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Llywodraeth Cymru Welsh Government

ORJIP Ocean Energy

Information Note: Encounters of Marine Animals with Mooring Systems and Subsea Cables

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MarineSpace Making Sense of the Marine Environment™

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1 INTRODUCTION

This series of technical, topic-specific Information Notes has been co-produced by the Welsh Consenting Strategic Advisory Group's Science and Evidence subgroup (SEAGP) in order to support the consenting of wave and tidal stream energy projects. The Information Notes have been developed to establish the current position of key stakeholders in Wales on the evidence available on interactions of wave and tidal energy technologies with the marine environment. They are designed to set out a starting point for applicants by providing an understanding of where consenting challenges might lie. The aim of the Information Notes is to support marine licence applications that are robust, proportionate and focused on assessing the key potential significant impacts and possible interactions between marine renewable energy (MRE) devices and the marine environment.

These Information Notes will support careful consideration of how, for a particular development, potential impacts that are considered low risk could be safely retired from further detailed consideration within Environmental Impact Assessments (EIA), where available evidence supports this approach. Ocean Energy Systems-Environmental (OES-Environmental) has set out a general process for risk retirement[1,2] but for developments in Welsh waters, risk retirement should always be discussed between developers and Natural Resources Wales (NRW) at the pre-application stage. In the context of these Information Notes, risk retirement implies that all potential impacts are included for consideration at the project scoping stage, and that following a review of the evidence some impacts may be 'scoped out' of any further detailed assessment to focus EIA on key significant impacts[3]. In all cases, potential impacts should be acknowledged in EIAs, with evidence-based justifications describing why particular impacts could be 'scoped out' of further detailed assessment.

Further information about this series of Information Notes, who these documents are for, how they were produced, and how they should be used can

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[1] https://tethys.pnnl.gov/events/oes-environmental-webinar-risk-retirement
[2] https://tethys.pnnl.gov/publications/state-of-the-science-2020-chapter-13-risk-retirement
[3] It should be noted that The Wildlife Trusts expressed concerns about the use of the phrase 'risk retirement' being applied in this context, particularly considering the uncertainties in impact assessment that are likely to arise with increasing scale of MRE developments.

be found in the accompanying document *Information Notes: Background Information.* The *Information Notes: Background Information* documentation also contains information about the terminology used in this document.

1.1 ENCOUNTERS OF MARINE ANIMALS WITH MOORING SYSTEMS AND CABLES - GENERAL

Some types of MRE devices are attached to the seabed and held in place by mooring systems consisting of mooring lines and anchors. These mooring systems allow devices to maintain their position within the water column or on the sea surface. Some mooring systems can be highly dynamic (e.g. those used to support tidal kites), whilst others are more rigid.

In a tidal stream array development multiple cables are used to carry power from devices to the shore or to subsea 'hubs' which are then connected to a single power export cable. The number and type of cables used will depend on the type and scale of the development.

There are some concerns that mooring lines and cables could be a hazard for marine animals due to the possibility of entanglement. Entanglement is sometimes also referred to as entrapment, and in this Information Note is defined as an animal becoming caught in a system without possibility of escape (Garavelli 2020).

Large cetaceans and basking sharks are thought to be most at risk from entanglement because of their behavioural traits and size (Benjamins et al. 2014). However, concerns about the possible risk to smaller marine mammals, diving seabirds and large fish have also been raised when considering the potential impacts of large arrays with multiple mooring systems and cables.

In the UK, those species of concern in relation to entanglement are protected under the Conservation of Habitats and Species Regulations 2017 and the Conservation of Offshore Marine Habitats and Species Regulations 2017. These regulations establish a network of Marine Protected Areas (MPAs) to protect habitats and species of national and international importance and make it illegal to deliberately disturb, injure or kill marine protected species, including dolphins, porpoises, whales, otters, seals and basking sharks.

Entanglement of marine animals with MRE mooring lines and subsea cables has not been observed to date and there is no evidence that suggests an event has occurred around a MRE development. Some evidence is, however, emerging regarding near field behaviour of marine animals around tidal turbines (e.g. avoidance of moving and static rotors by marine mammals and fish aggregation around devices). It has also been suggested that derelict (lost, abandoned, or discarded) fishing gear could become entwined with MRE device mooring systems and pose a further risk of entanglement (Benjamins et al. 2014,

Garavelli 2020), although there has not been any evidence of this impact to date.

Real-time monitoring data are currently limited and there is much less information available about the potential for entanglement (Garavelli 2020). Qualitative risk assessments to predict the influence of mooring configurations on entanglement risk suggested that catenary configurations (Figure 1) may pose the greatest risk to marine animals, but that overall mooring lines are a low risk to marine animals (Benjamins et al. 2014; Harnois et al. 2015).

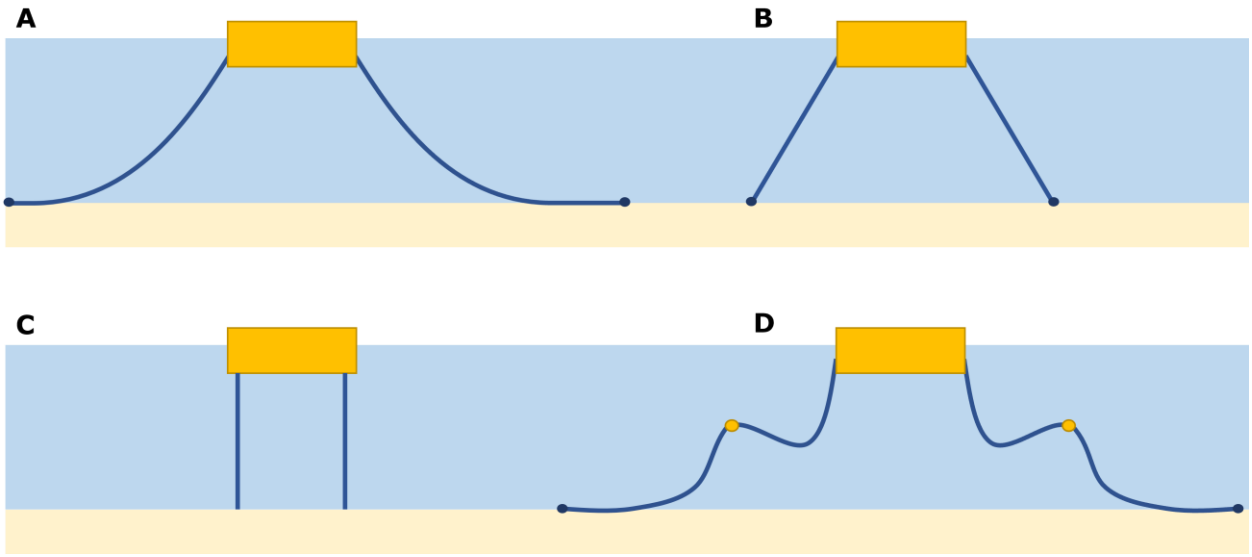

Figure 1: Mooring system configurations. A) catenary, B) taut, C) tension leg, D) lazy-s or lazy-wave. (after Davidson and Ringwood, 2017). Image not to scale.

At present the nature of interactions between marine animals and MRE device mooring systems and cables is uncertain. This uncertainty combined with the lack of empirical data means that there may be a disparity between perceived and actual risks with regards to this impact (Copping and Hemery 2020; Clarke et al. 2021).

1.2 EVIDENCE SOURCES CONSIDERED BY SEAGP

SEAGP members were asked to apply their expertise and were encouraged to read the OES-Environmental Short Science Summary document[4] on Encounters of Marine Animals with MRE Device Mooring Systems and Subsea Cables in advance of providing a response to a questionnaire on this topic. Respondents were also encouraged to consult the full chapter on the same topic within the

[4] https://tethys.pnnl.gov/summaries/short-science-summary-entanglement-risk-2020

OES-Environmental 2020 State of the Science Report[5]. Additional key references are listed at the end of this document.

2 VIEWS OF NATURAL RESOURCES WALES ON MARINE ANIMAL ENCOUNTERS WITH MOORING SYSTEMS AND CABLES

The information presented in this section was gathered in consultation with NRW specialists including those for fish, seabirds, and marine mammals.

2.1 GENERAL PERSPECTIVES

NRW's overall perspective on the general level of environmental risk associated with encounters with mooring systems and subsea cables can be found in Table 1.

Table 1. NRW perspectives on the general level of environmental risk* associated with marine animal encounters with mooring systems and subsea cables for generic development scenarios

Deployment scale	Very low	Low	Intermediate	High	Very high
Single device		✓			
Small array			✓		
Large array			✓		

**Note that risks are, by their nature very site-specific. This table should be treated as a general indication of risk.*

Risk of entanglement is of greatest concern with regards to marine mammals, followed by fish. For these marine mammals and fish, NRW agree that the potential level of risk would increase with the scale of the array. Encounters with mooring lines and cables are unlikely to pose substantial risk to seabirds, although further details are provided in Section 2.3.

2.1.1 Status of the evidence base

NRW indicate that current understanding of interactions between marine animals and MRE device moorings and subsea cables is mixed, depending on the receptor in question. In the context of supporting decision-making, NRW consider that for marine mammals the available evidence base is poor at all scales, while it is adequate for seabirds at all scales. For fish, there is greater

[5] https://tethys.pnnl.gov/publications/state-of-the-science-2020-chapter-8-moorings

uncertainty in the evidence so NRW suggest that better evidence is required to support decision-making relating to larger scale developments.

2.1.2 Mitigation strategies

NRW identify a number of potential mitigation strategies that could reduce the risk of entanglement and/or collision with moorings and cables. These include:

- Maintaining taut mooring lines,
- Removing any derelict fishing gear that may have become caught on device infrastructure during routine inspections of mooring lines and cables, as it may pose an entanglement risk to marine animals,
- Agreement with fishermen not to fish near to the device or cabling, and warning of the dangers that lost equipment poses to marine animals,
- Designing cables with maximum bend radius,
- Reporting loss of fishing gear in the area to operators, and
- Installing tension sensors on mooring lines.

2.2 FISH

From NRW's perspective, interactions with MRE device mooring lines and cables would not be likely to pose a risk to fish until developments increase in scale to large arrays (>30 devices, Table 2).

Table 2. NRW perspective on the importance of encounters with mooring systems and subsea cables to fish and on the status of the current evidence base

Deployment scale	Importance*	Available evidence base
Single device	Negligible	Adequate
Small array	Negligible	Adequate
Large array	Very low (but assessed on a case by case basis)	Poor

**the scale for importance is 'negligible, very low, low, intermediate, high, very high'*
***the scale for evidence base is 'very poor, poor, adequate, good, very good'*

2.2.1 Factors influencing effects on fish

For tidal stream developments with mooring systems and subsea cables, the design of the mooring system and cabling infrastructure is an important factor when considering risk; for example, mooring systems used to support floating tidal platforms will have different effects than those used to support tidal kites, which are more dynamic and would potentially pose different issues.

NRW identify that risks to fish would also increase in sensitive locations, for example essential feeding, spawning, or nursery areas or on migration routes.

2.2.2 Status of the evidence base and requirement for data collection

Project-specific data and information addressing this impact would only be expected for large array developments, as NRW note that there is very little information currently available for these developments. Additional evidence would therefore be required to support decision-making.

Research and monitoring of this risk should be given moderate priority, although it would only likely be 'scoped in' for detailed assessment in EIAs for fish in the case of large arrays.

2.2.3 Mitigation strategies

The Tethys Management Measures Tool[6] encourages the use of fishing exclusion zones around developments to minimise the risk of lost gear becoming caught on moorings and cables, leading to entanglement. However, in Wales it is suggested that developers should engage early with local fishers on potential MRE developments.

2.3 SEABIRDS

NRW suggest that for seabirds, interactions with cables and mooring lines are of negligible importance (Table 3). NRW expect that this impact pathway would only need to be considered should there be many mooring lines per device, increasing the potential risk of entanglement.

For seabirds, NRW suggest that monitoring and research of interactions with mooring lines and cables is of low priority.

Table 3. NRW perspective on the importance of encounters with mooring systems and subsea cables to seabirds and on the status of the current evidence base

Deployment scale	Importance*	Available evidence base
Single device	Negligible	Adequate
Small array	Negligible	Adequate
Large array	Negligible	Adequate

**the scale for importance is 'negligible, very low, low, intermediate, high, very high'*
***the scale for evidence base is 'very poor, poor, adequate, good, very good'*

[6] https://tethys.pnnl.gov/management-measures

2.4 MARINE MAMMALS

Interactions with MRE device moorings and cables are of intermediate importance for marine mammals, although NRW highlight that specific level of entanglement risk is project-specific. The location, type and number of mooring lines and cables deployed will influence the level of potential risk. NRW suggest that where mooring systems are designed with greater slack in the lines, the risk of entanglement and entrapment would be increased.

The UK's nature conservation bodies, including NRW have agreed marine mammal management units (MMUs) for the seven most common cetacean species in UK waters. These units provide an indication of the spatial scales at which impacts of plans and projects should be assessed (IAMMWG 2015).

2.4.1 Factors influencing effects on marine mammals

As the scale of MRE developments increases, risk to marine mammals will be amplified. Mooring lines and cabling associated with single device deployments will occupy a smaller cross-section of the water column than those associated with larger arrays. For large arrays, there is greater uncertainty associated with estimating the risk of a marine mammal encountering a mooring line or inter-array cables (Table 4). Furthermore, NRW note that it is unknown to what degree a larger array would produce a barrier effect resulting in animals avoiding the deployment area, rather than transiting through an increasing number of moorings and producing risk of entanglement or collision.

Table 4. NRW perspective on the importance of encounters with mooring systems and subsea cables to marine mammals and on the status of the current evidence base

Deployment scale	Importance*	Available evidence base
Single device	Intermediate	Poor
Small array	High (with substantial uncertainty)	Poor
Large array	High (with substantial uncertainty)	Poor

**the scale for importance is 'negligible, very low, low, intermediate, high, very high'*
***the scale for evidence base is 'very poor, poor, adequate, good, very good'*

For deployments in or near to MPAs designated for marine mammals, NRW advise that the extent of any potential impacts would largely depend on the scale of the infrastructure relative to the area of the MPA. Marine mammal densities are likely to be higher in proximity to an MPA, so nearby developments would be more likely to pose a risk. NRW assume that, due to their mobile nature, any losses of marine mammals within a marine mammal management unit from entanglement with MRE devices would be a loss to the MPA population.

2.4.2 Status of the evidence base and requirement for data collection

NRW would expect to see project-specific information provided to support decision-making on this topic at all development scales. Given the substantial uncertainty around marine mammal interactions with mooring lines and cables, NRW assign a high priority with research and monitoring for this impact. For developments at all scales, NRW would ask that this issue is considered, if only to be ruled out as a significant concern following a review of the evidence and/or collision modelling and adequate mitigation.

3 PERSPECTIVES FROM ENVIRONMENTAL ORGANISATIONS

Both the Royal Society for the Protection of Birds (RSPB) and The Wildlife Trusts (TWT) were consulted on this potential impact pathway.

For RSPB, encounters between seabirds and MRE device moorings and cables is an issue of interest, although it is not currently a main area of focus. RSPB suggest that data on bycatch and entanglement of seabirds and other marine animals in fishing gear could be used to inform research, monitoring, and decision-making on this topic, given the lack of MRE-specific evidence.

The potential for mobile species such as marine mammals to become entangled with mooring systems and cables was a key concern of TWT. This concern applies to both direct entanglement with device cables and moorings and indirect entanglement, where an animal becomes entangled with material such as derelict fishing gear that has become caught in a device's mooring system or cables. TWT note that another potential impact from mooring systems or cables is drag along the seabed and the resulting disturbance or loss to seabed habitat and benthic communities.

TWT highlight that barrier effects from MRE mooring systems are also largely unknown. Barrier effects occur when animals are prevented from crossing through or navigating around an array. The potential for significant impact from barrier effects is likely to increase as the size of the array increases, depending on the location of the devices within the water column and the length of the mooring cables. Barrier effects would be of particular concern for Welsh waters because of the large number of migratory species that pass through the Celtic Sea each year.

4 PERSPECTIVES FROM INDUSTRY

The overall perspective of industry representatives on encounters of marine animals with mooring lines and cables is that this potential impact is of low risk at all scales of development. However, industry recognises that this impact may be more important for marine mammals and potentially for seabirds,

particularly in relation to large arrays where mooring systems are used. This is a result of uncertainty in how the increase in numbers of mooring lines and/or dynamic cables in the water column would increase entanglement and entrapment risk for these species.

4.1 FACTORS INFLUENCING EFFECTS FROM MOORING SYSTEMS AND SUBSEA CABLES

Industry recognises that there could be an additional risk to marine animals from the entanglement of discarded or lost fishing gear with project infrastructure but note that this would not only increase risk to marine animals but also the project (and its associated infrastructure) itself. For this reason, it is most likely that project infrastructure (at all scales of development) would be monitored in order to ensure that any fishing (or other debris) is identified and can be removed at the earliest opportunity. It should also be noted that the presence of discarded or lost fishing gear is not the responsibility of the MRE sector.

Industry members suggest that cables associated with developments using bottom-mounted devices pose less of an entanglement risk in comparison with developments using floating devices which may have a more dynamic cable system.

Although cables associated with tidal kites will be highly dynamic, it is expected that these would pose lower entanglement risk in comparison to some other moored systems, given that there is only one tether from the device to the seabed.

Like NRW, industry recognise that the significance of this effect is dependent on the location of a development and proximity to MPAs or important locations for species of interest. Strategic environmental assessments and regional locational guidance could also incorporate early guidance to developers on the level and risk that could be attributed to this effect, and therefore any appropriate mitigation strategies.

4.1.1 Status of the evidence base and requirement for data collection

Industry members consider the current evidence base to be adequate to support decision-making for small arrays but may be insufficient for larger arrays. Industry suggest that it is generally assumed that cables and mooring lines will not have sufficient slack for entanglement or entrapment to be considered an issue at any scale, but that it is important that evidence be developed to validate this assumption, particularly as the species at risk are often of national and international conservation importance.

As there are few examples of MRE arrays to provide evidence, industry suggest there are opportunities to apply information from other sectors such as oil and gas, aquaculture and floating offshore wind. Additionally, for MRE developments

research and monitoring associated with this effect should be given moderate priority.

MRE industry members expect that project-specific information would likely be required to support EIAs of this effect for large arrays.

5 SUMMARY AND RECOMMENDATIONS

Marine animal interactions with mooring systems and subsea cables are most frequently associated with a risk of entanglement. This risk is generally considered to be low for single device deployments, with risk increasing as the development size increases.

Risk of entanglement is perceived to be greatest for large marine mammals, although there is substantial uncertainty about the likelihood of entanglement occurring. NRW would expect to see project-specific information addressing this topic for marine mammals at all scales.

Several factors will influence the level of risk associated with mooring systems and subsea cables, including the number and tension of mooring lines, and the presence of mid-water column cabling (for example in floating devices). The entanglement of discarded or lost fishing gear around MRE device structures is recognised as an additional risk to marine animals and to project infrastructure. Very little data exists about the effects of 'ghost' fishing gear in UK waters, and so it is difficult to assess what, if any, risk would be posed to marine animals in relation to MRE developments. Evidence from other marine industries could be applied to reduce uncertainty around this risk.

5.1 RECOMMENDATIONS

- The current lack of empirical and modelling studies examining entanglement as an impact pathway has resulted in substantial uncertainty as developments scale up to large arrays, although at present this effect is assumed to be of relatively low risk to marine animals.
- Voluntary reporting of derelict gear found on and around devices would not only help to mitigate risks associated with this effect but would also serve to increase our understanding of the prevalence of ghost fishing gear and its effects in association with MRE.
- Data from research and monitoring programmes associated with existing developments could help to deliver an evidence base that would better inform consenting of large arrays with respect to entanglement.
- A greater understanding of animal behaviour and movement patterns would help assess the potential risk of interactions with mooring lines and cables. Appropriate strategic studies could be developed, with collaboration across the sector, supported by funding from public and private sources.

6 REFERENCES

NOTE THAT ADDITIONAL REFERENCES ARE INCLUDED THAT ARE NOT CITED IN THIS INFORMATION NOTE

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APPENDIX A ADDRESSING ENCOUNTERS WITH MOORING SYSTEMS AND CABLES IN PREVIOUS MARINE ENERGY PROJECTS: LICENSING DOCUMENTS AND CONSENT CONDITIONS

Project Name	Location	Technology	Consenting Status	How collision risk is addressed	EIA/ HRA/ Other
Morlais	Wales	Tidal Stream Demo Zone	Consented	ES provides details on regular maintenance operations to ensure no entanglement of discarded nets, ropes or other debris on the mooring lines which could increase the risk of marine mammal entanglement.	EIA
Dounreay Tri	Scotland	Floating Offshore Wind	Consented	To reduce the risk of entanglement, specific to fish ecology, Dounreay Trì Limited has systems in place to detect damaged or compromised mooring lines and cables: Routine inspections of mooring lines and cables (Mitigation measure FE01) will ensure that any damage is detected and repaired at the earliest opportunity reducing risk of entanglement. This will also ensure that any debris such as fishing gear caught in mooring system/cables is detected and removed, minimising secondary entanglement (Mitigation measure FE02).	EIA
Dounreay Tri	Scotland	Floating Offshore Wind	Consented	The vertical clump mooring lines will be permanently taut (under tension) and will consist of sheathed spiral strand wire made up of steel stranded ropes with a plastic sheathing, so neither design type poses an entanglement risk for marine mammals or basking sharks.	EIA

Project Name	Location	Technology	Consenting Status	How collision risk is addressed	EIA/ HRA/ Other
Dounreay Tri	Scotland	Floating Offshore Wind	Consented	Mitigation for fishing gear to become snagged on cables causing indirect entanglement include a Cable Laying Strategy and Method Statement (GM18) which should include a Cable Burial Strategy and the FMP (CF01). Cable monitoring (CF03) will ensure that protection measures are maintained, and the cable is not exposed. Fishermen will be informed of the location of the cable through the Fisheries Liaison Officer (FLO) (CF02) and it will be publicised on Kingfisher or other navigational notification sources.	EIA
Hywind Scotland	Scotland	Floating Offshore Wind	Consented	There is a design requirement that no mooring line should ever go into slack, even in extreme conditions. Therefore, considering the large dimensions of the chain and the tension in the lines, it is considered virtually impossible for a marine mammal to get entangled in the lines.	EIA
Hywind Scotland	Scotland	Floating Offshore Wind	Consented	There is a design requirement for high bending stiffness of the cables, which result in a high minimum bending radius that makes it impossible for the cable to bend around a marine mammal.	EIA
Hywind Scotland	Scotland	Floating Offshore Wind	Consented	Smaller whales and dolphins could be at risk from secondary entanglement in lost fishing gear that becomes entangled in the Project mooring lines and inter-array cables. Criteria for Sensitivity is assessed, and the sensitivity of receptor has been set as low and the Magnitude of Effect of negligible has been determined.	EIA

Project Name	Location	Technology	Consenting Status	How collision risk is addressed	EIA/ HRA/ Other
Kincardine	Scotland	Floating Offshore Wind	Consented	Routine monitoring of the development to check for entanglement, animal behaviour / presence around the site and trapped derelict fishing gear. Regular underwater visual inspection of the conditions of moorings, and subsea cables is required for operational reasons at Kincardine Offshore Windfarm. Such inspections will also be used to detect derelict fishing gears and items with a potential risk of mammal entanglement.	HRA
Kincardine	Scotland	Floating Offshore Wind	Consented	Taut mooring lines	EIA
DeltaStream	Wales	Tidal Stream Demo Zone	Consented	Taut mooring lines	EIA
META	Wales	Wave and Tidal Demo Zone	Consented	No slack mooring lines will be required as the device will be deployed from vessels or a test support buoy.	EIA
EMEC	Scotland	Wave and Tidal Demo Zone	Consented	An emergency shutdown protocol for any entanglement events helping to minimise potential injury to any entangled marine mammals.	EIA
EMEC	Scotland	Wave and Tidal Demo Zone	Consented	Initial uncertainty about the potential for entanglement, monitoring took place that served to gain further information about the likelihood of entanglement.	EIA

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