continuation of post construction monitoring for Moray East and Beatrice).
- Thinking that for monitoring beyond 2023, would be good to have a discussion on managing these projects.

Progress on reporting

1. Paper on Broad scale responses of harbour porpoises (Published, 2021)
2. Porpoise responses prior to pile-driving (circulated 5/9/22) - **no responses to the circulated report yet and looking to submit soon.**
3. Comparison of piling noise at Beatrice and Moray East (Circulated 27/7/22) – **similarly there have been no responses to the circulated report.**
4. Assessing the far-field effects on coastal bottlenose dolphins (Published, 2021)
5. Evasive responses of small cetaceans to anthropogenic disturbance (In review)

6. Temporal variation in abundance and vital rates of harbour seals and bottlenose dolphins (In progress) - put to one side this year. BC taken the lead on this hopeful to have update in the spring.

Questions:

JW asked the group whether there are plans to respond to the circulated reports and when.

JD – Gives apologies, has reviewed, and confirms BOWL happy with them.

EK – Asks what the deadline for response is.

PT – Explains that there is no absolute deadline. Will be away for 6 weeks hoping for this to be moved on whilst away. Asks for deadline to be set by MFRAG.

EK – Suggests Monday 17th October

Everyone in agreement

Action to review reports by the 17th October.

Update on work packages

WP1. Harbour seal and bottlenose dolphin work packages have been a continuation as normal but trying some new techniques which allow to be more cost effective and collect additional data to inform population trends. As well as extending the time series of counts that have been carried out at Loch Fleet the harbour seal numbers are continuing to increase. Drone surveys going well, looks like this is the way forward. There have been 8 UAV trips with one or two more planned for later in the summer. These have received good quality images and have been able to identify a number of animals from the air. Developed collaboration with colleagues in data science in Aberdeen. There is a PhD student who is looking to develop AI methods to match some of these, this is progressing nicely – further update to be provided next year.

WP2. Bottlenose dolphin surveys have been constrained due to weather this year. It has been quiet in terms of dolphins. When looking at preliminary estimates of numbers that have been seen its not so different from some past years. More trials being done with drones to get better estimates of body size and condition – went well. Also have been routinely deploying acoustic recorders during photo ID surveys on a floating mooring which is then recovered at the end of the encounter which has successfully managed to record whistles alongside some photoID. We are working to see how this can be extended to identify signature whistles and therefore movements by individuals – looking promising.

WP3. For the minke whale monitoring field recordings, the sound trap is yet to be recovered. It was deployed in Moray West in May and hoping to retrieve in October. The recordings from previous years in

combination with the East Coast Marine Mammal Acoustic Survey (ECOMASS) recordings that have been available have been really useful for developing an AI algorithm.

AI collaborations ongoing with colleagues in Germany and since extended this collaboration to SAMS and teams in the United States where there has been good progress with an AI minke whale detector. Currently in the process of running the newest version of algorithm through previous data.

In terms of Moray West monitoring, the first step will be to look at those detections in relation to digital area survey data from 2021. All being well full set digital aerial survey data and underwater recordings for 2022 as well.

WP4. Marine mammal responses to windfarm construction & operation.

Pairs of CPODs were deployed within Beatrice and the northern part of Moray East. Each pair has one POD positioned within 50m of the turbine and another one at a mid point between that turbine and the next turbine. These also overlap with sites that MSS have been using for fish tracking during PrePARED and for the baited video camera work that University of Exeter have been doing.

There are also reference sites and long term recordings in Moray West as part of the pre construction work. 28 pairs of CPODs were deployed in Beatrice and Moray East at the end of July - it was hoped to remove these in early September. The last CPOD was removed from Beatrice yesterday (21/9/22) and looking to get rest out of Moray East in the next few days. Moray First Marine (MFM) has so far managed to recover everything that was put out.

Lessons learned

- Successful changes in methodology – utilising UAV's to monitor seals and developing AI techniques for acoustic detections.
- Contracting timescales and evolving HSE requirements pose a risk to successful delivery.
- Uncertainty over fuel costs, vessel availability and supply chain issues make this kind of work ever more challenging to plan, cost and deliver.
- Interactions with fisheries continue to be a constraint for study designs. This was mitigated with a shorter deployment.

No further comments

3.2 Agreement on plans for Construction Monitoring at Moray West

PT gives overview of 2023 Moray West construction monitoring

1. Firstly there is a continuation of the long-term MMMP work package annual bottlenose dolphin and harbour seal surveys. In the addendum MMMP it was agreed (partly in response to NatureScot's desire to see more seal tracking) that additional tracking could be linked into construction monitoring to see if we might see both changes in distribution in relation to the existing windfarms but also if we are able to detect some responses to piling at Moray West.

Then additional studies of harbour porpoise responses and noise. There the emphasis being on harbour porpoise responses to piling noise when they're not in a pristine environment but already navigating a new landscape with existing windfarms. Also a focus on how the predictions of monopiling noise relate to observed/detected received noise levels.

NAO – Gave a construction timeline update. Monopile installation campaign at Moray West Site is planned to commence in August 2023 and continuing until March 2024. Supply chain issues and procurement process for the monopile installation vessels is ongoing Timeline will be refined when contracts are in place with installation vessel.

PT – Identified the challenge with some of the work that is being planned, it will make a difference how feasible things are whether work can begin in August, Oct or Nov. There is uncertainty over resource requirements partly due to supply chain issues, cost of vessels, fuel prices, finding crew and skippers, issues with seal tags.

PT – Proposes a delay to seal tracking until Moray West post-construction. Likely to be difficult to procure kit sooner than that. Issues with securing qualified people for catching seals. SMRU facing issues for resourcing currently. Timescales for contracting and sub-contracting, can't put in large orders for seal tags until a contract is confirmed.

MMMP 2023 will likely be carried out under a variation of the existing contract.

Key points looking for agreement from MFRAG

- Postponement of harbour seal tracking to assess changes in foraging areas.

JW – Asks what will be missed out on by not doing this? Perhaps we shouldn't talk about this as impossible to carry out perhaps if there are different opportunities to gather this data elsewhere. Any questions?

EK – Explains that it doesn't sound like there is much choice - sounds sensible. Plan for what is achievable and it will be post-construction.

PT – Answers JW's question of 'what do we miss out on?' Primary objective was to see how seals respond to changes in prey landscape and will still be able do this. The bonus might have been if they were foraging

closer to the windfarm site then it might have possible to characterise responses to piling noise, but given the uncertainty at this stage over when piling will be happening, difficult to plan for even if we had the tags. Useful piece of work even if carried out a few years down the line.

No further comments, agreement to postpone harbour seal tracking at Moray West until post-construction.

2. PT - Explains that they are looking into what is the best design for a passive acoustic monitoring array to assess whether presence of existing windfarms moderates harbour porpoise responses to piling noise. Ideal world would by now have analysed all data from PAMs currently being taken out of the water, but based on last years result the prediction is that more porpoises are foraging in the vicinity of turbines and this might mean they are more likely to hang around and not respond to pile driving quite as much. One of the challenges is knowing where piling will occur and where you can have a PAM array in the water. Hoping to focus study on piling that's going on in eastern end of Moray West, might not necessarily be the first locations that are piled. Expecting responses to be most obvious in the 5- 10 km range. Suggest using some of the same sites used this year, some of the same sites MSS are using for fish receivers or for other new turbine sites, using the same micro-siting criteria used in 2022.

Can look at gradient response as done before but this would rely on quiet periods before and after piling. At Beatrice this worked well as weather windows allowed for this data collection, at Moray East there weren't as many gaps between piling episodes. With the pairs of PODs it brings the opportunity to collect finer scale data as piling going on, one POD of each pair located near the turbine and one located at some distance. This summer was ambitious, gone for similar number or fewer, propose to use acoustic releases where possible to reduce the need for ROV work.

IG – Nothing else to add

JW – Asks for comments

CC – Explains that its difficult to come back with definite advice at this point as having just seen the presentation.

PT - Explains that there are constraints in terms of micro and macrositing and need to work out costings and plan to get a contract in place before the work starts - extra purchases would be required if using acoustic releases. Hopeful for answer to be sorted for return to work in November. Feedback to IG and BC with comments and discuss with NAO.

JW – Asks if it is a specific presentation slide PT is wanting feedback on.

PT – Confirms seeking feedback on proposals for a PAM array to monitor responses of porpoises to piling at Moray West (incorporating receivers in Moray West, Moray East and BOWL, to enable monitoring along distance gradients).

JW- Asks if the same 17th of October deadline can be used for this as well?

JD- Says it would be interesting to see if there's any way this influences the work that could be done in relation to Beatrice next year. Wouldn't have any technical comments and understands Beatrice consideration is the second stage of review, once agreement reached for Moray West monitoring in terms of work packages 1 & 2 and general around WP 4 (this work likely to continue to be led by PrePARED in 2023, as it was in 2022).

PT – Explains that this work is primarily in terms of Moray West construction even though some PAM locations will be in Beatrice and Moray East, this is primarily for them to finalise construction monitoring. BOWL monitoring for next year will be similar to 2022, contributing to the harbour seal and bottlenose dolphin monitoring.

HM- Adds that there has been discussion around ScotMER and operational noise keeps coming up, it could be a good to opportunity to get some operational noise recordings. Need to work out inventory if devices available, if putting out moorings anyway it would be good to tag on a broadband recorder.

PT - Explains that as we depend on Moray First Marine for so many projects it's a good idea to think about how we integrate work to make it easier. Good to have a discussion to see what we can get multiple devices on to moorings. Also the opportunity to use some of the directional hydrophones that SAMS have used for measuring noise from operating floating wind. Can then be worked out if the noise is coming from turbine direction or other, something to think about in the Spring.

Action for those discussions to take place to identify if it might be possible to take advantage of vessel time and deployments that might be happening.

JW - Gives October 17th deadline for a response to the proposal in Pauls slide for a PAM array to monitor responses of porpoises to piling at Moray West.

PT - Explains that if there are any questions to chat to IG to discuss further.

PT - Explains that some of the moorings will be shared with fish receivers. Possibilities of adding extra receivers on temporary moorings to look at possible overspill effects on fish moving outside of the windfarm.

Action for MFRAG-MM members to feed back comments (if any) to PT on proposed design for a PAM array to monitor responses of porpoises to piling at Moray West (incorporating receivers in Moray West, Moray East and BOWL, to enable monitoring along distance gradients), with a deadline set for the 17th October.

Post Meeting Note – Isla Graham circulated updated version of the MMMP Addendum on 23/9/22 to provide further background for this request for comments. The document included proposed changes to

seal tracking and the 2023 PAM array design of the slide presented at the meeting. No comments received by October 17th. This document is enclosed as Appendix A of these minutes.

3. Priorities for measurement of pile driving noise

- PT explains that we want to see better characterisation of noise from monopiles
- Characterisation of piling noise based on recommendations from ORJIP and NatureScot feedback.
- Looking at nearer field measurements (750m) than what has been done in the past.
- Alongside these near field measurements, ideally there will be far field measurements more like the ones that have done in the past.
- Recommended measurement distances: 750m, 1.5 – 3km, 5-8km and greater than 10km.
- Advantage of far field measurements is that kit can be left in the water for longer and capture different events.
- Can perhaps only do 750m on two sites
- Uncertainties around best practice. It is possible to take measurements of far field recordings from many different piles, meaning more piling sites measured. If looking at 750 metres, what has been the expectation and then which might the priority sites be?
- UoA not in a position to be able to take measurements at 750 meters and rather work with Moray West to bring in sub-contractors for this, but again timescales and when the piling might happen might constrain this.

CC - Asks whether PT has been able to work out the 750m issue as can recognise challenges. As many recordings as you can get in the far field is advantageous. For 750m have to think about the number we would need. Difficult to confirm in this meeting. Is there anything we can learn from the sites that have done the 750m, how did they do it?

PT - Asks if the ORJIP report is available?

CC - Explains that she has reviewed the draft.

PT – Would be possible to measure at 750m from 4 sites with a couple of recorders deployed and then have far field sites cover a few more. Wouldn't necessarily be the first few piles as may have to prioritise them in slightly different ways to make it possible and match it as far as possible with those sites that were use for the noise modelling in the piling strategy, so as to have some predictions to compare with.

PT - Asks that CC and HM discuss and feed back to NAO.

NAO - Says she can share the locations that MW are choosing for modelling.

PT- Discusses suitable contractors.

JW - Suggests that this is a separate chat for HM, CC and PT.

JW - Asks for a date for feedback on 750m discussion.

EK - Asks if the 17th of October would again be suitable.

PT - Explains that the sooner NAO able to approach contractors then theres a better chance we have got of it happening.

PT - Suggests for when NAO comes back from holiday on the 3rd October

EK - Suggests to get feedback to NAO no later than Friday the 7th October

JW – Asks for clarification that there are two tasks ongoing. Procurement of the noise modellers which is completely separate to the collection of the data themselves covered in previous slide.

PT - Explains no it's all related to the collection of the noise data.

JW - Asks if this is linked with the deployment of the other equipment.

PT - Explains that this is not necessarily so and depends on the site. Some people might do 750m over the side rather than leaving a deployed recorder.

Action for CC and HM to discuss precedents for noise monitoring at 750m distance from pile driving and feed back to NAO no later than Friday 7th October. (Action completed – NatureScot emails to NAO 28/09/22 and 26/10/22)

3.3 Approaches to future co-ordination and management of WP1 and WP2 to fulfil post construction monitoring requirements

PT – Explains he has been in discussion with developers about contracting and managing the future work packages on harbour seal and bottlenose dolphin work that give developers, MS and the UoA the confidence that it will happen.

JW - Asks about the current contract.

PT – Explains that last year Moray West offered to take the lead and build in elements and cost share but this would need to change longer term. Still clear Moray West should take the lead for 2023 contract. Makes sense to do this as a variation of contract and on CSA with developers if chance of having paperwork in time for this work to start but have discussion afterwards. Have further conversation in parallel as to what we do after that.

JD – Explains that BOWL have signed up until the amended MMMP 2031 and supportive of some sort of CSA arrangement. Would look in parallel at contracting (if other developers in agreement) with a consultancy to project manage and deliver this work; discussion ongoing, goals broadly aligned on this.

PT – Says that it would be good to think that this discussion has progressed well down the line in the first two quarters of next year to get an internal mechanism to deliver this.

JW – Explains that there are advantages to getting something in place sooner rather than later to limit the risk of non delivery as much as possible

PT – Says that perhaps we would like to bring this discussion together at the next meeting.

JW – Asks if this seems reasonable

EK- In agreement.

JW - Asks from a developers' perspective to aim for next meeting to have plan process and timescales

NAO – Says, yes happy to. Moray West will be the leading party of the 2023 contract, should be easier than what went through for pre-construction

JD – In agreement

Action to discuss progress at next meeting

4 Project Updates

4.1 Moray West

NAO gave an update

1. Pre-construction site investigations 2022

- Moray West currently have a vessel on site carrying out geophysical surveys to target UXOs which will be ongoing until October.
- Nearshore area was surveyed in early summer – data has been processed.
- Once all surveys are completed, another vessel will mobilise and investigate the potential UXO's.

2. Pre-construction monitoring surveys

- Continued aerial digital surveys with only one left in October. The pre-construction surveys for Moray West will be completed after this.
- Aerial survey data has been collected from 2021 but Moray West have not received the full data set, just draft reports so far.
- The 2021 benthic survey report has been provided. The company conducting this year's surveys are expected to provide a similar report – Not received this yet.

3. Pre- construction activities

- UXO marine license and EPS licence applications have been submitted and now with MS-LOT. The works are proposed to commence from November until March 2023 to include all UXO activities from UXO target investigations to clearance activities.
- Consents plans have all been submitted except the Windfarm Cable Plan (which is being reviewed with a target to submit by the end of month or early Oct) and the O&M Maintenance Plans will be submitted at a later date.
- Rest of consent plans are at different stages and only have two formally approved (EMP and WSI & PAD). Most are back to MS – still on track to start construction towards December.
- The piling strategy requires approval before starting offshore works in December.
- Document has been split and will be submitted as a revision of the piling strategy. The OfTI piling strategy will cover the installation of OSPs monopiles and the Wind Farm piling strategy will cover the installation of the WTG monopiles
- Comments that came back from the consultation on the piling strategy, requested to present more realistic piling scenarios rather than worst case., New modelling locations have been selected and the impact assessment will be updated.. Moray West will aim to submit the OfTI piling strategy towards October to allow time for consultation.

Construction update

Two dates to note. The first activity to note would be the offshore works (HDD) at landfall planned to commence from **1st December** which will run until early next year.

Second activity offshore is the installation of scour protection looking to begin on the **1st June** ahead of the monopile installation campaign planned to commence from **August 2023**.

Questions:

GH asked if the low order methods are being looked at for UXO clearance.

NAO confirmed that the marine licence application covers all possible options for flexibility, however the preference would be avoidance of interference with infrastructure. The procurement process is ongoing to select UXO clearance contractor. High order UXO neutralisation methods are last option.

GH mentioned that the UK government & DEFRA currently debating the policy position on UXO clearance and MS-LOT will be feeding into that.

4.2 Moray East

EA gave update

- Surveys as discussed are at stage of collecting CPODs from site in the next days/ weeks.
- Completed surveys on birds for May, June & July in combination with MW.

- In terms of activities monitoring of cable burial export and inter array ongoing. Completed the export cable moving to inter array cables next week subject to weather conditions. EPS licence not required.
- Other surveys starting mid-October in anticipation to major repairs at some turbines. These are to inform jack up vessel footprint. ME in contact with NS to use same equipment as last time and no EPS license required given frequency of equipment using.

No further questions

4.3 BOWL

JD gave an O&M update

- Ongoing maintenance works coming to a close in next months
- Full survey of cables was carried out over the summer and BOWL are looking into a potential exposure [Update 141022 – further analysis has determined this is not a cable exposure]
- This area of potential exposure doesn't look like it will interact with any marine mammal monitoring deployments.
- Marine mammal monitoring and Great Black Backed Gull monitoring in association with MW ongoing.
- PrePARED monitoring has been ongoing.
- Puffin monitoring AI camera will be installed soon, to be in position for next breeding season.

Questions:

PT asked how the deployment of an un-crewed surface vessel by Xoccean at BOWL went

Joe stated that he hasn't seen results; hopefully the initial issues have been ironed out

PT noted that its good to see it becoming more streamlined

JW asked what Xoccean was doing

JD explained they were conducting bathymetry surveys along the cables. Xoccean have also been used at Greater Gabbard, there were some initial deployment issues but haven't heard any issues around second deployment, looking positive.

No further comments

5 Update on other strategic work

5.1 PrePARED

JW - Discussed the project management. Change in approach to PrePARED. The lead from the project has moved away from the MSS renewable energy programme across to Bill Turrel who manages the MSS

environmental monitoring and assessment programme. He will now be the lead and have project management resource for day to day running of the project. SO and JW will stay involved but the day to day running is shifting to Bill Turrel.

JW - Explained that there is a project proposal being developed which focusses on tagging salmon smolt in the region with the aim of using the existing PrePARED detectors to detect smolt as they move through windfarm sites. The proposal may include an increase in the number of fish tag receivers.

PT - Provided update on Moray Firth PrePARED work.

- Fieldwork receivers deployed in April 2022 and fish tagging also started in April and ongoing.
- It has been challenging catching fish at depth, so the numbers tagged so far are relatively low. These receivers will be out for a few years – time to build up sample sizes of tagged fish.
- Intention is for receivers to be collected and the data downloaded before being cleaned and dropped down again in October/November.
- One of the receivers was trawled up but was recovered and another had to be moved. Even with a few days deployment they collected tagged fish data.

Fisheries acoustic work was limited to a 3-day cruise in the Moray Firth covering repeats of transects done around Moray East and Beatrice and buffers. More of the work was carried out in the Firth of Forth. A lot of bird tracking was cancelled in the Forth due to the avian flu outbreak. More time has been requested for June next year for something similar.

Baited underwater camera work done by Exeter University starting at beginning of August. They were doing a series of drops within Moray East at and in-between turbines and some in Moray West - all went well. Most drops were carried out in the first two or three weeks of August and the data is being analysed over the winter. One camera that got wrapped around a jacket structure at Beatrice but has now been recovered.

PT - Asks JW if there is any news on annual meeting.

JW - Says the annual meeting is pencilled in for November but likely moved out.

JW - To take action on providing summary of progress to date to this group on what has been happening.

JD - Asks JW that there would be interest from BOWL to have presentation from someone at PrePARED to provide a presentation to the site team on what data coming out of the first year of surveys; a half hour summary would be well received.

JW - Asks for an action on the PrePARED team to offer presentations to developers in Moray Firth on update.

PT - Mentioned that it was challenging to explain the procedures and what's involved in all the different elements of this work so is happy to share visuals that were taken for future use. Feedback that the developer Marine Control teams have been great.

JD - Will feed this positive feedback to BOWL Marine Control team.

Action on JW to provide summary of progress to date to this group.

Action on the PrePARED team to offer presentations to developers in Moray Firth on update.

5.2 Outputs from Moray East UXO Monitoring

PT - Explained that the paper put together that integrated NNG and Moray East results has been provisionally accepted in Marine Pollution Bulletin and waiting for the final edit. As soon as it's ready to go it can be circulated. Much of the information on the explosions and propagation was based on scare charges of known size rather than the actual UXO's themselves.. It will be the most extensive dataset on underwater explosions so far. Should be available in the next few months.

5.3 Any other relevant work

PT - Asks if anyone is familiar with EcoWind and if it has any relevance to this group?

EK - Explains that there is a meeting coming up on EcoWinds and will look up the date.

JW - Mentioned that there were three projects funded.

PT - Mentioned that two are Firth of Forth and the other one is off North Wales. Seabirds seem to be involved in all but hasn't seen details.

JW - Says that the EcoWinds stakeholder workshop meeting is scheduled for the 18th November

PT - Asks who's involved in work to feed back to the group?

EK - Explains that NatureScot have been asked to contribute to the PELAGIO and UKCEH projects.

JW - States that Marine Scotland Science are partners in the PELAGIO project but not sure if directly involved in the other two. Ecowind projects to be discussed in next meeting and how it interacts with the Moray Firth.

KB - Confirms that they are submitting project proposals to the ScotMER board at the moment and will update at next meeting.

JW -Asks what subject areas from a MM perspective

KB - Explains that they are varied. Three that were spoken about at ScotMER receptor group meeting; one on seal measurements of hearing ability, one on bottlenose dolphin signature whistles and potentially being able to track individuals with them and there will be one on potential and planned increased expansion on the ECOMASS project, potentially one on tracking some grey seals from the Ythan estuary

and in discussions on how might formulate a project around noise mitigation and what would be required to make noise mitigation feasible.

PT - States that a couple of those do relate to MMMP work.

6 AOB

No comments

7 Next meeting and close

March/April suggested by developers. EA to send out Doodlepoll



Appendix A: Addendum to the Moray Firth MMMP_230922

Addendum to the Moray Firth MMMP to integrate construction monitoring at the Moray West Offshore Wind Farm with ongoing post-construction monitoring at Beatrice and Moray East Offshore Windfarms

Paul Thompson, 23rd Sept 2022

1. Introduction

The overall objectives and workplan for the Moray Firth Marine Mammal Monitoring Programme (MMMP) were outlined in the document dated 27th June 2016 (Thompson, 2016). The details of studies to be conducted during construction of the Beatrice Offshore Wind Farm were subsequently developed in discussion with key stakeholders and the final workplan agreed at the November 2016 meeting of the MFRAG-MM Subgroup (BOWL, 2016). In response to key findings from Beatrice monitoring, the MFRAG-MM Subgroup agreed that construction monitoring at the Moray East Offshore Wind Farm should be adapted to balance elements of on-going long-term monitoring with more detailed studies exploring remaining areas of uncertainty. Proposals were presented to the MFRAG-MM Subgroup in July 2018, and an addendum to the construction MMMP (cMMMP) workplans previously approved by MFRAG (Thompson 2018) was subsequently approved by MS-LOT.

The development of pre-construction and construction monitoring programmes for Moray West Offshore Windfarm has progressed in parallel with ongoing stakeholder discussions over the required scope of post-construction monitoring for all Moray Firth developers.

- At the October 2020 meeting of the MFRAG-MM Subgroup, Moray West were asked to lead discussions on longer term project and strategic monitoring requirements with Beatrice, Moray East, NatureScot, MSS and MS-LOT.
- On 11th March 2021, Moray West met with NatureScot and MSS to scope their marine mammal pre-construction monitoring plans in relation to anticipated construction monitoring requirements. These were subsequently presented in Moray West (2021).
- Throughout 2021, MSS have been developing a funding bid to the Crown Estate's Offshore Wind Evidence and Change (OWEC) programme for a strategic study of Predators and Prey Around Renewable Energy Developments (PrePARED). Key work packages within PrePARED build upon the MMMP, and MSS have been in discussion with Moray West and other developers to identify where ongoing consent monitoring can provide in-kind support for this broader strategic project.
- Finally, In August 2021, a MFRAG-MM Subgroup meeting focussed on post-construction monitoring requirements for the Moray Firth. NatureScot subsequently issued a guidance note to MFRAG-MM, outlining how they and MSS would expect the MMMP to be adapted to meet future construction and post-construction consent monitoring requirements (NatureScot 2021).

A document dated 15th April 2022 built upon these stakeholder discussions and the NatureScot guidance note to provide an addendum to the cMMMP workplans previously approved by MFRAG. This was subsequently approved by MFRAG-MM and is further amended here in response to discussion at the 22nd Sept 2022 MFRAG-MM meeting.

1.1 Overview of monitoring during Beatrice and Moray East Construction

Studies undertaken during previously agreed programmes of work during construction at Beatrice and Moray East have been summarised in Annual Reports presented to the MFRAG MM-Subgroup (e.g. Graham *et al*, 2021). The programme has consisted of four work packages, which together aimed to validate and optimise the assessment frameworks and mitigation measures used to support the regulation of offshore wind farm developments.

The first work package (WP1) covered the requirements for harbour seal monitoring. This included maintaining population studies to follow any changes in abundance and vital rates through the pre-construction, construction and post construction phases of these developments. Detailed tracking studies were also conducted in both the pre-construction and construction phases to characterise behavioural responses to piling, with the intention of assessing any population consequences of disturbance.

The second work package (WP2) covered the requirements for bottlenose dolphin monitoring. Like the seal studies, this work package was underpinned by population studies, but also included passive acoustic monitoring (PAM) of the variation in occurrence of dolphins on the southern Moray Firth coast using moored echolocation detectors (CPODs).

The third work package (WP3) aimed to monitor the responses of harbour seals and harbour porpoises to acoustic deterrent devices (ADD) and piling noise. Tagged harbour seals were not observed within the vicinity of the wind farm site, so these studies focussed on the use of PAM arrays to study changes in the occurrence of harbour porpoises which occurred in areas experiencing different levels of noise exposure.

Finally, the fourth work package (WP4) involved measuring and modelling levels of noise from ADD and piling to underpin analyses of marine mammal behavioural responses and noise exposure.

1.2 Summary of Sept 2021 NatureScot and MSS guidance on pre-, during and post-construction monitoring for the three consented Moray Firth wind farms

The key species of concern at all sites remain the bottlenose dolphins associated with the Moray Firth SAC and harbour seals associated with the Dornoch Firth and Morrich More SAC. Minke whales are also considered a species of interest for Moray West due to proximity to the Southern Trench MPA. In addition, it is recognised that harbour porpoises are a strategic species of interest for the industry, and provide an important model for understanding behavioural changes due to disturbance.

For construction monitoring at Moray West, monitoring the levels of piling noise generated during the installation of large monopiles is a priority. Furthermore, there is a need to understand behavioural responses of harbour porpoises to the noise from monopile installation.

Finally, the guidance highlighted key strategic monitoring questions relating to the extent to which porpoises react to different foundation types, their foraging behaviour around structures, and how this may moderate their reactions to decommissioning.

1.3 Linkage between PrePARED and the Moray Firth MMMP

PrePARED aims to provide more robust cumulative assessments of the consequences of renewable developments. It will do this by gathering new data on predator prey interactions in and around operational offshore wind farms in two focal study areas; the Firth of Forth (focussing on interactions between seabirds and their prey) and the Moray Firth (focussing on studies of marine mammals and their prey).

The key linkage with the MMMP is within PrePARED Work Package 4, which aims to improve understanding and modelling of marine mammal responses to offshore windfarm developments in the Moray Firth. This work will be carried out alongside detailed University of Exeter and MSS studies of fish communities around structures, and results will feed into energetic and modelling work being conducted by SMRU Consulting and the University of Aarhus.

Following discussion between MSS and the Moray Firth developers, three Tasks within PrePARED Work Package 4 have been designed to either build upon existing MMMP data, or integrate new data available through future consent monitoring.

Task 4.1 Drivers of broadscale marine mammal distribution. Under this task, MMMP archive data on porpoise and seal distribution will be integrated with digital aerial survey data to explore how outputs from the MSS sandeel model can be used to provide more robust measures of prey fields in assessment models such as DEPONS.

Task 4.2 Fine-scale marine mammal distribution in response to OWF and prey fields.

This Task will use new PAM data collected between 2022 and 2024 to assess fine-scale changes in harbour porpoise occurrence and behaviour around turbines, and relate these to University of Exeter data on variation in prey.

Task 4.3 Dose response curves. This Task will use new PAM data collected during Moray West construction to replicate and extend studies conducted at Beatrice and Moray East. Critically, PrePARED will extend these dose-response models to incorporate new data on prey fields and reef effects, providing context-specific dose-response curves to characterise disturbance from both pile-driving and vessel traffic.

2. Proposed restructuring of MMMP Work Packages

The following restructuring of the MMMP work packages are proposed in response to the emerging policy questions highlighted in the NatureScot guidance note and during related meetings with key stakeholders. Each of these work packages addresses objectives identified for pre-, during and post-construction monitoring as outlined in Table 1.

Table 1. Table indicating where the proposed Work Packages contribute to the different phases of consent monitoring for each of the Moray Firth offshore windfarm developments.

		MORAY WEST			BEATRICE	MORAY EAST
		Pre-Construction	Construction	Post-Construction	Post-Construction	Post-Construction
WP 1	1.1	✓	✓	✓	✓	✓
	1.2			✓	✓	✓
WP 2	2.1	✓	✓	✓	✓	✓
	2.2	✓	✓	✓	✓	✓
WP 3	3.1	✓				
WP 4	4.1	✓			✓	✓
	4.2		✓			
WP 5	5.1		✓			

Work Package 1: Harbour Seal Monitoring

The objective of this Work Package is to collect data that can be used to assess demographic trends and key foraging areas of the population of harbour seals using the Dornoch Firth and Morrich More SAC.

Harbour seal monitoring will continue to focus on individual-based studies at the core long-term study sites within Loch Fleet NNR. However, changes in sandbank structure within Loch Fleet have made collection of shore-based photo-identification (photo-ID) data challenging in recent years. At the same time, new technologies and AI processing algorithms can provide efficiencies in data collection and data processing that offer greater resilience for long-term monitoring.

1.1 Monitoring Population Size, Structure and Vital Rates

Following successful pilot studies in 2021, a series of annual unoccupied aerial vehicle (UAV) surveys will be undertaken to extend the long-term monitoring of harbour seals in Loch Fleet. In 2022 and 2023, 10 UAV surveys will be made between May and September. A DJI M300 will be flown at 50-60m to allow simultaneous collection of wide-angle imagery for geo-referencing and counting individual seals, while a second camera operator zooms in to obtain photo-ID images (Figure 1). A sub-set of individuals will be photographed using conventional shore-based photo-ID.

Task 1.1.1. To estimate population size and structure from a sub-set of surveys conducted annually in Loch Fleet during the pupping season (15 June-15 July) and moult (1-31 Aug). Georeferenced orthomosaics created from each of these surveys to count seals will also be used to measure individuals and characterise changes in population structure.

Task 1.1.2. To extend our time-series of sightings of known individuals and use these individual recapture histories to periodically update estimates of vital rates. To achieve this, we will develop a training dataset of high-resolution aerial images which have been matched from simultaneous shore-based photo-ID. These data will then be used to train AI algorithms being developed by collaborators to identify harbour seals from pelage markings.

Task 1.1.3. To evaluate the potential for using new UAV techniques to extend the spatial coverage of surveys to assess connectivity between haul-out sites and spatial variation in population structure.

1.2 Assessing Temporal Changes in Foraging Distribution

There is extensive information on the foraging movements of Moray Firth harbour seals prior to the installation of turbine structures in the Moray Firth. Analyses of data collected in 2017 demonstrated that tagged individuals did not forage in areas where behavioural responses or hearing damage were likely to occur during construction at Beatrice. As a result, further tagging work was not proposed when piling was undertaken at more distant sites within Moray East (Thompson 2018). However, harbour seals have been shown to forage around operational windfarms (Russell et al. 2014). If prey availability is now higher around jackets at Beatrice and Moray East, baseline foraging distribution may have changed, and there may be greater opportunity to characterise harbour seal responses to pile driving noise at more inshore Moray West sites.

Task 1.2.1 To explore whether harbour seals have responded to changes in habitats and prey fields around constructed windfarms and provide insights into the potential use of operational windfarms for foraging. To achieve this, it had been anticipated that a sample of 20 individuals from the Loch Fleet population would be tagged before the first phase of pile-driving at Moray West, with the aim of subsequently characterising responses to piling activity (see WP 4). However, supply chain issues mean that this work cannot now be incorporated into Moray West construction in 2023/24 but will be undertaken later within the post-construction phase of the MMMP. Work will be carried out in collaboration with SMRU, and GPS-GSM tags used to characterise individual foraging patterns. Importantly, these tags will transmit summarised accelerometer data, providing new fine scale data on variation in prey capture events.

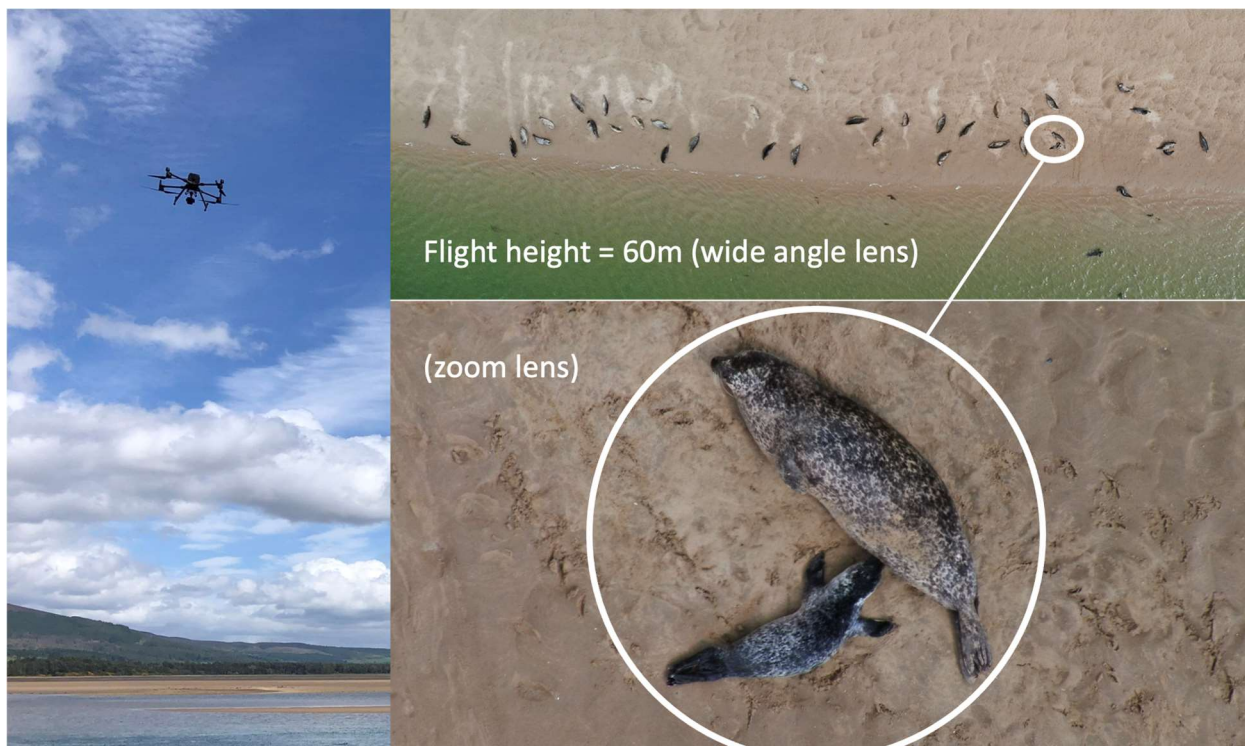


Figure 1. Example imagery taken during pilot studies at Loch Fleet using DJI M300 and H20 lens.

Work Package 2: Bottlenose Dolphin Monitoring

The objective of this Work Package is to extend the time-series of data that can be used to assess demographic trends in the population of bottlenose dolphins using the Moray Firth SAC, and to monitor seasonal occurrence and activity within core foraging areas.

This work is linked to the cycle of Site Condition Monitoring (SCM) for the Moray Firth SAC. During the final two years of the current reporting cycle, we will explore ways to integrate future management, data processing and reporting of photo-ID studies that have been conducted through a long-term collaboration between the University of Aberdeen and SMRU. In parallel with exploration of emerging AI techniques, and integration of photo-ID and PAM data, these efforts aim to improve the efficiency and resilience of this monitoring programme to support consent monitoring across all Scottish East coast sites.

2.1 Monitoring Population Size, Structure and Vital Rates

Bottlenose dolphin monitoring will continue to focus on boat-based photo-ID studies that are conducted within the Moray Firth SAC.

Task 2.1.1. To collect data on trends in population size and vital rates as agreed under existing SCM plans. Approximately 20 boat-based photo-ID surveys will be carried out between May and September each year.

Task 2.1.2. To collect parallel data on body size using laser photogrammetry (Cheney et al. 2017) and, where possible, using UAVs (Figure 2), with the aim of using this information to increase the power of the study to detect changes in demographic trends.



Figure 2. Picture illustrating UAV image of length and width measurements of a bottlenose dolphin, with inset photographs from a survey in the Moray Firth showing UAV launch and concurrent UAV and laser photogrammetry and photo-ID (Cheney et al submitted, Cheney et al 2017).

2.2 Assessing Temporal Change in Use of, and Connectivity with, Key Foraging Areas

Previous PAM studies highlighted high inter-annual variability in the occurrence of bottlenose dolphins along the southern Moray Firth, but no discernible far-field effects on these patterns during three periods of offshore impulsive noise (Fernandez-Betula et al. 2021).

In future, work on variations in occurrence within key foraging areas will focus on core-foraging sites within the Moray Firth SAC that are surveyed during photo-ID studies (i.e. the Sutors and Chanonry Narrows). The proposed use of broadband PAM recordings provides opportunities to integrate these data with those from the MSS ECOMAS array to monitor changes in vessel noise in key areas. Potentially, connectivity with other parts of the population's East Coast range could also be assessed through individual identification of signature whistles (see Longden et al. 2020) on these recordings.

Task 2.2.1. To monitor temporal variation in dolphin occurrence and foraging activity within the Sutors and Chanonry narrows. CPODs will be deployed annually within each site, extending the PAM monitoring started at these sites in 2006 (see Fernandez-Betula 2019).

Task 2.2.2. To collect broadband recordings within the Sutors and Chanonry narrows in order to characterise variation in vessels and other anthropogenic noise within the SAC. Building on work initiated in 2018, Soundtraps will be deployed in each of these areas between May and September, providing data both on underwater noise and on dolphin foraging activity. These data will also provide a resource to explore longer term use of signature whistles to measure connectivity and movement rates. By subsequently incorporating these data with other recordings (such as MSS ECOMMAS) this could underpin further monitoring both at local and regional scales.

Work Package 3: Minke Whale Monitoring

Given the proximity of the Moray West site to the Southern Trench MPA, this Work Package has been introduced to the MMMP to meet agreed pre-construction monitoring requirements for Moray West.

3.1 Spatial and Temporal Variation in Occurrence

Task 3.1.1. To characterise broad-scale spatial variation in the occurrence of minke whales across the Moray West site and adjacent areas. This work will be based upon marine mammal sightings extracted from Digital Aerial Survey (DAS) data collected during seabird monitoring at Moray West, and these will be integrated with other available DAS data from nearby areas.

Task 3.1.2. To characterise temporal variation in the occurrence of minke whales around offshore windfarm sites. This work will build upon earlier coastal studies within the Moray Firth using ECOMMAS data (Risch et al. 2019). Soundtraps will be deployed to make broadband recordings within the Moray West site during the summer of 2021 and 2022 (Figure 3), and these will be used to explore fine-scale temporal variation in minke whale detections. This work will involve optimisation of new AI algorithms to detect minke whales, opening up the potential to cost-effectively analyse archive recordings and characterise longer-term temporal variation in occurrence.

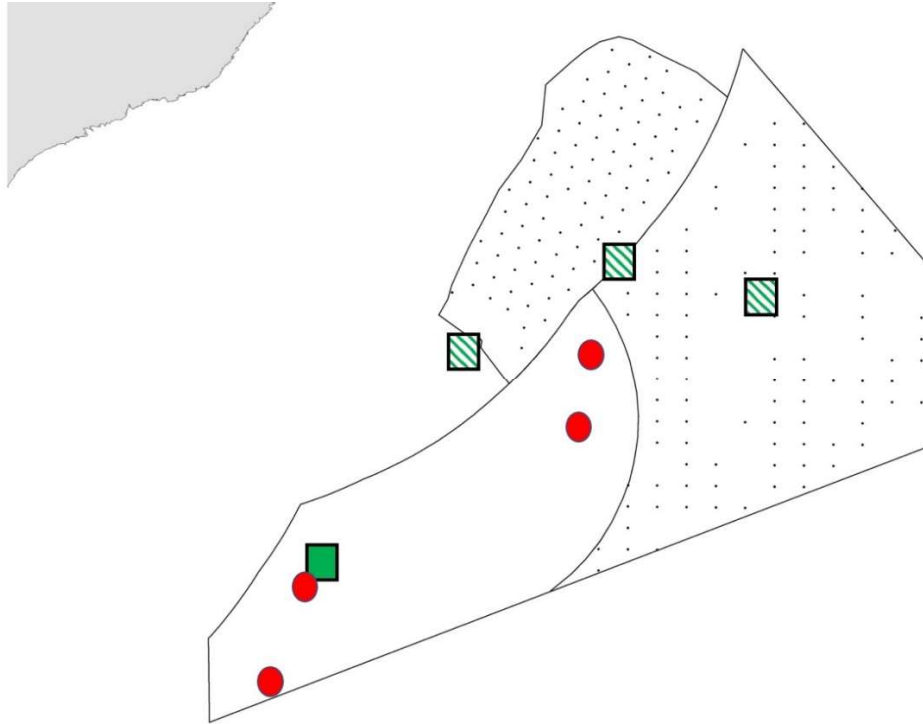


Figure 3. Location of moorings for Soundtrap deployments in 2021 and 2022 (Green square). Also shown are 1) locations where archive broadband recordings are available from 2018-21 for additional analysis of minke whale occurrence (Green hatched squares) 2) CPOD sites used for baseline monitoring of harbour porpoises in 2021 and 2022 (Red circles) (see Task 4.1.2).

Work Package 4: Marine mammal responses to Windfarm Construction and Operation

The overall objective of this Work Package is to understand how harbour porpoises may respond to construction activity and new habitats created by offshore structures. Proposed work on harbour porpoises is directly aligned to the PrePARED project.

4.1 Foraging Around Structures

This work package will focus on post-construction monitoring of the fine-scale distribution of harbour porpoises within the Beatrice and Moray East windfarms during 2022, and baseline characterisation of harbour porpoise distribution within Moray West. Work carried out through Task 1.2 will also provide an opportunity to understand whether the foraging distribution of harbour seals has changed as a result of windfarm construction

Task 4.1.1. To assess whether harbour porpoises using offshore windfarm sites are attracted to jacket structures. CPODs will be deployed within 50m of at least 20 jackets in the Beatrice and Moray East Windfarms, and at paired sites in the corridors between jackets. These data will underpin PrePARED Task 4.2, and sites have been selected to match those being used for PrePARED studies of prey using baited video cameras (Figure 4). Data collection will focus on August 2022 to maximise overlap with fish survey work and periods of high porpoise occurrence. Deployments will be restricted to a 4-6 week period to minimise equipment losses from unknown levels of fishing activity within the wind farms.

Task 4.1.2 To collect pre-construction baseline data on the occurrence and foraging activity of harbour porpoises within Moray West. CPODs will be deployed at four long-term monitoring sites during the summers of 2021 and 2022 (Figure 3). These include sites at which historic baseline has been collected during earlier studies, and will provide baseline for future comparison of responses of harbour porpoises to jacket and monopile substructures.

Task 4.1.3 To assess whether harbour seals are attracted to jacket structures. This question will be addressed using data collected within Task 1.2.1.

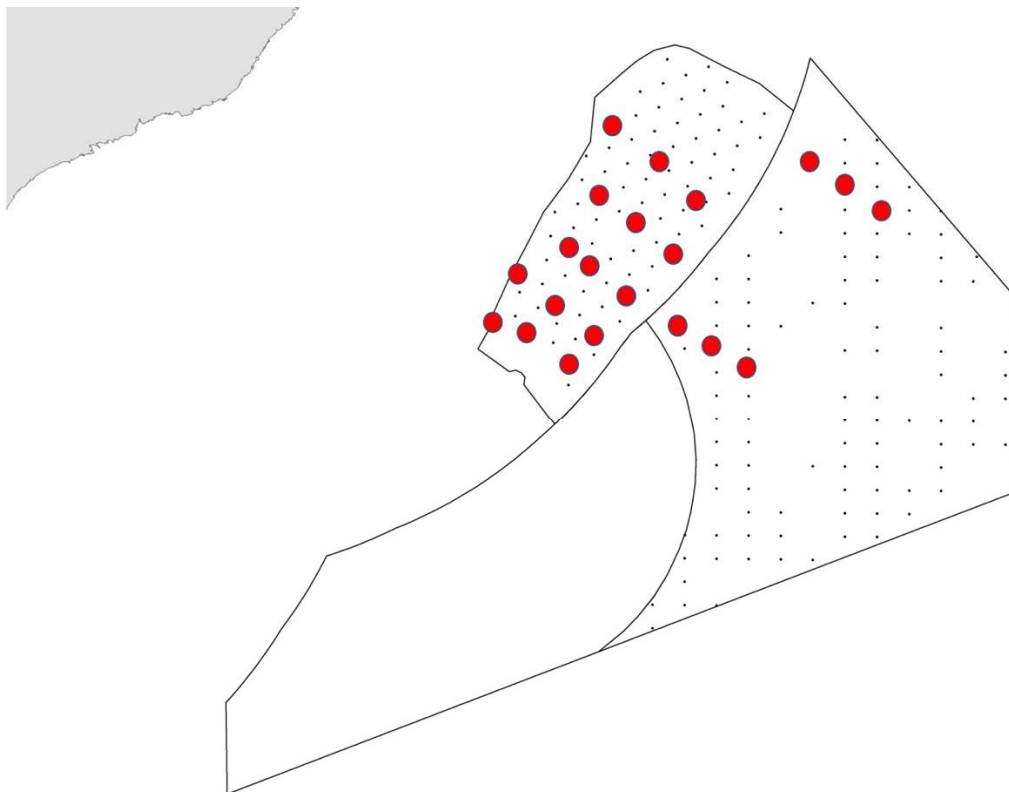


Figure 4. Indicative layout of CPOD array for August 2022 studies under Task 4.1.1. Each red circle represents a turbine where there will be a pair of CPODs deployed; one within 50m of the turbine and the second mid-way between the focal turbine and an adjacent turbine. Sites are selected to match PrePARED baited video camera sites.

4.2 Responses to Piling and Other Anthropogenic Noise Sources

This work package aims to improve understanding of how key marine mammal receptors respond to pile driving noise. The focal species will be harbour porpoises, first, due to their known presence on or proximity to the Moray West site and, second, due to their occurrence in sufficient numbers for response studies to be feasible. The rationale for extending earlier work at Beatrice and Moray East is twofold. First, responses to higher energy piling of monopiles will permit greater generalisation of results from the Moray Firth studies. Second, linkage with PrePARED provides an opportunity to assess how response levels vary in relation to local prey availability.

Task 4.2.1. To assess changes in the occurrence and feeding activity of harbour porpoises in response to piling noise at Moray West. CPODs will be deployed in a gradient design to replicate studies used at Beatrice and Moray East and compare dose response relationships for these three construction programmes. Depending on the timing of pile driving at selected turbine locations in Moray West (see Figure 5), CPODs or FPODs will be deployed at up to 25 locations in Moray West, 28 locations in Beatrice and 12 locations in Moray East. Building on studies in 2022, the array will incorporate paired sites at and between turbines to assess whether new foraging habitat around structures moderates cumulative responses to disturbance.

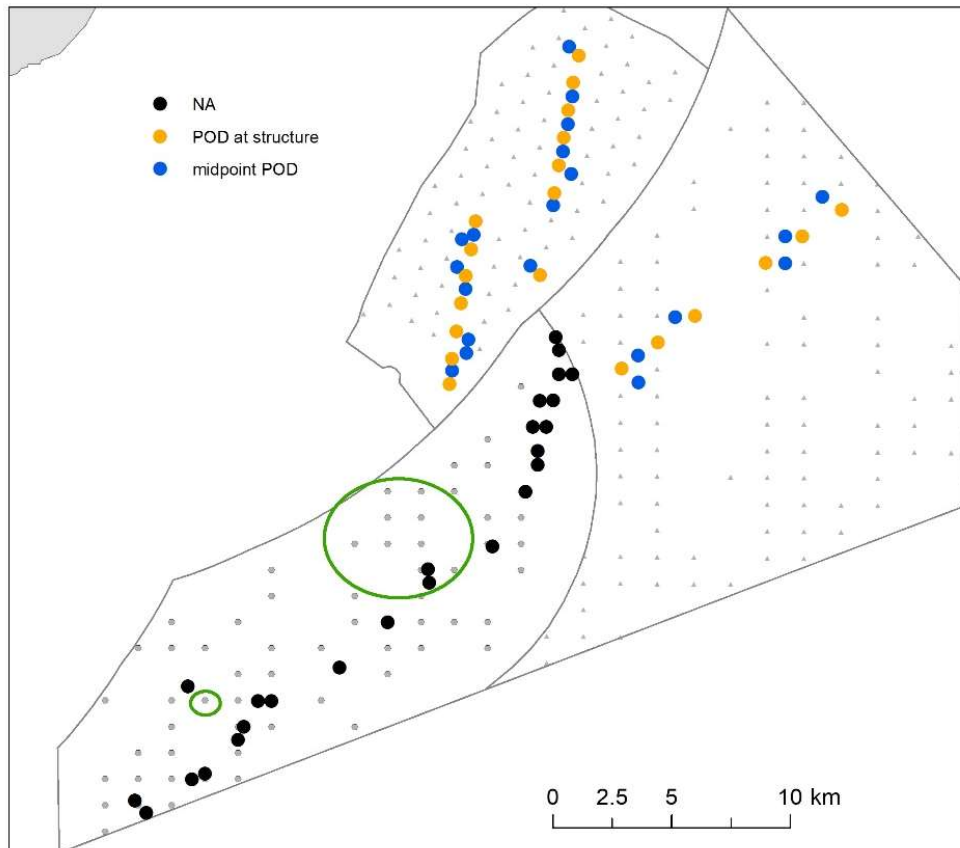


Figure 5. Indicative layout for CPOD/FPOD array during construction of Moray West offshore windfarm in 2023/24. Orange circles represent PODs deployed within 50m of the turbine; blue circles represent PODs deployed mid-way between the focal turbine and an adjacent turbine; black circles represent PODs deployed outside the operational windfarms. Green circles indicate piling locations likely to be selected for study.

Work Package 5: Noise measurement and modelling

This work package aims to reduce uncertainty over levels of piling noise generated during the installation of large monopile foundations and how these vary with hammer energy. This information will also be used to optimise noise propagation models for the Moray Firth and generate estimates of received levels to incorporate into dose-response analyses to be conducted within Task 4.2.1.

5.1 Characterisation of Received Noise Levels from Monopile Installation.

Task 5.1. To make field measurements during the installation of monopile foundations. Work carried out at Beatrice and Moray East will be replicated at a subset of sites within Moray West. Measurements of received levels will be based upon calibrated Soundtrap recordings, and these data related to engineering records to assess how received levels vary in relation to changes in hammer energy. In addition, independent nearfield measurements will be made at 750m to facilitate comparison with data from other European sites.

Task 5.2. To optimise propagation models to predict spatial variation in piling noise. Propagation modelling approaches used in studies at Beatrice and Moray East will be optimised using new field recordings. These models will then be used to estimate received levels at key PAM sites and in areas being used by foraging seals. These outputs will then be incorporated into analyses carried out within Work Package 4.

Summary

The proposed re-structuring of Work Programmes is summarised in Table 2. The anticipated timescale for each work package is presented in Table 3, assuming construction of Moray West starts in 2023.

Table 2. Summary of proposed changes to the MMMP Work programme.

WP #	Title	Proposed Amendments
WP 1. Harbour seal monitoring		
WP 1.1	Monitoring Population Size, Structure and Vital Rates	<p>Integrates previous WP 1.1 (Individual based studies of reproduction and survival) and WP 1.2 (Trends in abundance)</p> <p>Core strategic photo-ID studies at Loch Fleet will be continued through the development of UAV based aerial photogrammetric techniques that will provide information on abundance, vital rates and population structure.</p> <p>The potential for extending these techniques to other key haulout sites to quantify connectivity will also be assessed</p>
WP 1.2	Assessing Temporal Changes in Foraging Distribution	<p>Integrates part of previous WP 1.3 (Characterisation of foraging areas and responses to piling)</p> <p>Additional tagging work was originally proposed to cover the period immediately before construction and during the first phase of piling at Moray West. This has now been postponed to be conducted within post-construction monitoring.</p>
WP 2. Bottlenose dolphin monitoring		
WP 2.1	Monitoring Population Size, Structure and Vital Rates	<p>Integrates previous WP 2.1 (Individual based studies of reproduction and survival) and WP 2.2 (Trends in abundance)</p> <p>Continue core-strategic boat-based photo-ID studies through annual monitoring in the SAC. Extend scope of this work to monitor the structure of the population using laser and UAV photogrammetry.</p> <p>Explore how best to improve the efficiency and resilience of long-term monitoring through new technology and integration of studies across Moray Firth and Forth and Tay.</p>
WP 2.2	Assessing Temporal Change in Use of, and Connectivity with, Key	Previously WP 2.2 (Baseline occurrence of dolphins in favoured areas & responses to piling)

	Foraging Areas	<p>No further MMMP data collection at PAM sites on the South coast of the Moray Firth.</p> <p>Continue annual monitoring at core sites within the SAC and extend use of CPODs to include broadband recordings that provide potential for additional work on variation in noise levels and acoustic identification of individual dolphins to support studies of connectivity.</p>
WP 3. Minke Whale Monitoring		
WP 3.1	Spatial and Temporal Variation in Occurrence	New Work Package to meet pre-construction monitoring requirements at Moray West
WP 4. Marine mammal responses to Windfarm Construction and Operation		
WP 4.1	Foraging Around Structures	New work package to incorporate post-construction monitoring of marine mammal responses to wind farm structures and support broader strategic studies through PrePARED.
WP 4.2	Responses to Piling and Other Anthropogenic Noise Sources	<p>Previous WP 3 on responses to piling and ADD for harbour seals (WP 3.1) and harbour porpoises (WP 3.2).</p> <p>Work package developed to explore how harbour porpoise cumulative responses to piling are moderated by the presence of existing wind farm structures and vessel activity.</p> <p>Studies of harbour porpoises designed to support broader strategic studies through PrePARED.</p>
WP 5. Noise measurement and modelling		
WP 5.1	Characterisation of Received Noise Levels from Monopile Installation	Previous work under WP 4 now focussed upon characterisation of piling noise levels from monopile installation, and modelling of received noise levels that feed into analyses within new WP 4.2.

Table 3. Indicative timescales for the timing of different Work Packages within the MMMP, assuming that construction at Moray West is carried out in 2023.

		2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
WP 1	1.1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	1.2			✓	✓						
WP 2	2.1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	2.2	✓	✓	✓	✓	✓					
WP 3	3.1	✓									
WP 4	4.1	✓	✓								
	4.2		✓								
WP 5	5.1		✓								

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