RESPONSE

Project title:	Allod Energy Ltd MUL240005		
Subject:	Supplementary material in relation to the reasons set out in the proposed licence		
To:	MARA		
Project number:	24084	Document ref.:	MUL240005 Supplementary Information
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Checked by:	Joey O'Connor	Date of issue:	16/10/2026
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1 INTRODUCTION

Allod Energy Ltd proposes to undertake marine geophysical site investigations within the Celtic Sea to assess the potential for hydrogen storage. A Maritime Usage Licence (MUL) application was prepared by GDG on behalf of Allod Energy Ltd and received by the Maritime Area Regulatory Authority (MARA) on 19 September 2024. A response to a Request for Further Information (RFI) was subsequently submitted to MARA on 27 April 2026.

Following its assessment of the application, MARA issued a Proposed Maritime Usage Licence (MUL240005), together with a Minded to Determine Notice on 25 September 2026, which are welcomed by Allod Energy Ltd.

This document provides the supplementary material provided by Allod Energy Ltd in relation to the reasons set out in the proposed licence for MARA to consider before making a final determination on the licence application.

Allod Energy Ltd welcomes MARA's intention to grant a maritime usage licence for the undertaking of marine geophysical site investigations within the Celtic Sea and is grateful for the consideration given to the application and supporting environmental assessments. We appreciate this opportunity to provide a submission in response to the Minded to Determine Notice to set out our concerns and the basis upon which Allod Energy Ltd respectfully requests reconsideration prior to finalisation of the MUL. We have identified areas for clarification and have concerns in respect of one proposed condition, Condition 28, relating to time periods when survey activities shall not be undertaken.

We acknowledge that MARA may impose such conditions as it considers necessary and appropriate in the particular circumstances of a licence holder. However, it would appear there is limited scientific basis for inclusion of Condition 28, suggesting that MARA considers this to be necessary and appropriate.

Allod Energy Ltd’s concern is that Condition 28 is not supported by available scientific literature or appropriate in the circumstances of the proposed survey campaign, as is detailed in this submission and briefly below, and has the potential to limit proposed survey operations and potentially result in an unintended consequence of additional environmental emissions.

Allod Energy Ltd therefore request that MARA remove Condition 28.

We thank MARA for the opportunity to consider and provide a submission and look forward to receiving the MUL.

If there are any queries arising out of this submission, we would be pleased to address them prior to MARA’s decision issuing.

2 CLARIFICATIONS

Allod suggest the following amendments are considered.

2.1 PARTICULARS SCHEDULE

- **Current Wording**
    - Allód Energy Ltd
- **Suggested Amended Wording**
    - Allod Energy Ltd
- **Reason**
    - 'Allod Energy Ltd' does not have a fada

2.2 DEFINITIONS

- **Current Wording**
    - Definitions for "Ebbing Tide", "Spring Tide" and "Daytime" are included
- **Suggested Amended Wording**
    - Remove these definitions
- **Reason**
    - "Ebbing Tide", "Spring Tide" and "Daytime are not referenced in the MUL.

2.3 CLAUSE 9 (I) & (II): INSURANCE

- **Current Wording**
    - "effect and keep in force……" at the start of clauses 9(i) and 9(ii).
- **Suggested Amended Wording**
    - Replace "effect and keep in force" with "The Holder shall effect and keep in force for the duration of any mobilisation, activity, works or operations undertaken pursuant to the Licence, including associated demobilisation,".
- **Reason**
    - To clarify that the activity-specific insurances are required only while the activities are undertaken

2.4 APPENDIX 1: THE LICENSED AREA

- **Current wording**
    - Licence area 1,479.88km^2

- **Suggested Amended Wording**
    - 1,481km^2
- **Reason**
    - To ensure the area presented in the text matches the area presented in Appendix 1: The Licensed Area.

3 CONDITIONS

3.1 CONDITION 28: FISH SPAWNING AND NURSERY GROUNDS

- **Current wording**
    - The Holder shall not undertake the Permitted Maritime Usage between 1st April & 31st May and 1st August & 30th September annually, to ensure least disturbance at known fish and Nephrops (Dublin Bay prawn) spawning and nursery times.
- **Suggested Amended Wording**
    - Remove this condition
- **Reason**
    - The proposed condition is not supported by available scientific literature. Please see further supplementary information provided with this response (Appendix A) for more information.
    - Imposing Condition 28 in its current wording would prohibit 4 months of a 6-month weather window. As is stated above and evidenced in the further supplementary information provided (Appendix A), exclusion of 4 optimal weather periods is not supported by available scientific literature and will pose significant operational constraints that may lead to additional environmental emissions.

APPENDIX A: FURTHER SUPPLEMENTARY INFORMATION REGARDING CONDITION 28

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EXECUTIVE SUMMARY

Allod Energy Ltd submits that there is limited evidence to support the proposed Condition 28 that the proposed survey activity shall not be undertaken between 1st April & 31st May and 1st August & 30th September annually on the basis that this would disturb known fish and Nephrops (Dublin Bay prawn) spawning and nursery times.

We acknowledge that limited numbers of spawning adult fish may be disturbed by underwater noise from the proposed survey activities, however there is limited evidence to support the conclusion that undertaking the proposed survey activity between 1st April & 31st May and 1st August & 30th September annually would harm spawning and nursery grounds for commercial fish species. Furthermore, these areas have a large extent and distribution both within the Celtic Sea and the wider marine environment and the proposed MUL area makes up a very limited proportion of these areas.

We further submit that there is very limited evidence that Nephrops are sensitive to underwater noise, and it should be recognised that Nephrops grounds have minimal spatial overlap with the MUL area.

A defacto two-month (June &July) survey window annually materially increases the risk that weather or mobilisation delays force a second campaign, which is more likely to require additional vessel and equipment mobilisation/demobilisation, which could result in:

- additional emissions and vessel activity;
- a second period of fisheries disruption; and
- a longer overall environmental disturbance period.

Implementation of the mitigation measures set out in the MUL application in relation to marine mammals will further ensure the risk of disturbance during known spawning and nursery times from underwater noise is reduced.

Therefore, we request that Condition 28 is removed.

1 BACKGROUND

Allod Energy Ltd proposes to undertake marine geophysical site investigations within the Celtic Sea to assess the potential for hydrogen storage. A Maritime Usage Licence (MUL) application was prepared by GDG on behalf of Allod Energy Ltd and received by the Maritime Area Regulatory Authority (MARA) on 19 September 2024. A response to a Request for Further Information (RFI) was subsequently submitted to MARA on 27 April 2026.

Following its assessment of the application, MARA issued a Proposed Maritime Usage Licence (MUL240005), together with a Minded to Determine Notice on 25 September 2026.

This Technical Note has been prepared to provide supplementary information in relation to Condition 28 of the Proposed Licence.

The Technical Note builds upon the ecological baseline and assessment presented in the Assessment of Impact of the Maritime Usage (AIMU) submitted in support of MUL application MUL240005, incorporating additional scientific literature for consideration by MARA.

2 PROPOSED LICENCE CONDITION 28

Condition 28 of the Proposed Maritime Usage Licence (MUL240005), entitled 'Fish spawning and nursery grounds', states:

"The Holder shall not undertake the Permitted Maritime Usage between 1st April & 31st May and 1st August & 30th September annually, to ensure least disturbance at known fish and Nephrops *(Dublin Bay prawn) spawning and nursery times.*

Reason: *To ensure protection of the marine environment."*

The proposed condition, if included, would in effect limit survey activities to 1st June to 31st July annually when weather conditions within survey vessel operating capabilities are taken into account and noting the 2027 temporal requirements of the derogation licence granted by NPWS derogation number DER-CETACEAN-2027-01 under the EUROPEAN COMMUNITIES (BIRDS AND NATURAL HABITATS) REGULATIONS, 2011 (S.I. No 477 of 2011).

3 SUPPLEMENTARY INFORMATION

3.1 COMMERCIAL FISH SPAWNING AND NURSERY GROUNDS

3.1.1 INTRODUCTION

The sensitivity of fish to underwater noise varies according to species-specific hearing capabilities, including the detection of sound pressure and particle motion, and the characteristics of the sound source.

Fish detect underwater sound through particle motion, with some species also capable of detecting sound pressure through specialised anatomical structures. Hearing sensitivity varies between species and is influenced by the presence and function of the swim bladder and its relationship with the inner ear (Popper *et al*., 2014; Hawkins and Popper, 2017).

Potential responses to anthropogenic underwater noise include behavioural avoidance, changes in swimming or feeding behaviour, physiological stress, masking of biologically important acoustic signals and, at sufficiently high exposures, auditory or physical injury.

Behavioural responses do not necessarily indicate injury or population-level effects. However, the extent to which repeated or sustained disturbance may influence individuals or populations during important biological activities remains an area of ongoing scientific research. Table 3-1 summarises the available scientific evidence concerning hearing characteristics and documented underwater-noise effects for the six fish species with mapped spawning and/or nursery grounds overlapping the MUL Area.

Table 3-1 Hearing characteristics and documented effects of Underwater Noise on Fish Species which have Spawning and/or Nursery Grounds Overlapping the MUL Area

Species	Sound detection and hearing characteristics	Evidence of underwater noise effects	Relevance to proposed survey activities
Haddock (*Melanogrammus aeglefinus*)	Detects underwater sound at approximately 30–500 Hz, with greatest sensitivity between 100–300 Hz (Chapman, 1973). Ambient noise can mask acoustic signals, although directional separation can reduce masking by approximately 8 dB (Chapman, 1973). Male haddock produce low-frequency reproductive calls (Hawkins and Amorim, 2000), with a mean peak frequency of 258 Hz (Stanley et al., 2017). Vessel noise reduces the modelled effective communication range of these calls (Stanley *et al*., 2017). Classified as a higher-sound-sensitivity hearing generalist by BlueWise Marine (2023)	Ambient noise can mask acoustic signals, although directional separation can reduce masking by approximately 8 dB (Chapman, 1973). Vessel noise reduces the modelled effective communication range of spawning calls (Stanley *et al*., 2017).	**Established hearing-range overlap:** The seismic airgun array (15–60 Hz dominant range; broadband output) overlaps the lower portion of the reported haddock hearing range (30–500 Hz). The boomer (300–3,000 Hz) and sparker (300–1,400 Hz) overlap its upper portion (300–500 Hz). Survey-vessel noise (predominantly low-frequency broadband) may also overlap the hearing range, including frequencies associated with spawning calls (mean peak approximately 258 Hz). Haddock detect both sound pressure and particle motion through swim-bladder-associated hearing mechanisms (Popper et al., 2014; Hawkins and Popper, 2017).
Horse mackerel (*Trachurus trachurus*)	Detects sound-induced particle motion through the inner-ear otolith organs (Popper and Fay, 2011). Classified as a lower-sound-sensitivity hearing generalist (BlueWise Marine, 2023). No species-specific hearing frequency range established.	No direct experimental evidence of noise-induced injury or reproductive disturbance verified for this species.	**Potential detectability inferred from hearing anatomy:** The seismic airgun array (15–60 Hz), boomer (300–3,000 Hz), sparker (300–1,400 Hz) and survey-vessel noise (predominantly low-frequency broadband) may generate detectable particle motion. Horse mackerel possess a swim bladder, but its contribution to hearing has not been established. The potential for particle-motion detection is inferred from the general function of teleost otolith organs (Popper and Fay, 2011; Radford et al., 2012), rather than species-specific hearing measurements. Consequently, frequency overlap cannot be confirmed.

Species	Sound detection and hearing characteristics	Evidence of underwater noise effects	Relevance to proposed survey activities
Megrim (*Lepidorhombus whiffiagonis*)	Detects underwater sound primarily through particle motion, consistent with the hearing characteristics of flatfish (Popper *et al*., 2014). Flatfish generally exhibit limited sensitivity to higher-frequency sounds, although a species-specific hearing range has not been established for megrim. Classified as a lower-sound-sensitivity hearing generalist (BlueWise Marine, 2023).	No direct experimental noise-effect study verified for this species.	**Potential detectability inferred from hearing anatomy:** The seismic airgun array (15–60 Hz), boomer (300–3,000 Hz), sparker (300–1,400 Hz) and low-frequency broadband survey-vessel noise are potential sources of detectable particle motion. As a flatfish without a swim bladder, megrim is expected to detect underwater sound primarily through particle motion (Popper *et al*., 2014). However, no species-specific hearing frequency range is available to establish which equipment frequencies are audible
European hake (*Merluccius merluccius*)	Swim bladder present. Sound-pressure sensitivity plausible, but species-specific hearing thresholds not established here. Classified as a higher-sound-sensitivity hearing generalist by BlueWise Marine (2023)	No direct experimental noise-effect study verified for this species.	**Potential detectability inferred from hearing anatomy:** The seismic airgun array (15–60 Hz), boomer (300–3,000 Hz), sparker (300–1,400 Hz) and low-frequency broadband survey-vessel noise may generate detectable underwater sound. Hake possess a swim bladder, suggesting the possibility of sound-pressure sensitivity in addition to particle-motion detection; however, the extent to which the swim bladder contributes to hearing has not been established. Consequently, species-specific frequency overlap cannot be confirmed.
White-bellied anglerfish (*Lophius piscatorius*)	Detects sound-induced particle motion through the inner ear (Popper and Fay, 2011). Classified as a lower-sound-sensitivity hearing generalist by BlueWise Marine (2023). No species-specific hearing frequency range established.	No direct experimental noise-effect study verified for this species.	**Potential detectability inferred from hearing anatomy:** The seismic airgun array (15–60 Hz), boomer (300–3,000 Hz), sparker (300–1,400 Hz) and low-frequency broadband survey-vessel noise may generate detectable particle motion. This is inferred from general fish inner-ear

Species	Sound detection and hearing characteristics	Evidence of underwater noise effects	Relevance to proposed survey activities
			hearing mechanisms rather than species-specific experimental evidence. No reliable species-specific audiogram is available to establish the audible frequency range.
Black-bellied anglerfish (*Lophius budegassa*)	Detects sound-induced particle motion through the inner-ear otolith organs, consistent with general teleost hearing mechanisms (Popper and Fay, 2011). No species-specific hearing frequency range established.	No direct experimental noise-effect study verified for this species.	**Potential detectability inferred from hearing anatomy:** The seismic airgun array (15–60 Hz), boomer (300–3,000 Hz), sparker (300–1,400 Hz) and low-frequency broadband survey-vessel noise may generate detectable particle motion. This inference is based on the established role of otolith organs in fish hearing, rather than demonstrated species-specific sensitivity. No reliable hearing frequency range is available to confirm overlap with the proposed equipment.
Note: Hearing classifications from BlueWise Marine (2023) are broad assessment groupings rather than experimentally measured audiograms for each species.			

For spawning grounds, BlueWise Marine (2023), which examined the potential impacts of geophysical and geotechnical site investigation surveys on fish and shellfish, and Long et al. (2026), which reviewed these impacts specifically in the context of Irish waters, identified the principal receptors of concern are spawning adults, fertilised eggs and newly hatched larvae. Potential effects include disturbance of spawning behaviour, masking of reproductive acoustic communication and effects on egg or larval development and survival.

For nursery grounds, the principal receptors are juvenile fish, including recently settled individuals, with potential effects including behavioural disturbance, displacement, altered feeding and effects on growth or survival.

The hearing characteristics of the fish species with mapped spawning and/or nursery grounds overlapping the MUL Application Area, together with the available evidence concerning underwater-noise effects, are summarised in Table 3-2.

Table 3-2 Fish life stages associated with spawning and nursery grounds and potential underwater-noise effects

Habitat	Main receptors of concern	Potential effects of underwater noise	Relevant fish species
Spawning grounds	Spawning adults, fertilised eggs and newly hatched larvae	Disturbance of spawning behaviour, masking of reproductive calls (where applicable), and potential effects on egg or larval development and survival.	• Haddock • Horse mackerel • Megrim
Nursery grounds	Primarily juvenile fish, including recently settled individuals	Behavioural disturbance, displacement, altered feeding and potential effects on growth or survival.	• Horse mackerel • Megrim • European hake • White-bellied anglerfish • Black-bellied anglerfish

Early life stages require particular consideration because fish eggs are unable to actively avoid an approaching sound source, while larvae generally have more limited avoidance capabilities than mobile juvenile and adult fish.

Popper *et al*. (2014) provide guidance for assessing potential effects of underwater sound, such as that produced by geophysical and seismic surveys, on fish, including eggs and larvae. However, the evidence supporting quantitative assessment of early life stages remains limited. Long *et al*. (2026) identify a particular lack of studies examining the effects of continuous underwater noise on fish eggs and larvae. This limits the extent to which conclusions derived from adult fish or other sound sources can be applied to developing fish.

There is limited evidence for the effects, if any, of underwater noise on fish eggs, larvae and nurseries.

3.1.2 SPATIAL OVERLAP

Spawning grounds are areas used by sexually mature fish for reproduction, including for the release and fertilisation of eggs, whereas nursery grounds are areas used by juvenile fish for feeding, growth and development.

These areas may overlap geographically but represent different ecological functions and life stages. Eggs and larvae may also be transported beyond spawning grounds by prevailing currents, while juvenile nursery habitats may occur elsewhere from a species spawning ground.

Section 6.4.5.2 of the AIMU (GDG, 2024) assesses the spatial distribution of mapped spawning and nursery grounds for commercially important fish species in relation to the MUL Application Area. This assessment was informed by datasets obtained from Ireland's Marine Atlas (2021), with the findings illustrated in Figures 6-5 to 6-14 and summarised in Table 6-4 of the AIMU.

The results of this assessment are reproduced in Table 3-3, which establishes the relevant commercial fish species and associated life stages.

Table 3-3 Proportion of Mapped Commercial Fish Spawning and Nursery Grounds with the MUL Application Area

Species	Nursery Area	Spawning Area
Black Belly Angler Monk	0%	0%
Cod	0%	0%
Haddock	0%	5%
Hake	1%	0%
Herring	0%	0%
Horse Mackerel	0.5%	0.7%
Mackerel	0%	0%
Megrim	1%	1.7%
White Belly Angler Monk	1.5%	0%
Whiting	0%	0%

Of the ten commercially important fish species considered in the AIMU, six were identified as having mapped spawning and/or nursery grounds overlapping the MUL Application Area. Spawning ground overlap was identified for three species (haddock, horse mackerel and megrim), while nursery ground overlap was identified for five species (black-bellied anglerfish, white-bellied anglerfish, European hake, horse mackerel and megrim). No overlap was identified for cod, herring, Atlantic mackerel or whiting.

It is clear from Table 3-3 that the MUL application area makes up a very small proportion (0.5%-5%) of the five nursery and three spawning grounds it overlaps with. These grounds have large extents

and are widely distributed both within the Celtic Sea and the wider marine environment. Asany effects on these species from underwater noise from the proposed survey activities are expected to be confined to a relatively small area surrounding the survey operations, it is expected that any impacts to these species will not be harmful at scale of the individual nursery or spawning grounds.

3.1.3 TEMPORAL OVERLAP

Spawning and nursery grounds represent important habitats supporting the reproductive success and recruitment of fish populations. However, the timing and duration of habitat use vary between species and life stages. Spawning activity may occur during relatively defined seasonal periods, whereas nursery grounds may support juvenile fish over more extended periods, with recruitment and habitat use influenced by species-specific life histories and environmental conditions.

In considering potential temporal overlap between the Proposed Surveys and spawning and nursery activity, it is important to distinguish between documented spawning periods, observations of juvenile fish and established seasonal peaks in nursery activity. The presence of mapped spawning or nursery grounds within the MUL Application Area does not necessarily indicate that the relevant life stages occur at their greatest abundance or sensitivity during particular months.

Published spawning periods and available information on juvenile occurrence and nursery habitat use for fish species with mapped spawning and/or nursery grounds overlapping the MUL Application Area are summarised in Table 3-4. The potential temporal overlap with the exclusion periods specified under Condition 28 are shown in Figure 3-1.

Table 3-4 Review of Fish Spawning and Nursery Information

Species	Grounds overlapping MUL area	Spawning period	Nursery period	Citation	Potential Disturbance Periods
Haddock (*Melanogrammus aeglefinus*)	Spawning	February – May	Not applicable – no mapped nursery overlap	Long *et al*. (2026), Table 7.1	4-month spawning period, overlapping the proposed April–May exclusion period.
Horse mackerel (*Trachurus trachurus*)	Spawning and nursery	December – September	Juveniles recorded during February–April and September–December survey periods; peak nursery period not established.	Campanella and van der Kooij (2021), pp. 35–38	10-month spawning period overlapping both proposed exclusion periods; April – May, and August - September. Juveniles have been recorded during February–April and September–December surveys, including April and September; however, these observations do not establish a peak nursery period.
Megrim (*Lepidorhombus whiffiagonis*)	Spawning and nursery	January – April	Juveniles occupy offshore nursery grounds throughout the year; a specific peak nursery period has not been established.	GDG (2024), Section 6.4.5.2, Table 6-4; APEM (2021), pp. 72–73; Trinity College Dublin (2020), History of the Megrim Sole.	4-month spawning overlapping the proposed April–May exclusion period in April. Juvenile habitat use is reported throughout the year, with no established seasonal peak.
European hake (*Merluccius merluccius*)	Nursery	Not applicable – no mapped spawning overlap	Juvenile nursery grounds documented. Late summer–early autumn has been identified as a period of juvenile transition to demersal habitats; peak nursery period not established.	APEM (2021); Kacher and Amara (2005); Alvarez *et al*. (2001), for larval transport context	Nursery grounds overlap the MUL Application Area; however, a discrete seasonal peak in juvenile settlement or nursery use has not been established.
Black-bellied anglerfish (*Lophius budegassa*)	Nursery	Not applicable – no mapped spawning overlap	Young-of-the-year juveniles recorded in autumn (October), originating predominantly from May–July hatching. Peak nursery period not established.	Hernández *et al*. (2014); APEM (2021), pp. 75–77; GDG (2024), Table 6-4.	Bay of Biscay research indicates estimated hatching during May–July and records juveniles in October. These findings do not establish a peak nursery period within the MUL Application Area.
White-bellied anglerfish (*Lophius piscatorius*)	Nursery	Not applicable – no mapped spawning overlap	Pelagic larval phase approximately 2–4 months, followed by demersal juvenile development. Peak nursery period not established.	GDG (2024), Table 6-4; APEM (2021), pp. 75–76; Maggini et al. (2022), p. 7.	Bay of Biscay research indicates estimated hatching during April–June and records juveniles in October. These findings do not establish a peak nursery period within the MUL Application Area.

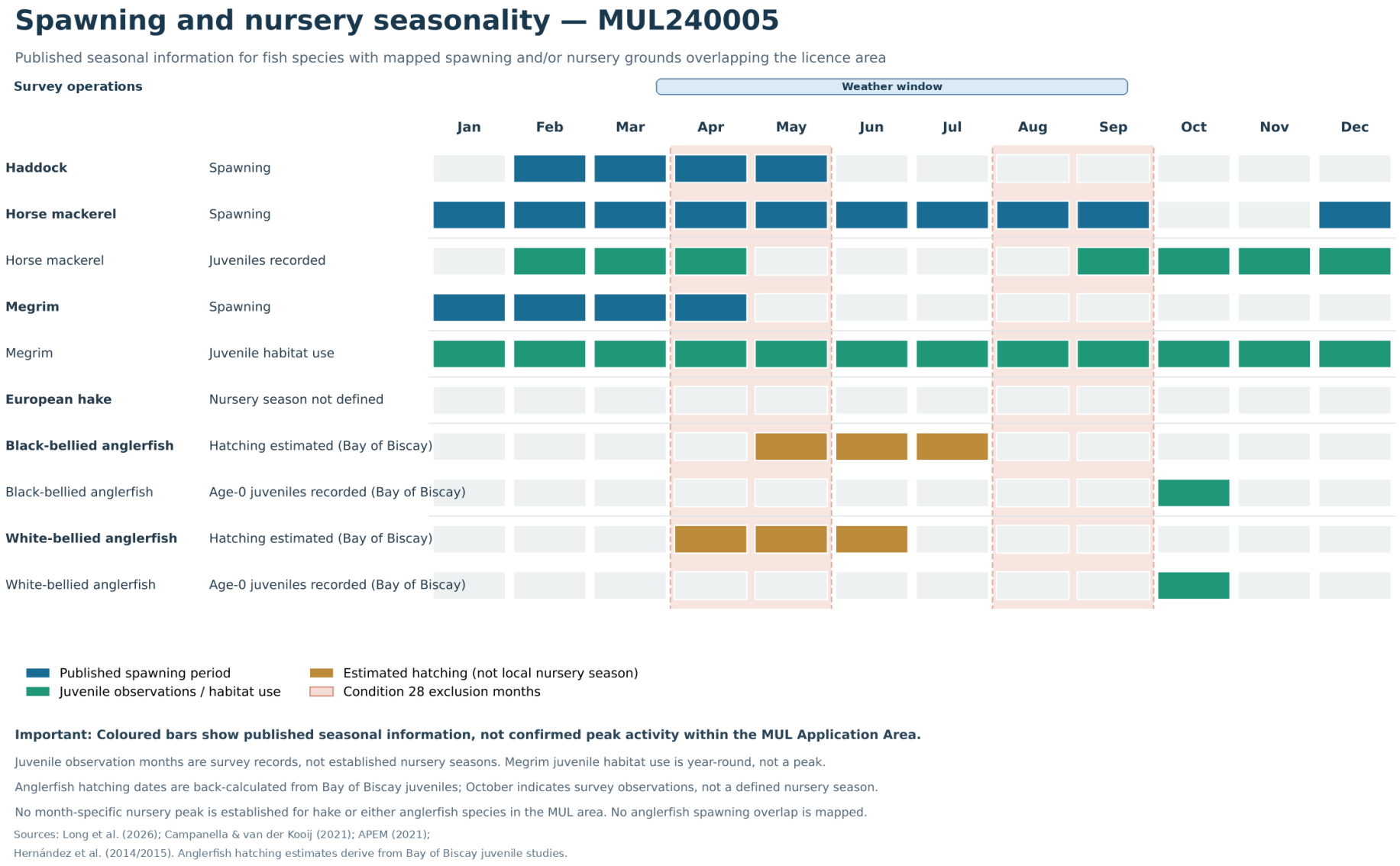


Figure 3-1 Published spawning and nursery seasonality for fish species with mapped spawning and/or nursery grounds overlapping the MUL Application Area, showing the proposed Condition 28 exclusion periods.

3.1.4 CONCLUSION (COMMERCIAL FISH SPAWNING AND NURSERY GROUNDS)

While auditory injury thresholds may be exceeded within short distances, spawning and nursery grounds which overlap with the MUL area have a large extent and distribution both within the Celtic Sea and the wider marine environment and the proposed MUL area makes up a very limited proportion of these areas. These life stages are generally not site-faithful and tend to occur at low densities within the area (Popper et al., 2014).

The potential for effects on spawning and nursery grounds is therefore expected to be localised and not harmful at the scale of the spawning and nursery grounds of these species, as demonstrated in Table 3-3

The three species with spawning grounds which overlap with the MUL area have long spawning periods of 4-9 months duration, including during times of year where survey activities will not be possible due to weather (i.e. October to March). No clear evidence of peak nursery ground use has been identified for the three species with nursery grounds which overlap with the MUL area.

Given that the proposed survey is planned to last only approximately 20 days, the impacts on fish spawning and nursery grounds are therefore anticipated to be localised and short-lived.

We therefore conclude that undertaking the survey works between 1st April & 31st May and 1st August & 30th September would not significantly disturb known fish spawning and nursery events.

3.2 DUBLIN PRAWNS (NORWAY LOBSTER-*NEPHROPS NORVEGICUS*):

Nephrops norvegicus (commonly known as Dublin Bay Prawn or Norway lobster) is a commercially important benthic crustacean associated with muddy seabed habitats in which individuals construct and occupy burrow systems. Its distribution is strongly influenced by sediment characteristics, with populations occurring in geographically distinct areas of suitable habitat.

Benthic invertebrates, including Nephrops and other commercially important shellfish, are not currently assessed as sensitive to underwater noise under the Marine Evidence–based Sensitivity Assessment (MarESA, 2018), reflecting a general scientific consensus that these species exhibit limited responsiveness to acoustic pressures in the marine environment.

Nephrops detect underwater sound primarily through particle motion rather than sound pressure as crustaceans possess mechanosensory structures that enable them to detect water movement and substrate vibrations (Edmonds et al., 2016; Hawkins and Popper, 2017). The literature indicates that Nephrops may be able to detect low-frequency water vibrations, with postural responses reported at 20–180 Hz (Goodall et al., 1990, cited in Edmonds et al., 2016). This overlaps with the typical peak-frequency range of seismic survey noise (20–200 Hz; Edmonds et al., 2016). Exposure to anthropogenic underwater noise has also been associated with altered burrowing and activity in Nephrops (Solan et al., 2016). However, species-specific evidence demonstrating effects of seismic airgun exposure on egg development, hatching success or larval survival remains lacking and sound exposure studies involving other crustaceans have reported variable responses. For example, adverse developmental effects have been reported in snow crab eggs while researchers did not find any statistically significant developmental or mortality effects on Dungeness crab larvae tested under noise exposure conditions (Christian et al., 2003; Pearson et al., 1994, as reviewed by Edmonds et al., 2016).

3.2.1 TEMPORAL OVERLAP

The reproductive cycle of Nephrops involves mating and ovarian maturation, followed by egg extrusion, an extended period of egg incubation and subsequent hatching and larval release. Following hatching, larvae undergo a planktonic development phase before settling to suitable seabed habitats.

Published information for Irish Nephrops populations indicates that mating and maturation generally occur during late spring and summer, with egg extrusion principally occurring in late summer and early autumn. Females subsequently carry their eggs externally throughout autumn and winter, with hatching and larval release occurring during the following spring.

The principal reproductive stages and their reported seasonal timing are summarised in Table 3-5.

Table 3-5: Reported seasonal reproductive cycle of *Nephrops norvegicus* (Marine Institute[1])

Period	Reproductive stage
Early summer (May–July)	Mating and ovarian maturation
August - September	Egg extrusion, with a reported peak in September
Autumn – winter	Egg incubation; females carry eggs externally and spend extended periods within burrows
April – May	Egg hatching and larval release
May onward	Planktonic larval development followed by settlement to suitable seabed habitat

The April–May period overlaps the reported period of egg hatching and larval release, while the August–September period overlaps egg extrusion, including the reported September peak.

Following settlement, juvenile *Nephrops* occupy suitable muddy seabed habitats associated with established populations. Unlike species with geographically distinct nursery grounds, juvenile and adult *Nephrops* may occupy the same general habitat. A discrete seasonal peak in nursery activity within the MUL Application Area has not been established.

3.2.2 SPATIAL OVERLAP

As shown in Figure 3-2, there is very limited spatial overlap between the Nephrops Grounds of Functional Unit 2021 and the MUL area, which includes line change areas; in total, the MUL area represents 2.6% of the Labadie Jones Nephrops Grounds within the wider Functional Unit 2021.

There is no spatial overlap between the MUL area and other Functional Units in the Celtic Sea.

[1] https://www.marine.ie/site-area/news-events/press-releases/sampling-nephrops-larvae-west-aran-islands-first-time-rv?utm_source=chatgpt.com

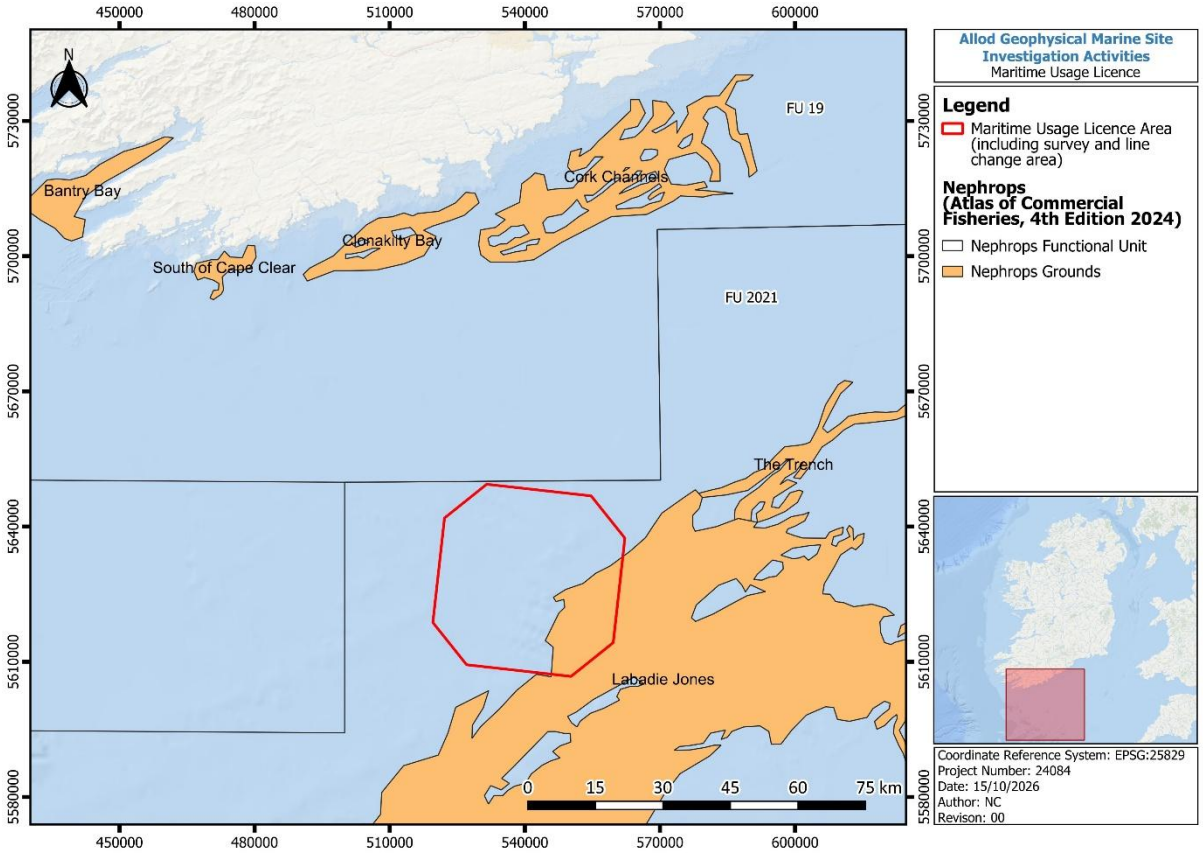


Figure 3-2 MUL Area and Nephrops Grounds (Atlas of Commercial Fisheries, 2024)

3.2.3 CONCLUSION (NEPHROPS)

Given the limited spatial overlap and general scientific consensus that shellfish exhibit limited responsiveness to acoustic pressures in the marine environment, undertaking the survey works between 1st April & 31st May and 1st August & 30th September would not significantly disturb Nephrops (Dublin Bay prawn) spawning and nursery events.

4 OPERATIONAL CONSIDERATIONS

As described in the MUL application, survey operations can only be carried out in a sea state of less than approximately 2 meters wave height. This naturally restricts operations to early April to late September.

It should be noted that while a survey vessel would be booked approximately 6 months in advance of planned operations, actual vessel arrival is subject to weather conditions and technical performance on preceding surveys within this 6-month period, over which the vessel supplier has limited control.

It is thus standard that booked vessel arrival dates have a +/- 30 day window (60 days).

Considering the standard vessel 60-day uncertainty on vessel arrival and the expected approximately 20 day survey operations, it would be highly likely Condition 28 would lead to considerable survey restrictions.

- In the event of early vessel arrival (for instance May rather than June) survey operations would need to be cancelled and rebooked for the following year.
- In the event of late vessel arrival (for instance mid-July) survey operations could commence but would likely be forced to cease prior to completion and rebooked for the following year.
- In the event of late vessel arrival and having to cease operations prior to completion, a remobilisation the following year would likely cause inconvenience to other marine users (such as fisheries) who had adjusted their operations to integrate with our operations and would need to adjust their operations for a second period the following year.

Having to remobilise a vessel to the area the following year would also result in an unintended consequence of additional environmental emissions such as:

- additional noise to the marine environment on equipment testing and start-up procedures;
- additional noise to the marine environment due to additional vessel noise on second mob/demob;
- additional atmospheric emissions due to engine emissions on second mob/demob.

5 MITIGATION

Standard mitigation measures, as detailed by “Guidance to Manage the Risk to Marine Mammals from Man made Sound Sources in Irish Waters” (DAHG, 2014) and set out in the Risk Assessment for Annex IV Species which accompanies the MUL application, shall be implemented for during deployment of noise emitting equipment.

With the implementation of these measures, efforts will be made to reduce the duration and intensity of disruptions caused by site investigation activities.

Any disturbance to fish species, if it occurs, will be brief and confined to a small area. Any impacted species are expected to recover swiftly once noise produced by the site investigation activities ceases.

6 CONCLUSION

Limited numbers of spawning adult fish may be disturbed by underwater noise from the proposed survey activities, however there is limited evidence to support the conclusion that undertaking the proposed survey activity between 1st April & 31st May and 1st August & 30th September annually would harm spawning and nursery grounds for commercial fish species.

These areas have a large extent and distribution both within the Celtic Sea and the wider marine environment and the proposed MUL area makes up a very limited proportion of these areas.

There is very limited evidence that Nephrops (Dublin Bay prawn) are sensitive to underwater noise. Nephrops grounds have been shown in this report to have minimal spatial overlap with the MUL area.

Implementation of the mitigation measures set out in the MUL application in relation to marine mammals will ensure any risk of disturbance during known spawning and nursery times from underwater noise is reduced.

We therefore conclude that proposed Condition 28 is not supported by scientific evidence, is likely to impose operational constraints which may require multiple surveys, and ask that proposed Condition 28 is removed.

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