Beam Trawl (Shrimp) on Maerl

Introduction

The Assessing Welsh Fisheries Activities Project is a structured approach to determine the impacts from current and potential fishing activities, from licensed and registered commercial fishing vessels, on the features of Marine Protected Areas.

1. Gear and Feature	Beam Trawl (Shrimp) on Maerl
2. Risk Level	Purple (High risk)
3. Description of Feature	Maerl is a generic term for nodule forming calcareous red algae and is comprised of three species in Britain; *Phymatolithon calcareum*, *Lithothamnion coralloides* and *Lithothamnion glaciale*. **The 'maerl beds' biotope complex (SS.SMp.Mrl)** encompasses a number of biotopes (see annex 1 for full biotope description). *Phymatolithon calcareum* dominates in SMp.Mrl.Pcal (and its sub-biotopes SMp.Mrl.Pcal.R and SMp.Mrl.Pcal.Nmix), *Lithothamnion corallioides* dominates in SMp.Mrl.Lcor and *Lithothamnion glaciale* dominates in variable salinity (SMp.Mrl.Lgla). In all cases the dominant maerl forms a unique habitat that supports a diverse assemblage of species (Perry & Tyler-Walters, 2016). Both *Phymatolithon calcareum* and *Lithothamnion coralloides* are listed in the EC Habitats Directive Annex V (EC, 1992) which restricts the exploitation and taking in the wild. *Lithothamnion corallioides* is listed on Section 7 of the Environment (Wales) Act 2016 and the OSPAR list of threatened and/or declining species and habitats. *Phymatolithon calcareum* and *Lithothamnion corallioides* form the only live maerl bed known in Wales (Bunker *et al,* 2007; Carro *et al,* 2014). Beds of maerl predominantly occur in coarse clean sediments of

	gravels and clean sands, either on the open coast or in tide-swept channels or sheltered areas of marine inlets. In fully marine conditions the dominant maerl is typically *Phymatolithon calcareum* (SMp.Mrl.Pcal) (Perry & Tyler-Walters, 2016). Maerl is a fragile long lived and slow growing calcified red algae which grows in unattached nodules on the seabed. It favours clear clean seawater, is intolerant of siltation (Wilson *et al*, 2004) and thrives mainly in areas of moderate tidal flow (Bunker *et al*, 2007). Maerl beds are an important habitat for a multitude of animals and plants which live attached to the branches, in the spaces between, or burrow in the coarse gravel of dead maerl beneath (Bunker *et al*, 2007). As maerl requires light to photosynthesize, the depth of live beds is determined by water turbidity, it can occur from the lower shore to approximately 40m (Hall-Spencer *et al*, 2010), although in Welsh waters the distribution is restricted to shallower waters.
4. Description of Gear	A beam trawl consists of a cone-shaped body of net ending in a bag or codend, which retains the catch. In these trawls the horizontal opening of the net is provided by a beam, made of wood or metal, attached to two solid metal plates called ‘shoes’. These ‘shoes’ are welded to the end of the beam which slide over the seabed when the beam and net are dragged by the vessel (FAO, 2001). When fishing for flatfish, mainly sole or plaice, the beam trawl is equipped with tickler chains to disturb the fish from the seabed. For operations on rough fishing grounds chain matrices/mats can be used. Chain matrices/mats are rigged between the beam and the ground rope to prevent damage to the net and to prevent boulders/stones from being caught by the trawl. A beam trawl is normally towed on outriggers with one 4m beam trawl on each side of a powerful vessel, the gear can reach a weight of up to 9000kg. A ‘Eurocutter’ beam trawler with an engine power <221Kw will leave parallel trawl tracks of approximately 4m wide and 11m apart on the seabed (ICES, 2014). The total length of the net used on

	a ‘Eurocutter’ should be between 10 and15m. Inshore vessels may use one smaller beam, approximately 2m, off the stern of the vessel. The total length of the net should be about 5m. The penetration depth of a beam trawl ranges from 1 to 8cm but depends on the weight of the gear and the towing speed, as well as on the type of substrate (Paschen *et al*, 2000). **Beam trawl (shrimp)** gear is lighter than a flat fish beam trawl, the trawl net has a smaller mesh size and does not use tickler chains. A ground rope with rubber bobbins is used, this rolls over the sea bed to flush up the shrimp, keeping the shrimp beam trawl in contact with the bottom and gives flatfish an opportunity to escape. There is a requirement for all trawls fishing for shrimp in Welsh waters to be fitted with a separator trawl (veil) or sorting grid (Welsh Government, 2008) to reduce bycatch of fish.
5. Assessment of Impact Pathways: 1. Damage to a designated habitat feature (including through direct physical impact, pollution, changes in thermal regime, hydrodynamics, light etc). 2. Damage to a designated habitat feature via removal of, or other detrimental impact on, typical species.	There are a lack of studies specifically investigating the impacts of beam trawling (shrimp) on maerl communities; therefore it is necessary to widen the research parameters to include other comparable bottom contacting mobile gear. **1.** A study by Hall-Spencer & Moore (2000a) investigated the profound long term impacts of scallop dredging on maerl habitats, and although the study title gear differs, a comparison is frequently drawn between scallop dredging and demersal trawling throughout the article. Hall-Spencer & Moore (2000a) state that the integrity of maerl habitat depends upon the survival of a surface layer of slow-growing algae. The action of the beam trawl shoes and ground rope, like the impacts from scallop dredges, will affect the maerl by coming into direct contact with the slow growing surface layers, causing lethal disturbance and destruction of the maerl. Beam trawls cause direct mortality to non-target organisms through shoe, tickler chain or chain mat impact on the seabed (Bergman & van Santbrink, 2000).

	In maerl areas, rhodolith-forming algae disappears under moderate trawling pressure and recovery would take many decades or never happen, due to the slow growth rates of these species (Bordehore *et al*, 2003). Growth rates of European maerl species range between tenths of a millimetre to 1 millimetre per annum (Bosence & Wilson, 2003). Maerl beds represent a non-renewable resource as extraction and disruption far out-strips their slow rate of accumulation (Barbera *et al*, 2003). Hall-Spencer & Moore (2000a) also indicated that the maerl will be indirectly affected by smothering from redistributed sediment after the beam trawl has passed. Maerl algae will eventually die in prolonged periods without sunlight. The study concludes that a single tow of three dredges caused sediment redistribution onto the live maerl that was clearly discernible four years after the event. Given the similar nature of sediment disturbance caused by these towed demersal fishing gears, it can be assumed that shrimp beam trawling could cause a similar degree of sediment disturbance and live maerl burial. Wilson *et al* (2004) recognise trawling as one of the main anthropogenic hazards for live maerl. In their study (Environmental tolerances of free-living coralline algae (maerl): implications for European marine conservation) they conclude that maerl burial, especially in fine or anoxic sediments, was lethal or caused significant stress. **In conclusion**; although beam trawls used to fish for shrimp are lighter than flat fish beam trawls, the mesh on the nets is smaller and they do not use chain matrices/mats but a ground rope with rubber bobbins to roll over the seabed, any direct contact between beam trawl (shrimp) fishing gear and a maerl bed could cause lethal damage. However, recovery could occur, but due to slow growth rates this may take many decades. Repeated fishing would further reduce the rate of recovery or it may not happen at all. **2.** Maerl beds support diverse communities of burrowing infauna,

	especially bivalves, and interstitial invertebrates; including suspension feeding polychaetes and echinoderms (Perry and Tyler Walters, 2016). Maerl is known as a particularly diverse habitat with over 150 macroalgal species and 500 benthic faunal species recorded (Birkett *et al*, 1998). The sea cucumber *Neopentadactyla mixta* can reach densities of up to 400/m² in loose gravels such as maerl (Smith & Keegan, 1985). Hall-Spencer & Moore (2000b,c) examined the recovery of maerl community after scallop dredging in previously un-dredged and dredged sites in Scotland. In comparison with control plots, mobile epibenthos returned within one month; fleshy macroalgae within six months; the abundance of *Cerianthus lloydii* was not significantly different after 14 months; other epifauna (e.g. *Lanice conchilega* and *Ascidiella aspersa*) returned after 1-2 years; but some of the larger sessile surface species (e.g. sponges, *Metridium senile*, *Modiolus modiolus* and *Limaria hians*) exhibited lower abundances on dredged plots after four years. Work by Hall-Spencer & Moore (2000b) on maerl beds showed that four years after the initial disturbance had occurred, certain fauna, such as the nest building bivalve *Limaria hians*, had still not recolonized trawl tracks. It was also shown that live mearl was buried up to 8cm below the sediment surface and carbonate structures (maerl thalli, echinoid test plates and bivalve shells) were crushed and compacted. Although some of the live mearl that had been buried was still alive initially, if the area is sheltered and the tidal movement did not wash away the sediment then the maerl would eventually die. Hall-Spencer (1999) discovered that days after dredging had taken place natural bottom features (e.g. sediment ripples, crab feeding pits and megafaunal burrows) were eliminated along the dredge tracks and boulders up to 1m² had been dragged along the sediment surface. A shift in granulometric structure of the surface layer of sediment was evident by comparison with adjacent, unfished areas. Mud and sand had been brought to the surface of the tracks and maerl gravel had been sculpted into 3cm high ridges at the edge of

		each dredge path. It is also suggested that maerl beds are a nursey ground for a number of marine shellfish species such as king scallops *Pecten maximus*, queen scallops *Aequipecten opercularis* and *Mya arenaria* (Kamenos *et al*, 2004), **In conclusion**, the current evidence regarding the recovery of maerl suggests that if maerl is removed, fragmented or killed then it has almost no ability to recover. If the maerl is killed but the bed remains (a bed of dead maerl) then then the resident community (but not the maerl) may recover within 2-10 years, but where the maerl is fragmented, species richness will probably decrease (Perry and Tyler Walters, 2016).
6. MPAs where feature exists	**Pembrokeshire Marine SAC**	In Milford Haven, *Phymatolithon calcareum* and *Lithothamnion corallioides* form the only live maerl bed known in Wales. It is an ancient bed with a sample of fossil maerl collected from Stack Rock having a calibrated age of between 184 BC to 12 AD (Blake, 2005). The maerl bed is confined (with high confidence) between the LNG jetty access trestle and Stack Rock Fort (Bunker *et al,* 2007). The maerl bed is a component part of the Estuaries and the Large Shallow Inlet and Bays features of the Pembrokeshire Marine SAC. Within the area the maerl bed occurs the Welsh Government's Byelaw 39 limits the size of a beam to 4m. The assessment information presented above can be used to conclude that the impact from a smaller 2 or 3m beam will cause the same initial damage as a larger beam, over the area covered.

7. Conclusion

The information presented above indicates that the action of fishing with beam trawl (shrimp) gear directly on maerl beds is likely to cause lethal damage to the maerl and associated species, whilst recovery, which may take many years, is potentially possible, this would be less likely if fishing activity was repeated. Additionally, fishing with beam trawl (shrimp) gear adjacent to maerl beds could have a negative impact from short or long term smothering, this impact would depend on the extent and frequency of the activity and the tidal and environmental conditions in the area of the habitat.

8. References

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Annex 1
Biotope descriptions (version 15.03) (JNCC - http://jncc.defra.gov.uk/marine/biotopes/hierarchy.aspx?level=5)

SS.SMp.Mrl.Pcal - *Phymatolithon calcareum* maerl beds in infralittoral clean gravel or coarse sand
Maerl beds characterised by *Phymatolithon calcareum* in gravels and sands. Associated epiphytes may include red algae such as *Dictyota dichotoma, Halarachnion ligulatum, Callophyllis laciniata, Cryptopleura ramosa, Brongniartella byssoides* and *Plocamium cartilagineum*. Algal species may be anchored to the maerl or to dead bivalve shells amongst the maerl. Polychaetes, such as *Chaetopterus variopedatus, Lanice conchilega, Kefersteinia cirrata, Mediomastus fragilis, Chone duneri, Parametaphoxus fultoni* and *Grania* may be present. Gastropods such as *Gibbula cineraria, Gibbula magus, Calyptraea chinensis Dikoleps pusilla* and *Onoba aculeus* may also be present. *Liocarcinus depurator* and *Liocarcinus corrugatus* are often present, although they may be under-recorded; it would seem likely that robust infaunal bivalves such as *Circomphalus casina, Mya truncata, Dosinia exoleta* and other venerid bivalves are more widespread than available data currently suggests. It seems likely that stable wave-sheltered maerl beds with low currents may be separable from SMP.Pcal; having a generally thinner layer of maerl overlying a sandy /muddy substratum with a diverse cover of epiphytes (e.g. Bosence 1976; Blunden et al. 1977; 1981; Davies & Hall-Spencer 1996) but insufficient data currently exists on a national scale. Wave and current-exposed maerl beds, where thicker depths of maerl accumulate, frequently occur as waves and ridge / furrows arrangements (see Bosence 1976; Blunden et al. 1977; 1981; Irvine & Chamberlain 1994; Hall-Spencer 1995). At some sites where Pcal occurs, there may be significant patches of maerl gravel containing the rare burrowing anemone *Halcampoides elongatus*; this may be a separate biotope, but insufficient data exists at present. Northern maerl beds in the UK do not appear to contain *L. corallioides* but in south-west England and Ireland *L. corallioides* may occur to some extent in Pcal as well as Lcor, where it dominates.

SMp.Pcal.R - *Phymatolithon calcareum* maerl beds with red seaweeds in shallow infralittoral clean gravel or coarse sand
Upper infralittoral maerl beds characterised by *Phymatolithon calcareum* in gravels and sand with a wide variety of associated red seaweeds. These algae typically include *Dictyota dichotoma, Plocamium cartilagineum, Phycodrys rubens, Chondrus crispus, Halarachnion ligulatum, Chylocladia verticillata, Hypoglossum hypoglossoides* and *Nitophyllum punctum*. These species are not restricted to maerl beds but their abundance on maerl beds differentiates this biotope from Pcal.Nmix. Anthozoans and echinoderms are much less common in this biotope than in Pcal.Nmix, which typically occurs deeper than Pcal.R.

SMp.Pcal.Nmix - *Phymatolithon calcareum* maerl beds with *Neopentadactyla mixta* and other echinoderms in deeper infralittoral clean gravel or coarse sand
Lower infralittoral maerl beds characterised by *Phymatolithon calcareum* in gravels and sand with a variety of associated echinoderms. The echinoderm *Neopentadactyla mixta* is frequently observed in this biotope. Other echinoderms such as *Echinus esculentus, Ophiura albida* and rarely *Luidia ciliaris* may also be present. Red seaweed such as *Plocamium cartilagineum* may be present but at a much lower abundance than in Pcal.R and with fewer species present. Other, more ubiquitous echinoderms such as *Asterias rubens* may also be found in low numbers throughout Pcal biotopes.

SMp.Mrl.Lcor - *Lithothamnion corallioides* maerl beds on infralittoral muddy gravel
Live maerl beds in sheltered, silty conditions which are dominated by *Lithothamnion corallioides* with a variety of foliose and filamentous seaweeds. Live maerl is at least common but there may be noticeable amounts of dead maerl gravel and pebbles. Other species of maerl, such as *Phymatolithon calcareum* and *Phymatolithon purpureum*, may also occur as a less abundant component. Species of seaweed such as *Dictyota dichotoma, Halarachnion ligulatum* and *Ulva* spp. are often present, although are not restricted to this biotope, whereas *Dudresnaya verticillata* tends not to occur on other types of maerl beds. The anemones *Anemonia viridis* and *Cerianthus lloydii*, the polychaetes *Notomastus latericeus* and *Caulleriella alata*, the isopod *Janira maculosa* and the bivalve *Hiatella arctica* are typically found in SMP.Lcor where as *Echinus esculentus* tends to occur more in other types of maerl. The seaweeds *Laminaria saccharina* and *Chorda filum* may also be present in some habitats. Lcor has a south-western distribution in Britain and Ireland. Sheltered, stable, fully saline maerl beds in the north of Great Britain (where *L. corallioides* has not been confirmed to occur) may need to be described as an analogous biotope to Lcor (see Pcal).

SMp.Lgla - *Lithothamnion glaciale* maerl beds in tide-swept variable salinity infralittoral gravel
Upper infralittoral tide-swept channels of coarse sediment in full or variable salinity conditions support distinctive beds of *Lithothamnion glaciale* maerl 'rhodoliths'. *Phymatolithon calcareum* may also be present as a more minor maerl component. Associated fauna and flora may include species found in other types of maerl beds (and elsewhere), e.g. *Pomatoceros triqueter, Cerianthus lloydii, Sabella pavonina, Chaetopterus variopedatus, Lanice conchilega, Mya truncata, Plocamium cartilagineum* and *Phycodrys rubens*. Lgla, however, also has a fauna that reflects the slightly reduced salinity conditions, e.g. *Psammechinus miliaris* is often present in high numbers along with other grazers such as chitons and *Tectura* spp. *Hyas araneus, Ophiothrix fragilis, Ophiocomina nigra* and the brown seaweed *Dictyota dichotoma* are also typically present at sites. In Scottish lagoons this biotope may show considerable variation but the community falls within the broad description defined here.

SMp.Mrl.Lfas - *Lithophyllum fasciculatum* maerl beds on infralittoral mud
Shallow, sheltered infralittoral muddy plains with *Lithophyllum fasciculatum* maerl. This rarely recorded maerl species forms flattened masses or balls several centimetres in diameter (Irvine & Chamberlain 1994). Lfas may be found on mud and muddy gravel mixed with shell. Species of anemone typical of sheltered conditions may be found in association, for example, *Anthopleura ballii, Cereus pedunculatus* and *Sagartiogeton undatus*. Polychaetes such as *Myxicola infundibulum* and terebellids, also characteristic of sheltered conditions, may be present as may hydroids such as *Kirchenpaueria pinnata*. Occasional *Chlamys varia* and *Thyone fuscus* are present in all records of this biotope and red seaweeds such as *Plocamium cartilagineum, Calliblepharis jubata* and *Chylocladia verticillata* are often present.