# Pots, Traps & Creels Interactions with Mussel Bed on Mixed and Sandy Sediments

## 1. Introduction

The Assessing Welsh Fishing Activities (AWFA) Project is a structured risk-based approach to determining impacts from current and potential fishing activities (undertaken from licensed and registered commercial fishing vessels), upon the features of European marine sites (EMS) in Wales.

Further details of the AWFA Project, and all completed assessments to date, can be found on the AWFA website.

The methods and process used to classify the risk of interactions between fishing gears and EMS features, as either purple (high), orange (medium) or green (low) risk, can be found in the AWFA Project Phase 1 outputs: Principles and Prioritisation Report and resulting Matrix spreadsheet.

## 2. Assessment summary

| | |
|---|---|
| **Assessment Summary:**<br>**Pots, Traps & Creels Interactions with Mussel Bed on Mixed and Sandy Sediments** | **<u>Assessment of impact pathway 1: Physical damage to a designated habitat feature:</u>**<br><br>No studies were found that directly measured or estimated physical impacts of potting on Mussel Beds on Mixed and Sandy Sediments. As potting is a subtidal activity it is unlikely to interact with intertidal parts of this habitat. Indirect evidence, expert judgement and indicative MarLIN sensitivity assessments suggests that the physical impacts from pots, weights or anchors making contact with Mussel Bed on Mixed Sandy Sediment habitat could damage the biogenic substrate.<br><br>**<u>Assessment of impact pathway 2: Damage to a designated habitat feature via removal of, or other detrimental impact to, associated biological communities:</u>**<br><br>No studies were found that directly or indirectly measured impacts from potting on associated biological communities of Mussel Beds on Mixed and Sandy Sediments or similar habitats. As potting is a subtidal activity it is unlikely to interact with intertidal parts of this habitat. Expert judgement and indicative MarLIN sensitivity assessments suggests that the l impacts from pots, weights or anchors making contact with Mussel Beds on Mixed and Sandy Sediments habitat could cause damage to the biological communities.<br><br>Confidence in this assessment is **medium** (please see section 8). |

## 3. Feature description

| **Feature Description: Mussel Bed on Mixed and Sandy Sediments** | Juvenile mussels (spat) settle on a variety of intertidal and subtidal seabed types including sediments, mixtures of pebbles, cobbles and boulders, through to bedrock (JNCC, 2015e). Under certain environmental conditions high densities of mussels persist for multiple years, binding together substrates to form mussel beds (JNCC, 2015a).<br><br>Mussel beds on Mixed and Sandy Sediment includes mussel beds found on sand, muddy sand and mixtures of sand, mud, shell, gravel and pebbles. In Wales, there are two variants of this habitat depending on the species of mussel overgrowing and binding together sediments. These are the blue mussel (*Mytilus edulis*), which form mussel beds intertidally and subtidally, and includes one core biotope (described below and defined in Annex 1), and horse mussels (*Modiolus modiolus*) which form subtidal beds and includes two component biotopes (additional biotopes less frequently present in this feature are described in Annex 1, as are sensitivities to relevant pressures). As potting does not occur intertidally this feature description only includes subtidal elements of the feature.<br><br>*Mytilus edulis* beds on sublittoral sediment (SS.SBR.SMus.MytSS) is found in fully marine or outer estuarine shallow sublittoral mixed sediment habitat characterised by beds of blue mussels (JNCC, 2015b). Typical species primarily comprise the blue mussels that form the biogenic reef habitat (Tillin *et al*., 2016). Other common and characterising species include anemones (*Urticina feline)*, nemertean, polychaete worms (*Harmothoe* spp., *Kefersteinia cirrata* and *Heteromastus filiformis*), amphipods (*Gammarus salinus*), other crustaceans e.g. European spider crab (*Maja squinado*), gastropods e.g. dog and common whelks (*Nucella lapillus* and *Buccinum undatum*), common starfish (*Asterias rubens*) and occasionally red algae (JNCC, 2015a and 2015b).<br><br>*Modiolus modiolus* beds on open coast circalittoral mixed sediment (SS.SBR.SMus.ModMx) and *Modiolus modiolus* beds with hydroids and red seaweeds on tide-swept circalittoral mixed substrata (SS.SBR.SMus.ModT) are dense aggregations of horse mussel in deeper water from the infralittoral out to continental shelf seas (JNCC, 2015c; JNCC, 2015d). Found on sediments including muddy gravels and coarse sands (SS.SBR.SMus.ModMx) and mixtures of cobbles, pebbles and coarse muddy sediments (SS.SBR.SMus.ModT) (JNCC, 2015c; JNCC, 2015d). Byssus threads produced by horse mussel bind together sediments, small stones, dead shells and pseudofaeces to form a complex stable and raised habitat providing food resources and refuge to a diverse community of sessile suspension feeders, mobile detritivores and predators (Tillin *et al*., 2015).<br><br>Common epifaunal species within horse mussel beds include brittlestars (*Ophiothrix fragilis*), common starfish (*Asterias rubens*), edible urchin (*Echinus esculentus*), dead-man's fingers (*Alcyonium digitatum*), anemones |
|---|---|

| | |
|---|---|
| | (*Urticina* spp.), hydroids (*Abietinaria abietina* and *Sertularia argentea*), common whelk (*Buccinum undatum*) and in some areas, scallops such as *Pecten maximus, Chlamys* spp. and *Aequipecten opercularis* (Tillin *et al*., 2015). Infaunal species include polychaete worms (*Glycera lapidum*, *Paradoneis lyra*, *Aonides paucibranchiata*, *Laonice bahusiensis*, *Protomystides bidentata*, *Lumbrineris* spp., *Mediomastus fragilis*, *Exogone* spp. and *Sphaerosyllis* spp.), bivalves (*Spisula elliptica and Timoclea ovata*) and brittlestars such as *Amphipholis squamata* (JNCC, 2015c). |

## 4. Gear description

| | |
|---|---|
| **Gear Description: Pots, Traps & Creels** | Pots, traps and creels (pots) are rigid cage-like structures designed to capture fish or shellfish species living on or near the seabed (FAO, 2001; Seafish, 2020a). They typically comprise one or more funnel-shaped entrances that guide fish or shellfish into one or more easily accessed and usually baited compartments (FAO, 2001; Seafish, 2020a).<br><br>UK pot designs, sizes and construction materials vary geographically and according to target species, environmental conditions and fisher's preference (Seafish, 2020a). Top-entry inkwell pots (0.28-0.47 $m^2$ footprint) and side or top-entry parlour pots or 'D-creels' (0.24-0.55 $m^2$ footprint) weighing 15-20kg are used to catch crab or lobster and are made from wire, rubber, metal and netting (Gravestock, 2018; Cornwall Creels, 2020; Seafish, 2020a). Solid sided 20-30 litre rectangular containers with holes in the sides (0.09-0.14 $m^2$ footprint), a mesh funnel at the top, a concrete bottom and weighing 6-12kg are used to target whelks (Channel Pots, 2020; Seafish, 2020c). Lightweight plastic tubular pots with small-mesh sides and funnel entries at either end are used to target prawns (Coastal Nets, 2020; Seafish, 2020a).<br><br>Pots can be fished individually or in strings (fleets), where several pots are attached to a length of rope, laid along the seabed and marked at either end with a rope to the surface and a marker buoy (Seafish, 2020a). The number of pots in a fleet will depend on factors including pot design, target species, habitat fished, fisher's preference, vessel size and the available deck space to store the pots once they have been hauled (Seafish, 2020b).<br><br>Fishers can have multiple strings of pots deployed at any one time, hauled following a soak time of 24-48 hours (Seafish, 2020a). Multi-compartment 'parlour' pots generally retain catch for longer periods making them more suitable for longer soak times, whereas single compartment 'inkwell' pots are subject to more escapees during longer soak times (Swarbrick and Arkley, 2002).<br><br>Strings of lighter traps, such as prawn creels, use anchors or weights at either end to reduce movement in tides (Seafish, 2020a). Other pots are designed to be heavy or utilise concrete-weighted end-pots that replace the |

| | |
|---|---|
| | need for anchors or weights (Seafish, 2020b). Strings of pots are deployed (or shot) one at a time whilst the boat slowly moves over the target fishing ground (Seafish, 2020a). Single pots are generally set in rocky inshore areas and can be bounced along the seabed until they contact rock or reef (FAO, 2001).<br><br>Baited pots can capture undersized target species, non-target invertebrates and occasionally fish species (Pantin *et al*., 2015). However, the use of appropriate-sized mesh coverings, or the addition of large-mesh panels or escape-gaps, can ensure smaller individuals and non-target species are able to escape (Seafish, 2020a). |

## 5. Assessment of impact pathways

| | |
|---|---|
| **Assessment of impact pathway 1** | **1. Physical damage to a designated habitat feature (Physical Impacts)**<br><br>No studies were found that directly measured or estimated physical impacts of potting on Mussel Beds on Mixed and Sandy Sediments or any similar mussel bed habitat. As potting is a subtidal activity it is unlikely to interact with intertidal parts of this habitat.<br><br>Indirect studies highlight that abrasion could result in small areas of mussel bed being damaged or dislodged (Sørensen *et al*., 2015), with recovery dependant on the frequency of the interaction and the area of impact (Tillin and Mainwaring, 2016). When cleared patches occur in blue mussel beds, rapid recovery is possible following a period of good recruitment (Holt *et al*., 1998). However, damaged mussels can attract scavengers which could increase predation on undamaged mussels (Tillin *et al*., 2016).<br><br>Witman and Suchanek (1984) reported that small patches (115cm$^2$) of cleared horse mussel beds in New England (USA) had no re-colonisation after two years. In contrast, Collie *et al*. (2009) reported successful recruitment of horse mussels to settlement panels after two years. However, due to slow growth rates, Collie estimated it would take 10-15 years for clusters of larger horse mussels to re-form. This suggests the full recovery of horse mussel beds from partial clearances due to physical damage or fragmentation should be measured in decades rather than years (Collie *et al*., 2009; Tillin, 2016). Assessments based on expert knowledge suggest that potting may potentially cause physical damage to Mussel Bed on Mixed Sandy Sediments (Roberts *et al*., 2010; Hall *et al*., 2008; JNCC and NE, 2011; Walmsley *et al*., 2015).<br><br>Assessments based on expert knowledge suggest that potting may potentially cause physical damage to Mussel Bed on Mixed Sandy Sediments (Roberts *et al*., 2010; Hall *et al*., 2008; JNCC and NE, 2011; Walmsley *et al*., 2015). |

| | |
|---|---|
| | If potting were to occur across Mussel Beds on Mixed and Sandy Sediments, the general physical impacts from static gear, including pots, weights or anchors making contact with the seabed during gear deployment could cause surface disturbance and abrasion (JNCC and NE, 2011; Walmsley *et al*., 2015), which could lead to the erosion of the mussel bed and underlying sediments (Widdows *et al.,* 2002*)*. Where pots are fixed in strings, the retrieval of pots, or incidences of rough weather, could lead to ropes, pots and anchors dragging over, or entangling seabed structures, potentially causing physical damage or abrasion to the seabed (MacDonald *et al*., 1996; Roberts *et al*., 2010; JNCC and NE, 2011). During spring tides, strong wind and large waves, unintentional movement of pots and any associated seabed abrasion could be increased (Eno *et al*., 2001; Sørensen *et al*., 2015; Stephenson *et al*., 2015).<br><br>In addition to the abiotic physical substrate, the Mussel Bed on Mixed Sandy Sediment habitat is comprised of a biogenic physical structure created by the mussels. Mussel Bed on Mixed Sandy Sediment biotopes have been assessed to a range of pressures by MarLIN (Tyler-Walters *et al*., 2018). Relevant pressures for the assessment of potting impacts are primarily abrasion and penetration of the sediment. MarLIN abrasion and penetration sensitivity assessments for Mussel Beds on Mixed and Sandy Sediment biotopes shown in Annex 1 conclude: the Blue Mussel (*M. edulis*) biotopes have a medium sensitivity to abrasion and penetration, whilst the Horse Mussel (*M. modiolus*) biotopes have a high sensitivity to abrasion and penetration. Please refer to the MarLIN website which provides further information about the assessment methodology and the supporting evidence (www.marlin.ac.uk/).<br><br>Depending on the footprint and the intensity of potting, it is possible that the physical impacts from pots, weights or anchors making contact with Mussel Bed on Mixed Sandy Sediment habitat could cause damage to the biogenic substrate. Horse mussel (*Modiolus modiolus*) beds take many years to recover (Witman and Suchanek, 1984). The recruitment potential of blue mussels (*Mytilus edulis*) could allow rapid recovery if significant parts of the original bed remain, with recovery to pre-impact levels expected within 2-10 years depending on the severity of the impact (Tillin and Mainwaring, 2015; Tillin *et al*., 2015; Tillin *et al*., 2016). |
| **Assessment of impact pathway 2** | **2. Damage to a designated habitat feature via removal of, or other detrimental impact to, associated biological species (Impacts on Biological Communities)**<br><br>No studies were found that directly or indirectly measured impacts of potting on typical species of Mussel Beds on Mixed and Sandy Sediments or similar habitat. As potting is a subtidal activity it is unlikely to interact with intertidal parts of this habitat.<br><br>Assessments based on expert knowledge suggest that potting may potentially cause physical damage to Mussel Bed on Mixed Sandy Sediments (Roberts *et al*., 2010; Hall *et al*., 2008; JNCC and NE, 2011; Walmsley *et al*., 2015). |

| | |
|---|---|
| | Mobile species are less vulnerable to physical damage from potting compared to sessile epifauna (Gall *et al.,* 2020). Echinoderms (*Asterias rubens* and *Echinus esculentus*) rolled or were gently moved away from the pot impact zone by the pressure wave preceding the moving pot (Gall *et al.,* 2020). Assessments by Langmead *et al*. (2010) classified the soft coral 'dead-man's fingers' (*A. digitatum*), found on horse mussel beds, as 'fragile' in relation to physical impacts, whilst blue mussel, horse mussel, the boring sponge (*Cliona celata*) and anemones (e.g. *Urticina s*pp.) were classified as having 'intermediate' vulnerability to physical impact.<br><br>If potting were to occur across Mussel Bed on Mixed and Sandy Sediments, the general physical impacts from static gear, including pots, weights or anchors, making contact with the mixed and sandy sediments during gear deployment could cause surface disturbance and abrasion to biological communities (JNCC and NE, 2011; Walmsley *et al*., 2015). Where pots are fixed in strings, the retrieval of pots, or incidences of rough weather, could lead to ropes, pots and anchors dragging over or entangling the mixed and sandy sediments, potentially causing physical damage or abrasion to the biological communities (MacDonald *et al*., 1996; Roberts *et al*., 2010; JNCC and NE; 2011, Gall *et al*., 2020). During spring tides, strong wind and large waves may cause unintentional movement of pots and any associated seabed abrasion could be increased (Eno *et al*., 2001; Sørensen *et al*., 2015; Stephenson *et al*., 2015).<br><br>Mussel Beds on Mixed and Sandy Sediment biotopes have been assessed to a range of pressures by MarLIN (Tillin *et al*., 2016). Relevant pressures for the assessment of potting impacts are primarily abrasion and penetration of the sediment. MarLIN abrasion and penetration sensitivity assessments for Mussel Beds on Mixed and Sandy Sediment biotopes shown in Annex 1 conclude: the Blue Mussel (*M. edulis*) biotopes have a medium sensitivity to abrasion and penetration, whilst the Horse Mussel (*M. modiolus*) biotopes have a high sensitivity to abrasion and penetration.<br><br>Please refer to the MarLIN website which provides further information about the assessment methodology and the supporting evidence (www.marlin.ac.uk/).<br><br>Depending on the footprint and the intensity of potting, it is possible that the impacts from pots, weights or anchors making contact with Mussel Bed on Mixed Sandy Sediment habitat could damage the biological communities of horse mussel (*Modiolus modiolus*) beds. The recruitment potential of blue mussels (*Mytilus edulis*) could allow rapid recovery if significant parts of the original bed remain, with recovery to pre-impact levels expected within 2-10 years depending on the severity of the impact (Tillin and Mainwaring, 2015; Tillin *et al*., 2015; Tillin *et al*., 2016). |

## 6. SACs where the habitat occurs as a component of a designated feature

| | |
|---|---|
| **Lleyn Peninsula and the Sarnau SAC** | The Lleyn Peninsula and the Sarnau SAC contains examples of the mussel bed on mixed sandy sediments habitat, as evidenced by data and relevant literature (NRW, 2018a). Please see the latest SAC feature condition assessment for information on the location and condition of features.<br><br>The following features contain mussel bed on mixed sandy sediments habitat within the Lleyn Peninsula and the Sarnau SAC:<br>1. Reefs<br>2. Estuaries<br>3. Mudflats and sandflats not covered by seawater at low tide (at the lower (seaward) edge) |
| **Menai Strait and Conwy Bay SAC** | The Menai Strait and Conwy Bay SAC contains examples of the mussel bed on mixed sandy sediments habitat, as evidenced by data and relevant literature (NRW, 2018b). Please see the latest SAC feature condition assessment for information on the location and condition of features.<br><br>The following features contain mussel bed on mixed sandy sediments habitat within the Menai Strait and Conwy Bay SAC:<br>1. Large Shallow Inlets and Bays<br>2. Mudflats and sandflats not covered by seawater at low tide (at the lower (seaward) edge)<br>3. Reefs |
| **Cardigan Bay SAC** | The Cardigan Bay SAC contains examples of the mussel bed on mixed sandy sediments habitat, as evidenced by data and relevant literature (NRW, 2018c). Please see the latest SAC feature condition assessment for information on the location and condition of features.<br><br>The following features contain mussel bed on mixed sandy sediments habitat within the Cardigan Bay SAC:<br>1. Reefs |
| **Carmarthen Bay and Estuaries SAC** | The Carmarthen Bay and Estuaries SAC contains examples of the mussel bed on mixed sandy sediments habitat, as evidenced by data and relevant literature (NRW, 2018d). Please see the latest SAC feature condition assessment for information on the location and condition of features.<br><br>The following features contain mussel bed on mixed sandy sediments habitat within the Carmarthen Bay and Estuaries SAC:<br>1. Estuaries |

| | |
|---|---|
| | 2. Large Shallow Inlets and Bays<br>3. Mudflats and sandflats not covered by seawater at low tide (at the lower (seaward) edge) |

## 7. Evidence Gaps

- Direct studies to measure the impacts from potting on Mussel Beds on Mixed and Sandy Sediments.
- A study comparing the impacts from different types of pots and methods of potting.
- Map the distribution and extent of the AWFA Mussel Bed on Mixed and Sandy Sediments habitat.

## 8. Confidence assessment

The confidence score is the sum of scores from three evidence components: quality, applicability and agreement. These are qualitatively assessed as high, medium or low using the most appropriate statements in the table below, and these are numerically represented as scores of 3, 2, or 1 respectively.

A total confidence score of 3 – 5 represents low confidence, 6 or 7 shows medium confidence and 8 or 9 demonstrates high confidence in the evidence used in the assessment.

**This assessment scores 6, representing medium confidence in the evidence.**

| Confidence | Evidence quality | Evidence applicability | Evidence agreement |
|---|---|---|---|
| **High** | Based on more than 3 recent and relevant peer reviewed papers or grey literature from established agencies. | Based on the fishing gear acting on the feature in the UK. | Strong agreement between multiple (>3) evidence sources. |
| **Medium** | **Based on either relevant but older peer reviewed papers or grey literature from less established agencies; or based on only 2-3 recent and relevant peer reviewed evidence sources. Score 2.** | **Based on similar fishing gears, or other activities with a similar impact, acting on the feature in the UK. Score 2.** | **Some disagreement but majority of evidence agrees. Or fewer than 3 evidence sources used. Score 2.** |
| **Low** | Based on either less relevant or older grey literature from less established agencies; or based on only 1 recent and relevant peer reviewed evidence source. | Based on similar fishing gears acting on the feature in other areas, or the fishing gear acting upon a similar feature in the UK. | Little agreement between evidence. |

N.B. When evidence is indirect the evidence quality and applicability will be capped to medium, to ensure that direct evidence gaps are captured in this approach.

## 9. References


Channel Pots. (2020). Suppliers of whelk pots since 2015. [Accessed 10th August 2020]. https://www.channelpots.co.uk.

Coastal nets. (2020). Crab, Lobster, Crayfish, Cuttlefish, Whelk Pots & Potting Components. [Accessed 10th August 2020]. https://www.coastalnets.co.uk.

Collie, J.S., Hermsen, J.M. & Valentine, P.C. (2009). Recolonization of gravel habitats on Georges Bank (northwest Atlantic). Deep-Sea Research Part II, 56 (19-20), 1847-1855.

Cornwall Creels. (2020). Plastic coated pot frames. [Accessed 28th July 2020]. https://www.cornwallcreels.co.uk.

Eno, N.C., MacDonald, D.S., Kinnear, J.A.M., Amos, C.S., Chapman, C.J., Clark, R.A., Bunker, F. StP.D. & Munro, C. (2001). Effects of crustacean traps on benthic fauna. ICES Journal of Marine Science, 58: 11–20.

FAO. (2001). Fishing Gear types. Pots. Technology Fact Sheets. In: FAO Fisheries and Aquaculture Department [online]. Rome. Updated 13 September 2001. [Accessed 04th February 2020]. www.fao.org/fishery/geartype/225/en.

Gall, S.C., Rodwell, L.D., Clark, S., Robbins, T., Attrill, M.J., Holmes, L.., & Sheehan, E.V. (2020). The impact of potting for crustaceans on temperate rocky reef habitats: Implications for management. Marine Environmental Research, 105134.

Gravestock, V. (2018). The Needles MCZ – Part B Fisheries Assessment – Potting.

Hall, K., Paramor, O.A.L., Robinson L.A., Winrow-Giffin, A., Frid C.L.J., Eno, N.C., Dernie, K.M., Sharp, R.A.M., Wyn, G.C.& Ramsay, K. (2008). Mapping the sensitivity of benthic habitats to fishing in Welsh waters- development of a protocol. CCW [Policy Research] Report No: [8/12], 85pp.

Holt, T.J., Rees, E.I., Hawkins, S.J. & Seed, R. (1998). Biogenic reefs (Volume IX). An overview of dynamic and sensitivity characteristics for conservation management of marine SACs. Scottish Association for Marine Science (UK Marine SACs Project), 174 pp.

JNCC and Natural England. (2011). Advice from the Joint Nature Conservation Committee and Natural England with regards to fisheries impacts on Marine Conservation Zone habitat features. 113 pp.

JNCC. (2015a). The Marine Habitat Classification for Britain and Ireland Version 15.03. *Mytilus edulis* beds on littoral sediments (LS.LBR.LMus.Myt). [Accessed 03/06/2020]. Available from: https://mhc.jncc.gov.uk/biotopes/jnccmncr00000063.

JNCC. (2015b). The Marine Habitat Classification for Britain and Ireland Version 15.03. *Mytilus edulis* beds on sublittoral sediment (SS.SBR.SMus.MytSS). [Accessed 03/06/2020]. Available from: https://mhc.jncc.gov.uk/biotopes/jnccmncr00001202.

JNCC. (2015c). The Marine Habitat Classification for Britain and Ireland Version 15.03. *Modiolus modiolus* beds on open coast circalittoral mixed sediment (SS.SBR.SMus.ModMx). [Accessed 03/06/2020]. Available from: https://mhc.jncc.gov.uk/biotopes/jnccmncr00000660.

JNCC. (2015d). The Marine Habitat Classification for Britain and Ireland Version 15.03. *Modiolus modiolus* beds with hydroids and red seaweeds on tide-swept circalittoral mixed substrata. [Accessed 03/06/2020]. Available from: https://mhc.jncc.gov.uk/biotopes/jnccmncr00000657.

JNCC. (2015e). The Marine Habitat Classification for Britain and Ireland Version 15.03. [Accessed 02/06/2020]. Available from: https://mhc.jncc.gov.uk.

Langmead, O., Jackson, E.L., Bayley, D.T.I., Marshall, C. & Gall, S.C. (2010). Assessment of the long-term effects of fishery area closures on long-lived and sessile species. Report to Defra from the Marine Life Information Network (MarLIN). p. 68. Defra contract No. MB0101, Plymouth: Marine Biological Association of the UK.

MacDonald, D.S., Little, M., Eno, N.C. & Hiscock, K. (1996). Disturbance of benthic species by fishing activities: a sensitivity index. Aquatic Conservation: Marine and Freshwater Ecosystems, 6(4), 257-268.

NRW. (2018a). Pen Llŷn a'r Sarnau/Lleyn Peninsula and the Sarnau Special Area of Conservation Advice provided by Natural Resources Wales in fulfilment of Regulation 37 of the Conservation of Habitats and Species Regulations 2017. Natural Resources Wales, Bangor pp 143.

NRW. (2018b). Menai Strait & Conwy Bay / Y Fenai a Bae Conwy Special Area of Conservation. Advice provided by Natural Resources Wales in fulfilment of Regulation 37 of the Conservation of Habitats and Species Regulations 2017. Natural Resources Wales, Bangor pp 107.

NRW, (2018c). Cardigan Bay / Bae Ceredigion Special Area of Conservation: Indicative site level feature condition assessments 2018. NRW Evidence Report Series, Report No: 226, 39pp, NRW, Bangor.

NRW, (2018d). Carmarthen Bay and Estuaries / Bae Caerfyrddin ac Aberoedd Special Area of Conservation: Indicative site level feature condition assessments 2018. NRW Evidence Report Series, Report No: 225, 49pp, NRW, Bangor.

Pantin, J.R., Murray, L.G., Cambiè, G., Le Vay, L. & Kaiser, M.J. (2015). Escape Gap Study in Cardigan Bay: consequences of using lobster escape gaps. A Preliminary Report. Fisheries & Conservation report No. 44, Bangor University. 43 pp.

Roberts, C., Smith, C., Tillin, H. Tyler-Walters, H. (2010). Review of existing approaches to evaluate marine habitat vulnerability to commercial fishing activities. November 2010.

Seafish. (2020a). Fishing Gear Database: Pots and traps - general. [Accessed 04th February 2020]. https://seafish.org/gear-database/gear/pots-and-traps/.

Seafish. (2020b). Fishing Gear Database: Pots and traps - lobster. [Accessed 24th February 2020]. https://seafish.org/gear-database/gear/pots-and-traps-lobster/.

Seafish. (2020c). Fishing Gear Database: Pots and trap – nephrops. [Accessed 24th February 2020]. https://seafish.org/gear-database/gear/pots-and-trap-nephrops/.

Sørensen, T.K., Larsen, F. & Bridda, J. (2015). Impacts of bottom-set gillnet anchors on the seafloor and associated flora – potential implications for fisheries management in protected areas. In von Nordheim, H. & Wollny-Goerke, K. (eds) Proceedings of the Conference "Progress in Marine Conservation in Europe 2015" in Stralsund, Germany, 14-18 September 2015. Published 2016 and available online: https://www.bfn.de/fileadmin/BfN/service/Dokumente/skripten/Skript451.pdf.

Stephenson, F., Fitzsimmons, C., Polunin, N.V.C., Mill, A.C. & Scott, C.L. (2015). Assessing Long-Term Benthic Impacts of Potting in Northumberland. IN Walmsley, S.F., Bowles, A., Eno, N.C. & West, N. (2015). Evidence for Management of Potting Impacts on Designated Features. MMO1086 Defra Marine Biodiversity Impact Evidence Group (IEG). Final Report pp1 – 111.

Swarbrick, J. & Arkley, K. (2002). The evaluation of ghost fishing preventers for shellfish traps. Seafish Report No SR549. 46 pp.

Tillin, H.M., Tyler-Walters, H. & Garrard, S.L. (2015). *Modiolus modiolus* beds with hydroids and red seaweeds on tide-swept circalittoral mixed substrata. In Tyler-Walters H. and Hiscock K. (eds) Marine Life Information Network: Biology and Sensitivity Key Information Reviews. Plymouth: Marine Biological Association of the United Kingdom. [Accessed 15-06-2020]. Available from: https://www.marlin.ac.uk/habitat/detail/137.

Tillin, H.M. (2016). *Modiolus modiolus* beds on open coast circalittoral mixed sediment. In Tyler-Walters H. and Hiscock K. (eds) Marine Life Information Network: Biology and Sensitivity Key Information Reviews. Plymouth: Marine Biological Association of the United Kingdom. [Assessed 15-06-2020]. Available from: https://www.marlin.ac.uk/habitat/detail/342.

Tillin, H.M., Mainwaring, K. & Garrard, S.L. (2016). *Mytilus edulis* beds on sublittoral sediment. In Tyler-Walters H. and Hiscock K. (eds) Marine Life Information Network: Biology and Sensitivity Key Information Reviews. Plymouth: Marine Biological Association of the United Kingdom. [Accessed 15-06-2020]. Available from: https://www.marlin.ac.uk/habitat/detail/36.

Tyler-Walters, H. & Jackson, A. (1999). Assessing seabed species and ecosystems sensitivities. Rationale and user guide, January 2000 edition. Report to English Nature, Scottish Natural Heritage and the Department of the Environment Transport and the Regions from the Marine Life Information Network (MarLIN). Plymouth, Marine Biological Association of the UK. (MarLIN Report No. 4.).

Tyler-Walters, H., Tillin, H.M., d'Avack, E.A.S., Perry, F. & Stamp, T. (2018). Marine Evidence-based Sensitivity Assessment (MarESA) – A Guide. Marine Life Information Network (MarLIN). Marine Biological Association of the UK, Plymouth, pp. 91. Available from https://www.marlin.ac.uk/publications.

Walmsley, S.F., Bowles, A., Eno, N.C. & West, N. (2015). Evidence for Management of Potting Impacts on Designated Features. MMO1086 Defra Marine Biodiversity Impact Evidence Group (IEG). Final Report pp1 – 111.

Widdows, J., Lucas, J.S., Brinsley, M.D., Salkeld, P.N. & Staff, F.J. (2002). Investigation of the effects of current velocity on mussel feeding and mussel bed stability using an annular flume. Helgoland Marine Research, 56(1), 3-12.

Witman, J.D. & Suchanek, T.H. (1984). Mussels in flow: drag and dislodgement by epizoans. Marine Ecology Progress Series, 16 (3), 259-268.

## Annex 1: Welsh biotopes included in the AWFA potting and Mussel Bed on Mixed and Sandy Sediments assessment

The term ‘biotope’ refers to both the physical environment (e.g. substrate) and the unique set of species associated with that environment (Tyler-Walters and Jackson, 1999). Biotopes are defined by the JNCC Marine Habitat Classification for Britain and Ireland Version 15.03 (https://mhc.jncc.gov.uk/) and sensitivities to abrasion and penetration are from the Marine Evidence based Sensitivity Assessment (MarESA) (https://www.marlin.ac.uk/sensitivity/sensitivity_rationale). The MarESA approach considers a range of pressures and benchmarks for all biotopes using all available evidence and expertise (Tyler-Walters *et al*., 2018). The MarESA sensitivity to abrasion and penetration assessments highlighted in the table below consider any type of potential abrasion to the surface substratum and associated biology and do not specifically refer to potting activity (Tyler-Walters *et al*., 2018). High sensitivity indicates a significant loss of species combined with a recovery time of more than 10 years. Medium sensitivity indicates either significant mortality combined with medium recovery times (2-10 years) or lower mortality with recovery times varying from 2 to 25+ years. Whilst a low sensitivity indicates a full recovery within 2 years.

| **Littoral sediments** | **MarESA sensitivity to abrasion** | **MarESA sensitivity to penetration** |
|---|---|---|
| LS.LBR.LMus.Myt | Medium | Medium |
| LS.LBR.LMus.Myt.Mu | Medium | Medium |
| LS.LBR.LMus.Myt.Mx | Medium | Medium |
| LS.LBR.LMus.Myt.Sa | Medium | Medium |
| | | |
| **Sublittoral sediments** | | |
| SS.SBR.SMus.ModCvar | High | High |
| SS.SBR.SMus.ModHAs | High | High |
| SS.SBR.SMus.ModMx | High | High |
| SS.SBR.SMus.ModT | High | High |
| SS.SBR.SMus.MytSS | Medium | Medium |

Note: where the % cover of cobbles and/or boulders approaches or exceeds 10% cover of the substratum, the LS.LBR.LMus.Myt.Mx and LS.LBR.LMus.Myt biotopes can also be part of the ‘Mussel Beds on Boulder and Cobble Skears’ habitat.