STAKEHOLDER WORKSHOP TO DISSEMINATE THE ICES DEEP-SEA ACCESS REGULATION TECHNICAL SERVICE, AND SCOPE THE REQUIRED STEPS FOR REGULATORY PURPOSES (WKREG)

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Contents

i Executive summary

The EU enacted new legislation on regulating access to deep-sea fisheries in 2016. Two important aspects of the regulation are outstanding, namely the establishment of a list of areas where vulnerable marine ecosystems (VMEs) are known to occur or are likely to occur and the determination of the existing deep-sea fishing areas, the so-called "fishing footprint". ICES was asked to gather data and information to help determine the two aspects. ICES informed the Commission of its capacity to produce a complete technical service by the end of 2019 leading to a final advice in 2020. This final advice will constitute the basis for the Commission to adopt the implementing regulation fixing the fishing footprint and the list of VME locations.

In order to complete the technical service, a workshop was organised by ICES. The workshop reviewed the data and information on the fishing footprint (2009-2011) and the location of VMEs, and considered a potential tool for supporting transparent decision making in future. The strengths and weaknesses of this decision support tool were identified along with identified summary of the information content required for implementation. The group also outlined a framework whereby a range of closed area options could be given to managers and stakeholders to consider under different protection and management scenarios, to facilitate future decision-making. The workshop discussed future work processes planned to complete the ICES advisory process for this request i.e., the "second phase", to support the decision making required to facilitate the implementation of this piece of legislation.

ii Expert group information

Expert group name	Stakeholder workshop to disseminate the ICES deep-sea access regulation technical service, and scope the required steps for regulatory purposes (WKREG)
Expert group cycle	Annual
Year cycle started	2019
Reporting year in cycle	1/1
Chairs	Katell Hamon, the Netherlands
	Maurice Clarke, Ireland
	Peter Hopkins, Belgium
Meeting venue and dates	22-23 October 2019, ICES HQ, Denmark (21 participants)

1 Interpretation of the Deep Sea access regulation and the ICES request

Regulations (EC) 734/2008 and (EU) 2016/2336 establish the conditions for fishing deep-sea stocks in the northeast Atlantic. WGREG notes that the salient provisions of the Regulations are as follows:

- The Regulations apply to bottom gears in EU waters. Bottom gears include bottom trawls, dredges, bottom-set gillnets, bottom-set longlines, pots and traps (Regulation 734/2008 Article 1);
- The Regulations apply to fisheries with bottom gears operating at depths of > 400 metres (Regulation 2016/2336 Article 9);
- Deep sea fishing authorisations to use any bottom gears may normally be granted only for fishing activities within the areas that were fished with bottom gears during the period 2009-2011 (the fisheries "footprint"). Outside of the fisheries footprint, deep-sea fishing authorisations to use any bottom gears may be granted only if an impact assessment demonstrates that the protection of VMEs will not be compromised (Regulation 2016/2336 Article 8);
- Bottom trawling at depths >800 metres is prohibited in all areas (inside and outside the footprint) (Regulation 2016/2336 Article 9);
- Implementing acts to establish a list of areas where VMEs are known to occur or are likely to occur should have been drawn up by 13 January 2018 in order to prevent significant adverse impacts of VMEs in those areas (Regulation 2016/2336 Article 9). The list of areas is subject to annual review.

In order to prepare the implementing acts to protect the VMEs within the fisheries footprint, the European Commission made the following request to ICES:

On 28 June 2018, ICES provided an advice to DG MARE on "locations and likely locations of VMEs in EU waters of the NE Atlantic, and the fishing footprint of 2009-2011" to assist the implementation process of the deep-sea access regulation (EU) 2016/2336. On 30 November 2018, ICES provided a further technical service to aid the interpretation of the advice.

In both deliverables, ICES indicated that "missing information" and "(late) submission" of data were hindering the scientific process to deliver a full advice on the deep-sea fishing footprint and the locations and likely locations of VMEs. ICES indicated: "ICES will, in 2019, be able to better describe the overall bottom fishing footprint of 2009-2011 in EU waters of the NE Atlantic".

Further to the reception of the missing information and the evaluation of all data, DG MARE requests ICES to deliver the following in view of completing the implementation of Regulation (EU) 2016/2336:

- Provide a description of the existing deep-sea fishing areas based on the reference years 2009-2011 in EU waters of the North-East Atlantic. This description should be translated into static coloured maps and their specific coordinates entitled "Existing Deep-Sea Fishing Areas" and listed in map and tables on the model of Annex 1 of the "NEAFC Recommendation 19- 2014: Protection of VMEs in NEAFC Regulatory Areas".

- Provide a list of areas where VMES are known to occur or likely to occur. This list should be translated into static coloured maps and their specific coordinates entitled "List of areas where VMEs are known to occur or are likely to occur" and listed in map and tables on the model of Annex 2 of the "NEAFC Recommendation 19-2014: Protection of VMEs in NEAFC Regulatory Areas"

- Make the interactive map available beyond 31/03/2019.

In addressing this request WREG notes that the fisheries footprint refers only to vessels using bottom gears at depths >400 metres. Vessels using pelagic gears or vessels operating in depths < 400 metres are excluded from the footprint, even though they may have some impact on VMEs. Moreover, since the use of all bottom gears are prohibited outside the fisheries footprint, ICES assumes that the request to identify known or likely VME areas refers only to VME areas within the fisheries footprint as summarized in Figure 1.1. For information, the area of greatest interest (400 m–800 m bathymetry) is shown in Figure 1.2

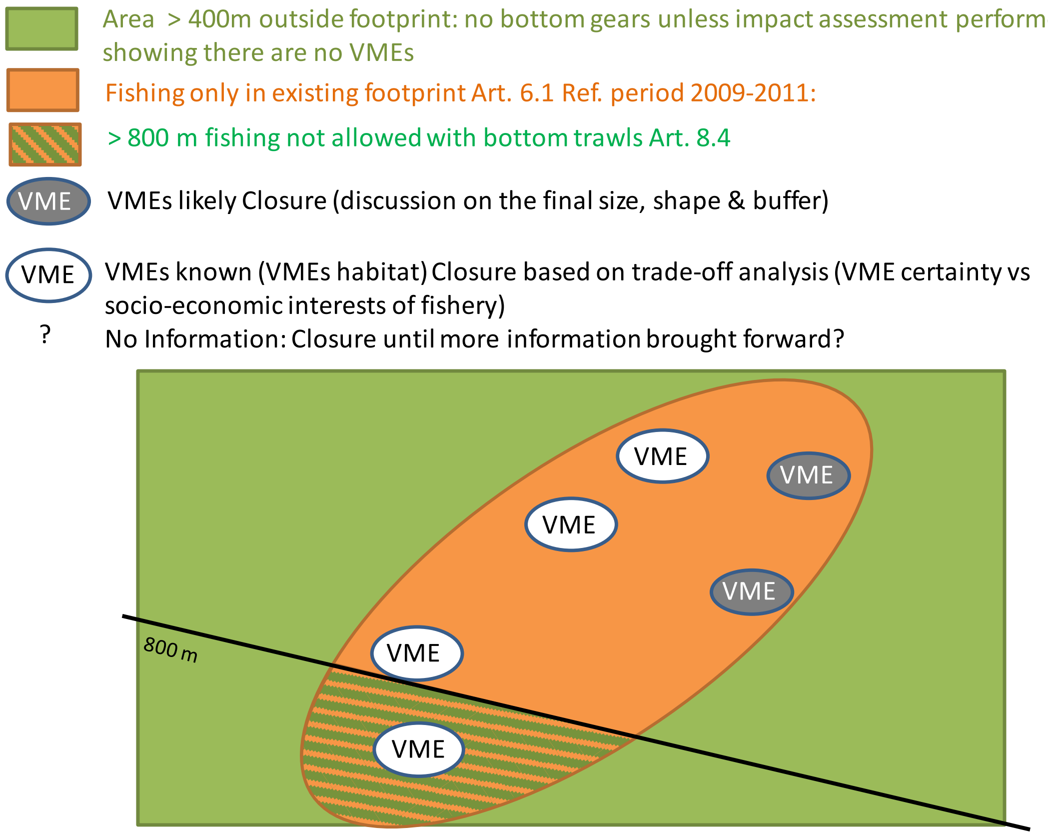

Figure 1.1. Conceptual understanding of the regulation regarding fishing with bottom gears in deep sea.

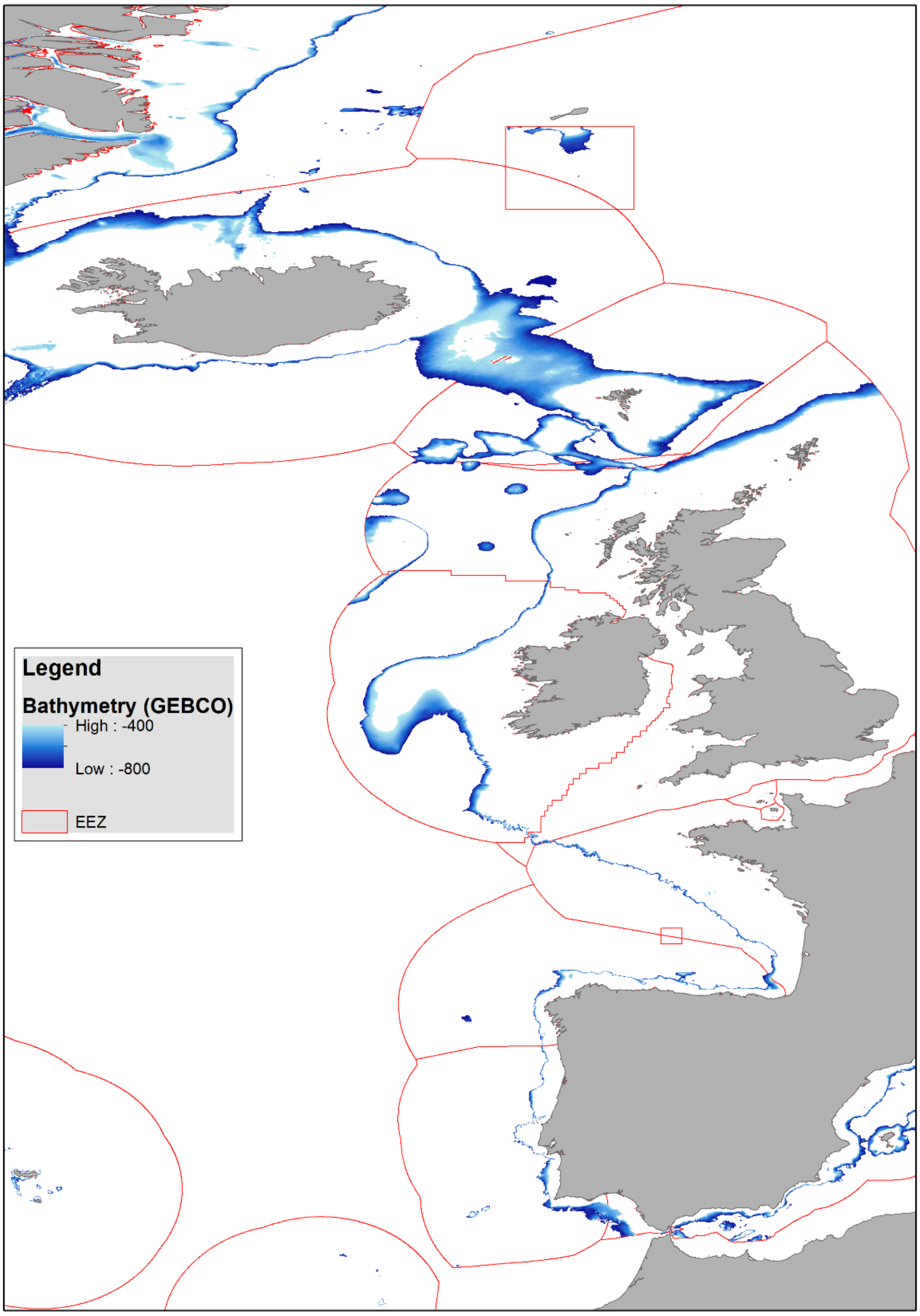

Figure 1.2. Northeast Atlantic with national exclusive economic zones and area between 400 m and 800 m depth. The EEZs of UK, Ireland, France, Spain and Portugal constitute EU waters.

2 A non-exhaustive review of existing VME conservation measures in EU Waters

Even before the 2016 legislation, VME species and habitats already had a degree of protection in EU waters through national conservation initiatives (such as the designation of Habitats Directive Special Areas of Conservation (SACs) or OSPAR marine protected areas). Common Fisheries Policy (CFP) technical conservation measures are already in place to support the conservation objectives of Natura 2000 SACs that require regulation of fisheries activities when SACs occur between 12 and 200 nautical miles. In addition, CFP technical conservation measures have been established to manage fish stocks and damage to VMEs. In designing options of area closures (for phase 2), the continuity with the current protected areas described in this chapter should be accounted for.

This section offers a non-exhaustive review of many current conservation designations in EU waters.

Habitats Directive

The EU Habitats Directive (92/43/EEC) requires Member States to designate Special Areas of Conservation (SACs) to protect some of the most threatened habitats and species across Europe. The relevant species/habitats are found in Annex I and II of the Directive. Sites designated under this directive form the Natura network, and related information and spatial data can be viewed and downloaded from http://natura2000.eea.europa.eu/.

OSPAR MPA Network

In 1998, OSPAR Ministers agreed to promote the establishment of a network of marine protected areas. The OSPAR database holds spatial and non-spatial data that OSPAR Contracting Parties have reported on MPAs that have been nominated to the OSPAR MPA network. The latest information can be found at: http://mpa.ospar.org/home_ospar

Common Fisheries Policy

A number of spatial closures enshrined in law as permanent technical conservation measures are in place to protect biodiversity (Table 1.2).

National measures

A non-exhaustive list of measures protecting VMEs is contained below:

Ireland

Ireland currently has 6 offshore Special Areas of Conservation protecting biogenic and geogenic reef habitat as listed in Annex 2 of the Habitats Directive. A CFP technical conservation measure banning bottom trawling from these four of these SACs is in place (Regulation (EU) No 2019/1241). An Orange Roughy box with Total Allowable Catch (TAC) set to zero was established to both protect spawning Orange Roughy aggregating above topographical highs (carbonate mounds) and the *Lophelia* reefs that occurred there (EEC 2270/2004/7). This measure was superseded in 2010 by Regulation (EU) 2018/2025 which established a zero TAC and no directed fishing for Orange Roughy and deep-sea sharks. Again, this fishing measure serves to reduce fishing effort over areas with known VMEs.

UK measures for the protection of VME

Spatial data for UK offshore MPA network are available for download from the interactive JNCC MPA mapper webpage (https://jncc.gov.uk/mpa-mapper/). Information and spatial data for the wider Natura network can be viewed and downloaded from http://natura2000.eea.europa.eu/ and for the OSPAR network from http://carto.mpa.ospar.org/1/ospar.map

Natura Network

- North west Rockall Bank SAC: This site was designated for the protection of Annex 1 reefs, and both coral and sponge VME indicator species have been recorded within the site. Depth within the site ranges between 102m and 428m. Bottom fishing is prohibited within part of the site under Regulation (EU) No. 2019/1241 which has replaced Regulation (EU) No. 850/98 and amending regulations. Measures were not progressed under CFP as a result, however it has now been noted that the existing prohibition does not cover the entire site and Marine Scotland are progressing measures to protect additional area of the site including a coral mound feature. A small portion of the site would remain open to bottom fishing. As a Natura 2000 site, the features of this site have additional protection from pressures caused by other industry activities.

- Hatton Bank cSAC: This site was designated for the protection of Annex 1 reefs, and both coral and sponge VME indicator species have been recorded within the site. Depth within the site ranges between 460m and 1740m. The full extent of Hatton Bank cSAC is closed to all bottom fisheries under Regulation (EU) No. 2019/1241 which has replaced Regulation (EU) No. 850/98 and amending regulations. Two further areas outside the SAC boundary, one to the southeast and one to the southwest of Hatton Bank are also closed to bottom fisheries (part of the NEAFC suite of closed areas, see Regulation (EU) No. 2019/1241). As a Natura 2000 site, the features of this site have additional protection from pressures caused by other industry activities.

- Darwin mounds SAC: This site was designated for the protection of Annex 1 reefs, and coral VME indicator species have been recorded within the site. Depth within the site ranges between 710m and 1129m. Under Regulation (EU) No. 2019/1241 (replacing Regulation (EU) No. 850/98 and amending regulations), the use of bottom-trawl or similar towed nets has been prohibited within Darwin Mounds SAC since 2004. As a Natura 2000 site, the features of this site have additional protection from pressures caused by other industry activities.

OSPAR network (national designations)

- Hatton Rockall Basin Nature Conservation MPA: This site was designated for the protection of deep-sea sponge aggregations, and sponge VME indicator species have been recorded within the site. Depth within the site ranges between 1080m and 1200m. The full extent of Hatton Rockall Basin is closed to all bottom trawls, bottom-set static gears under Regulation (EU) No. 2019/1241 which has replaced Regulation (EU) No. 850/98 and amending regulations.

Measures being progressed through CFP

Management for all UK marine sites in the offshore has been/is being progressed through the CFP. Following are a list of sites with VME features. Other sites exist in the offshore network but do not contain/were not designated for VME and the conservation objectives do not relate to VME. VME may occur in these sites, and fisheries measures introduced for these sites may confer some additional protection to VMEs, but this cannot/will not be a tangible concern in developing management measures for those sites

Natura sites with VME features present

- Anton Dohrn Seamount SAC: Designated for reefs, with evidence of coral garden and seafan VME indicator species. Depth within the site ranges between 760m and 2400m.
- East Rockall Bank SAC: Designated for reefs, with evidence of sponge and cup coral VME indicator species. Depth within the site ranges between 120m and 1730m.
- Haig Fras SAC: Designated for reefs, with evidence of sponge and cup coral VME indicator species. Depth within the site ranges between 39m and 107m
- Pisces Reef SAC: Designated for reefs, with evidence of sponge VME indicator species. Depth within the site ranges between 70m and 150m
- Pobie Bank Reef SAC: Designated for reefs, with evidence of sponge and cup coral VME indicator species. Depth within the site ranges between 58m and 137m
- Solan Bank Reef SAC: Designated for reefs, with evidence of cup coral VME indicator species. Depth within the site ranges between 20m and 140m
- Stanton Banks SAC: Designated for reefs, with evidence of sponge VME indicator species. Depth within the site ranges between 30m and 190m
- Wight-Barfleur Reef SAC: Designated for reefs, with evidence of sponge and cup coral VME indicator species. Depth within the site ranges between 25m and 100m
- Wyville Thompson Ridge SAC: Designated for reefs, with evidence of sponge and cup coral VME indicator species. Depth within the site ranges between 310m and 1010m

OSPAR network sites (national designations) with VME features present

- Central Fladen Nature Conservation MPA: This site was designate for burrowed mud feature; specifically, for the seapens and burrowing megafauna and tall seapen (Funiculina quadrangularis) components. Towed video and grab sample evidence of seapen presence within the site. Depth within the site ranges between 100m and 280m.
- East of Haig Fras Marine Conservation Zone: This site was designated for the seapen and burrowing megafauna feature, with evidence of seapen VME indicator species within the site. Depth within the site ranges between 80m and 100m.
- Farnes East Marine Conservation Zone: This site was designated for the seapen and burrowing megafauna feature, with evidence of seapen VME indicator species within the site. Depth within the site ranges between 30m and 100m
- Faroe Shetland Sponge Belt Nature Conservation MPA: This site was designate for deep sea sponge aggregations. Towed video and fisheries trawl survey evidence of sponge presence within the site. Depth within the site ranges between 400m and 800m.
- Geikie Slide and the Hebridean Slope Nature Conservation MPA: This site was designate for burrowed mud feature, including burrowing megafauna. There is evidence of deep-water seapens (Umbellula sp.) as bycatch in trawl surveys within the site. Depth within the site ranges between 113m and 1757m.

- Greater Haig Fras Marine Conservation Zone: This site was designated for the seapen and burrowing megafauna feature, with evidence of seapen VME indicator species within the site. Depth within the site ranges between 50 m and 200 m
- Northeast Faroe-Shetland Channel Nature Conservation MPA: This site was designate for deep sea sponge aggregations. Towed video, still image and fisheries trawl survey evidence of sponge presence within the site. Depth within the site ranges between 330 m and 2420 m.
- North West of Jones Bank Marine Conservation Zone: This site was designated for the seapen and burrowing megafauna feature, with evidence of seapen VME indicator species within the site. Depth within the site ranges between 100 m and 200 m
- Rosemary Bank Nature Conservation MPA: This site was designate for deep-sea sponge aggregations and seamount communities. Evidence of these features comes from trawl surveys and towed and still image analysis. Depth within the site ranges between 400m and 2270 m.
- The Barra Fan and Hebrides Terrace Seamount Nature Conservation MPA: This site was designate for burrowed mud, including seapens and burrowing megafauna, orange roughy and seamount communities. Evidence of these features comes from trawl surveys and towed and still image analysis. Depth within the site ranges between 145m and 2345m.
- The Canyons Marine Conservation Zone: This site was designated for seapens, cold-water coral reefs and coral garden features. Evidence of these features comes from ROV surveys, acoustic and multibeam data, towed video and still images. Depth within the site ranges between 100 m and 2000 m.
  West of Walney Marine Conservation Zone: This site was designated for the seapen and burrowing megafauna feature, with evidence of seapen VME indicator species within the site. Depth within the site ranges between 15 m and 33 m.

Spain

Le Danois Bank deep-sea ecosystem (El Cachucho) was the first Spanish offshore Marine Protected Area (MPA) (Sanchez *et al.*, 2010)). It is an extensive offshore bank with surrounding slopes and a complex system of submarine canyons. Depths within the area vary from 500 to 4000 m, and a diverse biological hot spot, including sponge aggregations and gorgonian forests, exist. It also constitutes the Essential Fish Habitat (EFH) for some commercial species. Trying to preserve this vulnerable ecosystem, Spanish fisheries authorities proposed specific management of fishing activities, oil exploration, minerals and military manoeuvres.

Relevant regulations are:

- COUNCIL REGULATION (EC) No 1224/2009 of 20 November 2009 establishing a Community control system for ensuring compliance with the rules of the common fisheries policy. Article 50
- REGULATION (EU) 2019/1241 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 20 June 2019 on the conservation of fisheries resources and the protection of marine ecosystems through technical measures. Annex II, part B.1

France

Seven offshore Natura 2000 sites have been designated by France along the continental shelf in the Bay of Biscay specifically in order to protect deep cold-water coral areas. Discussions on fisheries measures within these areas, in the framework of article 12 of the Common Fisheries Policy are pending.

Portugal

Portugal, published in 2014 (Portaria No 114/2014), legislation that prohibits national flag vessels, from using fishing techniques that may affect the integrity of the seabed through the general ban on the use of fishing equipment like bottom trawling, nets, traps and other capture techniques that may cause irreversible damage to vulnerable marine ecosystems (VMEs) and the species characteristic of those habitats.

However, for example, in the Azores, considered the "precursors in the designation of ocean floor protected marine areas", they have regional and autonomous legislation, legally included in the Azores Marine Park, which preserves hydrothermal and other vulnerable marine ecosystems associated with seamounts, located inside and outside the subarea of the Exclusive Economic Zone region.

Table 1.2. Inventory of areas with fishing restrictions that protect vulnerable marine ecosystems under the Common Fisheries Policy (Grehan *et al.*, 2007).

Closure Name	Management Regime	Legislation	Status of closure	Fishing restrictions	Purpose	Measure
Orange roughy protection area (VIa) NW Rockall	CFP +	EEC 2270/2004/7	Permanent	All gears	Protect orange roughy stocks	
Orange roughy box (ICES VII)	CFP +	EEC 2270/2004/7	Permanent	All gears	Protect orange roughy stocks	Fishing for orange roughy prohibited within box
NW Rockall	CFP +	EEC 41/2006,13	Permanent	All bottom gears	Conservation of vulnerable deep sea habitats	
W Rockall Mound	CFP +	EEC 41/2006,13	Permanent	All bottom gears	Conservation of vulnerable deep sea habitats	
Logachev Mounds	CFP +	EEC 41/2006,13	Permanent	All bottom gears	Conservation of vulnerable deep sea habitats	
Hatton Bank	CFP +	EEC 41/2006,13	Permanent	All bottom gears	Conservation of vulnerable deep sea habitats	
Altair seamount closure	CFP	EEC 41/2006,13	Permanent	All bottom gears	Conservation of vulnerable deep sea habitats	Prohibited to conduct bottom trawling and fishing with static gear, including bottom set gill-nets and longlines

Closure Name	Management Regime	Legislation	Status of closure	Fishing restrictions	Purpose	Measure
Antialtair seamount closure	CFP	EEC 41/2006,13	Permanent	All bottom gears	Conservation of vulnerable deep sea habitats	Prohibited to conduct bottom trawling and fishing with static gear, including bottom set gill-nets and longlines
Faraday seamount closure	CFP	EEC 41/2006,13	Permanent	All bottom gears	Conservation of vulnerable deep sea habitats	Prohibited to conduct bottom trawling and fishing with static gear, including bottom set gill-nets and longlines
Hectate seamount closure	CFP	EEC 41/2006,13	Permanent	All bottom gears	Conservation of vulnerable deep sea habitats	Prohibited to conduct bottom trawling and fishing with static gear, including bottom set gill-nets and longlines
Part of the Reykjanes Ridge	CFP	EEC 41/2006,13	Permanent	All bottom gears	Conservation of vulnerable deep sea habitats	Prohibited to conduct bottom trawling and fishing with static gear, including bottom set gill-nets and longlines
Azores No trawl Zone	CFP	EEC 858/98/EEC 1568/2005	Permanent	Ban on bottom trawl	To protect highly sensitive habitats like cold water corals	
No trawl Zone -Madeira and Canaries	CFP	EEC 858/98	Permanent	Ban on bottom trawl	To protect highly sensitive habitats	

Note: a number of the regulations contained in Table 1.2 have been superseded by more recent regulations suggesting a review should be undertaken of current CFP regulations that support protection of VMEs.

In a review of fisheries management measures in Natura 2000 sites, N2K Group (2018), collated approaches adopted or proposed by Member States to manage fisheries in Natura 2000 sites (Table 1.3). Similar approaches may need to be considered to manage fisheries operating in the vicinity of VMEs that are not protected under the EU Habitats Directive.

Table 1.3. Member States (based on the information provided to the Marine Expert Group) (N2K GROUP, 2018).

Member State	Examples of approaches to fisheries management
Belgium	Zoning scheme to exclude or reduce the impact bottom of trawling and to counteract the loss of ecological integrity of the seafloor. Not developed for specific Natura 2000 sites, but to comply with MSFD requirements. Under consideration as part of a joint recommendation under Article 11 CFP.
Denmark	Regulation of fisheries with mobile bottom contacting gears in place and in preparation in a number of SACs to target 1170 and 1180 habitat types. Based on impact assessment. Introduced through site management plans and then implemented through CFP process or national executive order. Policy developed for fishery for blue mussels and oysters in Natura 2000 that sets the framework for article 6(3) requirements with focus on cumulative impact and integrity. Initiative to assess and monitor bycatch of harbour porpoise and sea birds.
France	Currently only within territorial waters where there are no other MS fishing interests. Site by site risk analysis will be carried out, followed by consultations. Within 12 nm of SAC Bay de Seine measures to reduce certain fishing activities in area and effort and zones of tranquillity around seabird islands.
Germany	Exclusion of specific gears from fisheries management areas within German Natura 2000 areas depending on the protected features (mobile bottom contacting gears/benthic habitats, set gillnets and entangling nets/harbour porpoise and sea birds), no-take zones, limitation of fishing effort.
Ireland	Restrictions on access to a fishery through vessel track record, restrictions on fishing times, gear restrictions, daily/weekly TACs and monitoring of fishing effort (using risk assessments and implemented through fisheries Natura plans).
Italy	Prohibition of fishing with specific gears such as towed nets, dredges, purse seines and shore or boats seines or removal of abandoned fishing gears (based on the analysis of pressures and threats).
Malta	Priority measures and conservation objectives under development. Obligations for fishermen to report any bycatch if retained (for transfer to a rehabilitation centre) or liberated; trawling limited to specific areas, and noise and light restrictions when navigating in certain areas along the coast where certain seabirds are known to nest.
Poland	Temporal and spatial limitations of fishing Designating fishing free zones (with use of the most dangerous fishing gear) More efficient execution of already existing provisions (especially regarding gillnets) Monitoring of fishing gear to get the best data on bycatch Testing alternative fishing gear and implementing if proved efficient Higher control of potential poaching Education on protected features and the need of fishermen's cooperation in this matter
Spain	Advanced notification of any change to the type of gear or commercial species fished to the authority responsible for MPA management No small-scale fishing gears operating in contact with the sea bottom are allowed within the location of habitat type 1120 (*Posidonia* seagrass meadows) Any bycatch to be reported and immediately returned to the sea unless they are turtles, in which case they will be delivered in port after informing emergency services. Note: This protocol is currently under assessment to determine if it would be better to release the turtles again directly To minimise bycatch of turtles, night-setting will be adopted by surface longline vessels and proper equipment to release turtles from hooks must be taken on-board Use of acoustic devices subject to prior authorization
Sweden	Prohibition of fishing activity of commercial fishing vessels in areas hosting bottom habitats with high conservation value Fishing vessels inside MPAs to be fitted with and maintain in operation AIS transponders to transmit position every 30 seconds

UK	Measures for benthic habitats have focused on removing or reducing those fishing activities that may adversely affect the features, namely principally demersal fishing gears. Fisheries management measures have also been considered for bird species designated as features of offshore SPAs (red-throated divers) in terms of the risk posed by fishing activities through direct mortality, impact on prey species and disturbance. At the current time, no measures have been deemed necessary for offshore SPAs. Fisheries management measures have been introduced for various MPAs (including SACs) within UK territorial waters. Draft proposals for Scottish offshore sites have also been published, e.g. prohibit all demersal fisheries, zonal exclusion of demersal towed gears, different restrictions on gears throughout the site or in zones.

3 Review maps/coordinates generated by the ICES deep-sea access regulation technical service for its suitability for regulatory purposes

Deep-sea fishing footprint, 2009-2011 *sensu* Regulation EU) 2016/2336

ICES has collected relevant Vessel Monitoring System (VMS) and logbook data from its member countries to describe, as a technical service to the European Commission, the existing deep-sea fishing areas for 2009–2011 in EU waters of the northeast Atlantic. Details can be found in the ICES Technical Service Report (ICES, 2019a) and are briefly summarized here.

The seabed area contacted by fishing gear was provided by geographically distinct VMS points, for which speed and course were available at intervals of a maximum of two hours. These were coupled with information on vessel size and gear used, derived from EU logbooks (Eigaard *et al.*, 2016). Vessel speeds which were considered to represent fishing activity were assigned to a 0.05°×0.05° grid, about 15 km² at 60°N latitude, which is the spatial resolution adopted by ICES known as the C-square approach (Rees, 2003). Due to the nature of the spatial fisheries data being mapped at a C-square resolution, it is difficult to closely describe the bottom-fisheries footprint for different depth bands. For example, to select C-squares where bottom fishing is occurring > 800 m, a bathymetric dataset such as GEBCO or EMODnet can be used to identify the 800 m depth contour. However, some C-square grid cells were inevitably crossed by the contour line, and parts of the grid square that were transected may thus be misclassified. This results in spatial overestimating of fishing pressure at the regional scale. C-squares, where fishing occurred in areas ≥800 m depth were displayed as the fishing activity footprint.

EU waters of the northeast Atlantic had a total of 2189 C-square existing fishing areas. From those data, three large deep-sea fishing areas were identified (ICES, 2019a). In addition to up-dated static PDF maps, interactive maps showing the same information with a number of se-lectable layers were provided to the European Commission. Furthermore, ICES provided, to the European Commission, as csv files, the full coordinates of all 2009–2011 deep-sea fishing areas calculated as described above.

Vulnerable Marine Ecosystems

Vulnerable Marine Ecosystems (VMEs) are defined within the Food and Agriculture Organisa-tion of the United Nations' (FAO) International Guidelines for the Management of Deep-sea Fisheries in the High Seas (FAO, 2009; para 14, 15) such that:

"Vulnerability is related to the likelihood that a population, community, or habitat will experience sub-stantial alteration from short-term or chronic disturbance, and the likelihood that it would recover and in what time frame. These are, in turn, related to the characteristics of the ecosystems themselves, especially biological and structural aspects. VME features may be physically or functionally fragile. The most vul-nerable ecosystems are those that are both easily disturbed and very slow to recover, or may never recover.

The vulnerability of populations, communities and habitats must be assessed relative to specific threats. Some features, particularly those that are physically fragile or inherently rare, may be vulnerable to most forms of disturbance, but the vulnerability of some populations, communities and habitats may vary greatly depending on the type of fishing gear used or the kind of disturbance experienced." (FAO, 2009).

The guidelines further provide direction on what is envisioned by a VME, that is, that a marine ecosystem should be classified as vulnerable based on the characteristics that it possesses, and provides a list of characteristics that should be used as criteria in the identification of VMEs:

1. Uniqueness or rarity
2. Functional significance of the habitat
3. Fragility
4. Life-history traits of component species that make recovery difficult
5. Structural complexity (FAO, 2009).

For criterion 5, Structural complexity, the guidelines elaborate that the VME is characterized by "complex physical structures created by significant concentrations of biotic and abiotic features. In these ecosystems, ecological processes are usually highly dependent on these structured systems". Accordingly, the ICES data on VMEs focuses on 'VME habitat' records. Those are generally determined from visual survey data (e.g. remotely operated vehicle (ROV) or towed/drop camera seabed imagery) that demonstrates the presence and location of a VME with a high degree of confidence and spatial accuracy (ICES, 2019b). Due to the limited number of such observations, ICES has also developed a methodology for otherwise detecting the presence of a VME, based on an assessment of data on VME indicator taxa (i.e. species and species groups meeting one or more of the five characteristics for VME habitats) (Morato *et al.*, 2018). VME indicator taxa included in the assessment were selected based on expert judgement. Briefly, a multi-criteria assessment (MCA) method was used to evaluate how likely a given area of seafloor (C-square) represents a VME. The MCA generated a VME index based on the mean values of all the VME indicator taxa present in a C-square ranked for vulnerability against the FAO criteria, and weighted by the associated abundance data if available. The index ranged from 1.51 to 4.52, with 5.0 being reserved for confirmed VME habitats. In order to enhance visualization, the VME index was split into three categories for mapping purposes using Jenks natural breaks classification method: Low < 2.6, Medium 2-6-3.7, High > 3.7. However, it should be noted that in applying this approach, cells can have a high index classification score if they have many low ranking VME indicator records and cannot be distinguished from those with a few higher ranking records. Consequently it will be important to review the type of VME that is being considered for protection once areas of interest are identified.

An index of confidence was also computed for each C-square based on the survey method, number of surveys, time span of surveys and time since last survey, with arbitrary classes for each defined (Morato *et al.*, 2018). For mapping purposes, values of confidence were subjectively categorized as Low (score = 0), Medium (score =0.5) and High (score =1) based on those inputs (Morato *et al.*, 2018). In this scheme, visual surveys with more than five conducted in a C-square and running for more than 20 years with the last survey less than 10 years ago ranked the highest confidence (value of 1). Confidence values ranged from 0.0 to 0.75, with 1 being reserved for those confirmed VME habitats.

Overall the MCA generally captured the important elements of the ICES VME database and provided a simplified, spatially aggregated, and weighted estimate of how likely a given area is to contain VMEs. This methodology provided a more systematic, transparent approach for assessing the likelihood of presence of VMEs in the northeast Atlantic, consistent with making the data, methods and results from ICES assessments easy to find, explore and re-run as per its Transparent Assessment Framework (TAF) approach.

Using this approach, ICES provided the best available information on the location of Vulnerable Marine Ecosystems (VMEs) within EU waters and adjacent areas beyond national jurisdiction. Updated information on the distribution of vulnerable habitats as well as important benthic species and communities in the North Atlantic and adjacent waters were compiled (ICES, 2019a,b) and archived appropriately using the ICES VME database, and disseminated via the ICES VME

Data Portal. WKREG data products included location, by C-square of VME habitats; and 9 categories of VME index/confidence score: High quality - High confidence; Medium quality - High confidence; Low quality - High confidence; High quality - Medium confidence; Medium quality - Medium confidence; Low quality - Medium confidence; High quality - Low confidence; Medium quality - Low confidence; Low quality - Low confidence. ICES also provided a set of coordinates for the location of the three largest VME areas in the EU waters of the northeast Atlantic based on the number of contiguous C-squares with VME habitats.

It should be noted that while the VME data provided were the best available data at the time of the WKREG meeting, there are likely to be VMEs not yet mapped for various reasons (see below) and so it will be very important to review results periodically as new information is gathered. Conversely, the location of valid null records (areas where surveys have been done and no VME indicator taxa and/or habitats have been found) would be valuable information for the current exercise and ICES is currently assessing how to incorporate such information into its database.

Discussion on the Data Products by WKREG

WKREG examined the above noted data products and considered them to be useful as a decision support tool for identifying areas where vulnerable marine ecosystems could be threatened by bottom-contact fishing gears. However, some issues were noted and are detailed below.

Fishing pressure data are available via ICES and have been used for other purposes. The VMS and logbook data collected and stored by the national fishery agencies are processed in ICES using standardized methods (ICES, 2016, 2019c) to produce data layers to the aggregated international fishing effort as values per ICES rectangle per group of gear and year. Data outputs at a higher resolution (C-square at 0.05°x0.05°) require permission from all data providers. The SAR is the swept area divided by the surface area of the grid cell. SARs are provided both as surface and subsurface components; surface abrasion is defined as the damage to seabed surface features (top 2 cm), and subsurface abrasion is the penetration and/or disturbance of the substrate below the surface of the seabed (below 2 cm) (ICES, 2019d). ICES has produced such fishing intensity products for HELCOM [2009 – 2013] and for OSPAR [2009-2015]), and those analysed data products can be downloaded directly from the ICES website (https://www.ices.dk/sites/pub/publication%20reports/forms/defaultone.aspx?rootfolder=/sites/pub/publication+reports/data+outputs&folderctid=0x0120005daf18eb10daa049bbb066544d790785). WKREG recommended that those layers be considered for the next phases of the request.

WKREG noted that if the cell size used for gridding (C-square) is large relative to the size of the fishing, and if fishing is patchy or follows depth contours, which is common, large parts of the cells are likely to remain unfished. Thus, using the mean SAR for large cells is therefore likely to result in an overestimate of pressure and impact, even when assessed over longer periods. WKREG further reflected that within a C-square with a high swept area ratio there may be discrete VMEs present, which have not been affected by fishing. This could arise through avoidance of VME areas by fishers. This must be borne in mind when interpreting fisheries footprint and fisheries heat maps and possibly revisited, however use of the C-square resolution when such issues occur will create a buffer within the derived boundaries, which will increase precaution. The issue is similar to that of delineating C-squares by depth contours as discussed above and can be resolved here by obtaining finer resolution VMS and VME data for areas of interest. Currently, point data on the locations of VMEs are available from ICES and could also be used to evaluate the distribution of the VME and allow for finer delineation of the polygon boundaries. In the Northwest Atlantic Fisheries Organization (NAFO), higher resolution fishing data are available (trawl tracks) and those were used to construct the closed area boundaries. This is not possible under the current agreements for use by ICES of Vessel Monitoring System (VMS) data. However, for the longer term, WKREG supports the recommendation previously made by ICES

(ICES, 2016) that the VMS ping frequency in the deep sea areas is increased to a 10 minute interval (from the current 2 hour interval), enabling fishing pressure maps to be produced at a finer scale. It is essential that this recommendation is included in the ongoing and future revision of the EU Fisheries Control Regulation (COM/2018/368 final). This would also ensure that the present spatial overestimating of fishing pressure at the regional scale can be improved for a more accurate picture. It is also noted that the EU Fisheries Control Regulation should ensure that VMS is also included for vessels <12 m with an authorisation to fish in deep-sea areas to ensure full fleet coverage. Given the reference period (2009-2011), the historical footprint only considers vessels larger than 15m. When the deep-sea areas are far from the shore it is not expected to be an issue as vessels that size probably remain in the coastal area. However, in the Iberic region, the deep-sea areas are close to shore. For those, extra information should be collected to identify the importance of the deep sea for vessels smaller than 15m fishing with bottom contact gears.

WKREG briefly considered whether mid-water (pelagic) trawls should also be considered in the fishing footprint. Mid-water trawls can negatively impact seamounts and associated VME indicator species (NAFO, 2010). Such gears are normally used to fish in the upper water layers targeting schooling fish, however, in some fisheries they are deployed near the seafloor in order to increase CPUE. Examples include fisheries for orange roughy (*Hoplostethus atlanticus*) and alfonsino (*Beryx* spp.) which are fished within meters of the seafloor and are also fished with bottom trawls. In the South Pacific Regional Fisheries Management Organisation (SPRFMO) Convention Area, observers on New Zealand vessels fishing alfonsino recorded an average of 10% (range 6-12%) of 238 mid-water tows with clear evidence of bottom contact during fishing in each of three years (2011–2013), and an average of 16% (range 13–19%) with strong evidence for having bottom contact (Tingley, 2014). In certain areas the incidence of strong evidence for bottom contact was as high as 25%. Interaction between mid-water trawls and the seafloor is expected to be higher on seamounts (Clark *et al.*, 2006). Consequently, WKREG suggested that the pelagic fishing footprint also be investigated for inclusion in fishing footprint ≥400 m.

Specifically WKREG concluded that the following fishing information, held by ICES, would be useful for advancing this work:

- Spatial fisheries pressure layers by gear type including pelagic trawls to determine what fisheries are impacted and what proportion of the activity is in conflict with the VME areas;
- Spatial fisheries pressure layers for 0-200 m to include those fisheries in trade-off analysis when areas to be protected (including buffer areas) overlap with shallow areas (> 400 m or even >200 m);
- Spatial fisheries pressure layers are needed for the years subsequent to the reference period, as up to date as possible, to identify areas where past and recent damage by bottom contact fishing may have occurred outside of the reference period and to capture the current use of the historical footprint to include in the trade-off analysis;
- Fisheries intensity maps (SAR) by gear for the reference period, and more recently, to provide an overview of consistently fished areas.

Additionally, WKREG discussed issues related to aspects of the VME data and the weighting scheme used to generate it:

- WKREG expressed concern that historic VME information was down-weighted in the MCA evaluation through the confidence index. Given the longevity of many of these taxa, the threshold for down-weighting may not be meaningful. Hence the weighting algorithm used and its impacts on the results should be investigated further.
- Some WKREG participants had personal knowledge that in the Irish sector, there are many VME records that are not registered in the ICES VME database. Although annual data calls are made this data has not yet been submitted. Further, new data from Irish

surveys (SeaRover) may be available for the years 2018-2019, but at time of writing, these also were not included in the data available to ICES and WKREG. It will be important to have as much data as possible for this exercise;

- WKREG noted that ICES is working on including valid null records into the VME database and considered that to be an important advancement for delineating boundaries.

Further, WKREG recognized that there were other data products available that could assist in this work and suggested that the following be considered:

- Polygons for existing closures protecting VMES in EU waters (e.g. Natura 2000);
- The OSPAR Data and Information System (ODIMS https://odims.ospar.org/) showing the OSPAR Threatened or Declining Habitats (https://odims.ospar.org/maps/1313) with the OSPAR boundaries drawn in as a data layer.

WKREG considered that a structured way of going forward was needed. Two scenarios utilizing the data products were summarized:

1. Identification of areas of overlap from existing data between fisheries and VME;
2. Identification of areas of overlap from existing data where there are VME but no current fishing.

For each of these scenarios the characteristics of both the fisheries (type of fishery, season) and VMEs (type of VME habitat) should be summarized. With that information, a literature search for other data on the areas/habitats should be conducted and evaluated and any georeferenced data provided. This review should also identify areas where more details are needed to further refine boundaries in future (such as C-squares where it is expected that the fisheries and VMEs may not overlap within them).

Lastly, WKREG suggested that a third step be undertaken which would:

1. Identify a suite of management options for 1 and 2.

Such options should consider buffers and other constraints such as enforcement issues and the technical feasibility of being able to circumscribe areas effectively. The trade offs made in choosing one option over another should be explained.

Decision Support Tools

Computational software for spatial conservation prioritisation (e.g. Zonation, Marxan) allow decision-makers to select optimal areas for protection through balancing trade-offs between conservation and different resource uses. WKREG considered the development of a Marxan-type of spatially-explicit decision-support (SEDS) tool that could also meet the ICES requirements for transparency of process (TAF) in delineating closed areas for VME protection. It was noted that in areas beyond national jurisdiction most RFMOs have not used SEDS to determine closed area boundaries for the protection of VMEs. Instead, expert judgement was used following the viewing of the fishing and VME locations. The exception is the SPFRMO which has successfully used SEDS tools to close areas to protect VMEs (Rowden *et al.*, 2013; Cryer, 2015).

Although there are many SEDS available, Marxan is the most widely used decision support software for conservation planning globally (www.marxan.net) and a demonstration at WKREG was made of how it could be applied to determine different management options for the protection of VMEs in EU waters. Marxan can be used to identify solutions to "minimum set reserve design problems" (Ball *et al.*, 2009). These problems relate to the identification and demarcation of optimal (or near optimal) reserve/conservation areas which (i) are spatially compact and coherent, (ii) efficiently meet targets for a range of biodiversity features for minimal cost, and (iii) achieve optimal (or near optimal) trade-offs between socio-economic considerations and conservation targets. It is important to note that cost in this context is simply a metric by which to measure the performance of a given reserve area; it is therefore not limited only to a monetary value (e.g. revenue generated by fisheries), it can also be a non-monetary "cost", e.g. the areal extent of the proposed reserve, or even some function of many variables, e.g. the difficulty of enforcing protection measures within a reserve, which depends on many factors.

Because of its ability to simultaneously consider multiple spatial data layers when selecting optimised reserve areas, Marxan is ideally suited to identifying areas in which management measures could be implemented that would maximise VME protections while minimising displacement of fisheries. It can readily identify different management scenarios given different targets.

At a minimum, Marxan requires the following data to run:

Planning Units

Marxan uses a planning unit grid comprising multiple polygons (of any shape, but often a regular square grid is used) which cover the entirety of the area in which area based management decisions are to be made. The resolution of the grid – i.e. the size and shape of the polygons comprising the grid – decides the spatial scale on which conservation measures can be implemented. ICES used VMS data to produce spatial layers of Swept Area Ratio (SAR) which are aggregated to a C-square resolution of 0.05^0. Also, the records in the ICES VME database are provided at this resolution. It would therefore seem logical to attempt to use a 0.05^0 x 0.05^0 C-square grid as a starting point for a Marxan planning unit grid (though this may well be found to be too fine a resolution, both in terms of the computational cost of examining potentially large conservation problems and also in terms of enforcing potentially complex closures).

Conservation features

Marxan requires data on the spatial distribution of the features which are to be protected. With the objective of protecting VMEs, the bona fide VME records (VME Habitats) from the ICES VME database would seem the most logical starting point for this. It is also worth noting that it is possible to "lock-in" cells containing verified VME records into the solutions produced by Marxan; this would mean that planning units containing known records of VMEs could always be protected in Marxan solutions.

Quantitative targets

It is required that the proportion of each of the conservation features to be protected be specified as a percentage of the total areal extent of that feature present in the entire area covered by the planning unit grid. Marxan will seek to select planning units which complement one another in order to find a parsimonious solution which achieves (or attempts to achieve) all conservation objectives for a minimum cost.

Cost

As stated previously, the "cost" of protecting an area is not necessarily only a measure of what socioeconomic trade-offs we are willing to concede to meet our conservation objectives. The cost of a planning unit could be some function of many considerations – e.g. fishing activity, areal extent, ease of protection etc. The cost parameter could also be an ideal place to incorporate auxiliary data which could augment the decision making process – for example outputs of Species Distribution Models (SDMs) which could help to address gaps in our knowledge of VME distributions. This could be achieved, for example, by applying a discount to cells in which there is predicted to be a high probability of VME occurring. Marxan will attempt to join conservation areas in which there are multiple known VMEs present, and the inclusion of SDM outputs would encourage the algorithm to join these areas in a more logical and meaningful (in terms of protecting contiguous areas of VME where there may be gaps in records). This is the section where the greatest input from managers is required in order to produce relevant management options.

Boundary Length Modifier

Marxan seeks to maximise the continuity of suggested conservation areas (i.e. avoiding a patchwork of multiple small MPAs by giving preference to larger continuous areas) by use of a boundary length modifier (BLM). This is a single number and it is usually found using a trial and error approach. Larger BLM values result in more consolidated larger conservation areas which are potentially easier to implement and enforce, but may also cause unnecessarily large impacts to fisheries.

WKREG **recommended** that ICES further explores the development of this SEDS tool to identify closed area boundaries under different management options in order to comply with the TAF principles. However, WKREG recognizes that this may not be available in 2020 as any such advice would have to go through the ICES system of review.

International Context

The legal basis for the protection and sustainable use of living and non-living resources in areas beyond national jurisdiction is the United Nations Convention on the Law of the Sea (UNCLOS). In support of UNCLOS, the United Nations General Assembly (UNGA) adopted a series of resolutions to protect VME and their associated biodiversity. These first appeared in 2002 where UNGA Resolution 57/141 (https://www.un.org/en/development/desa/population/migration/generalassembly/docs/globalcompact/A_RES_57_141.pdf) called for a halt to marine biodiversity loss and to fragile ecosystems in particular (para. 51), an end to destructive fishing practices and the establishment of marine protected areas (para. 53), and the protection of VMEs (para. 62a). The call specifying the protection of VMEs was developed under the "Sustainable Fisheries" resolutions, starting in 2003 with UNGA Resolution 58/14 (para. 46; https://documents-dds-ny.un.org/doc/UNDOC/GEN/N03/453/75/PDF/N0345375.pdf?OpenElement) which requested the Secretary General to report on risks to the marine biodiversity of vulnerable marine ecosystems. The following year, Resolution 59/25 (https://undocs.org/en/A/RES/59/25 para. 66-679) called on States and regional fisheries management organisations or arrangements (RFMO/As) to take urgent action to protect VMEs from destructive fishing practices in areas beyond national jurisdiction. The application of the precautionary approach was stressed, and seamounts, hydrothermal vents and cold-water corals were given as examples of VMEs. In 2006 the UNGA under resolution 61/105 (https://undocs.org/A/RES/61/105 para. 83) called upon RFMO/As to establish measures to assess, on the basis of best available scientific information, whether fishing activities would have significant adverse impacts on VMEs, and to close areas where VMEs are known or are likely to occur, unless conservation and management measures have been established to prevent significant adverse impacts on the VMEs. In order to assist States and RFMO/As in implementing UNGA Resolution 61/105 the FAO through a series of consultations produced a set of International Guidelines for the Management of Deep-Sea Fisheries in the High Seas (FAO, 2009) to further define and agree to criteria for the conduct of impact assessments of high seas bottom fisheries, identification of VMEs, and determining whether deep-sea fisheries would have significant adverse impacts on VMEs. In 2009, UNGA adopted Resolution 64/72 (https://undocs.org/A/RES/64/72) reaffirming commitments in 61/105 and identifying further actions for the identification and protection of VMEs. Later Resolutions, such as 66/88, have called for further actions to protect VMEs from significant adverse impacts and ensure sustainable management of bottom-contact fisheries. Given the poor state of knowledge of VMEs their protection is designed to be adaptive so that measures can evolve as more information is gathered from scientific surveys and commercial fisheries.

Closely following the adoption of the 2004 UNGA resolution 59/25 the North East Atlantic Fisheries Commission (NEAFC) closed five areas in the Mid-Atlantic Ridge (MAR) region to fishing as a precautionary and interim measure to protect benthic marine ecosystems. In 2007, following UNGA Resolution 61/105, both NAFO and the South East Atlantic Fisheries Organisation (SEAFO) closed a number of areas to protect seamounts, and NEAFC closed a portion of the Hatton Bank because of the presence of the stony coral *Lophelia pertusa*. It is noteworthy that these early actions by RFMOs to protect VMEs on the MAR and on seamounts, took place under a precautionary approach as most of the closed areas had not been surveyed and were selected based on topographic features that are known to contain VMEs. Such features include seamounts, canyons, steep slopes, vents and seeps (FAO, 2009). Currently, RFMOs have put closures in place around seamounts, knolls, MAR, cold seeps, canyons and steep flanks and have closed areas based on the presence of VME indicator species.

Most deep-sea areas are considered to be data poor. Increasingly, RFMO/As have used species distribution models (SDMs) to predict where VME indicator species occur in areas that have not been sampled (e.g. NAFO, SPRFMO). These models record the environmental characteristics (e.g. physical oceanography, depth, slope, etc.) associated with each known location of the VME indicator (sponge, coral etc.). They then use that information (and in some cases data on where they do not occur) to predict locations where the environment is similar and the indicator species may occur. Usually these are presented as probability of occurrence maps, but biomass can also be predicted. SDMs are a useful tool in data poor situations but can also help refine closed area boundaries and interpolate between sampling points within closed areas in well-sampled areas, as has been done in both NAFO and in Canada (Kenchington *et al.,* 2016).

The diversity of topography, VMEs and fisheries in the global oceans in areas beyond national jurisdiction has created regional differences in the approach taken by RFMO/As to implement the UNGA resolutions. Each region has progressed at different paces and all have introduced closures based on the precautionary approach in order to avoid irreversible harm to the VMEs.

4 Produce a prioritized list of objectives and constraints that are in line with the regulation, and, assess the technical feasibility of a combination of objectives, constraints and indictors

In moving forward on the implementation of the regulation on deep-sea fishing there are different approaches to advancing the protection of VMEs. The most ambitious and precautious approach would be to aim for full VME protection, be it known or likely VMEs. This protection could include unknown areas between known and likely VME areas, including buffer zones around these areas. Fishing would only be allowed in those areas where it is proven that there are no VMEs. In theory, the other end of the spectrum would be that only known VME are protected with fisheries closures. Because the EU regulation also specifically addresses areas where VME are likely to occur this end of the spectrum is not an option under the regulation. Clear and transparent guidelines on how to propose closed areas based on known and likely VME data are required to develop potential (reproducible) areas for closure. Combination of these proposed areas with the 2009-2011 fishing footprint maps will provide first insights into potential areas of conflict. As a next step, carrying out a trade-off analysis requires up to date data and detailed information from involved member states. The outcome of this trade-off analysis would ideally be closed areas that protect known and likely VME's but also take into consideration socio-economic interest of the involved member states. The main areas for negotiation (trade-offs) would be on the certainty of likely VME's and unknown areas but not on known VME's. This approach would enable the EU to put designated closed areas under the regulation that would have sufficient support from the affected Member States.

Defining the fisheries footprint

Just as managers face the choices of many small closures or fewer large closures for VME protection, similar choices need to be made when defining the fisheries footprint. This can be illustrated using the fishing footprint around Rockall Bank (Figure 4.1).

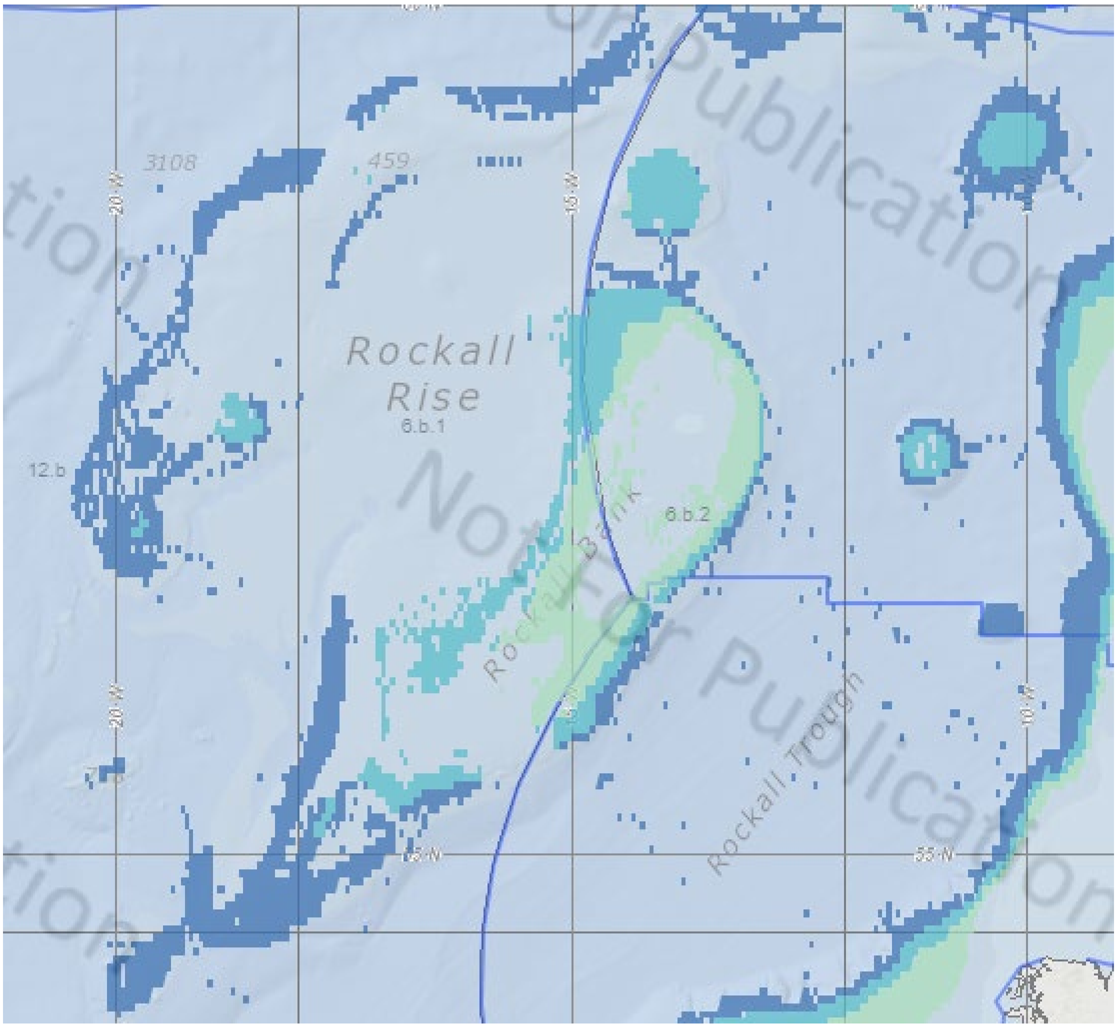

Figure 4.1. Fisheries footprint example, showing Rockall Bank. Fishing at depths >800 metres is shown in dark blue, fishing between 400 metres and 800 metres is shown in turquoise, and fishing between 200 metres and 400 metres is shown in light green.

Deep sea fishing activity is concentrated around the edge of the bank, with little activity on the bank itself. In addition there is significant shallower water fishing on the bank itself. One option is to define the fisheries footprint as several polygons within which (for example) 90% of all deep sea fishing activity takes place. This would, in the example of Rockall Bank, define most of the area to be outside of the fishing footprint. In that case the regulation would automatically protect VMEs in that area, because fishing would be prohibited unless there is a prior impact assessment.

The alternative would be to consider the footprint as one or a few large polygons that circumscribe the areas of highest fishing activity, but nevertheless include some areas of low fishing activity.

Another aspect that managers should bear in mind when interpreting the maps of the fisheries footprint is that only vessels using bottom gears are included, and only vessels fishing at depths of greater than 400 m are considered to define the footprint. There may be significant activity from vessels using pelagic gears (which may on occasion encounter the bottom either deliberately or accidentally), and there may be significant activity by vessels fishing at depths less than 400 m (where VMEs may well be present). Both could be important factors for managers to consider when deciding on closure areas (See Section 3).

Defining closure areas

To use the available information on VME occurrence and on the distribution of fishing in order to implement the regulation on deep sea fishing, managers must decide on the priority that is to be given to VME protection at the cost of disruption to the fishery. To conceptualize the choices to be made by managers and the risks and impacts resulting from those choices, WKREG came up with three hypothetical scenarios to be tested (see Table 4.1).

Table 4.1. Hypothetical management scenarios ranging from low protection/high risk to VMEs while preserving fisheries to high protection/low risk to VMEs where fisheries are more affected

	Scenario 1	Scenario 2	Scenario 3
Level of VME protection	Low	Medium	High
Level of risk for VMEs	High	Medium	Low
C-squares to be closed if	Outside historical footprint or VME habitat + “high quality” VME indicators	All cases of Scenario 1 + “medium” and “low quality” VMEs indicators	All cases of Scenario 2 + all areas without information
Possible management objective on fishing	90% of recent years fishing effort maintained	At least 70% of fishing effort maintained	At least 50% of fishing effort maintained
Buffer	Minimal		
Clustering	Low (many small closures)		

At one extreme, the impact on fishing could be minimized by allowing deep-sea fishing to continue in the whole of the footprint, closing only those regions where VMEs are known to occur. At the other extreme, VMEs can be given maximum protection by closing all areas to deep sea fishing unless it can be demonstrated that no VMEs exist in the areas where an authorization is requested. This would effectively apply the same rules within the fishing footprint as those the regulation already specified in the regulation for fishing in areas outside of the fishing footprint.

Neither of these extremes is likely to be acceptable to managers or stakeholders, so the outcome of discussions will be somewhere along the spectrum of possibilities. To aid these discussions three possible scenarios are described below, one minimizing disruption to the fishery, one giving a high degree of protection to VMEs, and one intermediate scenario.

An important consideration for these scenarios is the treatment of C-squares where there is no information at all. The precautionary approach, if strictly applied, would be to assume that VMEs are present in those areas. The impact of such an approach on the extent of the possible closures cannot be assessed with the information available at the workshop, because no distinction has been made between C-squares that have been surveyed without encountering a VME habitat or indicator, and those that have never been surveyed (see Section 3). A first step should be to make this distinction visible as layers on the interactive maps. In the longer term, a methodology is needed to identify areas likely to contain VMEs without the need for blanket survey coverage. One approach would be a predictive model (species distribution model or habitat suitability model; see Section 3) based on available environmental variables, validated by surveys to assess the confidence that can be placed in the model’s predictions.

The following maps illustrate some possible scenarios, showing the VME areas around Rockall. VME habitats are marked in red and all VME indicators whatever the quality or confidence are marked in yellow. The fishing footprint > 800 m is marked in blue and the fishing footprint 400-800 m in turquoise.

Scenario 1: High priority to the continuation of fishing activities

To give a high priority to the continuation of fishing activities, one approach would be to consider closing only the C-squares where VME habitats have been identified, or less extreme, to also include C-squares where the VME indictors are high quality.

Figure 4.2 shows the same area around Rockall with VME habitats in red and high quality VME indicators shown in yellow.

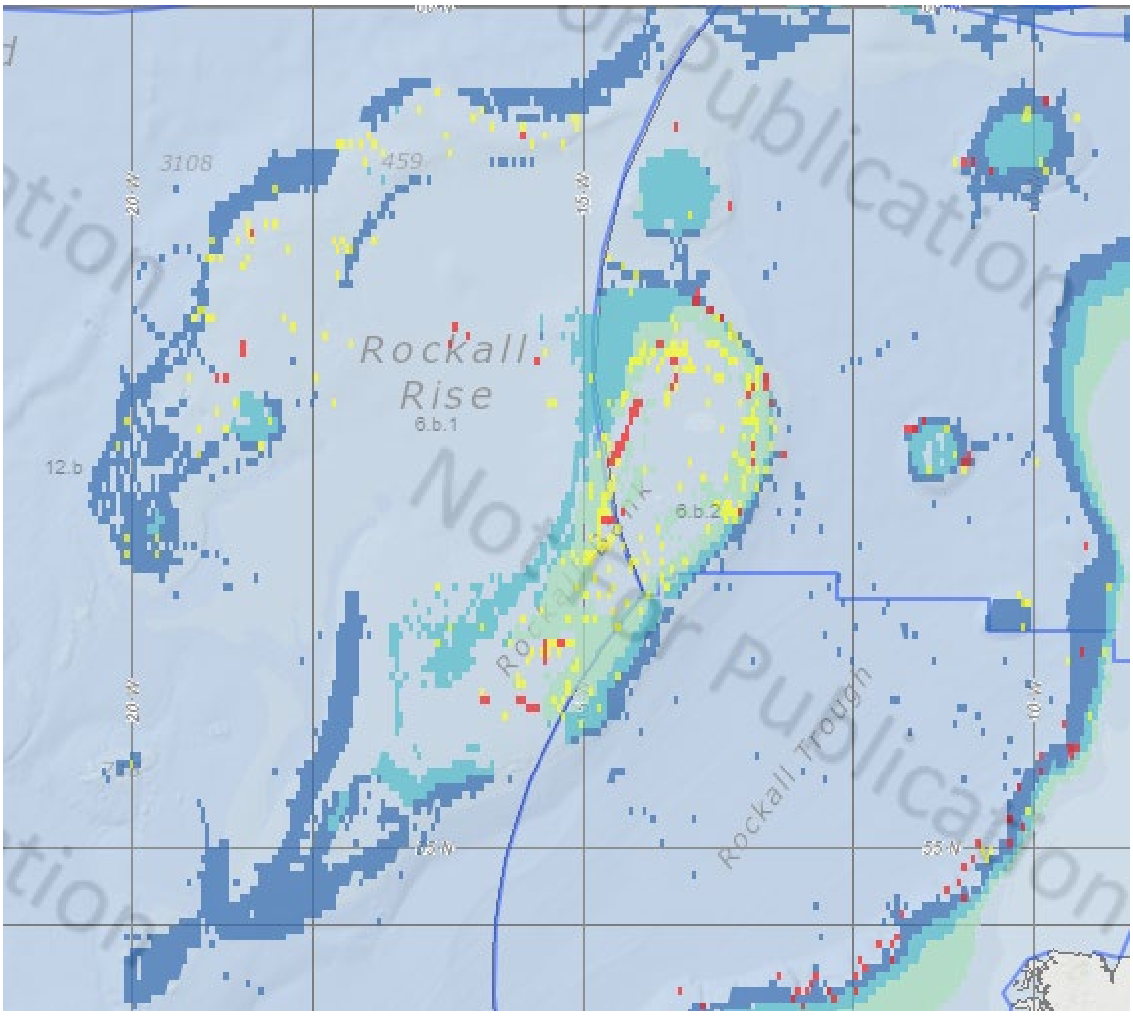

Figure 4.2. Scenario 1, whereby high priority is given to the continuation of fishing activities.

Figure 4.2 shows that very few of the candidates for closure are in existing fishing areas. Under this scenario, managers could opt to specify relatively small closure areas surrounding the VME squares, leaving open all other areas, including those where very little fishing has taken place. This minimizes the disruption to fisheries, and leaves open the possibility of the fisheries moving to other areas within the existing footprint, even though VMEs may be present in those areas.

Scenario 2: Intermediate priorities to VME protection and the continuation of fishing activities

In this scenario, protection is given to the C-squares with VME habitats and high quality VME indicators, as in scenario 1, but also squares with high and low quality indicators. The resulting map is shown below in Figure 4.3.

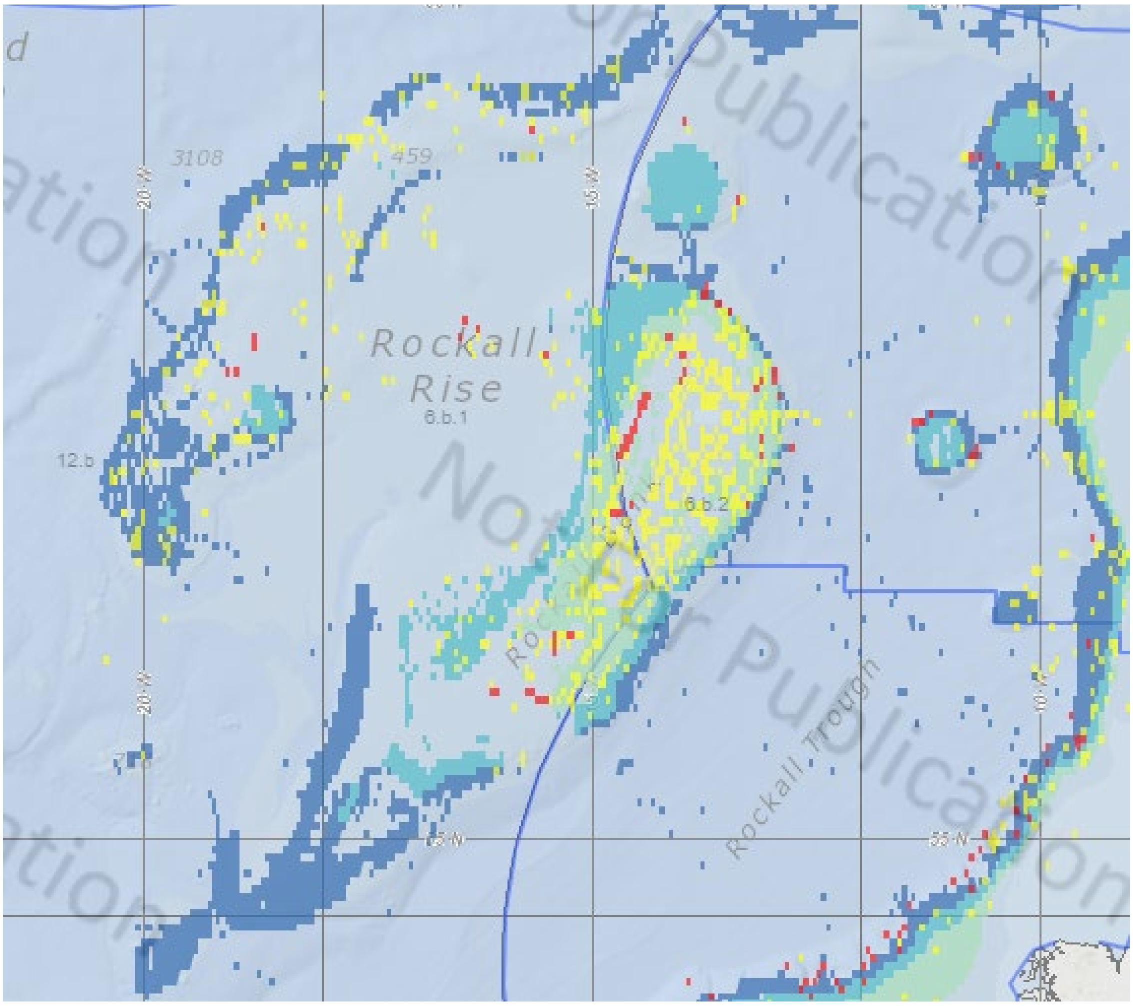

Figure 4.3. Scenario 2, whereby intermediate priorities are assigned to VME protection and to the continuation of fishing activities.

In this case, there are a greater number of VME indicator squares, but still some areas of the existing fisheries footprint where there are few or no VME squares. The choices between closing several small areas or fewer larger areas remain pertinent, with the associated trade-offs in protecting the fisheries (numerous smaller areas) or protecting VMEs and simplifying control and enforcement (fewer large areas).

Scenario 3: High priority to VME protection

In this scenario, all the areas that are protected under scenario 2 (Figure 4.3) would be included, and also any C-squares where we have no information should also be closed. This scenario would be the most precautionary. In practice, given that these squares cannot yet be identified, the scenario might take a less rigorous approach based on a subjective assessment of the likelihood of VME presence in a square based on the indicator information in surrounding squares, though this would increase the risk to VMEs.

In all of the scenarios, managers would need to choose between the closure of many areas so that a high proportion of the yellow and red squares are protected, or choosing larger polygons that would incorporate many but not all of those squares. Choosing many small polygons would have the disadvantage of being very burdensome for control and enforcement, but would allow fisheries to operate between the small closure areas. Larger polygons would be simpler to enforce, and although they may not be able to circumscribe all VME squares, they would also have the advantage of including many of the squares where no VMEs have been recorded but which nevertheless are within a cluster of red or yellow squares and therefore likely to contain VMEs. In this particular example, managers might note that there is very little fishing activity in the regions with the highest concentrations of VME squares, so closing off large polygons to encompass those squares would offer high protection with little disruption to the fishery.

Another aspect that managers will have to consider is that the effectiveness of the closures will depend on whether or not they lie within the EU's EEZ. The regulation can enforce closures in all areas of the fishing footprint for EU vessels, but cannot enforce those closures on non-EU vessels outside of the EU EEZ. This can affect the trade-off between VME protection and the disruption to fishing activities, in that there may be little benefit from preventing EU vessels from fishing in the footprint outside of the EEZ if non-EU vessels would in any case cause significant damage to the VMEs found there.

WKREG considered that in the next phases towards completion of this request (see Section 5), that managers and stakeholders be presented with a range of options, such as those illustrated above, to consider.

5 Planning for future processes

The WKREG workshop findings will be considered as input towards the development of an ICES advisory request process that will build on from the 2018 advice (ICES 2018a) and the two ICES technical services (ICES 2018b and 2019). During this so-called "second phase" of the process, ICES would establish a small but representative *ad hoc* ICES request-specific group, to guide technical further work, with regard to choices and/or decisions that may be required. The following ICES expert groups will be integral - WGECO (Working Group on Ecosystem Effects of Fishing Activities), WGSFD (Working Group on Spatial Fisheries Data), and WGDEC (Working Group on Deep-water Ecology). Similarly, the ICES Data Centre will be in a central role in the further development of the interactive maps into a so called "tool" that can be used to output a list of areas in line with a selected management options (with respective constraints). WKREG provides the initial input on the required set of constraints that result in management options that vary from maximum VME protections toward allowing more areas that could be fished. The required input (or parameterization) to operationalize this will be fully documented and done using ICES guidelines (TAF, transparent assessment framework). This work will draw on the available VMEs and fishing activity data at ICES that has been quality assured following the respective annual ICES data calls for VMS/logbook (link) and VMEs (link). As such the "second phase" will draw on the respective data governance groups (WGDEC and WGSFD), as well as WGECO to review the outputs (suggested area closures). The following highlights the steps needed:

1. **Scoping objectives and constraints.** Based on the input from WKREG, ICES will establish a small but representative *ad hoc* ICES request-specific group, including fishing representative, decision maker, analyst, fishing distribution, and benthic ecologist. The *ad hoc* group is to work by correspondence with one 2-day physical meeting, to scope objectives (e.g. minimize fishing displacement, maximize VME protections) and constraints (e.g. depth limits, enforceable areas, number of coordinates per area, etc.). The *ad hoc* group will agree on a set of constraints and relevant currencies in line with the deep-sea access regulation (EU) 2016/2336 to assess proposed area closures (i.e. the required input to carry out technical work described below in 2b). WGECO to provide technical input before the tool development step.
2. **Develop tool**. A technical group, with the support of WGSFD and WGDEC, to develop a tool that can be used to evaluate closed area choices. The tool can calculate the benefit of any closed area, and can draw areas, that are optimized based on agreed upon constraints. A list of areas will be produced as output from the tool.
3. **Review outputs.** WGECO to review outputs from tool, and provide the science foundation between different options for areas (as input to science-policy workshop).
4. **Science-policy workshop for area selection and delineation**. A workshop to look at a list of areas, discuss variants and harvest stakeholder arguments that can be used in a final round of fine-tuning a list of areas. The aim of the workshop will be to propose a list of NEAFC-like regulatory areas, based on the outputs of the tool and in line with the deep-sea access regulation (EU) 2016/2336.
5. **Peer-review** of workshop science-policy workshop
6. Provision of ICES **Advice**

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Annex 1: List of participants

Member	Country
Alice Doyle	UK
Anthony Grehan	Ireland
Benoit Archambault	France
Brian Smith	USA
Caroline Alibert-Deprez	European Commission
David Goldsborough	The Netherlands
Ellen L. Kenchington	Canada
Eugene Nixon	ICES (ACOM Vice Chair)
Francois Bastardie	Denmark
Isabel Teixeira	Portugal
Julie Kellner	ICES Secretariat
Katell Hamon	Co-chair, The Netherlands
Lara Salvany	ICES
Laura Robson	UK
Maurice Clarke	Co-chair, Ireland
Oisin Callery	Ireland
Peter Hopkins	Co-chair, Belgium
Raluca Ivaniescu	European Commission
Raquel Lopez Gonzalez	Spain
Sebastian Valanko	ICES Secretariat
Stefán Áki Ragnarsson	Iceland

Annex 2: Resolution

WKREG –The *stakeholder workshop to disseminate the ICES deep-sea access regulation technical service, and scope the required steps for regulatory purposes (WKREG),* chaired by Katell Hamon (The Netherlands) and Maurice Clarke (Ireland), and Peter Hopkins (Belgium) will meet in Copenhagen, Denmark, 22 – 23 October 2019. The workshop is tasked to:

a) Review maps/coordinates generated by the ICES deep-sea access regulation technical service for its suitability for regulatory purposes. Review should involve the active participation of persons involved in the deep-sea access regulation (EU) 2016/2336 (i.e. representatives of EU member states, stakeholders and scientists).
b) Produce a prioritized list of objectives and constraints that are in line with the deep-sea access regulation (EU) 2016/2336 and can be used to produce NEAFC-like regulatory areas. The following should be considered:
    i. objectives (e.g. minimize fishing displacement, maximize VME protections);
    ii. constraints (e.g. depth limits, enforceable areas, number of coordinates per area, etc.); and
    iii. to suggest relevant currencies that are in line with the deep-sea access regulation (EU) 2016/2336 that can be used to assess any proposed area closures.
c) The workshop will assess the technical feasibility of a combination of objectives, constraints and relevant currencies. This feasibility evaluation should ensure that a suggestion(s) is put forward, can serve as the required input for further technical work to produce a tool that can evaluate the benefits of any closed area choices, and that areas can be drawn so that they meet the agreed upon objectives and constraints.

In preparation for the workshop, the Chairs Katell Hamon (The Netherlands) and Maurice Clarke (Ireland), and Peter Hopkins (Belgium), together with ACOM invited attendees (tbc) will facilitate coordination and consolidation of work on TOR a-b. This group will also help ensure that the workshop report is finalized.

WKREG will report to the attention of ACOM by 12 November 2019.

Annex 3: Recommendations

Recommendation	Recipient	Has this recommendation be communicated to the recipient?
Combine OSPAR and ICES VME databases	ACOM, ICES Data Centre	It is recommended ACOM leadership explore the possibility of combining the OSPAR and ICES VME databases to ensure harmonization such that each contains the data stored in the other.
WKREG acts as ad hoc request group for Phase 2	ACOM	WKREG recommends to ACOM that the ICES request-specific group, be comprised of the co-chairs of WKREG taking forward the recommendations of WKREG. The *ad hoc* group is to work by correspondence with one 2-day physical meeting, to scope objectives (e.g. minimize fishing displacement, maximize VME protections) and constraints (e.g. depth limits, enforceable areas, number of coordinates per area, etc.). The *ad hoc* group will agree on a set of constraints and relevant currencies in line with the deep-sea access regulation (EU) 2016/2336 to assess proposed area closures (i.e. the required input to carry out technical work described below in 2b).