Beam Trawl (Shrimp) on Subtidal Bedrock Reef

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 Subtidal Bedrock Reef
2. Risk Level	Purple (High risk)
3. Description of Feature: (see Annex 1 for further information on description).	Bedrock is normally an unbroken solid rock which is often found underlying sediments in the marine environment. When exposed as an outcrop on the seabed, it is classed as a subtidal bedrock reef. It can often be found in a matrix of cobbles and boulders (JNCC[1]). For the purposes of the Assessing Welsh Fishing Activities Project the 'subtidal bedrock reef' assessment has been separated from the 'boulder and cobble' reef assessment. While the assessments share a number of supporting communities/biotopes that are subject to the same effects from mobile fishing gear, the effects of trawling on the structure of subtidal bedrock and boulder/cobble reefs could vary. An explanation of how subtidal bedrock reef and subtidal boulder/cobble reef have been separated is detailed in Annex 1. A list of biotopes commonly associated with subtidal bedrock reef are listed in Annex 2. Subtidal bedrock reef communities can vary according to a number of factors such as rock type, topographical features (e.g. vertical rock walls, gully and canyon systems and outcrops from sediment) and exposure to wave action and tidal currents (JNCC[1]). Areas with strong tidal flows are usually dominated by a robust turf of animals such as sponges and anemones, including species like the oaten pipes hydroid *Tubularia spp*.(JNCC[2]). For example, the Menai Strait and Milford

	Haven both have subtidal bedrock communities dominated by sponge species, which are thought to be partly as a result of the strong tidal flows and shelter from wave action (CCW, 2009a; CCW, 2009b). In contrast, foliose red seaweeds may dominate in shallower water (Stamp & Marshall, 2015), and areas that are extremely exposed to wave action tend to have fewer species and may be dominated by species like keel worms, anemones and encrusting sponges (JNCC[3]). There are various subtidal bedrock reef communities. The most commonly occurring biotopes found on subtidal bedrock reefs in Welsh waters are mixed faunal turf communities (CR.HCR.XFa), bryozoan turf and erect sponges on tide-swept circalittoral rock (CR.HCR.XFa.ByErSp), foliose red seaweeds on exposed lower infralittoral rock (IR.HIR.KFaR.FoR) and sponges and anemones on vertical circalittoral bedrock (CR.HCR.XFa.SpAnVt). Species associated with bedrock reef that are known to be particularly fragile include the pink sea fan *Eunicella verrucosa* and branching sponges such as *Axinella disimillis*. Other physical, chemical and biological factors such as; depth, water clarity, salinity and temperature can have influence on reef communities (JNCC[1]). Bedrock reefs in the shallow subtidal area, where there are good light levels, support a wide range of plants and animals dominated by kelps (most commonly *Laminaria hyperborea*, *Laminaria digitata* and *Alaria esculenta*) and other seaweeds. In deeper water, where the light levels are lower, the emphasis is towards animal-dominated communities with fauna typically including, sponges, corals, hydroids, anemones, sea squirts, echinoderms and bryozoans (JNCC[1]). Suspended sediments can also influence community structures with sediments in the water column limiting light availability, potentially causing scouring or effecting the availability of food supply (CCW, 2009c). The temperature of the water can also have an important influence (O'Connor *et al*, 2007). In the UK, there is a marked biogeographical trend in species composition related to

	temperature, with warmer water, temperate species such as the pink sea-fan (*Eunicella verrucosa*) occurring in south Wales (CCW, 2009b). In comparison with other areas of the UK, Welsh reefs have relatively low densities of the urchin *Echinus esculentus*, which results in low grazing pressures and consequently particularly luxuriant and diverse red algal turfs in some areas (CCW, 2009c).
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 between10 and 15m. 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 is a lack of studies specifically investigating the impacts of beam trawl (shrimp) gear on the associated biotopes listed in Annex 2; therefore it is necessary to widen the reseach parameters to include other comparable bottom contacting mobile gear. **1.** Demersal beam trawl gear can have a direct physical effect on the seabed wherever the beams, shoes, mats, nets and chains make contact with the seabed. Ways in which gear affects the seabed can be classified as: scraping and ploughing; sediment resuspension; physical destruction; removal, or scattering of non-target benthos (Jones, 1992). Boulcott & Howell (2011) conducted experimental Newhaven scallop dredging over a circalittoral rock habitat in the Kilbrannan Sound, Scotland. The results showed that a single trawl of a scallop dredge left clear discernible scrape marks in the bedrock which were evident in 5 of the 23 photographic quadrats. However, these direct impacts are not thought to negatively impact the integrity of the rock of subtidal bedrock feature. Jennings *et al.* (2001) discussed the direct effects of towed fishing gear on the substratum and conclude that habitat alteration may be permanent if bedrock formations become fragmented. However, the habitat would still remain a subtidal bedrock reef habitat but it may potentially provide opportunities for new flora and fauna to colonise.

	In conclusion, direct contact between beam trawl (shrimp) gear and subtidal bedrock reef is not thought to cause a significant impact to the integrity of the subtidal bedrock reef itself. **2.** Demersal mobile fishing gear reduces habitat complexity by: removing emergent epifauna, smoothing sedimentary bedforms, and removing or scattering non target taxa that produce structure (Auster & Langton, 1999; Jones 1992). Subtidal bedrock reef sites are thought to be sensitive to towed demersal gear effects,as they often are abundant in encrusting and erect biota that are easily damaged by bottom trawling (Kaiser *et al*, 2002). Bottom fishing has the potential to directly displace, injure, remove, or destroy flora and fauna colonies (Van Dolah *et al*, 1987; Sainsbury *et al*, 1997; Freese *et al*, 1999; Fosså *et al*, 2002; Wassenberg *et al*, 2002). Injuries, which may lead to delayed mortality (Freese & Wing, 2003), demand costly resources for regeneration, potentially impairing colony growth and sexual reproduction (Rinkevich, 1996; Henry & Kenchington, 2004), and hence may ultimately limit population recruitment. The solidity of rock and the fractal complexity of its surface provide an abundance of stable, niche habitats exploited by a wide diversity of species, leading to the modern perception that rocky reefs habitats have high biodiversity (Kostylev *et al*, 2005). Exclusive communities live in crevices and often do not protrude above the surface of the rock, they are are not thought to be at risk of damage from towed demersal gear. However, sensitive species that often characterise this feature occur on the surface of the subtidal bedrock reef and have limited protection from abrasion (Connor *et al*, 2004). The Marine Life Information Network (MarLIN) considers the sensitivity of biotopes/components of biotopes to the impacts from general abrasion. In the following analysis the MarLIN sensitivity assessments (Annex 2) are utilised and supported where further scientific literature is available on the specific interactions.

	Communities of flora and fauna that live in or on caves, overhangs, vertical walls and very large immovable boulders can be sensitive to abrasion. However, the operation of towed demersal gears prevents the gear from interacting with these subtidal bedrock reef habitat types. Therefore these features are considered as low sensitivity to abrasion from towed demersal gear. **Sponges** A number of studies have concluded that the effects of single trawl event from towed demersal gear on sponges led to a significant proportion of sponges being damaged and/or loosened and that recovery was slow (Van Dolah *et al,* 1987; Tilmant, 1979; Freese *et al*, 1999; Freese, 2001; Boulcott & Howell, 2011). Tilmant (1979) recorded that the a recovery was ongoing but not complete 11 months after a trawl event. Freese revisited a site one year after a trawl event and found no signs of sponge regrowth or recovery. Little information on sponge longevity and reslilience exists. Individual sponges are usually hermaphrodites (Hayward & Ryland, 1995) and reproduction can be asexual (e.g. budding) or sexual (Naylor, 2011). Growth and reproduction are generally seasonal (Hayward & Ryland, 1995) with sponge rejuvenation possible from fragments of sponge (Fish & Fish, 1996). Some sponges are known to be highly resilient to physical damage with an ability to survive severe damage, regenerate and reorganize to function fully again, however, this recoverability varies between species (Coleman *et al*, 2013; Wulff, 2006). The majority of the literature agrees that a single trawl could damage or remove 25-75% of sponges. Therefore it can be presumed that multiple trawl events will increase this level of impact. Sponges characterise biotopes such as: CR.HCR.XFa.ByErSp and CR.HCR.XFa.ByErSp.Sag **Anthozoans**

	Eunicella verrucosa is a sessile epifaunal species and is likely to be severely damaged by heavy mobile gears, such as scallop dredging (MacDonald *et al*, 1996; Tinsley, 2006; Hinz *et al*, 2011; Hiscock, 2007). *Eunicella* grows very slowly in British waters, approximately 1cm per year (Bunker, 1986; Picton & Morrow, 2005). Recovery following an abrasion event, such as trawling, is likely to take over 4 years (Coma *et al,* 2006; Sheehan *et al,* 2013). Importantly *Eunicella verrucosa* larvae are thought to generally settle near the parent (Hiscock, 2007; Weinberg & Weinberg, 1979), therefore recovery is most likely if fecund mature species are left after a fishing event. Boulcott & Howell (2011) conducted experimental Newhaven scallop dredging (a source of abrasion) over a circalittoral rock habitat in the sound of Jura, Scotland and recorded the damage to the resident community. Damage to circalittoral rock fauna was of an incremental nature, with loss of species such as *Alcyonium digitatum* and faunal turf communities increasing with repeated trawls. *Alcyonium digitatum, Tubularia indivisa* plus the anthozoan community are sedentary species that would likely suffer from the effects of abrasion (Stamp, 2015). The MarLIN resilience assessment of the CR.HCR.FaT.CTub.Adig biotope is largely based on the time taken for *Alcyonium digitatum* to recover (approximately 5 years). Without the recovery of this species, the biotope would change (Stamp, 2015). *Caryophyllia smithii* is a small (max 3 cm across) solitary coral common within tide swept sites of the UK (Wood, 2005). Fowler & Laffoley (1993) suggests that *Caryophyllia smithii* is a slow growing species (0.5-1mm in horizontal dimension of the corallum per year). This suggests that damage from a single trawl, however minor, could be long lasting. *Sagartia elegens*, *Urticina felina, Metridium senile, Actinothoe sphyrodeta* and *Corynactis virdis* can colonize bare surfaces through a-sexual reproduction within 1 year but may take up to 5 years to establish mature populations (Wood, 2005). If after a single trawling event, members of these species remained within the community it is likely they could recolonize without the need for larval recruitment.

	Some of the anthozoan community could potentially re-cover relatively quickly from damage caused by trawling, however if the assemblage is completely removed from the habitat, recovery would be less likely. Re-establishment of typical biomass will be driven by surviving individuals as well as recruitment (Stamp, 2015). Anthozoans characterise biotopes such as: CR.HCR.XFa.ByErSp.Eun, CR.HCR.FaT.CTub.Adig and CR.MCR.EcCr.UrtScr **Bryozoans** Typical bryozoans include *Flustra foliacea,* which although flexible, physical disturbance by passing mobile gear is likely to damage fronds and remove some colonies. Colonies on hard substrata are probably less vulnerable to fishing activity but would probably be damaged or partially removed (Bullimore, 1985; Jennings & Kaiser, 1998). Silén (1981) reported that experimental removal of a notch in the frond *of Flutra foliacea* was repaired within 5 -10 days. The newly formed margin where the notch has been removed grew at normal rates (4-5 zooid lengths per month). Additionally the removal of one layer of the bilaminar frond, experimentally (Silén, 1981) or by predators (Stebbing, 1971) was repaired with similar rapidity. It was noted that the un-damaged layer of the frond stopped growing while the damaged area was being repaired (Silén, 1981). *Bugula spp.* and other bryozoan species exhibit multiple generations per year, that involve good local recruitment, rapid growth and reproduction. Bryozoans are often opportunistic, fouling species that colonize and occupy space rapidly. For example, hydroids would probably colonize within 1-3 months and return to their original cover rapidly; while *Bugula* species have been reported to colonize new habitats within 6 -12 months. However, *Bugula* has been noted to be absent from available habitat even when large populations are nearby (Castric-Frey, 1974; Keough & Chernoff, 1987), suggesting that recruitment may be more sporadic (Tyler-Walters, 2005).

	The bryozoan community could potentially re-cover relatively quickly from damage caused by a single trawling episode, however if the assemblage is subjected to repeated trawling and/or completely removed from the habitat, recovery would take longer relying on re-colonization rates and good local recruitment from surviving communities (Stamp, 2015). Bryozoans characterise biotopes such as: CR.HCR.XFa.FluCoAs and CR.MCR.EcCr.FaAlCr.Flu **Hydrozoans** Hydroids are thought of as early colonizers of bare surfaces (Whomersley & Picken, 2003; Zintzen *et al,* 2008; Hiscock *et al*, 2010) with *Tubularia spp.* opportunistically often the first to colonize and reaching sexual maturity rapidly (Hughes, 1983). *Tubularia indivisa* is a short lived, common athecate hydroid species, and recruitment is seasonally variable with settlement peaking in early spring, however other smaller recruitment events occur within summer and autumn (Hughes, 1983). The hydrozoan community could potentially re-cover relatively quickly from damage caused by a single trawling episode, however if the assemblage is subjected to repeated trawling and/or completely removed from the habitat, recovery would take longer relying on re-colonization rates (which are thought to be high in hydroids) and good local recruitment from surviving communities. Hydrozoans characterise biotopes such as: CR.MCR.CFaVS.CuSpH and CR.HCR.FaT.CTub.Adig **Kelps and Seaweeds** Physical disturbance by towed demersal gear is likely to remove a proportion of macroalgae, such as fucoids and laminarians. The kelps

	Laminaria spp. act as ecosystem engineers (Jones *et al*, 1994; Smale *et al*, 2013) by altering; light levels (Sjøtun *et al*, 2006), physical disturbance (Connell, 2003), sedimentation rates (Eckman *et al*, 1989) and water flow (Smale *et al*, 2013), which can profoundly alter the physical environment for fauna and flora in close proximity. *Laminaria hyperborea* biotopes increase the three dimensional complexity of unvegetated rock (Norderhaug, 2004; Norderhaug *et al*, 2007; Norderhaug & Christie, 2011; Gorman *et al*, 2013; Smale *et al*, 2013) and support high local diversity, abundance and biomass of epi/benthic species (Smale *et al*, 2013), and serve as a nursery ground for a number of species. Kelp is also an important species as a primary producer (Kaiser*,* 2011), food resource (Kaiser, 2011) and provides bird foraging habitat (Iken, 2012). Christie *et al.* (1998) suggested that kelp habitats were relatively resistant to the direct disturbance/removal of the *Laminaria hyperborea* canopy. Recruitment of kelps following disturbance can be influenced by the proximity of mature kelp beds producing viable zoospores to the disturbed area (Kain, 1979; Fredriksen *et al,* 1995). Kain (1964) investigated the removal of kelp through trawling and found that the associated holdfast communities recovered in 6 years, however the epiphytic stipe community did not fully recover within the same time period. Even though the associated holdfast and stipe colonies eventually die as the substratum rots, over a few weeks at sea they are likely to shed thousands of larvae, and seaweed rafts are now seen as important dispersal agents (Hayward & Ryland, 2017). Seaweed communities (both red and brown) are likely to be affected by entanglement with the trailing nets of the beam trawl. This can cause tearing of the macroalgae. Recoverability is dependent on the remaining proportion of individuals, if the holdfast and/or stipe remain, regrowth is likely to be rapid in most species. However, if the whole plant is removed, recolonization is reliant on reproduction of nearby colonies. If nearby seaweed communities survive a trawling episode, their fitness (e.g. growth rates and reproductive output) may be compromised by the level of damage sustained during trawling.

	Therefore, surviving seaweed communities will be less efficient at aiding recolonization of adjacent lost individuals (Iken, 2012). Kelps and seaweeds can recover quickly from superficial tearing however repeated trawling and high impact damage, to the stipe or holdfast, could take more than 6 years to recover. Damaged individuals will be less efficient at aiding recolonization. Kelps and seaweeds characterise biotopes such as: IR.HIR.KFaR.LhypR, IR.LIR.K.LhypLsac, IR.MIR.KT.FilRVS and IR.MIR.KT.XKT **Ascidians** The ascidians are epifaunal and physical disturbance is likely to cause damage with mortality likely. Emergent epifauna are generally very intolerant of disturbance from fishing gear (Jennings & Kaiser, 1998). However, studies have shown *Ascidia spp*. to become more abundant following disturbance events (Bradshaw *et al*, 2000). Ascidians are likely to be significantly affected by abrasion caused by towed demersal fishing gear, although, given their high resilience, they are likely to recover quickly (Stamp, 2015). Ascidians characterise biotopes such as: IR.FIR.SG.DenCcor ***Sabellaria spp.*** (Detailed assessments of *Sabellaria spp*. reef have been undertaken separately). Beam trawling (shrimp) can negatively impact on *Sabellaria alevolata* and *Sabellaria spinulosa* reefs through partial or total damage and/or removal of the reef structure through abrasion and ploughing and through removal/damage of typical species. Recovery will be dependant on local factors such as season of impact, larval supply, environmental factors, condition of reef etc. Although there is a potential for rapid recovery of a partially damaged reef, and a much

	slower recovery for heavily impacted reefs, the conditions to support recovery are not guaranteed (AWFA, 2017a). *Sabellaria spp*. characterise biotopes such as: CR.MCR.CSab **Mussels** (Detailed assessments of Subtidal Mussel Bed on Rock have been undertaken separately). The action of fishing with beam trawl (shrimp) gear directly on subtidal mussel bed (*Mytilus edulis and Muculus discors)* on rock features is likely to be lethal by crushing or be indirectly damaging by weakening or breaking of the byssus threads, making them prone to becoming unattatched. While recovery is possible this is dependant on local environmental factors such as larval availability, tidal influence and the extent of the remaining bed. Recovery would also be less likely in periods of prolonged fishing. The damage or removal of a mussel bed would also result in the damage or removal of attached species. (AWFA, 2017b). Mussels characterise biotopes such as: CR.MCR.Cmus.Mdis, CR.MCR.Cmus.CMyt and IR.LIR.IFaVS.MytRS **Other habitat forming species** The urchin *Echinus esculentus* characterises biotopes such as: IR.MIR.KR.Lhyp.GzPk and IR.MIR.KR.Lhyp.GzFt and fluctuations in their numbers may give foliose seaweeds a chance to re-grow periodically. There may be a change in community structure when grazing pressure decreases, althoughrecoverability is probably high. However, recruitment can be sporadic or annual depending on locality and factors affecting larval pre-settlement and post-settlement survival (Lewis & Nichols, 1980). Brittlestars characterise biotopes such as: CR.MCR.EcCr.CarSp.Bri and CR.MCR.EcCr.FaAlCr.Bri and the removal of the dense brittlestar

		beds may change the community structure. Brittlestar beds have been assessed under this project separately (AWFA, 2017c). **In conclusion,** beam trawl (shrimp) gear could cause an abrasive pressure upon a number of the subtidal bedrock reef biotopes listed in Annex 2. Any activity that physically abrades the faunal crust is likely to result in localized damage. Increase in scour or other abrasion events are likely to remove sponge, ascidian and anemone components. Trawling can physically remove or damage much of the macro-epibenthic fauna. Small colonies that may survive a single trawl are unlikely to survive repeated trawls. On a comparison between cold and warm water experiments, impacts of trawling are much more persistent on cold water species due to the slower growth/regeneration rates. Damaged or lost individuals are likely to be replaced by early colonizers, which could change the biotope. Given the slow growth rates and long lifespans of the rich, diverse fauna in Welsh waters, it is likely to take many years for cold water communities to recover if adversely affected by physical damage. Impact from beam trawl gear on flora is likely to include tearing and/or displacement of individuals or communities which, depending on the remaining proportion of the flora, could recover quickly. Recovery is likely to be led by fast colonising individuals such as *Sagartia elegens*, *Urticina felina, Metridium senile, Actinothoe sphyrodeta* and *Corynactis virdis.* The majority of the epifauna species often rely on adjacent colonies for recolonization, however, recovery is likely to be slower if the adjacent colonies are degraded by trawling.
6. MPAs where feature exists	**Pembrokeshire Marine SAC**	The bedrock reefs in this site are distributed around the Pembrokeshire Islands and in shallow waters along most of the coast (generally to a distance of around 2Nm) with the exception of the central part of St Brides Bay, the section of Milford Haven between South Hook Point and the mouth of Pembroke River and the upper part of the Daugleddau and the Cleddau. There are records of the Section 7 habitat “Fragile sponges and anthozoans” around the North Pembrokeshire Islands, Skomer, Skokholm, north-west of St Ann’s Head and a single record at Dockyard Bank in Milford Haven and

		another west of Abereiddy. There are other, lower confidence, records in the mouth of Milford Haven and off Linney Head.
	Pen Llyn a'r Sarnau SAC	The majority of bedrock reef in the SAC is around the Llyn Peninsula and Bardsey Island, generally within 1 or 2Nm of the coast. The habitat is common in this area. There are records of the Section 7 habitat "Fragile sponges and anthozoans" around Bardsey Island and the adjacent headland and also on the north coast of the Llyn north of Porthysgaden, around Maen Mellt and south of Porth Oer.
	Menai Strait and Conwy Bay SAC	Bedrock reef has been recorded in the central tideswept part of the Menai Strait, around Puffin Island, North to Red Wharf Bay, around the Great and Little Ormes and in the north of the site near Moelfre.
	Cardigan Bay SAC	The distribution of bedrock reef is patchy and all records are close to the coast (within 1.5Nm). Most of the records are from the area surrounding Cardigan Island, with further records along the coast including Ynys Lochtyn. The Section 7 habitat "Fragile sponges and anthozoans" has been recorded off New Quay Head.
	Carmarthen Bay and Estuaries SAC	Bedrock reef occurs within the large shallow inlet and bay feature of the SAC off Caldey Island and East of Tenby, plus a small amount off Worms Head.

7. Conclusion

The information presented above indicates that the action of fishing with beam trawl (shrimp) gear directly on subtidal bedrock reef could potentially cause a fragmenting of the bedrock formation in some instances. However this impact would not change the physical structure of the subtidal bedrock feature itself. The effect of beam trawl (shrimp) gear during the initial interaction or from repeated fishing events is likely to cause damage, which could be long-lasting and lethal, to the species which occupy the subtidal bedrock reef habitat. While rapid recovery is possible for some species, this is often reliant on adjacent communities for recolonization. Fishing with beam trawl (shrimp) gear could potentially remove the majority of existing individuals, instigating a recolonization led by early colonisers such as *Sagartia elegans*, *Urticina felina, Metridium senile, Actinothoe sphyrodeta* and *Corynactis virdis*, which could change the species composition and potentially the biotope.

8. References

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Annex 1
Data manipulation

‘Bedrock reef’ has been split apart from ‘boulder and cobble’ reef for the purposes of the Assessing Welsh Fishing Activities project so it aligns with the approach taken by Natural England for a related piece of work. This is the first time that this has been attempted for Welsh data.

The first stage of this process is to ascertain whether the habitat / data point is classified as ‘reef’. For a habitat to be ‘stony reef’ it requires 10% or more of the seabed substratum at that location to be particles greater than 64mm across (i.e. cobbles). The figure of 10% is taken from a report determining the characteristics of stony reef (Irving, 2009). The remaining supporting ‘matrix’ could be of smaller sized material. The reef may be consistent in its coverage or it may form patches with intervening areas of finer sediment.

Bedrock reef, for the purposes of this exercise, is substratum which meets two conditions:

1. There is over 10% hard substratum in a finer sediment matrix, as described above.
2. The *proportion* of bedrock (of the total % rock in that location) is recorded as ≥50% bedrock. (We acknowledge this means that the substratum could comprises of up to 49% cobbles and boulders and this would still class as subtidal bedrock reef, but the line has to be drawn somewhere if we are to split these reef types.)

As the habitat type is specified as *subtidal* reef, only those biotopes which are subtidal have been included in the definition of Subtidal Bedrock reef. Those points which contain Littoral Rock or Littoral Sediment biotopes have been omitted.

Annex 2

Biotopes that have been associated with the Subtidal bedrock reef habitiat and their sensitivity to abrasion (MarLIN) (version 15.03) (JNCC - http://jncc.defra.gov.uk/marine/biotopes/hierarchy.aspx?level=5)

CR.FCR.Cv	High	CR.MCR.EcCr.FaAlCr.Car	Low	IR.HIR.KSed.XKScrR	Medium
CR.HCR.FaT.BalTub	Low	CR.MCR.EcCr.FaAlCr.Flu	Low	IR.LIR.IFaVS.MytRS	Medium
CR.HCR.FaT.CTub.Adig	Low	CR.MCR.EcCr.FaAlCr.Pom	Low	IR.LIR.K.LhypLsac	Medium
CR.HCR.XFa.ByErSp	Medium	CR.MCR.EcCr.FaAlCr.Sec	Low	IR.LIR.K.LhypLsac.Pk	Medium
CR.HCR.XFa.ByErSp.DysAct	Medium	CR.MCR.EcCr.UrtScr	Low	IR.LIR.K.Lsac.Ldig	Low
CR.HCR.XFa.ByErSp.Eun	Medium	CR.MCR.SfR.Hia	Medium	IR.LIR.K.Lsac.Pk	Low
CR.HCR.XFa.ByErSp.Sag	Medium	CR.MCR.SfR.Pol	Medium	IR.MIR.KR.HiaSw	Medium
CR.HCR.XFa.CvirCri	Low	IR.FIR.SG.CC	Low	IR.MIR.KR.Ldig.Bo	Medium
CR.HCR.XFa.FluCoAs	Low	IR.FIR.SG.CrSp	Low	IR.MIR.KR.Ldig.Ldig	Low
CR.HCR.XFa.FluCoAs.SmAs	Low	IR.FIR.SG.CrSpAsAn	Low	IR.MIR.KR.Ldig.Pid	Medium
CR.HCR.XFa.FluCoAs.X	Low	IR.FIR.SG.CrSpAsDenB	Low	IR.MIR.KR.Lhyp	Medium
CR.HCR.XFa.FluHocu	Low	IR.FIR.SG.DenCcor	Low	IR.MIR.KR.Lhyp.Ft	Medium
CR.HCR.XFa.Mol	Low	IR.FIR.SG.FoSwCC	Low	IR.MIR.KR.Lhyp.GzFt	Medium
CR.HCR.XFa.SpAnVt	Medium	IR.HIR.KFaR.Ala	Low	IR.MIR.KR.Lhyp.GzPk	Medium
CR.HCR.XFa.SpNemAdia	Medium	IR.HIR.KFaR.Ala.Ldig	Low	IR.MIR.KR.Lhyp.Pk	Medium
CR.HCR.XFa.SubCriTf	Medium	IR.HIR.KFaR.Ala.Myt	Low	IR.MIR.KR.LhypT	Medium
CR.MCR.CFaVS	Medium	IR.HIR.KFaR.FoR	Low	IR.MIR.KR.LhypT.Ft	Medium
CR.MCR.CFaVS.CuSpH	Medium	IR.HIR.KFaR.LhypFa	Medium	IR.MIR.KR.LhypT.Pk	Medium
CR.MCR.CMus.CMyt	Medium	IR.HIR.KFaR.LhypR	Medium	IR.MIR.KR.LhypTX.Ft	Medium
CR.MCR.CMus.Mdis	Medium	IR.HIR.KFaR.LhypR.Ft	Medium	IR.MIR.KR.LhypTX.Pk	Medium
CR.MCR.CSab	Medium	IR.HIR.KFaR.LhypR.Pk	Medium	IR.MIR.KR.LhypVt	Medium
CR.MCR.EcCr.AdigVt	Low	IR.HIR.KFaR.LhypRVt	Medium	IR.MIR.KR.XFoR	Low
CR.MCR.EcCr.CarSp	Low	IR.HIR.KSed.DesFilR	Medium	IR.MIR.KT.FilRVS	Low
CR.MCR.EcCr.CarSp.Bri	Medium	IR.HIR.KSed.LsacSac	Medium	IR.MIR.KT.LdigT	Medium
CR.MCR.EcCr.CarSp.PenPcom	Low	IR.HIR.KSed.ProtAhn	Low	IR.MIR.KT.LsacT	Medium
CR.MCR.EcCr.FaAlCr	Low	IR.HIR.KSed.Sac	Medium	IR.MIR.KT.XKT	Medium
CR.MCR.EcCr.FaAlCr.Bri	Medium	IR.HIR.KSed.XKHal	Medium		