OSPAR COMMISSION

An assessment of the ecological coherence of the OSPAR Network of Marine Protected Areas in 2012

Biodiversity Series

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OSPAR Convention

The Convention for the Protection of the Marine Environment of the North-East Atlantic (the "OSPAR Convention") was opened for signature at the Ministerial Meeting of the former Oslo and Paris Commissions in Paris on 22 September 1992. The Convention entered into force on 25 March 1998. The Contracting Parties are: Belgium, Denmark, the European Union, Finland, France, Germany, Iceland, Ireland, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

Convention OSPAR

La Convention pour la protection du milieu marin de l'Atlantique du Nord-Est, dite Convention OSPAR, a été ouverte à la signature à la réunion ministérielle des anciennes Commissions d'Oslo et de Paris, à Paris le 22 septembre 1992. La Convention est entrée en vigueur le 25 mars 1998. Les Parties Contractantes sont : l'Allemagne, la Belgique, le Danemark, l'Espagne, la Finlande, la France, l'Irlande, l'Islande, le Luxembourg, la Norvège, les Pays-Bas, le Portugal, le Royaume-Uni de Grande Bretagne et d'Irlande du Nord, la Suède, la Suisse et l'Union européenne

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Executive summary

This assessment evaluates the ecological coherence of the OSPAR network of Marine Protected Areas (MPAs) as at the end of 2012. It has been undertaken based upon Guidance developed by OSPAR and international best practice but accepting that there are a variety of views concerning how ecological coherence might be achieved and that the methods currently developed to evaluate ecological coherence are still being refined. Building on conclusions of the Draft 2012 Status Report of the OSPAR Network of MPAs, GIS analysis was applied in a pragmatic way, recognising assumptions and limitations. In particular data needed to make a complete assessment are currently not comprehensive or spatially inclusive, and thus it is only partially fit for purpose. Therefore techniques have been applied to OSPAR Regions and sub-Regions as data availability allowed and to demonstrate what may be possible in future. The assessment comprises two levels of testing: a basic level applied to the whole OSPAR Maritime Area and a more sophisticated second level of spatial tests applied to certain sub-regions that had greater numbers of MPAs and more complete data. The tests form part of an iterative cycle establishing where the network is not ecologically coherent as a means to suggest where aspects of ecological coherence can be identified.

At Level 1, the three Initial OSPAR Tests are expanded upon. Using basic thresholds to determine general distribution, the first spatial test identifies major gaps in the offshore and high seas areas of Regions I, IV and V. Using more stringent connectivity criteria the nearshore component of Regions II and III are showing signs of ecological coherence, with smaller gaps identified around the Channel Islands, southern Norway, southern Ireland and south east England. Test 2 considers biogeographic representation adding a replicate analysis to the results provided in the 2012 status report. As 7 of the 10 biogeographic provinces of particular relevance to OSPAR meet the 3% coverage threshold this test is passed, but for the provinces concerned there is a range between 4 and 305 replicates, roughly reflecting less to more common habitat types. Test 3, considering distribution across bathymetric classes, indicates a strong distribution bias of MPAs towards the coastal zone and shallow shelf, suggesting coherence has not been achieved at depths greater than 75 m.

At Level 2, in theory test 4 seeks to evaluate representation of threatened and/or declining species and habitats. Currently, however, in practice lack of data precludes this test. Nevertheless an illustration of use of predicted habitat modelling and identification of areas that are significant for species suggests such models can serve as viable proxies. Similarly the matrix approach, test 5, which draws together the collation of detailed information on species and assessment as well as the principles of network design, has been trialled in the Channel but it is also currently limited by data quality and availability. The remaining tests, which for this assessment were only applied in OSPAR Regions II and III, considered broad-scale habitat representativity and replication (test 6), adequacy and viability (test 7) and connectivity (test 8). They demonstrate that in specific areas varying degrees of these elements of ecological coherence have been achieved but they also highlight uncertainties and limitations.

On the basis of applying these tests the assessment concludes that whilst the OSPAR MPA network as a whole is not ecologically coherent there are positive signs. Furthermore, the identification of distributional gaps together with under-representation of biogeographic provinces and bathymetric zones can inform a strategic Region by Region approach to address deficiencies with a suggested

initial focus on representativity and replication. In future proportionate assessments of ecological coherence are recommended, recognising data needs and deficiencies. Given that the conclusions of this assessment are broadly in line with those reached by HELCOM, opportunity exists for further joint work. The use of Ecologically and/or Biologically Significant Areas, once described and endorsed by the Convention on Biological Diversity, could provide a focus for data collection and further development of the MPA network, together with Region-specific planning scenarios.

Récapitulatif

La présente évaluation porte sur la cohérence écologique du réseau d'aires marines protégées (AMP) OSPAR à la fin 2012. Elle a été entreprise en se fondant sur *les orientations élaborées par OSPAR et la meilleure pratique internationale, tout en acceptant que* les points de vue divergent quant à la manière de parvenir à la cohérence écologique et que les méthodes développées actuellement pour l'évaluation de la cohérence écologique font encore l'objet d'un affinement. L'analyse GIS, s'inspirant des conclusions du projet de rapport d'avancement de 2012 sur le réseau d'AMP OSPAR, a été appliquée de manière pragmatique, en reconnaissant les présomptions et les limites. Les données, en particulier, nécessaires pour réaliser une évaluation complète ne sont actuellement pas exhaustives ou sont exclusives sur le plan spatial, et elles ne sont donc que partiellement adéquates. L'application de techniques aux Régions et sous-Régions OSPAR dépend donc de la disponibilité des données et a pour but de démontrer les possibilités éventuelles futures. L'évaluation comporte deux niveaux de tests: un niveau de base appliqué à l'ensemble de la zone maritime OSPAR et un niveau plus complexe, appliqué sur le plan spatial, à certaines sous-régions qui possèdent un plus grand nombre d'AMP et des données plus complètes. Les tests font partie d'un cycle itératif déterminant les zones où le réseau n'est pas cohérent sur le plan écologique suggérant ainsi où l'on peut déterminer des aspects de la cohérence écologique.

Niveau 1. Les trois tests préliminaires OSPAR sont développés. Le premier test spatial identifie, en utilisant des limites de base permettant de déterminer la répartition générale, les lacunes principales que présentent les zones de haute mer des Régions I, IV et V. Lorsque l'on utilise des critères plus rigoureux pour la connectivité les composantes du littoral des Régions II et III révèlent des indices de cohérence écologique, des lacunes moindres étant identifiées aux environs des Iles Anglo-Normandes, de la Norvège méridionale, de l'Irlande méridionale et au sud-ouest de l'Angleterre. Le deuxième test considère la représentation biogéographique en ajoutant, aux résultats fournis dans le rapport d'avancement de 2012, une analyse en parallèle. Ce test est réussi car sept des dix provinces biogéographiques particulièrement pertinentes à OSPAR se conforment à la limite de couverture de 3%, mais dans le cas des provinces concernées, il existe un éventail de 4 à 305 répliques, reflétant approximativement des types d'habitats plus ou moins communs. Le troisième test, considérant la répartition parmi les classes bathymétriques, indique une forte répartition d'AMP dans la zone côtière et les hauts fonds, suggérant que l'on n'est pas encore parvenu à une cohérence à des profondeurs supérieures à 75 m.

Niveau 2. Théoriquement le quatrième test tente d'évaluer la représentation des espèces et habitats menacés et/ou en déclin. Actuellement, l'absence de données ne permet donc pas en pratique de réaliser ce test. Une illustration de l'utilisation de la modélisation des habitats anticipés et de la détermination des zones significatives pour les espèces suggère que de tels modèles peuvent

néanmoins servir de substituts réalisables. De même, l'approche au niveau d'un compartiment, le cinquième test, qui rapproche le recueil d'informations détaillées sur les espèces et l'évaluation ainsi que les principes de la conception d'un réseau, a été testée dans la Manche mais elle est également limitée pour l'instant par la qualité et la disponibilité des données. Les tests restants, qui dans le cas de la présente évaluation n'ont été appliqués qu'aux Régions II et III OSPAR, considèrent la représentativité et la réplication des habitats à grande échelle (test 6), la pertinence et la viabilité (test 7) et la connectivité (test 8). Ils démontrent que dans des zones spécifiques on est parvenu à divers degrés de cohérence écologique pour ces éléments mais ils mettent également en évidence les incertitudes et les limites.

En se basant sur l'application de ces tests, l'évaluation conclut que certains indices sont positifs quoique le réseau d'AMP OSPAR, dans son ensemble, ne soit pas cohérent sur le plan écologique. De plus, l'identification de lacunes dans la répartition ainsi que le fait que des provinces biogéographiques et des zones bathymétriques soient sous-représentées pourraient informer une approche stratégique par région pour traiter les faiblesses en se focalisant initialement sur la représentativité et la réplication. On recommande à l'avenir des évaluations proportionnées de la cohérence écologique, en prenant en compte les besoins en données et les faiblesses. Etant donné que les conclusions de la présente évaluation correspondent dans l'ensemble à celles d'HELCOM, il existe des possibilités de travaux conjoints. Les aires significatives sur le plan écologique et biologique, une fois entérinées par la Convention sur la diversité biologique, pourraient être utilisées et constituer ainsi un point focal pour le recueil des données et le développement ultérieur du réseau d'AMP ainsi que pour des scénarios propres à une région.

Scope of work

This report sets out an assessment of the ecological coherence of the OSPAR Commission's Network of Marine Protected Areas (MPAs) as at the end of 2012 in accordance with the contract for work issued by the OSPAR Commission Secretariat commencing on 18th February 2013

The specification required the following production stages:

a. an acknowledgement of the context within which OSPAR is assessing ecological coherence of its MPA network and Guidance adopted by OSPAR;

b. interpretation of the three initial OSPAR spatial tests as presented in the Draft 2012 Status Report on the OSPAR Network of MPAs (OSPAR, 2013a), undertaking further GIS analysis of ecological criteria and presenting, as far as the data allow, an assessment of the ecological coherence of the OSPAR Network of MPAs in terms of its adequacy, representativity, replication and connectivity as at the end of 2012 identifying where the network may be coherent and making note of where the network is not yet coherent:

    i. Across the whole OSPAR Maritime Area
    ii. By OSPAR Region
    iii. By the Dinter biogeographic regions
    iv. By ecosystem feature (OSPAR Listed Species and Habitats)

c. noting and where appropriate incorporating the work on the 'matrix approach'; as presented to the OSPAR Biodiversity Committee 2013;

d. discussion of these results including different ways of interpreting ecological coherence and approaches that might secure coherence and/or a route to coherence with timescales involved (*e.g.* alternative representativity benchmarks) and, where appropriate, consideration of work on ecological coherence being undertaken elsewhere; and

e. Proposing recommendations as to how the ecological coherence of the OSPAR MPA network could be improved and identify the challenges / risks envisaged.

This has been the responsibility of a multi-disciplinary team co-ordinated by a contractor (Seascape Consultants Ltd.) reporting to a Task Team and advised by a Focus Group meeting held on 22nd March 2013 in Berlin (see Annex 1). The contractor would like to express sincere thanks to those who provided additional data for use in this assessment including Dr Kerry Howell (PML), Mr Ben Lascelles (Birdlife International), and Dr Peter Harris (GRID Arendal).

Introduction

Marine Protected Areas (MPAs) are clearly defined geographic areas that are designated, regulated and/or managed to achieve specific conservation and management objectives. With a coverage exceeding 5% of the OSPAR Maritime Area, the OSPAR MPA Network as it stands at the end of 2012 can already be considered a significant achievement. However, whilst overall % coverage is important, the design of an MPA network requires additional considerations of scale, size and spacing of the individual MPAs for the purposes of improving the likelihood of ecological coherence. Furthermore, reflecting the guidance in OSPAR (2007), ecological coherence requires consideration of connectivity, representation (including habitat structuring species), replication of ecological features, adequacy and viability. Connectivity is important for life history stages of sessile species and for movement / migratory patterns of mobile species. Except for birds, however, mobile species data were not made available. Although not part of the OSPAR definition of coherence, it will in the future be important also to consider changing environmental conditions (*e.g.* through climate change and ocean acidification), which will influence future species distributions and larval development, matters that are becoming increasingly pertinent in the North-East Atlantic. As shall be reiterated throughout this report, there are several practical first steps that can be taken towards assessing this ambitious goal.

Annex V to the OSPAR Convention on the Protection and Conservation of the Ecosystems and Biological Diversity of the Maritime Area obliges the OSPAR Commission to develop means, consistent with international law, for instituting protective conservation, restorative or precautionary measures related to specific areas or sites or related to specific species or habitats (Article 3(1)(b)(ii)). In 1994 OSPAR sub-divided its Maritime Area into 5 Regions for the purpose of assessment and monitoring (I – Arctic Waters, II – Greater North Sea, III – Celtic Sea, IV – Bay of Biscay and Iberian Coast, V – Wider Atlantic). These Regions vary in terms of how they represent coastal, offshore and deep-sea waters and their associated administrative governance (*i.e*. territorial seas, Exclusive Economic Zones (EEZs), Areas Beyond National Jurisdiction (ABNJ)). OSPAR Ministers agreed to promote the establishment of a network of MPAs (throughout all 5 Regions) in the 1998 Sintra Statement (OSPAR, 1998). Subsequently the World Summit on Sustainable Development (WSSD, 2002) signalled a global commitment to representative networks of MPAs.

In 2003, the OSPAR Commission, jointly with the Helsinki Commission (HELCOM), adopted Recommendation 2003/3 with the purpose of establishing networks of MPAs and ensuring that they were an ecologically coherent network of well-managed MPAs. This initial recommendation was supported by Guidelines for the Identification and Selection of MPAs including criteria (OSPAR Agreement 2003-17) stating that 'the OSPAR network should take into account the linkages between marine ecosystems and the dependence of some species and habitats on processes that occur outside of the MPA concerned' (OSPAR, 2003). Additional tools are the Biogeographic Classification of the OSPAR Maritime Area (Dinter, 2001), that divides the seafloor, the deep sea and open oceanic waters into a series of representative biogeographic zones and the OSPAR List of Threatened and/or Declining Species and Habitats (OSPAR Agreement 2008-6).

The development of the OSPAR MPA network has been driven to a large extent within European waters by areas designated as part of the Natura 2000 process as part of the requirements of the Birds and Habitats Directives to provide protection for the species and habitats named in the associated Annexes. Contracting Parties are also increasingly identifying new MPAs under national legislation, such as Marine Conservation Zones in England, Wales and Northern Ireland, Nature Conservation MPAs in Scotland; Marine Natural Parks in France and National Parks in Norway. There are also a number of sites that have been driven by local initiatives such as the Marine Fisheries Reserves in Lira and Cedeira in Galicia, Spain. In areas beyond national jurisdiction (ABNJ), OSPAR has led the development of MPAs.

However, as noted in OSPAR (2007) 'A non-systematic approach gives little assurance that initially selected areas will in the end represent an optimal distribution of sites required for an effective network of protected areas.' There is a strong pragmatic basis for the existing collection of MPA sites, but it remains to ensure that the MPAs taken as a whole act as a network, protecting different habitats and associated features and species; and that replication and connectivity takes into consideration how species may move between sites and the wider marine environment. The effectiveness of using systematic conservation planning techniques in MPA network development (and gap analyses) comes from its efficiency in using limited resources to achieve conservation goals and its accountability in allowing decisions to be critically reviewed (Margules and Pressey, 2000).

An ecologically coherent MPA network requires a number of ecological components to be considered. The 13 ecologically coherent design principles set out originally by OSPAR (2006) can be grouped into four assessment criteria: Adequacy/viability, representativity, replication and connectivity. Together these four criteria influence and take into account the size of MPAs, the coverage of species and habitats by MPAs, the distribution of MPAs across biogeographic regions, the number of replicate sites for specific features of interest, as well as between-site connections at different scales (OSPAR, 2013a). In 2008 the Convention on Biological Diversity (CBD) built on Scientific Guidance to establish similar criteria for selecting areas to establish a representative network of MPAs, including those in open waters and deep-sea habitats (CBD IX/20, Annex 2). Maximising connectivity, whereby sites benefit from larval and/or species exchanges and functional linkages from other network sites is generally agreed as a key criterion. However, many aspects of connectivity are poorly understood and it has been identified as a research priority for multidisciplinary studies involving oceanographic modelling, larval ecology and population genetics (Olsen *et al*., 2013). Therefore, representativity is more often used in practice to assess MPA network progress. In this report, proximity is used as a coarse proxy for connectivity.

In practice, a network of sites is most often developed through an iterative cycle of MPA designation and analysis. In large, multi-national regional sea areas such as within the OSPAR Maritime Area it is unrealistic to expect that an ecologically coherent network will emerge from a single systematic planning process. In the real world, despite many national and international goals being set, and the universally perceived urgency of the issues, no coherent networks of protected areas have yet been designated on land or in the water, except perhaps recently in Australia[1], and certainly not in a single planning process. Therefore, the OSPAR situation is by no means unusual in that regard.

The OSPAR MPA network is developing in response to a number of different international and national drivers. As these evolve over time, OSPAR should periodically review the network's ecological coherence using a methodology that is proportionate to both the status of the sites and the available data. The tests introduced in this report build upon the existing OSPAR tests, and are consistent with them. They are designed to inform future planning and allow Contracting Parties to identify gaps in the OSPAR Network. Contracting Parties might then, individually or jointly, nominate MPAs to fill gaps and/or identify how the acquisition of new data might improve the ecological coherence of the Network.

Guidance to date

The development of ecologically coherent networks inevitably raises questions about network design. How far apart should the MPAs be? How big? How many? The use of the terms 'network' and 'ecologically coherent network' are often (but not always) used interchangeably to imply some aspect of synergy or coherence in purpose or design.

As a Regional Seas Convention, OSPAR does not have a legal mandate to set specific targets for where/what Contracting Parties should consider when nominating MPAs within their jurisdiction in order to contribute to an ecologically coherent MPA network. However, OSPAR can provide advice and guidance. There could also be a role for such advice with regard to the Marine Strategy Framework Directive process (article 13.4).

Guidelines and principles developed by OSPAR in 2006 (OSPAR Agreement 2006-03) formed the basis for work leading up to this assessment. In 2007, OSPAR produced a background document to support the assessment of the ecological coherence of the OSPAR MPA network (OSPAR, 2007), which in addition to the four main assessment criteria (adequacy/viability, representativity, replication and connectivity) put forward 30 assessment guidelines. The background document recommended that 'the assessment of ecological coherence should be carried out in a stepwise fashion, beginning with initial basic assessments, and then later following up with subsequently more detailed assessments'. This advice is still applicable to the tests undertaken within this assessment and for the foreseeable future. Indeed, it is the lack of detailed data that has meant that simplified tests have been necessary.

In 2008, OSPAR produced an additional background document outlining three initial spatial tests, which could be used in an initial assessment of the MPA network (OSPAR, 2008). This was designed

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[1]Amidst considerable controversy responding to the government's claim that its new MPA network is representative. See: Pressey B. 2013. Australia's new marine protected areas: why they won't work. The Conversation, 17 January. http://theconversation.edu.au/australias-new-marine-protected-areas-why-they-wont-work-11469 (A paper on this topic is forthcoming.)

as a starting point to complement previous guidelines and principles and allowed the MPA network to be tested without detailed bio-physical spatial data. The three initial spatial tests are:

a. whether the MPAs are well distributed, without more than a few gaps;
b. whether the MPA Network covers at least 3% of most (seven of the ten) relevant Dinter biogeographic provinces;
c. whether the MPA Network represents most (70%) of the OSPAR threatened and/or declining habitats and species (with limited home ranges), such that at least 5% of each habitat type/species distribution for each OSPAR Region in which they occur [or at least 3 replicate sites per region] is [are] protected.

The background document noted that 'the degree to which an MPA network is, or is not, ecologically coherent must be stated as a likelihood, based on a continuum of progressively more detailed tests until a test (or a group of tests) is not met' (OSPAR, 2008). While in theory this reiterative process could continue indefinitely,[2] in practice expert judgement combined with the results of the various tests, can indicate when the goal has been met.

The assessment presented here continues on this basis with further analysis intended to help identify where the network lies on the continuum between 'very unlikely to be ecologically coherent' to 'very likely to be ecologically coherent'. A number of different tests have been put forward that are both proportionate to the data available and the developmental stage of the Network. This assessment and its use of thresholds is consistent with previous guidance which stated that 'The numerical threshold limits suggested in these tests should not be confused with targets; they should rather be seen as cut-off points beneath which ecological coherence has clearly not been achieved' (OSPAR, 2008).

Regarding the scale of the analysis, this assessment follows the advice that, 'Ecological coherence should be assessed at several scales, from that of a single site protecting a single small feature, to ultimately a global network' (OSPAR, 2007). Tests have been applied to the whole OSPAR Maritime Area, to specific OSPAR Regions and sub regions. For example, Regions II and III have more developed networks in the nearshore region and therefore these warrant closer examination. Hence, certain analyses presented here have considered separately nearshore waters (0-12nm) from offshore waters[3] (12-200 nm).

Globally, whilst OSPAR is at the forefront of efforts to develop and measure ecological coherence of MPAs it is acknowledged that this is 'work in progress and that theoretical concepts as well as practical approaches and methods will need to be developed further and refined over time as the general knowledge of marine ecosystems and the availability of data on ecosystem components

[2] As described in Zeno's dichotomy paradox if you walk halfway to your destination one day, and half of the remaining distance the next day, and half the following day, and so on… you will theoretically never get there! In practice, however, you do.

[3] Offshore waters is used here loosely to simply mean waters from 12-200nm, and is without prejudice to the formal legal status of any waters within the OSPAR Maritime Area.

increase' (OSPAR, 2013a).[4] The box below sets out a number of key terms used in connection with this assessment and generally accepted as essential aspects of ecological coherence.

- **Representativity:** To be representative an MPA network needs to protect the range of marine biodiversity found in our seas. This also includes protecting those features of conservation importance that are known to be rare, threatened or declining.
- **Adequacy:** Refers to both the overall size of an MPA network and the proportion of each feature protected within the MPA network.
- **Viability:** For an individual MPA to be viable it must be able to maintain the integrity of its features (population of species or condition and extent of the habitat), and to be self-sustaining throughout natural cycles of variation. Viability is determined nu the size and shape of individual MPAs in conjunction with their effective management.
- **Connectivity:** Connectivity is the extent to which populations in different parts of a species range are linked by the movement of eggs, larvae or other propagules, juveniles or adults (Palumbi 2003). The MSFD do not define "network" though dictionary usage contemplates "connectedness" as characteristic of the term.
- **Replication:** Replication is the protection of the same feature across multiple sites within the MPA network, taking biogeographic variation into account. All features should be replicated and replicates should be spatially separate.
- **Protection level:** A broad range of protection levels exist with no current European overview available.
- **Best available science:** A vital element of building (or assembling) an ecological coherent MPA network is ensuring that the best available science is used. Uncertainties in our knowledge should be recognised and taken into account throughout the process. However, decisions will need to be taken based on the best available science and lack of full scientific certainty should not be a reason for postponing proportionate decisions on site selection.

(Modified from Ashworth et al., 2010)

[4] Some OSPAR Contracting Parties, for example Sweden with 17.7% of national waters within the OSPAR Maritime Area covered by MPAs, have indicated that further certainty on ecological coherence is needed before they can commit more resources to designation of MPAs.

Methodology

Building on previous OSPAR Background documents, this assessment aims to provide practical, stepwise tests that are proportionate to the available data, and appropriate to the level of progress in the designation of MPAs across the OSPAR Maritime Region as a whole, OSPAR Regions and sub regions. If appropriate, future work could also consider the Marine Strategy Framework Directive regions.

Consequently, two broad levels of tests have been conducted:

Level 1: broad-scale tests across the OSPAR Maritime Area;
Level 2: more detailed tests of ecological coherence at the regional and sub-regional scale

Level 1 tests integrate the 'Three Initial Spatial Tests' identified by OSPAR (OSPAR, 2008). The assumptions behind these Three Initial Tests were not questioned, but rather taken at face value as existing OSPAR policy. Level 2 tests include the matrix approach, which was trialled in the Channel by the UK and France. This report provides only a short overview of the matrix tests because they have been recently and comprehensively described elsewhere (OSPAR, 2013b). It would be very data intensive to undertake such a method across the whole OSPAR Maritime Area.

The MPA Network in a Region or sub-region should satisfy the thresholds and criteria set in Level 1, before passing to Level 2. There is little point in spending time and money in carrying out sophisticated Level 2 assessments when the Network is not meeting basic thresholds. Beyond Level 1 the tests are not necessarily designed to be carried out in any particular order. Tests within Level 2 assess one or two ecological coherence criteria and are designed to provide feedback that can assist network planning. All tests are data-dependent, but particularly at Level 2, where the available data largely determines what further testing can be applied. A summary of data sets used for this assessment is at Annex 2. Some of the uncertainties, assumptions, strengths and weaknesses for each of the tests will be discussed, recognising that it is an extensive topic extending beyond the immediate concerns of this scope of work (see also Annex 3).

The series of tests does not include the OSPAR MPA Network Rapid Self-Assessment Checklist (OSPAR Agreement 2007-6). This can be seen as a stand-alone, subjective analysis which allows assessment of the network at different spatial scales, but mainly at the local level of the MPA manager. No GIS is required; rather, the Rapid Self-Assessment Checklist has been designed to be able to be used where data are lacking, but where expert judgement can still be applied. As a tabular tool, with stratified scoring according to the four ecological coherence criteria, it was designed to direct planners and decision makers towards elements of ecological coherence that may not have been fully considered, and where the relative strengths and weaknesses of their particular network(s) may lie. Combined with the OSPAR management self-assessment checklist, management measures relevant to eco-coherence can be developed. As a heuristic tool, it is a valuable complement to the sorts of spatial GIS analyses performed here.

Level 1

Level 1 of this assessment incorporates three tests that can be carried with basic levels of data to determine whether the Network meets initial thresholds of ecological coherence. The tests allow the assessment of the OSPAR Maritime Area using datasets that are available over its entire extent.

Test 1 – Test to determine whether the network is generally well distributed

The first of the 'three initial spatial tests' described in the OSPAR Background document (OSPAR, 2008) provides the most basic visual overview and evaluation of the MPA network to determine if MPAs are generally well distributed and without major gaps.

The test uses approximate rules of thumb to determine if there are any 'major gaps'. In general these spacing thresholds are set to ten times the value commonly found in scientific literature (OSPAR, 2008):

- Nearshore/Coastline: No gaps wider than 250 km and no more than 10 gaps;
- Offshore: No gaps greater than a 500 km diameter circle (~200 000 km^2) and no more than 5 gaps;
- High Seas: No gaps greater than a 1 000 km square (1 000 000 km^2) and no more than 2 gaps.

The results of this test as applied previously have been described in the OSPAR Quality Status Report (OSPAR, 2010) and the Draft 2012 Status Report on the OSPAR Network of MPAs (OSPAR, 2013a). 'Offshore' generally relates to the benthic (seabed) environment and 'High Seas' to the pelagic environment. Care should be taken when considering charts that overlay both of these components in the oceanic and deep-sea areas of the OSPAR Maritime Area.

For this study, a more advanced consideration of Test 1 used a comprehensive GIS analysis for the whole OSPAR Maritime Area. The test as applied here used MPA proximity as a proxy to provide some quantitative feedback of whether and where the network is meeting some basic distribution thresholds. Each MPA was buffered to the appropriate threshold distances, clipped to Mean High Water and any resulting unconnected buffer components removed. Once assembled, the buffers identified those MPAs that are proximate within the threshold distance.

The thresholds used within the GIS analysis were based on those used within the initial spatial test. Thus, the buffers used were half the threshold distance, since two separate MPA buffers will meet up to form the required distance. For the nearshore components, the Network was also tested under criteria of 80 km and 50 km in Regions II and III only. The first threshold was based on the maximum recommended distance in Roberts *et al.* (2010) for the English MCZ project; the latter is the maximum figure used in HELCOM's connectivity analysis (HELCOM, 2010)[5]. These values were

[5] It should be noted that in many ways the Baltic is not directly comparable with the OSPAR Maritime Area, however, due account has been taken of the joint commitment towards ecological coherence and methodologies considered by HELCOM.

used in light of the greater density of MPAs in significant parts of OSPAR Regions II and III allowing for distributional gaps to be located at a fine scale.

Test 2 – Test of representation at biogeographic level

This basic test of representation relating to the Dinter provinces was introduced by OSPAR (2008) as the second of three 'initial spatial tests'. The suggested threshold is whether the network covers at least (3%) of most (seven out of ten) relevant Dinter biogeographic provinces (Dinter, 2001). Again, these low thresholds were selected as very basic criterion to determine where ecological coherence has *not been met,* and are set at $1/10^{th}$ of the value commonly found in the literature (OSPAR, 2008).

Test 3 – Testing the representativity of bathymetric zones

This analysis provided a basic interpretation of how the network has been distributed across different depth classes in the OSPAR Maritime Area.

Across the network, the following depth classes were adopted as bathymetric representation: 0-10m (coastal zone); 10-75m (shelf seas); 75-200m (deeper shelf seas); 200-2 000m (slope/upper bathyal) and >2000m (lower bathyal/abyssal). Histograms at an OSPAR Region level were also examined to determine how future bathymetric tests could be tailored to better reflect Regional characteristics.

Level 2

Test 4 – Representation of threatened and/or declining species and habitats

This test is the last of the three 'initial spatial tests' (OSPAR, 2008). It asks whether 'most (70%) of the threatened and/or declining species and habitats (with limited home ranges) represented in the OSPAR Network of MPAs, such that at least 5% [or at least three sites] of all areas in which they occur within each OSPAR Region is [are] protected.'

A comprehensive data set of OSPAR threatened and/or declining species and habitats does not exist for any OSPAR Region. Furthermore the reporting on the extent to which features are protected within respective MPAs is not yet available for the OSPAR Maritime Area.

The Draft 2012 Status Report on the OSPAR Network of MPAs therefore concluded that the test could not be conducted and no reliable conclusions could be drawn on the adequacy or representativity of the OSPAR Network of MPAs regarding the specific protection it provides for specific threatened and/or declining species or habitats (OSPAR, 2013a).

However, as an example of a technique that could be employed more widely in data-limited circumstances, this study highlights the use of predictive habitat modelling of *Lophelia pertusa* reefs, (an OSPAR threatened and/or declining species) sponge habitats and giant protozoans by Ross and Howell (2012). They suggest that 'predictive habitat modelling may provide a useful method of better estimating the extent of listed habitats, providing direction for future MPA establishment and a means of assessing MPA network effectiveness against politically set percentage targets.' (Ross and Howell, 2012 p1)

Test 5 – A matrix to assess features, representativity, replication, resilience and connectivity

The Joint Nature Conservation Committee (JNCC) and Agence des Aires Marines Protegées (AAMP) carried out a trial matrix analysis of broad-scale habitats and OSPAR threatened/and or declining species in the Channel. The report of the trial was presented to the OSPAR Biodiversity Committee (BDC) in February 2013. Taking a tabular approach, broad-scale habitats were assessed against adequacy, replication, representativity and connectivity criteria. MPAs that were considered to afford protection for each habitat were identified. This is an assumption that we have carried through into this report. However, it is an untested assumption. A proper assessment of management measures for each MPA should be required to refine this broad (and likely overly optimistic) assumption. For OSPAR threatened and/or declining species and habitats, the matrix table defines replication and viability criteria. The level of information for some habitats depended on whether they were defined as a 'Natura 2000' or 'non Natura 2000 habitats'.

There are several similarities between the matrix approach and the overall approach of this assessment, including the use of spatial tests. However, the matrix reported out in a tabular format, whereas here both maps and tables are used.

The matrix trial established some thresholds under which certain principles would be met:

- Features/Representativity: All EUNIS level 3 habitats and OSPAR threatened and declining habitats and species;
- Replication and resilience: At least two MPAs for each EUNIS level 3 habitat and at least 3 examples of OSPAR threatened and declining habitats and species for which MPAs are considered appropriate control measures.

No thresholds were set for minimum patch size or for connectivity (proximity).

Test 6 – Spatial analysis of broad-scale habitat representativity and replication

This analysis determined which broad-scale habitats at EUNIS level 3 are represented within MPAs in Regions II and III. The test also calculated the number of replicates for each habitat in the MPA network for each Region. A habitat was considered to be represented and replicated if it was contained within an MPA with a minimum patch size of 0.24 km^2 or 3% of the proportion within the MPA.

Piekainen and Korpinen (2008) in HELCOM (2010) set a minimum protected patch size of 0.24 km^2 or greater than a proportion of 3% of the habitat within the MPA before it could be taken into account in an analysis. These minimum sizes were established because they equated to 6 pixels on the broad scale habitats maps being used (HELCOM, 2010). As is discussed below, a basic analysis of the data showed that the use of this HELCOM threshold removed many small 'slivers' of habitat, but that nonetheless several others remained.

This represents a very basic threshold of representativity. Further analysis of viability and adequacy were considered in Test 7.

In the OSPAR Maritime Area, the coverage of the EU SeaMap broad-scale habitat data is limited to Regions II and III, therefore this analysis was only undertaken within these Regions.

Test 7 – Spatial analysis of adequacy

This test analysed the number of broad-scale habitats that were meeting different thresholds of adequacy ranging between 5% and 40% of the proportion of habitat in each Region. This analysis was undertaken for Regions II and III. To enable the analysis of OSPAR threatened and/or declining species for this report it would be necessary to have records for each species both within and outside the network, or to develop a predictive habitat model. Lacking these data, the test focused only on broad-scale habitat at EUNIS level 3, within Regions II and III, based on the limits of EU SeaMap coverage.

The analysis was split into nearshore (within 12 nm) and offshore (12-200 nm) to allow more detailed testing of which parts of the network were likely to be meeting adequacy criteria, since there was a clear visual split, with many more MPAs nearshore than offshore. As per test 6, a minimum patch size of 0.24 km^2 or 3% of the proportion within the MPA was used, based on the HELCOM precedent. In future work, this threshold should be refined based on the realm, wherein nearshore and offshore would be treated differently.

The analysis also provides an overview of the sizes of MPAs – minimum, median and mean sizes. A threshold of 5 km^2 has been used for the viability analysis based on recommendations by Roberts *et al*. (2010) for England's Ecological Network Guidance (Natural England and JNCC, 2010).

Adequacy targets for the proportion of a habitat included in the MPA Network are likely to vary considerably for different habitats. This analysis enabled the OSPAR Network to be assessed at a number of different ranges. They are all to a large extent arbitrary, following other EU and global recommendations and targets that are seldom supported by specific ecological rationale. Nevertheless, by looking at different ranges of these arbitrary targets, a graphical picture emerges. The lowest ranges of 5% and 10% were intended as basic thresholds. Ranges of 20%, 30% and 40% were designed to reflect ranges identified in the literature or had been used in similar adequacy assessments, and which were considered to be more appropriate in relation to ecological coherence.

Widespread habitats generally require a lower percentage to be protected and more unusual, degraded, or rare habitats a higher percentage. Adequacy targets within the English Marine Conservation Zone region ranged from 11% to 42% based on research carried out on behalf of the JNCC by Rondinini (2011). The lower figures for each broad-scale habitat were designed to reflect the proportion of broad-scale habitat required to represent 70% of species known to occur within each broad-scale habitat type (Natural England and the JNCC, 2010). Ranges are provided for each broad-scale habitat type. Based on the EU Habitats Directive, for HELCOM <20% is considered inadequate, 20-60% dependant on the feature and >60% assuring a 'normal condition' (HELCOM, 2010).

England's Ecological Network Guidance (Natural England and Joint Nature Conservation Committee, 2010) stipulated that a MPA (and hence a viable broad-scale habitat) should have a minimum diameter of 5 km (*i.e.* at least 19.6 km^2) with an average of between 10 (>78.5 km^2) and 20km (>314.2 km^2) in diameter. These figures are based on recommendations following research into distances moved by mature adults of 72 species from a wide range of invertebrate, fish and seaweed groups for which data were available (Roberts *et al.*, 2010). For the assessment of adequacy of Baltic Sea Protected Areas a minimum size of 30 km^2 (3 000 ha) for MPAs was used by HELCOM (2010).

As described in previous tests, the very low requirement of a minimum patch size of greater than 0.24 km^2 or 3% of the proportion of broad-scale habitat within the MPA was used as a starting point, in the understanding that the criteria should get more stringent as the network develops.

Test 8 – Spatial analysis of broad-scale habitat connectivity

The analyses of Test 8 examined the distance between MPAs to determine whether they were unlikely to be meeting proximity criteria. The 'initial spatial GIS analysis' tested some thresholds for nearshore, offshore and high seas MPAs for all OSPAR MPAs. These analyses examined distance between MPAs protecting the same habitat type using the same threshold distances as in the Three Initial OSPAR Tests:

- Offshore (12-200 nm): 500 km and;
- Nearshore (Mean High Water to 12 nm): 250 km and 50 km.

As described in previous tests, a minimum patch size of greater than 0.24 km^2 or 3% of the proportion of broad-scale habitat within the MPA was used.

Within each MPA, patches of the selected habitat meeting the minimum size criteria were buffered to the appropriate threshold distance, clipped to Mean High Water and had resulting unconnected parts of the buffer removed. The resulting components were merged into single features.

Distance between MPAs is just a first look at the question of possible connectivity, and is not in itself a test for biological requirements associated with connectivity (*e.g*. habitat suitability), wider links to the broader environment, or other oceanographic factors (currents, temperatures, *etc*.).

Results

Level 1

Test 1 – Test to determine whether the network is generally well distributed

The most recent Draft Status Report on the OSPAR Network of MPAs (OSPAR, 2013a) concluded that the OSPAR MPA Network was not yet spatially well distributed across the OSPAR Maritime Area and its respective Regions. The vast majority of MPAs are situated in coastal waters and clustered around central latitudes. However there are signs of ecological coherence in Regions II and III and in the Azores archipelago that justify further analysis. In OSPAR Regions I, IV and V it is clear that major gaps remain in the network. In Region V, there is a particular problem in ensuring that the continuous change in species with increasing depth (owing to physiological tolerances) is accounted for, particularly on the upper continental slope.

Figure 1 shows a gap in the Bay of Biscay between Regions IV and V and in the far south-west of the OSPAR Maritime Area to the south of the Milne Seamount cluster. The most significant gaps can be seen in Region I, particularly the area between Iceland and Greenland; between Norway and Greenland as well as east of Svalbard. Figure 1 includes MPAs in the Network across the full range of depths. If the data, particularly for Regions I and V, were presented as a number of different depth layers, and for pelagic and benthic environments separately, then greater gaps would be evident.

The analysis shown in **Figure 2** has used a linear decay function or 'kernel analysis' to show the various "shades" of proximity and highlight the biggest gaps in the MPA network. Again, caution in Regions I and V is required because of the large changes that occur in species distributions with increasing depth. While species may occur over the whole of the Atlantic or Arctic Region, they are often restricted in depth to only a few hundreds of metres.

With the MPA network more developed in Regions II and III an analysis was carried out using thresholds of 50 km and 80 km for nearshore areas. **Figure 3** identifies gaps around the Channel Islands, southern Ireland, south east England, the northern part of Spain, southern Norway, and eastern Iceland.

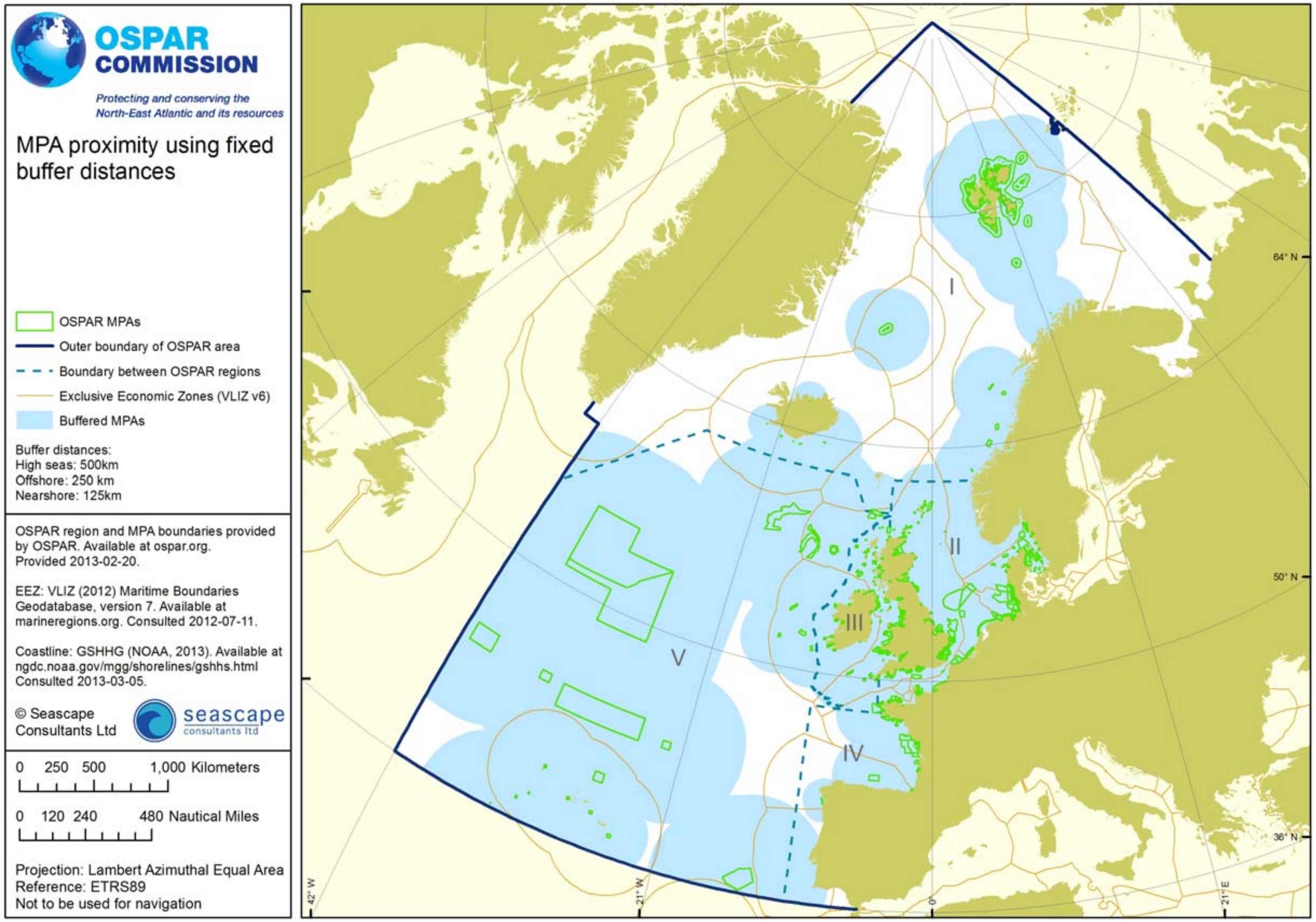

Figure 1. The OSPAR MPA network analysed to proximity thresholds of 1 000 km (High Seas), 500 km (Offshore) and 250 km (Nearshore)

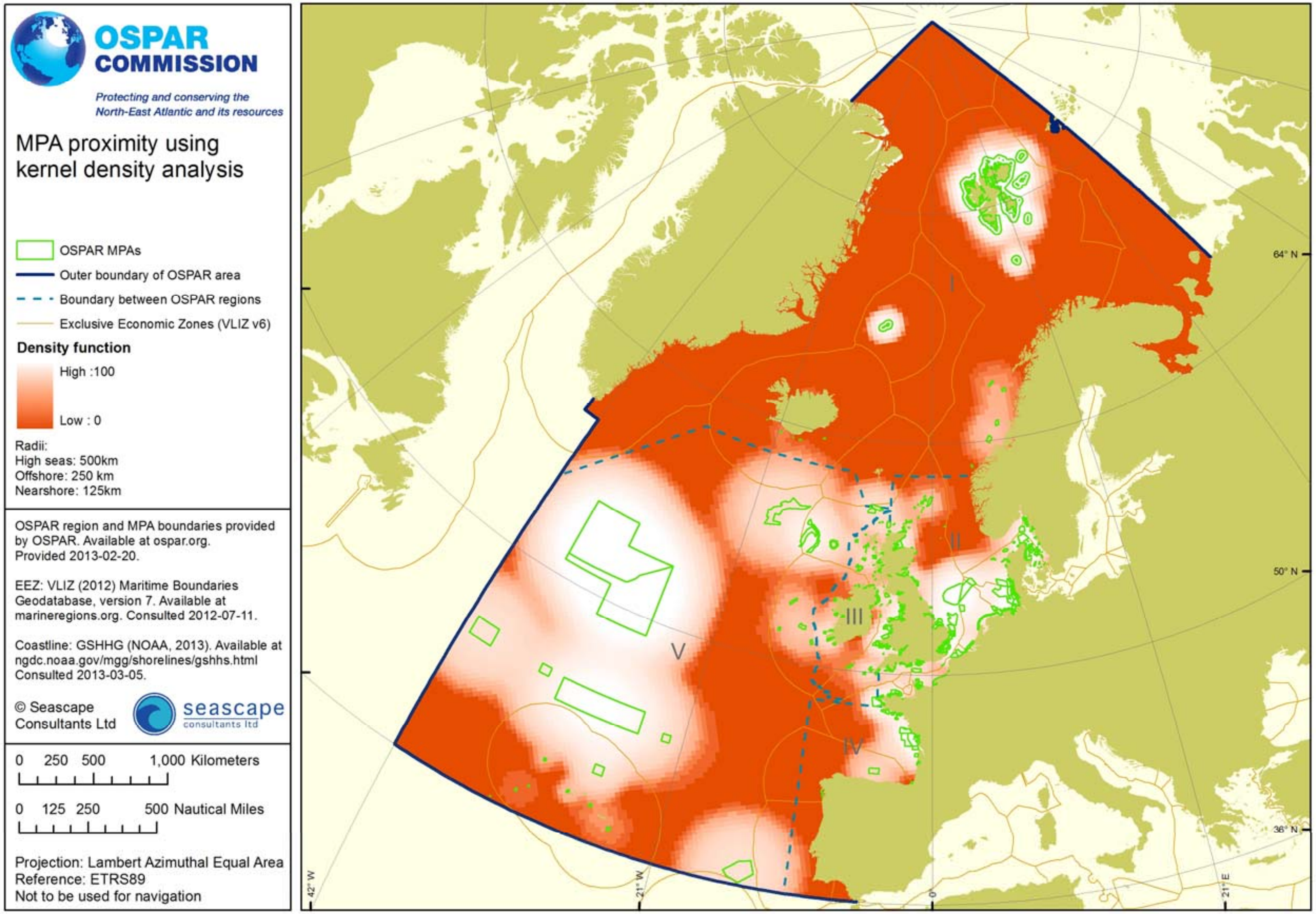

Figure 2. The OSPAR MPA network buffered to thresholds of 1000 km (High Seas), 500 km (Offshore) and 250 km (Nearshore) using a kernel density analysis to highlight gaps in the network.

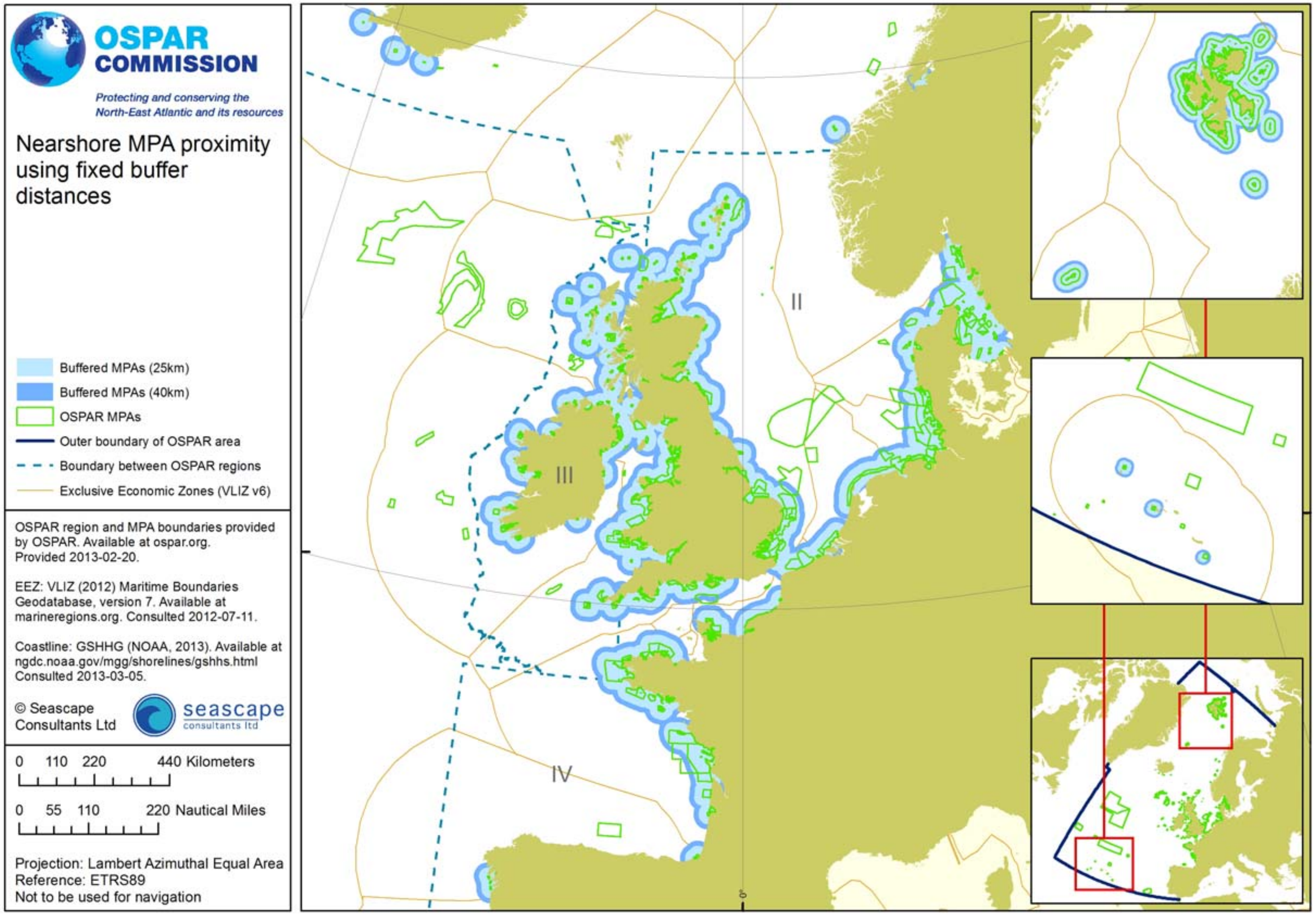

Figure 3. MPAs in Regions II and III analysed to proximity thresholds of 80 km and 50 km. The boxes show areas around Svalbard and the Azores. Buffers were not clipped to Territorial Seas.

Test 2 – Test of representation at biogeographic level

Representativity analysis was carried out by Bundesamt für Naturschutz (BfN) for the Draft 2012 Status Report on the OSPAR Network of MPAs, using the of the Dinter biogeographic provinces (2001). These provinces are shown in **Figure 4.** For this assessment, an analysis was also conducted on the number of replicates for each Dinter Province **(Table 1). T**he Dinter provinces do not characterise the biogeographic features of OSPAR Region V (Wider Atlantic) and therefore require further refinement before representativity there can be considered using this classification system. The 3 Initial OSPAR Tests excluded the Arctic region from its assessment criteria. However, given the recent protections in the north, it would be worthwhile to reconsider this exclusion.

Table 1. Reproduction of the findings for biogeographic provinces (OSPAR, 2013a) and number of replicates. Green indicates provinces where the test criteria have been met – at least 3% coverage and with replication (2 or more examples).

Region	Sub region	Province	Total Area (km^2)	Area protected (km^2)	MPA Coverage (%)	Replicates
(Holo) Pelagic						
Arctic			3 334 941	76 002	2.28%	7
Atlantic	East Atlantic Temperate	Cool-temperate Waters	6 690 666	462 869	6.92%	305
Atlantic	East Atlantic Temperate	Warm-temperate Waters	3 522 504	146 940	4.17%	45
Shelf and Continental Slope						
Arctic		North-East Greenland Shelf	277 879	0	0%	**0**
Arctic		Northeast Water Polynya	71 845	0	0%	**0**
Arctic		High Arctic Maritime	809 874	11 036	1.36%	**4**
Arctic		Barents Sea	1 258 371	67 285	5.81%	**6**
Arctic		South East Greenland – North Iceland Shelf	425 600	0	0.00%	**2**
Atlantic	East Atlantic Temperate	Norwegian Coast (Finnmark and Skagerrak and West Norwegian)	413 698	4 688	1.13%	**13**
Atlantic	East Atlantic Temperate	South Iceland-Faeroe Shelf	306 382	156	0.05%	**9**
Atlantic	East Atlantic Temperate	Boreal	710 185	55 823	7.86%	**210**
Atlantic	East Atlantic Temperate	Boreal – Lusitanean	455 947	39 882	8.75%	**73**
Atlantic	East Atlantic Temperate	Lusitanean – Boreal	151 202	16 844	11.14%	**24**
Atlantic	East Atlantic Temperate	Lusitanean (Cool and Warm)	118,277	3,972	3.36%	**14**
Atlantic	East Atlantic Temperate	Macaronesian Azores	22 545	812	3.60%	**4**
Deep Sea						
Arctic			2 235 011	0	0	**0**
Atlantic			6 995 818	483 218	6.91%	**23**

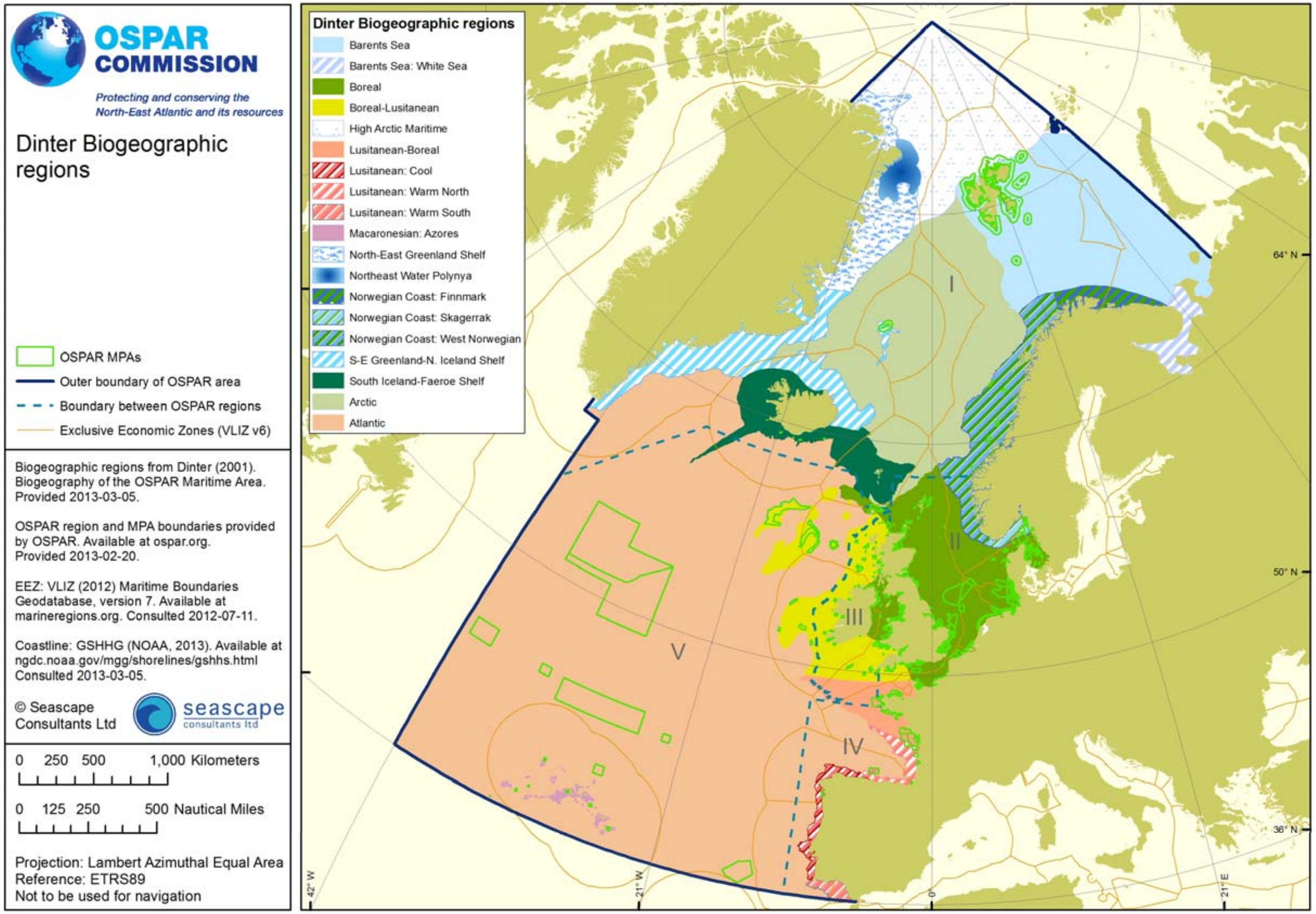

Figure 4. Dinter biogeographic regions and OSPAR MPA network, mapped by Seascape from files provided by OSPAR. Note that pelagic and benthic provinces are both depicted on this map.

Test 3 – Testing the representativity of bathymetric zones

The distribution of the OSPAR MPA network is shown overlaid with a shaded bathymetric map (**Figure 5**). A histogram shows this distribution binned into five broad depth classes (**Figure 6**). This overview is a first glance at MPA distribution, and should not be interpreted to signify a network analysis. Nevertheless, certain trends are already clear; namely the bias towards shallower areas. Note that the two deepest classes (bathyal and abyssal) were combined to form the "deep sea" class, deeper than 2000m, as there are currently very few human threats in the OSPAR Maritime Area at these depths that can be directly mitigated through the use of MPAs (fishing, for example, generally goes no deeper than 1500m).

However, there are a number of impacts that do require consideration, or will in the near future, including climate change, acidification, the downslope impacts of sediment slides and turbidity currents initiated by bottom trawling, exploration for minerals within the Azores archipelago and in ABNJ areas of the Mid-Atlantic Ridge, and the introduction of pollutants from terrestrial sources into the deep sea, often funnelled through canyon systems. These and other human impacts, although relevant to MPA placement (*e.g*. a vulnerability assessment), will not be considered further here.

In general, for depths where direct impacts do occur at present it is apparent that shelf seas (75 to 200m) and the upper continental slope (200-2000m) require greater representation in the MPA Network. Shelf seas cover a large proportion of Regions I, II and IV are important for productivity in these Regions. Most of these waters have been impacted significantly by human activities. Although outside the scope of this report to analyse, it should be noted that some habitats are even affected significantly by minor human activities whilst others are more resilient. Upper continental slope depths in some Regions are now experiencing extensive pressures from bottom trawling and oil and gas production. Spatial planning of resource development and conservation is required to ensure MPAs and other measures are applied at the same depths at which human impacts are occurring.

Note also that the scales on the x axes in **Figures 7, 8 and 9** are different.

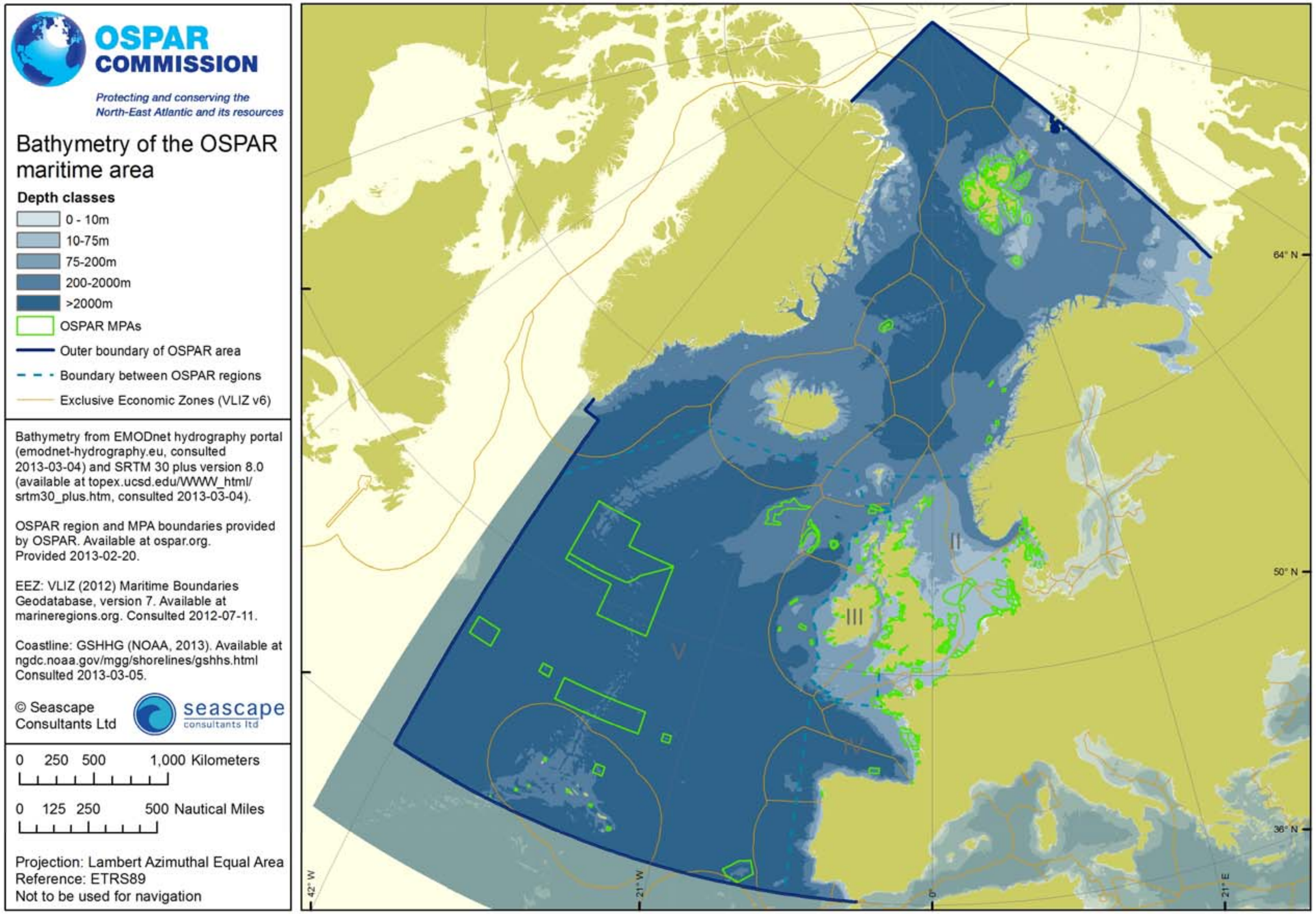

Figure 5. Bathymetry of the OSPAR marine area and OSPAR MPA network

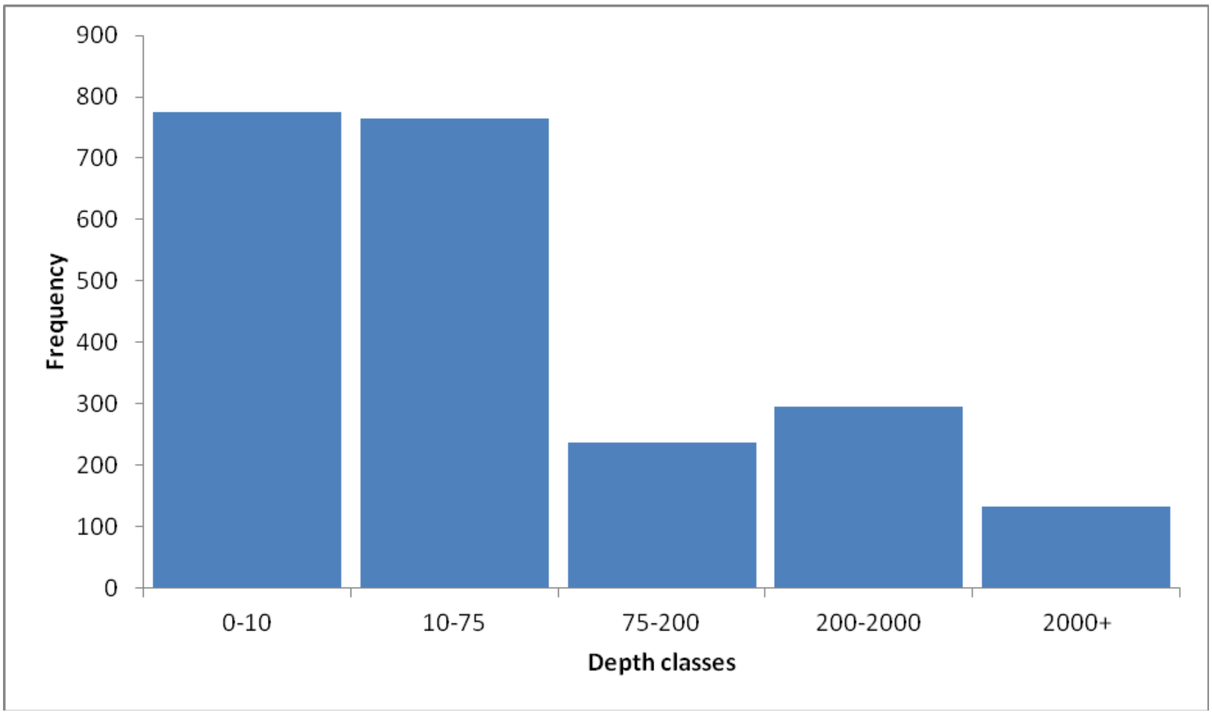

Figure 6. Distribution of depths within MPAs in the OSPAR maritime area by depth class: littoral, shallow shelf, deeper shelf, slope, and deep sea.

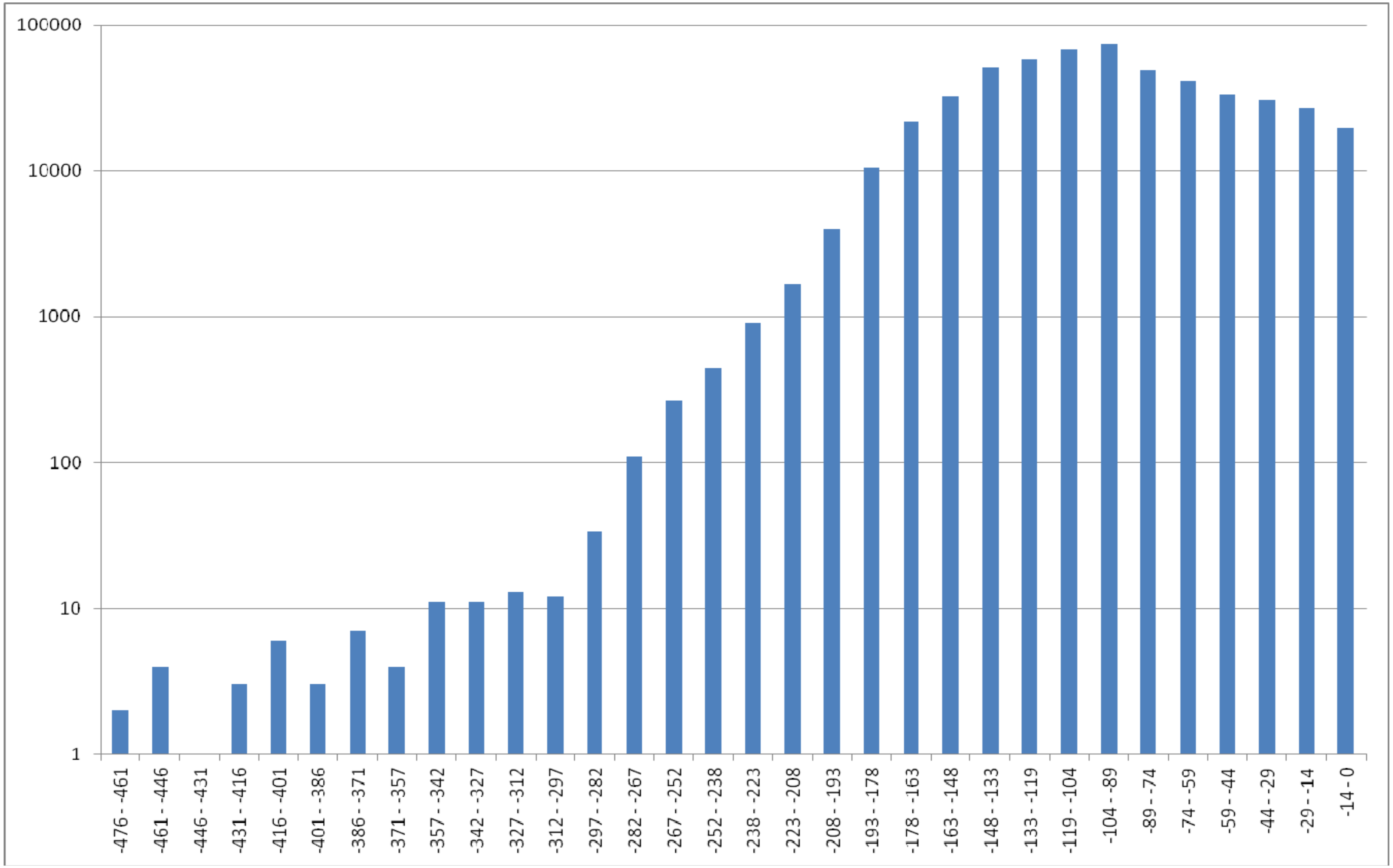

Figure 7. Distribution of depths within MPAs in Region III. Horizontal axis is depth in metres. Vertical axis is a relative scale, based on the analysis grid squares.

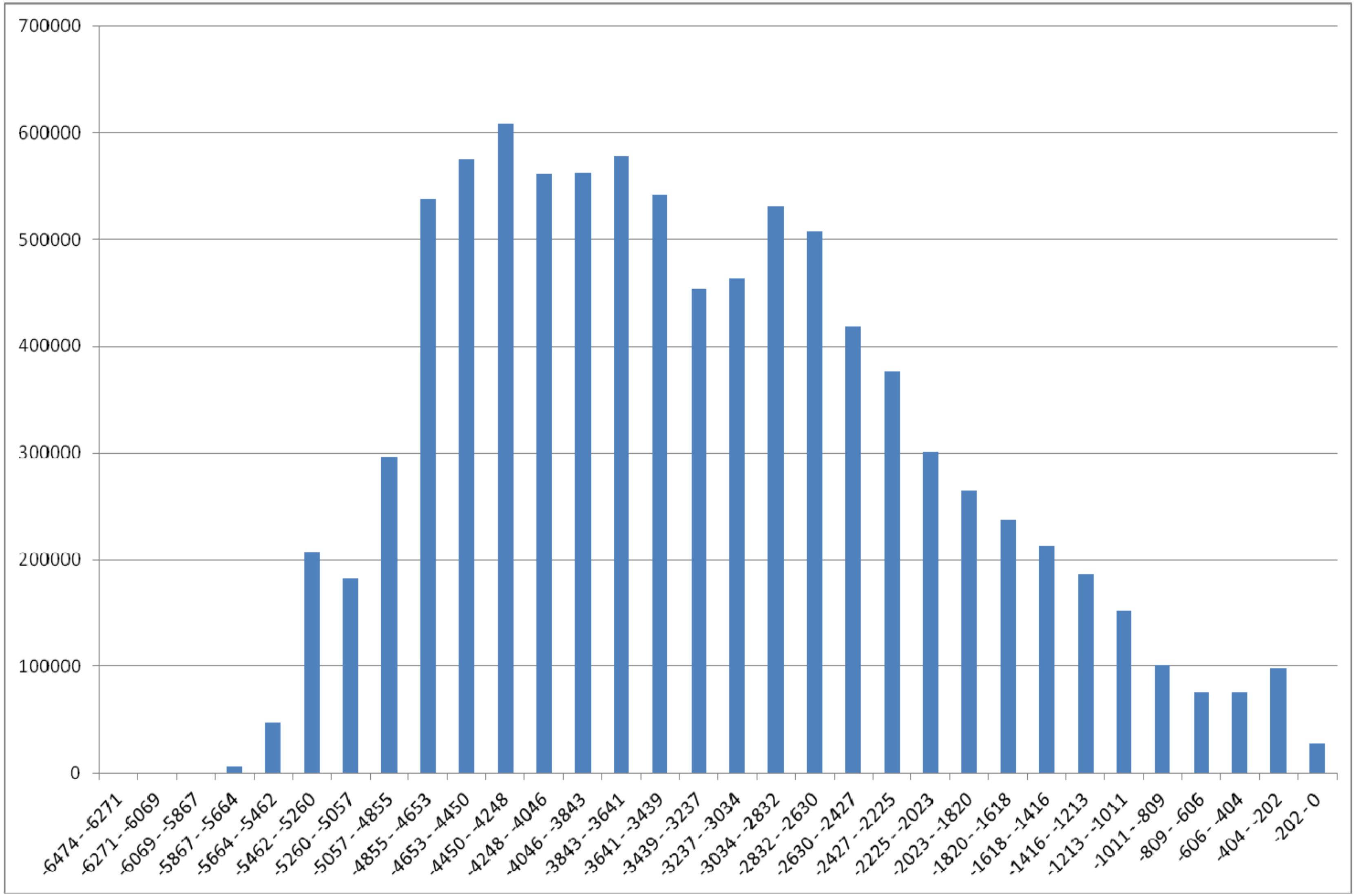

Figure 8. Distribution of depths within MPAs in Region V. Horizontal axis is depth in metres. Vertical axis is a relative scale, based on the analysis grid squares.

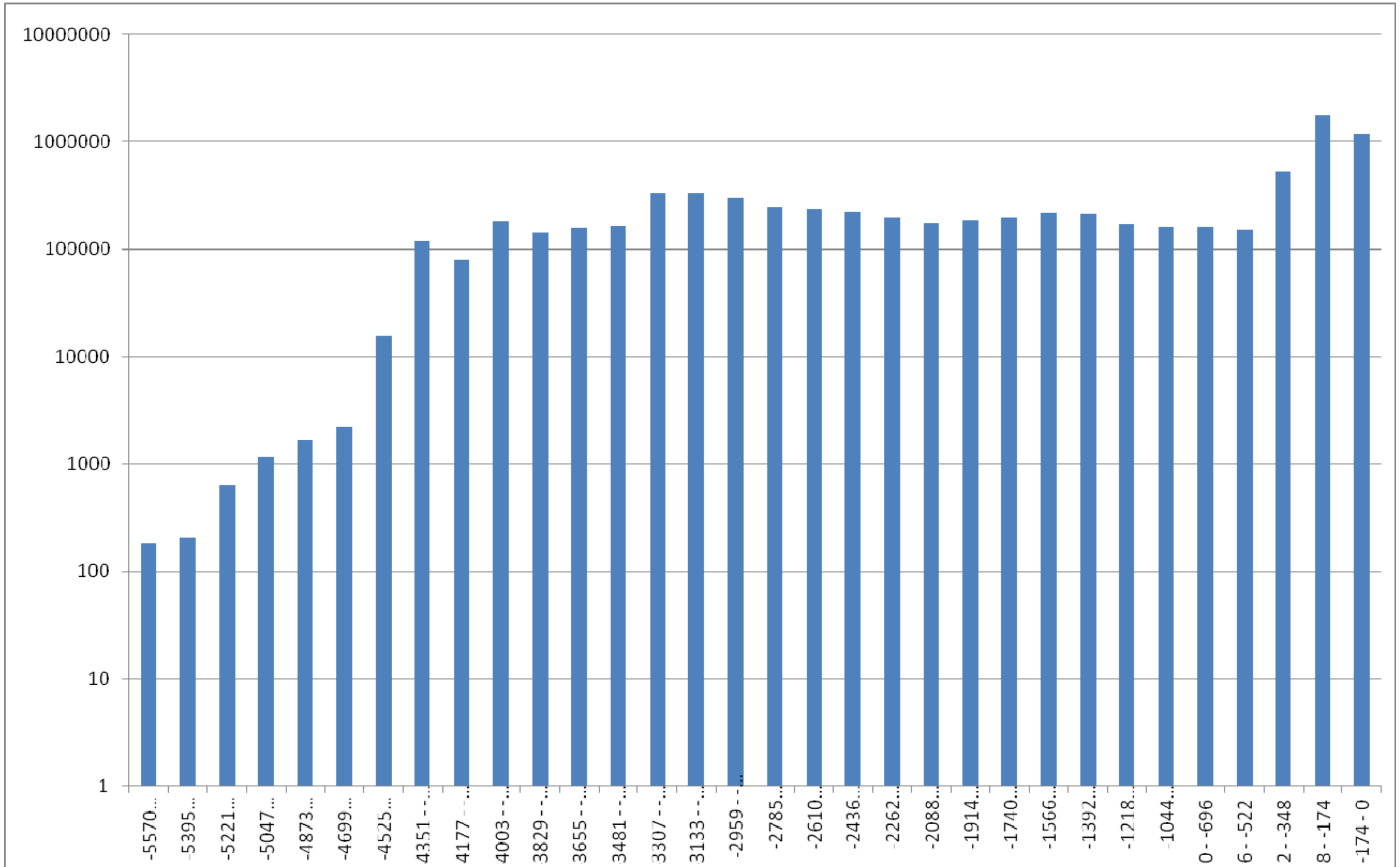

Figure 9. Distribution of depths within MPAs in Region I. Horizontal axis is depth in metres. Vertical axis is a relative scale, based on the analysis grid squares.

Level 2 (Regional and sub-Regional scale)

Test 4-Representativity of OSPAR threatened and/or declining species and habitats

A trial GIS analysis to overlay two existing geo-referenced datasets (OSPAR habitat mapping and MPA data) for Regions I, II, III and V was undertaken in 2011 and reported to the OSPAR Biodiversity Committee in 2012 (BDC 12/3/13). Information on presence of threatened and/or declining habitats and replicates yielded initial ecological coherence-related results but highlighted the paucity of data available compounded by a mix of point and polygon data. This trial recommended improvements in data gathering and suggested that, as yet, this test cannot be meaningfully undertaken. However, the trial also recommended the use of EUNIS Level 3 categories and EUSeaMap data – a suggestion taken up by this assessment.

Although some progress has been made with collating OSPAR threatened and/or declining habitats data led by the Joint Nature Conservation Committee on behalf of OSPAR, there remains a limited understanding of the distribution of OSPAR threatened and/or declining habitats and species across the OSPAR Maritime Area. As such, this assessment drew upon information on the predictive distribution of one OSPAR threatened and/or declining habitat – *Lophelia pertusa* reefs, to indicate how this test could be applied. Ross and Howell (2012) provided an analysis of the proportion of the predicted occurrence of the cold-water coral *Lophelia pertusa* contained within the MPA network within their study region of UK and Irish waters. They found that '[*Lophelia pertusa* reef] suitable environments are the most well protected within the study area (23.2% contained within OSPAR MPAs) with protection at national levels varying from 35.6% in UK to 12.5% in Irish waters. Note that not all the OSPAR Maritime Area was included (Figure 1). Ross and Howell (2012) concluded that 'given the coarse resolution of the model, the percentages should be taken as maximal figures, with habitat occurrence likely to be less prevalent in reality'. We would also highlight the likelihood of false positives, which are common in these sorts of models. Hence, the level of protection is indicative, but needs site level validation. Further discussion on the accuracy of the model can be found in their publication.

Figure 10 below shows the OSPAR MPA network overlaid with the results of the habitat model for *Lophelia pertusa* reef. Similar charts are presented by Ross and Howell for sponge aggregations (*Pheronema*) and giant protozoans (xenophyophores, *Syringammina*) on the upper continental slope, but are not reproduced here.

Regarding seabirds, the third initial spatial test (OSPAR, 2008) asks: 'Are most (70%) of the OSPAR threatened and/or declining seabirds protected through MPAs that include at least 5% of their inter-annually persistent at-sea concentrations; *e.g.* Important Bird Areas (IBAs).

For this analysis Birdlife International provided a seabird data layer of prioritised seabird distributions and abundances gleaned from multiple sources. It highlights areas of greatest conservation significance as those meeting (or that may meet) the Birdlife International Important Bird Area (IBA) criteria.[6] These data have been mapped alongside the OSPAR MPA network in **Figure 11** below. As can be seen, most of the offshore and high seas IBAs fall outside of OSPAR MPAs.

[6] Further details on the IBA criteria can be found at www.birdlife.org/datazone/info/ibacriteria

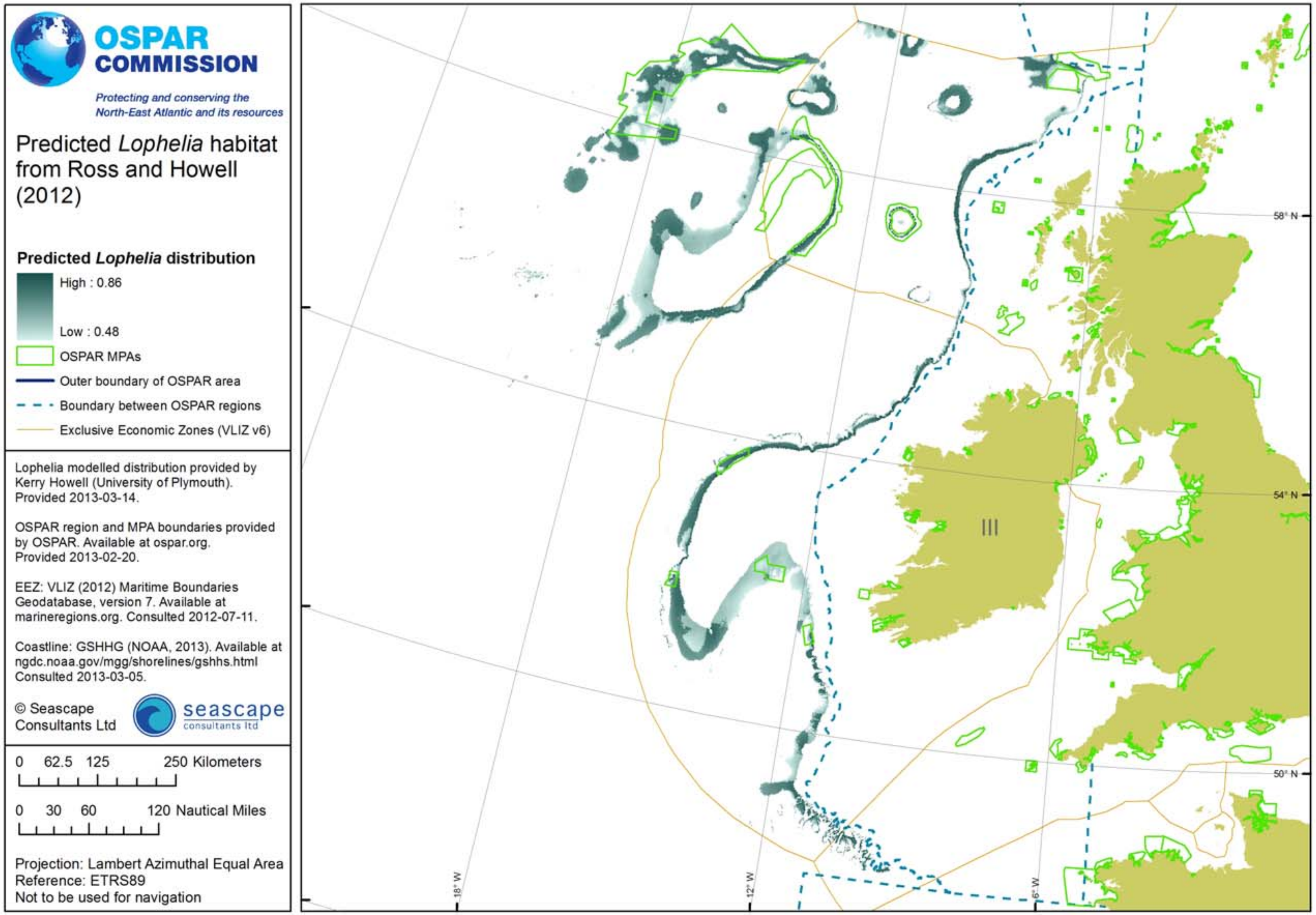

Figure 10. Predicted Lophelia pertusa habitat distribution from Ross and Howell (2012) and the OSPAR MPA network

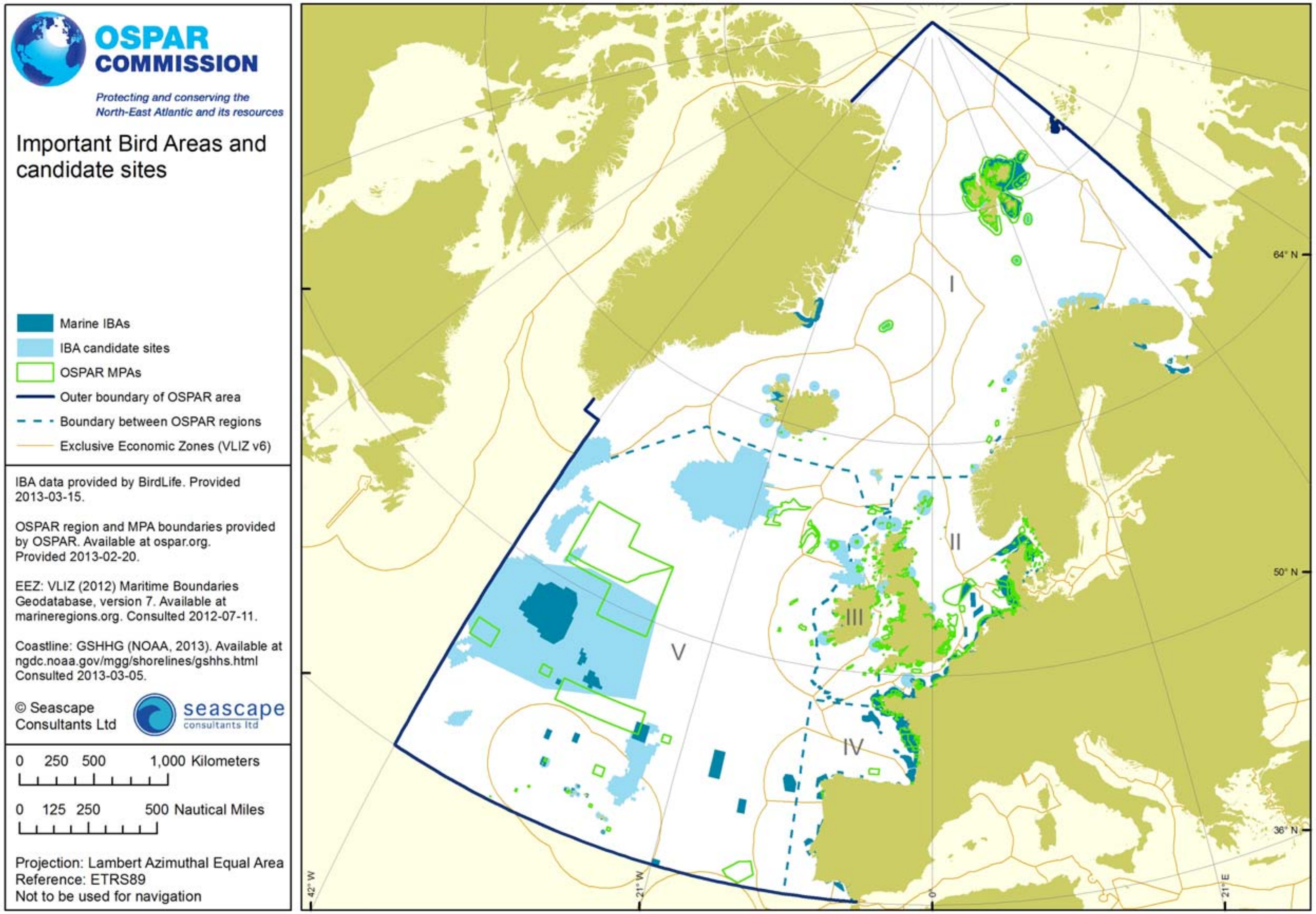

Figure 11. Important Bird Areas and candidate sites and the OSPAR MPA network, courtesy Birdlife International

Test 5 – A matrix to assess features, representativity, replication, resilience and connectivity

The results of the matrix trial are described in the report presented to ICG-MPA and BDC in January and February 2013 respectively (OSPAR, 2013b).

Test 6 - Spatial analysis of broad-scale habitat representativity and replication

Tables 2 and 3 show the area of each broad-scale habitat in Regions II and III, respectively, together with the total area assumed to be protected within an MPA boundary. All broad-scale habitats that are found in each Region are presented, several of which are not protected/covered yet by the MPA network. Those broad scale habitats that have not met the current threshold are highlighted in red.

A broad-scale habitat is considered represented if an area greater than 0.24 km^2 or a proportion greater than 3% of the respective MPA exists within the boundary of an MPA. Those that are represented in Region II and III are identified in the tables with green shading. The replication threshold was set to the minimum (*i.e*. 2).

It is difficult to ascertain whether broad-scale habitats are effectively protected from occurrence within an OSPAR MPA because they are frequently not listed in their own right on designation orders or there has not been a translation to determine whether designated features correspond to protection of a particular broadscale habitat. Consequently, for the purposes of this test we have assumed that broad-scale habitats falling within MPAs are afforded protection.

Intertidal habitats are missing as they are not included within the EU SeaMap broad-scale habitat data. The overall percentage protected is considered in **Test 7**, below.

Table 2. Broad-scale habitats that are represented in the network highlighted in green and the number of replicates that surpass a threshold of 2 highlighted in green for Region II

Eunis Level 3 code	EUNIS Level 3 reference	Total area in region II (km^2)	Area in MPAs (km^2)	Replicates
A3.1	Atlantic and Mediterranean high energy infralittoral rock	3 561.03	**1 321.43**	**45**
A3.2	Atlantic and Mediterranean moderate energy infralittoral rock	3 200.34	**939.51**	**59**
A3.3	Atlantic and Mediterranean low energy infralittoral rock	285.04	**32.77**	**14**
A4.1	Atlantic and Mediterranean high energy circalittoral rock	2 336.26	**646.84**	**30**
A4.2	Atlantic and Mediterranean moderate energy circalittoral rock	20 647.69	**2 299.60**	**42**
A4.3	Atlantic and Mediterranean low energy circalittoral rock	9 340.66	**539.16**	**13**
A5.1	Sublittoral coarse sediment	112 235.98	**14 004.00**	**82**
A5.2	Sublittoral sand	377 999.23	**41 286.67**	**89**
A5.3	Sublittoral mud	59 981.35	**3 987.55**	**44**
A5.4	Sublittoral mixed sediments	16 769.33	**1 521.03**	**45**
A6.1	Deep-sea rock and artificial hard substrata	990.06	**2.21**	**1**
A6.2	Deep-sea mixed substrata	2 910.32	**0.04**	
A6.3 or A6.4	Deep-sea sand or deep-sea muddy sand	12 070.69		
A6.5	Deep sea mud	61 770.09	**1 136.69**	**4**
	Deep circalittoral mixed hard sediments	5 282.04	**7.29**	**1**
	Deep circalittoral seabed	4 209.21	**3.61**	**4**
	High energy circalittoral mixed hard sediments	105.02	**6.42**	**3**
	High energy circalittoral seabed	748.27	**6.66**	**6**
	High energy infralittoral mixed hard sediments	539.47	**24.81**	**4**
	High energy infralittoral seabed	4 317.23	**108.60**	**15**
	Low energy circalittoral mixed hard sediments	740.16	**0.64**	**1**
	Low energy circalittoral seabed	727.92	**3.77**	**5**
	Low energy infralittoral mixed hard sediments	0.34		
	Low energy infralittoral seabed	266.62	**3.28**	**3**
	Mid bathyal coarse sediment	172.48		
	Mid bathyal seabed	1 429.46		
	Moderate energy circalittoral mixed hard sediments	3 504.98	**381.69**	**6**
	Moderate energy circalittoral seabed	1 831.95	**3.36**	**2**
	Moderate energy infralittoral mixed hard sediments	488.94	**121.12**	**3**
	Moderate energy infralittoral seabed	875.87	**15.44**	**12**
	Upper bathyal coarse sediment	2 341.70		
	Upper bathyal seabed	711.55		
	Upper slope coarse sediment	6 886.33		
	Upper slope mixed hard sediments	3 920.06		
	Upper slope seabed	2 873.84		
	Total	**726 071.54**	**68 404.21**	**533**

Table 3 Broad-scale habitats that are represented in the network highlighted in green and the number of replicates that surpass a threshold of 2 highlighted in green for Region III

Eunis Level 3 code	EUNIS Level 3 reference	Total area in region III (km^2)	Total area in MPAs (km^2)	Replicates
A3.1	Atlantic and Mediterranean high energy infralittoral rock	5 725.85	**589.46**	**38**
A3.2	Atlantic and Mediterranean moderate energy infralittoral rock	1 952.10	**384.96**	**40**
A3.3	Atlantic and Mediterranean low energy infralittoral rock	705.66	**83.43**	**18**
A4.1	Atlantic and Mediterranean high energy circalittoral rock	2 125.05	**238.97**	**21**
A4.2	Atlantic and Mediterranean moderate energy circalittoral rock	1 5235.35	**1 222.81**	**35**
A4.3	Atlantic and Mediterranean low energy circalittoral rock	12 671.58	**545.39**	**22**
A5.1	Sublittoral coarse sediment	83 150.29	**4 445.12**	**42**
A5.2	Sublittoral sand	86 479.63	**4 064.04**	**52**
A5.3	Sublittoral mud	28 720.20	**1 119.19**	**32**
A5.4	Sublittoral mixed sediments	20 941.01	**780.57**	**26**
A6.1	Deep-sea rock and artificial substrata	52.75	**20.97**	**3**
A6.2	Deep-sea mixed substrata	47.55	**0.45**	**1**
A6.3 or A6.4	Deep-sea sand or deep-sea muddy sand	648.72	**3.72**	**2**
A6.5	Deep-sea mud	1 467.40	**24.68**	**2**
	Deep circalittoral seabed	88 611.00	**66.35**	**8**
	High energy circalittoral mixed hard sediments	15.06		
	High energy circalittoral seabed	598.86	**65.87**	**11**
	High energy infralittoral mixed hard sediments	12.12		
	High energy infralittoral seabed	3 678.33	**419.16**	**17**
	Low energy circalittoral mixed hard sediments	6.84		
	Low energy circalittoral seabed	836.79	**16.66**	**6**
	Low energy infralittoral mixed hard sediments	19.73		
	Low energy infralittoral seabed	205.66	**13.02**	**13**
	Moderate energy circalittoral mixed hard sediments	47.22		
	Moderate energy circalittoral seabed	5 316.22	**115.37**	**7**
	Moderate energy infralittoral mixed hard sediments	2.58		
	Moderate energy infralittoral seabed	405.02	**19.13**	**9**
	Upper slope coarse sediment	309.99	**0.02**	
	Upper slope seabed	718.14		
	Total	360 706.69	**14 239.32**	**405**

Test 7 - Initial tests of adequacy and viability for broad-scale modelled habitats

The results of this test provide an indication of the adequacy of the network in each Region by showing the numbers of EUNIS habitat classes that are within MPAs, ranging from 5% to 40%, within inshore and offshore waters of each of OSPAR Regions II and III.

In Region II, 1 358 patch sizes are less than 4 km^2 and 672 are greater than 4 km^2(**Figure 12**). For Region III the figures are 1 049 and 342 respectively (**Figure 13**). The preponderance of small patches suggests that these will need to be further investigated to assess their ecological relevance. (See Discussion, below.)

As per test 6, a minimum patch size of 0.24 km^2 or 3% of the proportion within the MPA was used, based on the HELCOM precedent.

Table 4. EUNIS level 3 classes and the proportion within MPAs, with the tested thresholds ranging between 5% and 40% in the nearshore area of Region II. EUNIS classes that do not intersect MPAs are not shown.

Habitat	Total area (km^2)	Area in MPAs (km^2)	% in MPAs	5% in MPAs	10%	20%	30%	40%
A3.1 - Atlantic & Mediterranean high energy infralittoral rock	3 550.17	1 301.58	36.7	YES	YES	YES	YES	NO
A3.2 – Atlantic & Med. moderate energy infralittoral rock	2 965.47	859.87	29.0	YES	YES	YES	NO	
A3.3 – Atlantic & Med. low energy infralittoral rock	281.60	27.25	9.7	YES	NO			
A4.1 – Atlantic & Med. high energy circalittoral rock	1614.20	218.56	13.5	YES	YES	NO		
A4.2 - Atlantic & Med. moderate energy circalittoral rock	9 152.37	1 088.42	11.9	YES	YES	NO		
A4.3 – Atlantic & Med. low energy circalittoral rock	4 509.23	320.58	7.1	YES	NO			
A5.1 - Sublittoral coarse sediment	41 290.27	5 772.41	14.0	YES	YES	NO		
A5.2 - Sublittoral sand	47 606.55	14 029.12	29.5	YES	YES	YES	NO	
A5.3 - Sublittoral mud	8 829.90	2 235.05	25.3	YES	YES	YES	NO	
A5.4 - Sublittoral mixed sediments	8 753.61	1 372.51	15.7	YES	YES	NO		
A6.1 - Deep-sea rock and artificial substrata	924.15	2.21	0.2	NO				
A6.5 - Deep-sea mud	9 035.00	55.89	0.6	NO				
Deep circalittoral seabed	4 209.21	2.54	0.1	NO				
High energy circalittoral mixed hard sediments	95.65	4.07	4.3	NO				
High energy circalittoral seabed	748.27	2.67	0.4	NO				
High energy infralittoral mixed hard sediments	189.16	7.23	3.8	NO				
High energy infralittoral seabed	4 317.23	97.70	2.3	NO				
Low energy circalittoral seabed	727.92	2.69	0.4	NO				
Low energy infralittoral seabed	266.62	1.88	0.7	NO				
Moderate energy circalittoral mixed hard sediments	190.49	10.74	5.6	YES				
Moderate energy circalittoral seabed	1 831.95	0.89	0.0	NO				
Moderate energy infralittoral seabed	875.87	11.09	1.3	NO				

***Table* 5.** Region II *EUNIS level 3 classes and the proportion within MPAs, with the tested thresholds ranging between 5% and 40% in the* offshore *area of Region II. EUNIS classes that do not intersect MPAs are not shown.*

Habitat	**Total area (km^2)**	**Area in MPAs (km^2)**	**% in MPAs**	**5% in MPAs**	**10%**	**20%**	**30%**	**40%**
A3.2 - Atlantic and Mediterranean moderate energy infralittoral rock	234.88	55.26	23.5	YES	YES	YES	NO	
A4.1 - Atlantic and Mediterranean high energy circalittoral rock	722.06	404.86	56.1	YES	YES	YES	YES	YES
A4.2 - Atlantic and Mediterranean moderate energy circalittoral rock	11 495.32	1 196.70	10.4	YES	YES	NO		
A4.3 - Atlantic and Mediterranean low energy circalittoral rock	4831.43	214.36	4.4	NO				
A5.1 - Sublittoral coarse sediment	70 945.71	8 219.39	11.6	YES	YES	NO		
A5.2 - Sublittoral sand	330 392.68	27 220.02	8.2	YES	NO			
A5.3 - Sublittoral mud	51 151.45	1 736.81	3.4	NO				
A5.4 - Sublittoral mixed sediments	8 015.72	143.85	1.8	NO				
A6.5 - Deep-sea mud	52 735.09	1 080.46	2.0	NO				
Deep circalittoral mixed hard sediments	4 813.40	7.29	0.2	NO				
High energy circalittoral mixed hard sediments	9.38	1.55	16.6	YES	YES	NO		
High energy infralittoral mixed hard sediments	350.31	17.39	5.0	NO				
Moderate energy circalittoral mixed hard sediments	3 314.49	370.11	11.2	YES	YES	NO		
Moderate energy infralittoral mixed hard sediments	441.65	120.00	27.2	YES	YES	YES	NO	

Table 6. Region III EUNIS level 3 classes and the proportion within MPAs, with the tested thresholds ranging between 5% and 40% in the nearshore area of **Region** III EUNIS classes that do not intersect MPAs are not shown.

Habitat	Total area (km^2)	Area in MPAs (km^2)	% in MPAs	5% in MPAs	10%	20%	30%	40%
A3.1 - Atlantic and Mediterranean high energy infralittoral rock	5 687.19	574.51	10.1	YES	YES	NO		
A3.2 - Atlantic and Med. moderate energy infralittoral rock	1 862.94	342.10	18.4	YES	YES	NO		
A3.3 - Atlantic and Med. low energy infralittoral rock	705.51	74.86	10.6	YES	YES	NO		
A4.1 - Atlantic and Med. high energy circalittoral rock	2 035.08	230.44	11.3	YES	YES	NO		
A4.2 - Atlantic and Med. moderate energy circalittoral rock	9 376.12	837.94	8.9	YES	NO			
A4.3 - Atlantic and Med. low energy circalittoral rock	3 113.54	167.56	5.4	YES	NO			
A5.1 - Sublittoral coarse sediment	32 359.15	3 283.14	10.1	YES	YES	NO		
A5.2 - Sublittoral sand	29 184.77	3 652.10	12.5	YES	YES	NO		
A5.3 - Sublittoral mud	14 422.97	1 096.01	7.6	YES	NO			
A5.4 - Sublittoral mixed sediments	7 408.02	483.28	6.5	YES	NO			
A6.1 - Deep-sea rock and artificial substrata	52.74	20.68	39.2	YES	YES	YES	YES	NO
A6.2 - Deep-sea mixed substrata	29.00	0.41	1.4	NO				
A6.3 or A6.4 - Deep-sea sand or deep-sea muddy sand	117.54	3.57	3.0	NO				
A6.5 - Deep-sea mud	109.22	24.40	22.3	YES	YES	YES	NO	
Deep circalittoral seabed	5 203.60	64.55	1.2	NO				
High energy circalittoral seabed	598.20	56.66	9.5	YES	NO			
High energy infralittoral seabed	3 607.61	410.80	11.4	YES	YES	NO		
Low energy circalittoral seabed	562.76	14.14	2.5	NO				
Low energy infralittoral seabed	201.80	10.99	5.4	YES	NO			
Moderate energy circalittoral seabed	4 730.55	113.22	2.4	NO				
Moderate energy infralittoral seabed	311.45	16.25	5.2	YES	NO			

Table 7. EUNIS level 3 classes and the proportion within MPAs, with the tested thresholds ranging between 5% and 40% in the offshore area of **Region III** EUNIS classes that do not intersect MPAs are not shown.

Habitat	Total area (km^2)	Area in MPAs (km^2)	% in MPAs	5% in MPAs	10%	20%	30%	40%
A3.2 - Atlantic and Mediterranean moderate energy infralittoral rock	89.17	23.05	25.9	YES	YES	YES	NO	
A4.2 - Atlantic and Med. moderate energy circalittoral rock	5 859.23	371.63	6.3	YES	NO			
A4.3 - Atlantic and Med. low energy circalittoral rock	9 558.04	368.97	3.9	NO				
A5.1 - Sublittoral coarse sediment	50 791.15	1 156.40	2.3	NO				
A5.2 - Sublittoral sand	57 294.87	402.82	0.7	NO				
A5.3 - Sublittoral mud	14 297.23	17.53	0.1	NO				
A5.4 - Sublittoral mixed sediments	13 532.99	291.51	2.2	NO				
Deep circalittoral seabed (level 4)	83 407.40	1.17	0.0	NO				

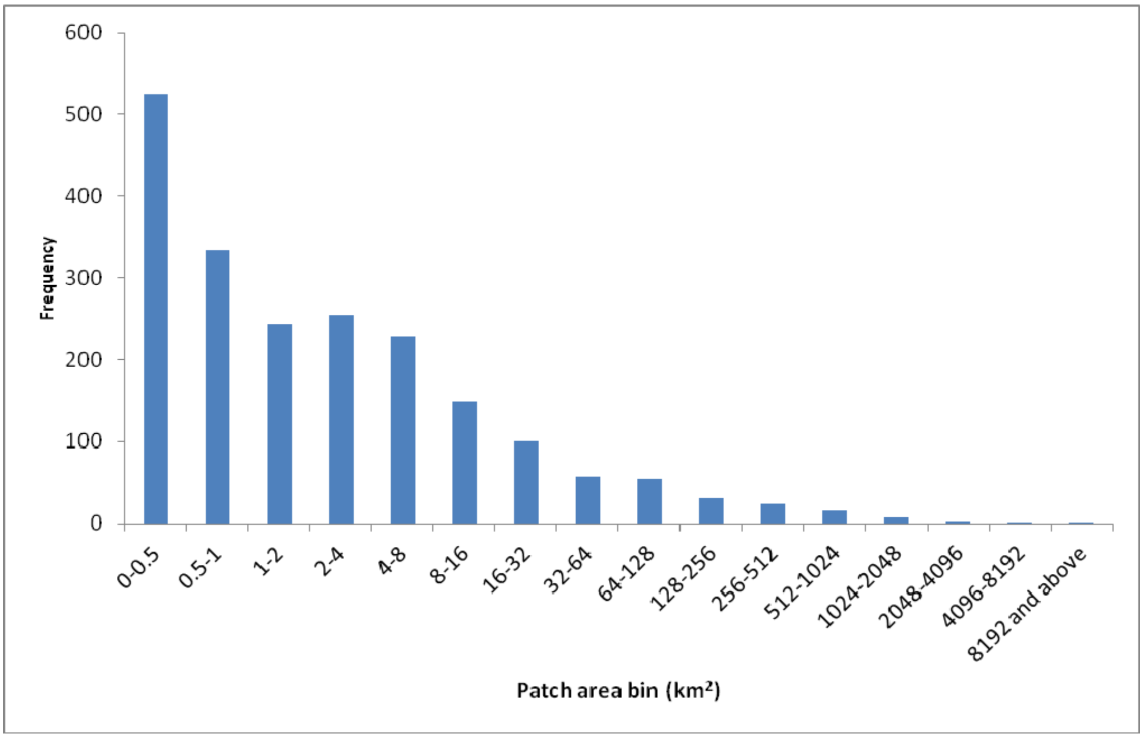

Figure 12 Histogram showing patch size distribution for broadscale habitats within Region II. Frequency' on the x-axis is a relative measure reflecting the analysis grid squares. Note the large number of very small patches, suggesting the possibility of classification artefacts

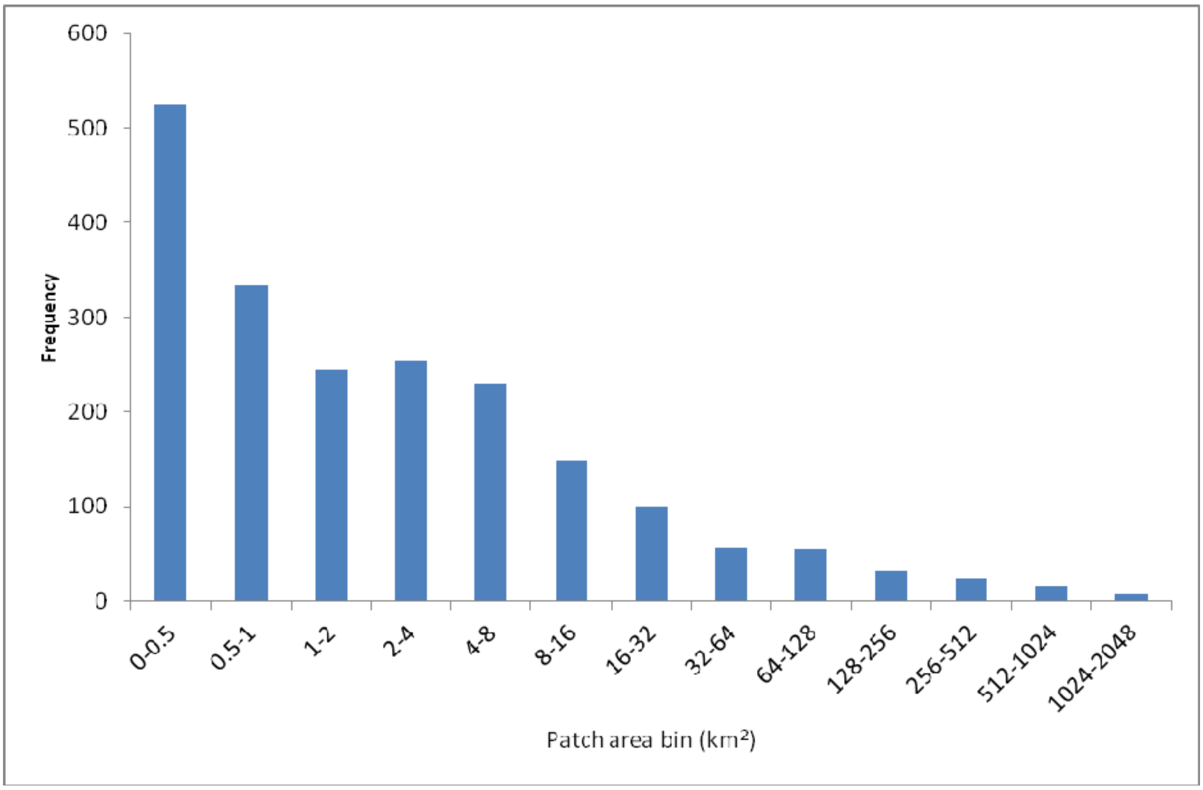

Figure 13. Histogram showing patch size distribution for broadscale habitats within Region III. 'Frequency' on the x-axis is a relative measure reflecting the analysis grid squares. Note the large number of very small patches, suggesting the possibility of classification artefacts.

Test 8 – Spatial analysis of broad-scale habitat proximity

A proximity analysis was performed for EUNIS Level 3 classes: high energy circalittoral rock; high energy infralittoral rock and circalittoral rock are shown in **Figures 14, 15 and 16** for Regions II and III. Using the numbers from the OSPAR 3 Initial Tests, each example of the habitat that is protected within an MPA was analysed for proximity to other examples of the same broad-scale EUNIS class, at thresholds of 250 km and 500 km offshore (buffer of 125 km and 250 km) and 50 km and 80 km nearshore. The assumption is that the same EUNIS classes were more likely to be relevant to an associated species' connectivity than different ones. However, it is acknowledged that different life history stages could require different habitat types, and that at a finer scale analysis this would need to be considered.

High Energy Infralittoral rock and High Energy Circalittoral rock are both sparsely distributed habitats found primarily in the nearshore area. It is challenging to meet larger proximity thresholds. There are large gaps in the North Sea, Irish Sea and Celtic Sea that are primarily due to the limited natural occurrence of these habitats.

Sublittoral coarse sediment (EUNIS 5.1) is a more widely distributed habitat that has mostly met the close proximity thresholds (*i.e.*, 80 km). However, gaps occur in the northern North Sea. At a threshold level of 50 km, smaller gaps at lower thresholds, smaller gaps have been identified in the Western Channel and parts of the Irish Sea.

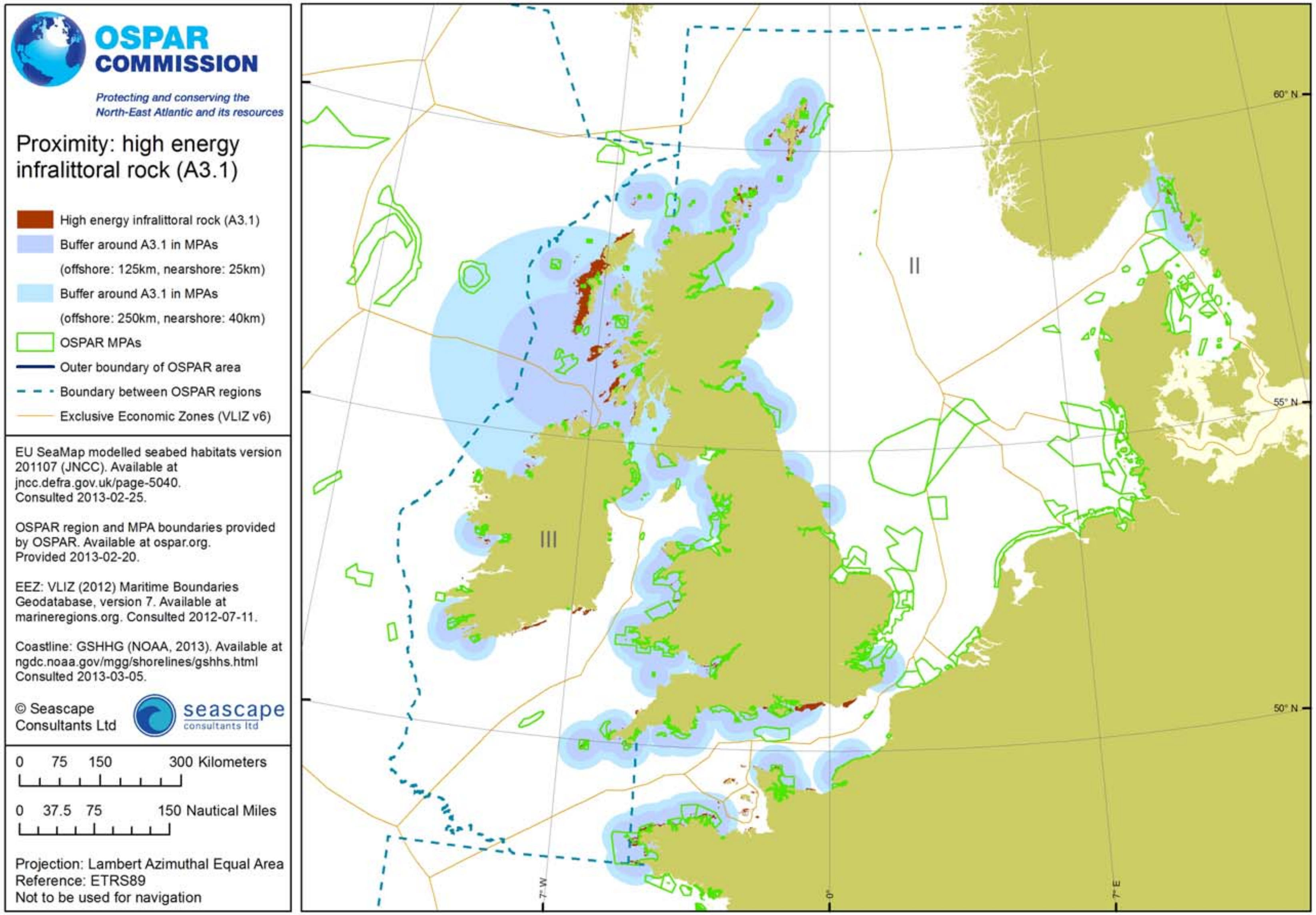

Figure 14. Proximity of infralittoral rock in MPAs Regions II and III using thresholds offshore of 500 km and 250 km; and nearshore of 80 km and 40 km 14 m

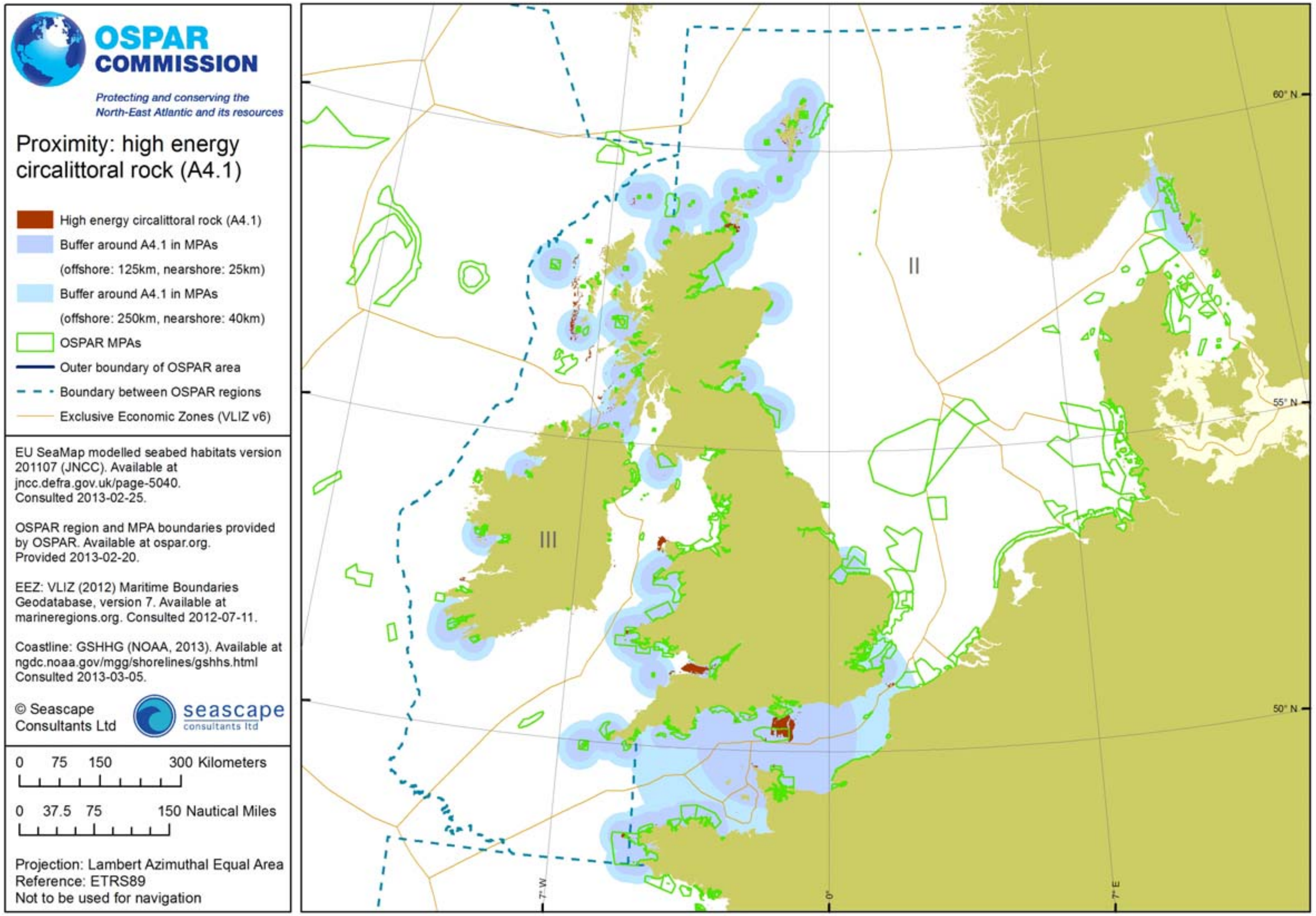

Figure 15. Proximity of high energy circalittoral rock in MPAs Regions II and III using thresholds offshore of 500 km and 250 km; and nearshore of 80 km and 40 km

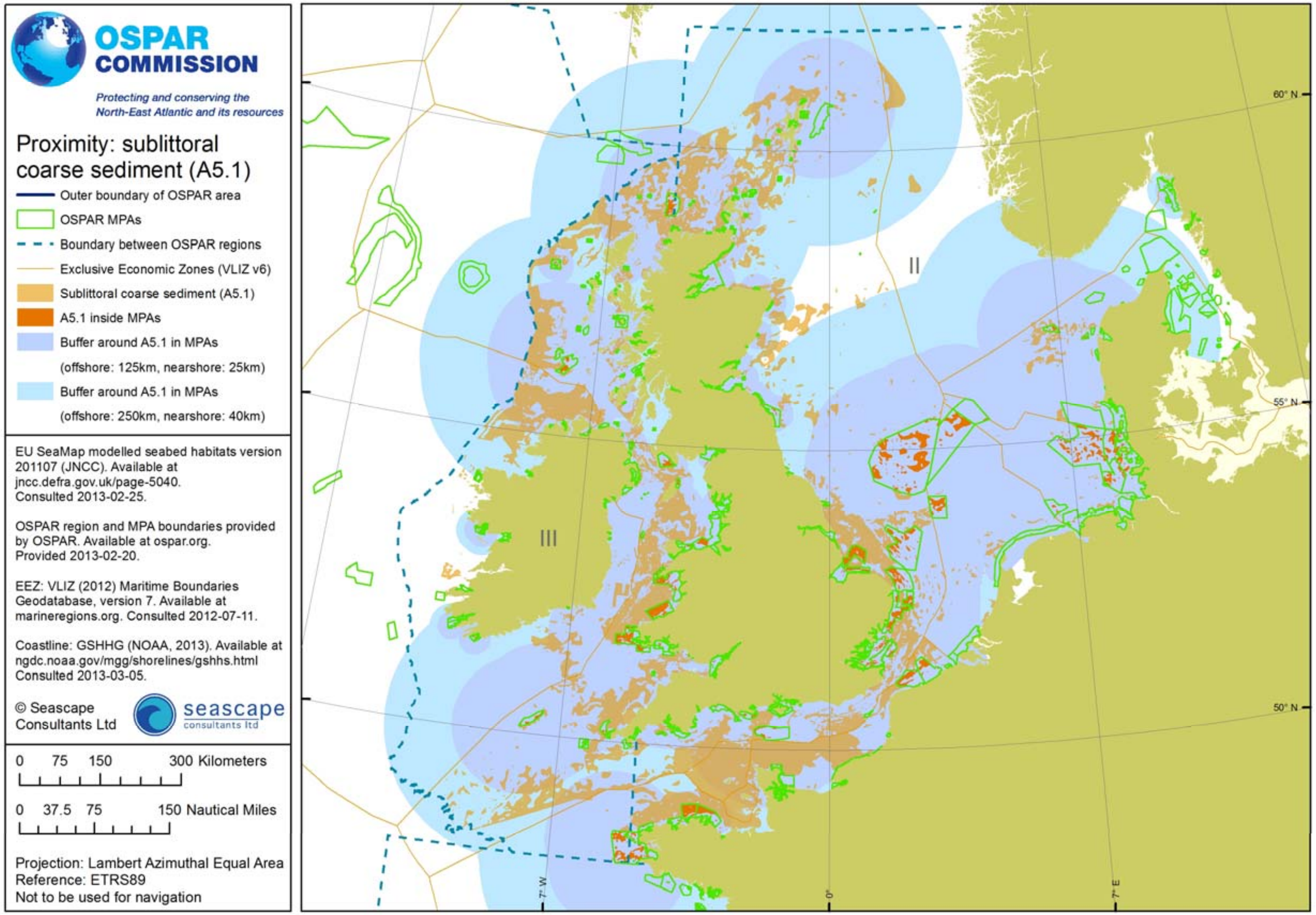

Figure 16. Proximity of sublittoral coarse sediment in MPAs Regions II and III using thresholds offshore of 500 km and 250 km; and nearshore of 80 km and 40 km

Discussion

Level 1

Test 1 – Test to determine whether the network is generally well distributed

As the very first step, this basic test helps to identify which parts of the OSPAR Maritime Area are very unlikely to be ecologically coherent (**Figure 1**). OSPAR (2008) reminds us of the value of the eye and human brain to detect visual patterns and gaps, while taking into consideration factors such as the shape of coastlines. The use of a GIS analysis allows quantification of this visual test. This test also presents mapped outputs that can provide a visual tool, identifying the principal gaps in distribution connectivity within the network to assist future planning. The inverse map (**Figure 2**) provides a quick method to identify where the network is most unlikely to be ecologically coherent. The inverse kernel density analysis takes this method further by recognising that there is no specific cut-off distance in connectivity (and hence proximity), but rather a gradation, reflecting the many differing larval and adult dispersal distances for any given ecological community.

It should be borne in mind that these thresholds are set at a very low level, and therefore the map represents only the most significant spatial gaps in the network, and by no means all of them. Care is also needed when interpreting the results. For example, even in those areas that appear to be well covered, the two-dimensional nature of the map in **Figure 1** may hide larger gaps in different depth layers (albeit that the intention of Test 3 is to give this additional information). Similarly whilst the kernel density (**Figure 2**) may be particularly useful for nearshore habitats, this may be misinterpreted for deep environments where a large range of depths are covered (*e.g.* Hatton Rockall Bank areas and the Charlie-Gibbs Fracture Zone).

It is clear from this first test that Regions I, IV and large parts and depths of Region V are very unlikely to be ecologically coherent. At a threshold of 250 km, Regions II and III are meeting the criteria and are shown to have no major spatial gaps. Therefore, in subsequent tests more stringent criteria have been used based on thresholds that have been used in the English MCZ project (Roberts *et al*. 2010) and the analysis for HELCOM (HELCOM, 2010), as well considering the proximity between habitats of the same general type.

This approach demonstrates how the OSPAR MPA network can be analysed using a stepwise approach, using techniques and thresholds that are most appropriate to the developmental stage of the network within a particular Region. Though ultimately it is the ecological properties of the species and habitats that must be met, an iterative process of testing , gap filling and designation of new sites, can allow the network to work towards an ecologically coherent status, albeit at different rates in each Region.

The principles set out in OSPAR (2008) for how gaps could be filled in data poor situations, recommend using expert opinion and local knowledge; picking the best or best known sites. Where appropriate, collating data from the Census of Marine Life MAR-ECO project and affiliated research project ECOMAR would help to identify areas within Ecologically or Biologically Significant Areas (EBSAs) as a priority for protection.

Test 1 Summary: Test to determine whether the network is generally distributed
Using basic thresholds this test identifies major gaps in the offshore and high seas areas of Regions I, IV and V. Using more stringent connectivity criteria the nearshore components of Regions II and III are showing signs of ecological coherence, with smaller gaps identified around the Channel Islands, southern Norway, southern Ireland and south east England.

Test 2 – Test of representation at biogeographic level

As noted in the Draft 2012 Status Report on the OSPAR Network of MPAs: 'In 2012 the majority of the ten biogeographic provinces considered in this test surpass the 3% threshold coverage by OSPAR Marine Protected Areas (marked green): the five continental shelf provinces Lusitanean-Boreal (11.14%), Boreal-Lusitanean (8.16%), Boreal (8.16%), Macaronesian Azores (3.60%), and Lusitanean (Cool & Warm) (3.36%), and the two pelagic provinces Cool temperate Waters (6.92%) and Warm-temperate Waters (4.17%). and are marked in green on **Table 1**. Therefore, according to this test 'for the first time the results of this initial spatial test indicate a degree of ecological coherence of the OSPAR Network of MPAs with regard to coverage of the various biogeographic provinces within the North-East Atlantic' (OSPAR 2013a, p36). At the province scale this is a coarse test. It should be noted also that other provinces (Barents Sea and Deep Sea Atlantic) exceed 3% but are not considered to be one of the 10 provinces included in the test.

Here, the OSPAR analysis was expanded to consider whether replication is being met at a biogeographic level. The extent of the Dinter provinces varies widely in size between 22,545 km^2 and 6,690,666 km^2 which can affect how readily replication thresholds can be met. In general, rarer habitats require a greater proportion of protection than the widely distributed ones, suggesting that future MPA selection should deliberately seek to replicate examples of the less common habitats that may also be more vulnerable to harm if left unprotected.

In the current analysis, very small patches of a given class were still counted as a replicate. Future refinements should consider establishing minimum patch size limits that reflect the precision of the data, lessening the risk that "noise" is being counted (*e.g.* less than 1 km^2) and taking into consideration the generally accepted precepts of community ecology.

In addition to the Dinter biogeographical provinces, the use of geomorphological maps that are currently being developed under the Global Seabed Geomorphology Map (GSGM) may provide a second proxy for broad-scale habitat representativity (see **Figure 15** as an illustrative analysis). This new GSGM is being produced in partnership with Geoscience Australia, UNEP-GRID Arendal and Conservation International and is on track to be completed at the end of 2013. It will identify GIS polygons comprising the 21 International Hydrographic Office defined seabed features to provide an inventory of those features globally and at a resolution of 900m (Jonas Rüpp, pers. Comm.). Improved geomorphology could be a great asset in the development of improved habitat classifications. However, geomorphology alone should not be confused as a habitat classification, which should take into account many other environmental factors as well as species-habitat associations. This new work could be used alongside EUNIS, but would be subject to similar caveats around data accuracy and scale (see below). In the future, OSPAR may wish to consider the use of these new data sets in its representativity analyses.

Test 2 Summary: Test of representation at biogeographic level
The OSPAR MPA Network of meets this test overall, though not all provinces were represented. This assessment has added a replicate analysis to the results that have been provided in the Draft 2012 Status Report. For those biogeographic provinces meeting the 3% coverage threshold there is a range between 4 (East Atlantic Temperate, Macaronesian Azores) and 305 replicates (East Atlantic Temperate, Cool-temperate Waters), which to some extent reflects the relative sizes of the provinces.

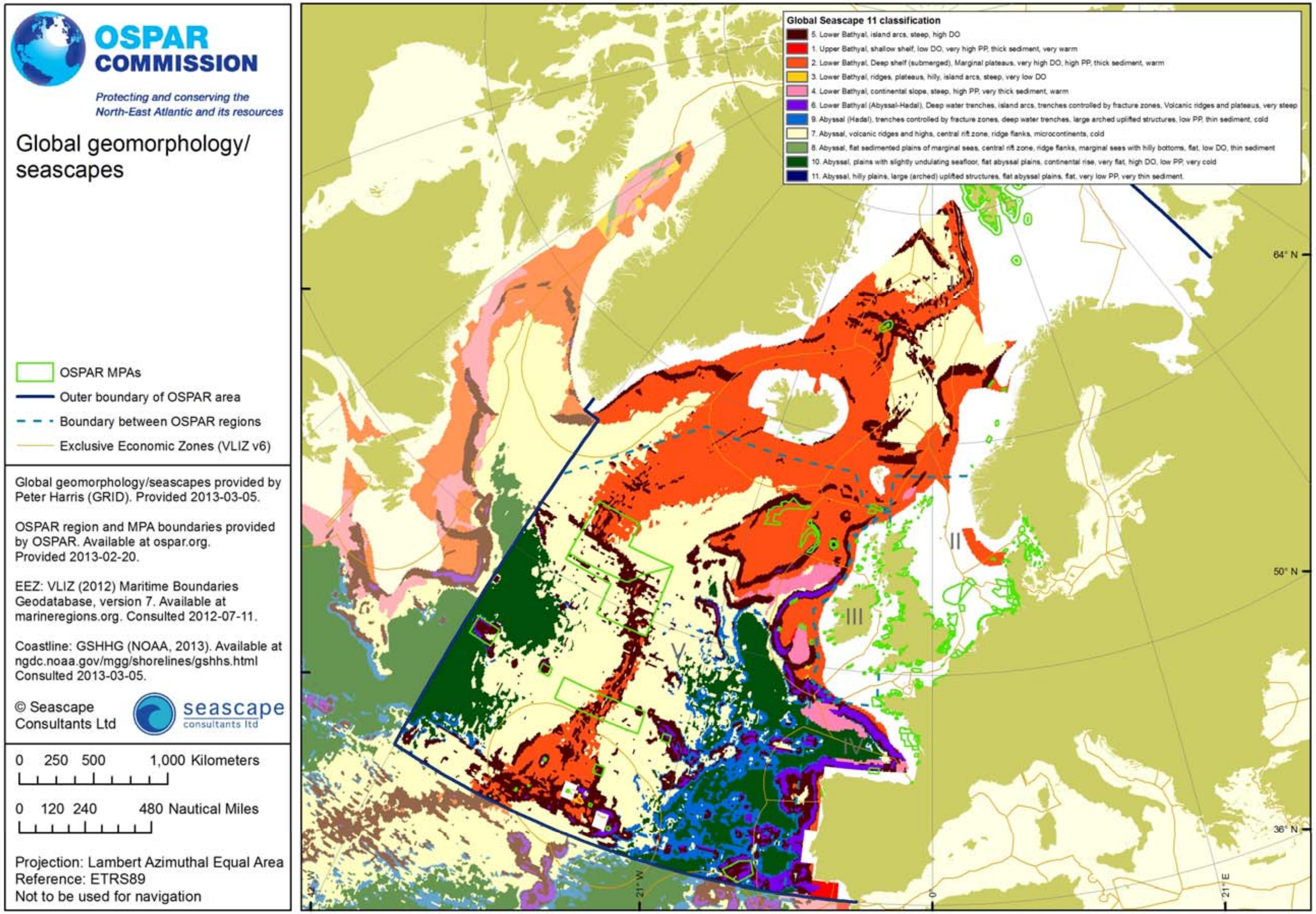

Figure 17. The (draft) global seascape classification, courtesy GRID Arendal

Test 3 – Test of distribution across bathymetric classes

In addition to OSPAR Test 1, which looks at the distribution of MPAs in two dimensions, this analysis adds the third spatial dimension –depth. If broad depth ranges are found to be poorly represented, it would strongly suggest a gap in the eco-coherence of the network.

As with the other initial tests, bathymetry can only provide a very rudimentary 'first glance' at representativity. Once this rudimentary test is met, further consideration should be given to more sophisticated factors such as currents, shape of the coastline and seafloor sediment type. If OSPAR is in agreement, a future test could include combining bathymetry with each Dinter biogeographic zone.

The histogram in **Figure 6** shows an uneven distribution across the depth ranges, with the two shallowest classes (0-75m) having much higher representativity than the deeper classes, with the deepest class (>2 000m) the least represented. To a certain extent it might be expected that MPAs nearshore would be smaller and more numerous; but these results indicate a strong bias towards shallower nearshore areas, which perhaps reflects human interest in areas closer to land.

As can be seen in the histograms in **Figures 7, 8 and 9** different OSPAR Regions have very different depth profiles. Future analyses could take these differing characteristics into account when assessing the distribution of MPAs by depth at a regional scale. For example, depth classes could be determined by looking for break points in the histogram distributions. Areas that are predominantly of one depth range could possibly have additional depth sub-classes, reflecting the sub-Regional character.

Test 3 Summary: Test of distribution across bathymetric classes
This test indicates a strong bias of MPA distribution towards the coastal zone and shallow continental shelf, suggesting coherence has not been achieved at depths greater than 75m.

Level 2

Test 4 – Representation of threatened and/or declining species and habitats

One of the recommendations presented in this report is for efforts to be focused on developing a more comprehensive database on OSPAR threatened and/or declining species and habitats for the OSPAR Maritime Area. Data gathering for this purpose has become intimately connected with monitoring requirements under the EU Maritime Strategy Framework Directive (MSFD) and subsequent sharing of biological data (through EMODnet). Linking future OSPAR tests of eco-coherence to data readily available through the MSFD process would be an efficient use of resources.

In the absence of comprehensive sampling, new approaches are being developed using models to predict the existence of particular species based on habitat parameters such as depth, exposure and substrate. This approach was trialled for the deep-water coral species *Lophelia pertusa* described in Ross and Howell (2012). Further work to examine connectivity of *Lophelia pertusa* within MPAs using larval dispersal models is on-going (K. Howell pers.comm). As with the use of any model, care must be given to the interpretation of its results. In general, false positives (predicted habitat where the organism actually does not occur) are common, and hence can lead to the false security that a threatened or declining species has been protected when in fact it has not. This and other issues, such as precision and uncertainty, underline the need to validate results.

Test 4 Summary: Representation of threatened and/or declining species and habitats
Records for OSPAR threatened and/or declining species and habitats need to become more comprehensive across Regions before analysis can be carried out. The use of predicted habitat modelling and identification of areas that are significant for species can serve as viable proxies for incomplete point data. For the area considered in Ross and Howell (2012) 23.2% of habitat predicted to be suitable for *Lophelia pertusa* is contained within MPAs. Field surveys would be required to validate this prediction.

Test 5 – A matrix to assess features, representativity, replication, resilience and connectivity

The matrix approach (OSPAR, 2013b) provides a valuable contribution, which can be used for assessing ecological coherence gaps for broad-scale habitats and OSPAR threatened and/or declining species. This approach can also be carried out only when the data exist for relevant habitats and species. As a tabular methodology it provided an effective means of cross-referencing whether ecological coherence criteria have been met for particular broad-scale habitat and OSPAR threatened and/or declining species.

Due to a lack of quantitative data for total species populations and habitat areas for OSPAR threatened and/or declining species in the Channel, it was not possible to evaluate the proportion of features protected, or reach a definitive conclusion on the adequacy or viability of the network in this region. The trial also highlighted problems of consistency in the way that information on MPAs is reported by Contracting Parties.

As with the other methodologies set out within this report, the matrix approach rests on a number of assumptions within the data sets that are used. The matrix approach would, in our opinion, benefit if it were presented together with a visual representation of its results through maps and GIS analyses.

Test 5 Summary: Matrix assessment of features, representativity, replication, resilience and connectivity
Recognised by OSPAR as a valid approach drawing together the collation of detailed information on species and assessment as well as the principles of network design but currently limited by data quality and availability as well as the need for more consideration of determination of scientific criteria for success.

Test 6 - Spatial analysis of broad-scale habitat representativity and replication

Representativity is a heuristic for looking at the ecological distribution of the building blocks with which an MPA network is constructed. Systematic conservation planning requires clear choices about the features to be used as surrogates for overall biodiversity in the planning process (Margules and Pressey, 2000), and representativity is that in its most fundamental form. While such "coarse filter" analyses miss many ecological nuances, they do manage to capture some of the overall scope of the solution space (*i.e*. what is "out there"). If these broad-scale bounds are 'found to be wanting', it is unlikely that the finer nuances are being addressed either.

Representativity, therefore, is a first look to assess whether 'the full range of species, habitats, landscapes and ecological processes present within a sea area [are] adequately represented within the MPA network' (OSPAR, 2007)

Greater than EUNIS Level 3 was previously recommended 'to reasonably reflect the variation in biological character of the habitats in the OSPAR area' (OSPAR, 2008). It is our opinion, however, that using EUNIS at a biotope or finer level could bring too much uncertainty (based on the EUNIS assumptions and the underlying data) to the analysis and the attendant risk that the network could be fitted around the "noise" of data and model uncertainty, rather than meaningful ecological "signal". It is salient to recall that EUNIS relies a great deal on a small number of samples, expert judgement and models. Emerging new work (such as the geomorphology work by GRID-Arendal – **Figure 17**) could add another perspective on representativity.

The test also considered the extent to which these broad-scale habitats were replicated within OSPAR Regions II and III. (This is assuming that these broad-scale types will l harbour similar ecological community types.) Having more than one MPA of the same habitat type or feature is a way of spreading risk and strengthening the network with the capability to respond to natural variation and movements of species and habitats and changes to the climate (OSPAR, 2007).

HELCOM sets a minimum of three examples of a representative habitat in each region (HELCOM, 2010). The Matrix approach set a minimum of two broad-scale habitat replicates in the Channel Area. The English MCZ project set minimum criteria of two broad-scale habitat examples within each Regional Project (Natural England and the Joint Nature Conservation Committee, 2010).

The analysis presented here was undertaken at a broad-scale habitat class and is based on the same (likely overly optimistic) assumptions of full protection as for representativity, with the additional caveat that replicated features are indeed replicates of one another. This admittedly may not always be true, and could be considered fundamentally impossible, since all places differ in certain regards from one another. Nevertheless, at this initial stage, it can be simplistically assumed that two habitats of the same EUNIS code, regardless of where they are, share more in common than in differences. More refined analyses may in the future have to revise this coarse assumption.

As the size of a planning area increases, one may reasonably expect the number of possible habitat types to increase (at a given scale). If each of these are to be replicated, the total number of replicates would therefore also increase. The Baltic Sea area is 413,946 km^2 whereas the OSPAR maritime area is nearly 14 million km^2. Only Region III is smaller than the HELCOM area, and Regions

I and V are over ten times bigger. Therefore, the OSPAR Maritime Area is very likely to have many more habitats (and attendant species) than the HELCOM area. Indeed, because the Baltic contains relatively young brackish water ecosystems, diversity there is depressed and also more sensitive to stressors (due to a lack of ecosystem and trophic level redundancies) (*e.g.* Gucu 1997; Ellis *et al.,* 2011). OSPAR comparisons with the HELCOM methods, approaches, and results should bear such critical differences in mind.

To better ensure the likelihood of effective protection, the number of replicates for features that are known to be threatened and/or declining would be expected to increase. Coarse feature classes will need more replicates than finer classes. Additionally, due to varying levels of data uncertainty, replication should also be expressed to varying degrees (though this is seldom done): features for which there are weak/incomplete data need greater replication than those features for which better data are available (OSPAR, 2007). However, for this initial analysis, the lowest value possible (*i.e*. two replicates) was used.

Further work will be necessary to determine the number of replicates that is appropriate for OSPAR threatened and/or declining species, taking into account the levels of confidence in the available data. An initial glance would suggest that it should meet or exceed the standard of three sites set by HELCOM, since there is a much greater likelihood of habitat variability within the larger and more diverse OSPAR Maritime Area. However, for the purposes of this initial analysis, the standard of two replicates, as used in the matrix approach (OSPAR, 2008; OSPAR 2013b) was used here as well.

As discussed above, future work to determine a minimum patch size will be necessary if this test is to be refined.

Combined with the adequacy figures presented in test 7, one can begin to get a picture of protection in terms of proportion and numbers. Additionally, if there are a sufficient number of replicates distributed across latitudinal and temperature gradients, there is a much greater chance that the network will exhibit robustness to climate change.

Test 6 Summary: Spatial analysis of broad-scale habitat representativity and replication

- 10 out of 35 (29%) of broad-scale habitat types found in Region II are not represented. Of those represented, 2 broad-scale habitat types (Deep circalittoral mixed hard sediments, Deep-sea rock and artificial hard substrata) are not meeting a replication threshold of 2.
- 7 out of 29 (24%) of broad-scale habitat types found in Region III are not represented. Of those represented, 1 broad-scale habitat type (Deep-sea mixed substrata) is not meeting a replication threshold of 2.

Test 7 - Spatial analysis of adequacy and viability criteria for broad-scale habitats

Achieving adequacy in an ecologically coherent MPA network means ensuring that a sufficient proportion of the network is protected as a factor of the individual size and number of MPAs in the network. Criteria for adequacy are usually provided as a percentage of habitat within the region. HELCOM (2010) summarised that 'many marine studies and international Conventions have suggested that ecologically coherent networks of MPAs should cover at least 20% of each habitat in a region to secure long-term viable populations and protection of the ecosystem'. As a basic indicator of ecological coherence, this threshold was used for this report.

In the absence of species-area curves, Ardron (2008a & b) described how the shape of the data themselves can be used as an indicator for setting varying representativity targets. For his analysis, a square root transformation was used to normalise proportional targets based on the overall abundance of the conservation features. Representation targets were scaled roughly in proportion to the square-root of representative features' overall areas, which allowed for a normal distribution of habitat protection across a given network. The two interlocked assumptions here are that in any given MPA network: 1) there is going to be a range of appropriate levels of protection; and 2) that this range can be statistically represented as roughly normal, but only if the habitat data themselves are normally distributed, and if they are not, then they must first be transformed. Whether it is appropriate to scale representation targets across a normal spectrum depends on the ecological targets of the network. For example, Johnson *et al*. (2008) point out that marine species associated with more common habitats are likely to be recruited from protected as well as unprotected sites, but that those associated with less common habitats will be more reliant on the dispersed "stepping stones" of protected areas, and thus proportionally more of those less-common habitats should be protected. All this points strongly towards the conclusion that flat across-the-board targets (like 20% for everything), while easy to communicate, are very unlikely to fully reflect the varying nature of the marine habitats and species under consideration. In the end, appropriate thresholds/targets for a given habitat (or species) will need to be developed on a case-by-case basis depending on the occurrence and vulnerability of habitats and species in the relevant biogeographic region (OSPAR, 2013a). An approach for rare features will also have to be decided.

Only one broad-scale habitat (A4.1, high energy circalittoral rock) has achieved more than 40% in the offshore area of Region II. Two further habitats (6.1, deep sea rock and artificial hard substrata; and 3.1, high energy infralittoral rock) have achieved high representation in the nearshore parts of Regions II and III.

Given that there are 333 OSPAR MPAs, adequacy and viability regarding individual size, shape and quality of each MPA was not considered, though it is relevant to the discussion.

OSPAR guidance is that the sizes of network sites (for a given feature) should be distributed throughout, or exceed, the estimated range of sizes necessary to sustain a viable population or community (OSPAR, 2008). As a basic indication of viability, the English MCZ Ecological Network Guidance (JNCC and Natural England, 2010) used a minimum patch size threshold of 5 km^2 and an average size of between 10 and 20 km in diameter for broad-scale habitats. As per test 6, a minimum patch size of 0.24 km^2 or 3% of the proportion within the MPA was used, based on the HELCOM precedent.

The histograms for broad-scale habitat adequacy show a skewed bias towards very small habitat patch sizes, often under 1 km^2 (**Figures 12 & 13**). The underlying causes are uncertain but it could be habitats that are highly mixed, perhaps including some rare habitats, as well as small MPA sizes. However, given the large number of these, they cannot all be rare habitats, suggesting that the data have been over-classified, and that these small patches are simply "noise"; *i.e*. not ecologically meaningful. Further analyses will be required to determine what the predominant factors are and if these very small patches should be removed from future analyses.

HELCOM (2010) also consider anthropogenic pressure in determining whether an MPA is likely to be viable, reasoning that areas under more pressure need to be more self-sufficient (*i.e*. larger). They considered pressures such as shipping traffic intensity, wind farms, and fishing intensity. OSPAR could also take this into consideration in future work.

More sophisticated analysis of OSPAR representativity and threatened and/or declining species could be more effectively achieved using a decision support tool such as Marxan or Zonation, though more data of better quality will be required for any such future exercise.

Test 7 Summary: Spatial analysis of which habitat meet overall adequacy/representaivity criteria
• Only one broad-scale habitat (A4.1, high energy circalittoral rock) has representativity of more than 40% in the offshore area of Region II. Two further habitats (6.1, deep sea rock and artificial hard substrata; and 3.1, high energy infralittoral rock) have achieved representativity thresholds in the nearshore parts of Regions II and III. • In Region II, 1 358 broad-scale habitat patch sizes are less than 4 km^2 and 672 are greater than 4 km^2. For Region III the figures are 1 049 and 342 respectively. (No cut-off was applied in this analysis.) • There is a strong bias of small habitat patch sizes. The underlying causes are unclear and require further attention. Future analyses may reduce the number of small patches, aiding analysis.

Test 8 – Spatial analysis of broad-scale habitat connectivity

Designing a network to maximise ecological linkages has generally relied on models that try and incorporate thresholds based on our current understanding of variables such as larval life spans, water movement, habitat type and the mobility of adults. OSPAR guidance recognises that the network cannot reasonably be expected to be designed to incorporate the movements and life histories of all species, and that the understanding of the mobility of most species is still relatively poor. Initial OSPAR guidance only required the network to 'recognise aspects of connectivity' or only to consider 'connectivity where a specific path between identified places is known'.

However, a number of recent assessments and planning processes have used some more advanced models to design networks based on modelling larval life-spans and current movements. Knowledge of the movement of species is still relatively poor. It is known that some individuals move between different habitats and others remain on the same habitat throughout their lives. Some species have very short larval life spans and therefore only disperse over less than a kilometre, whereas others move over many hundreds of kilometres. In a report to inform the MCZ process in England, Roberts *et al.* (2010) modelled the movements for 67 different species and provided a spacing recommendation of 40-80 km. In their analysis of the Baltic Sea Protected Area network thresholds of 25 km and 50 km were used as by HELCOM as proxy distance thresholds between seascape patches (HELCOM 2010).

In the absence of empirical data models can provide guidance on connectivity. Focusing initially on meeting representation, replication and adequacy targets a network that is geographically well distributed will emerge; and it is likely that the network will meet connectivity criteria if retrospectively applied.

Test 8 Summary: Spatial analysis of broad-scale habitat connectivity
• The wide variation in distances between habitat classes suggests varying degrees of potential connectivity. • Connectivity is the most difficult of the ecological coherence criteria to assess. An initial focus on representativity and replication is likely to be more cost-effective at this stage of planning.

Conclusions

Overall this assessment has concluded that the OSPAR MPA network is not ecologically coherent. This concurs with the Draft 2012 OSPAR Status Report on the OSPAR Network of MPAs. However, it should be noted that the OSPAR MPA Network has now passed the second initial spatial test (also test 2 of this assessment), which is a significant landmark.

The evolution towards an ecologically coherent network in the OSPAR Maritime Area is clearly more advanced in some OSPAR Regions and sub-regions than others. This assessment has also sought to augment the three Initial OSPAR Tests by applying GIS analyses in a pragmatic way that can help direct future planning and development of the network. These additional tests have had to make a fundamental assumption that the levels of protection extended equally to all species and habitats within the boundaries of all OSPAR MPAs, namely that any species or habitats associated with broad-scale habitat falling within an OSPAR MPA are afforded protection, hence are likely to be overly optimistic in their outcomes. Nonetheless, they provide illustrations of what is possible.

In terms of the OSPAR Maritime Area as a whole (Level 1), this assessment has confirmed distributional gaps. There is under-representation of biogeographic provinces and bathymetric zones, which greatly reduces the likelihood of achieving ecological coherence. However, significant uncertainty also remains. For example, from the Figures created in Test 1 it may look as though the MPA network can protect species over a wide area, but in reality because species are generally restricted to relatively small bathymetric ranges, the potential buffering may be much smaller. Alternatively deep-sea research results have shown great similarity between the fauna on the Mid-Atlantic Ridge and the continental margin (particularly the European Atlantic continental slope), suggesting that for some species larval connectivity (buffering) may be much greater than 500 km. Caution is also needed concerning the pelagic areas identified in Table 1, as whilst pelagic biogeographical provinces are generally broad in scale, there is probably greater complexity related to frontal systems, and depth, including specialist benthopelagic fauna which may change significantly on a continental margin/the continental slope with latitude.

Regarding future testing at this Level, the bathymetric distributions of the OSPAR Regions are radically different, thereby suggesting that a ‘Region by Region’ approach would bring forth characteristics lost at the OSPAR-wide scale. The new geomorphological dataset currently under development by GRID-Arendal and partners has potential applicability for future broad-scale representativity tests, though much will hinge on the details of the final product.

For those parts of the OSPAR Maritime Area within which Level 1 tests indicate positive signs of ecological coherence, and/or for which more comprehensive data are available, a further set of tests is possible (Level 2). Predictive modelling of habitat suitability, based on a degree of data completeness, can help illustrate regional representation of threatened and/or declining habitats on the OSPAR List. The example of *Lophelia pertusa* which is a better known (iconic) habitat, supported by a relatively good dataset, away from the coast where most ecological information has been gathered (and is the subject of an OSPAR Recommendation), showed the importance of shelf depths and continental slopes for this habitat. However, predictive modelling should not be perceived as a map of occurrence. Important Bird Areas and deep-sea sponge aggregations could also provide a basis for future species and habitat tests. Within Level 2 this assessment also analysed coarse habitat representativity and replication, together with habitat adequacy and viability, and potential connectivity (proximity), all using EUNIS level 3 categories.

The use of classification data and predictive analyses brings with it the (usually unstated) assumptions that went into the creation of these data layers. EUNIS, a valuable classification tool, nevertheless rests on several assumptions, and, like predictive habitat modelling, should not be confused with reality. At best, classifications such as EUNIS are a useful amalgamation of many disparate data sets into a single readily interpretable product that highlights physical environmental differences from one class to the next. However, at worst, these classifications provide a false sense of assurance that these coarsely modelled physical parameters translate to genuinely distinct ecological communities on a fine scale. In actuality, validation testing on EUNIS and other classifications has yielded mixed results, with efforts being made at the sub-regional scale to augment such physical data with biological observations (*e.g.* Howell, 2010). Therefore, we strongly recommend against reading too much detail into results arising from the use of EUNIS (or similar) data, and encourage OSPAR in future assessments of ecological coherence to develop procedures to disregard very small patches (*e.g.* a threshold less than 1 km^2).

The Quality Status Report 2010 (OSPAR, 2010) provided a brief overview of OSPAR MPAs by Region and highlighted the range of ecosystems for which they were established. In 2010, based on this evidence, OSPAR Ministers revised the 2003 ecological coherence target, recommending that ecological coherence should be achieved by 2012 to include sites representative of all biogeographic regions in the OSPAR Maritime Area and to be consistent with the CBD target[7] for effectively conserved marine and coastal ecological regions (OSPAR Recommendation 2010/2). Since then a significant number of sites have been added to the network, but several broad conclusions set out in the QSR 2010 are borne out by this assessment. Most specifically that ‘a comprehensive assessment of the ecological coherence of the current network of MPAs is hampered by limited information available on the distribution of many species and habitats within the OSPAR Maritime Area, including in OSPAR MPAs’ (OSPAR, 2010 p.137). The tests undertaken within this assessment are still very much linked to the principle that the value of the outputs is dependent on the quality of the data that are used for the input. Data quality, consistency and coverage continue to be the main barriers to effective testing of ecological coherence in all OSPAR Regions and one of the key recommendations of this report is for OSPAR to develop guidelines to improve the consistency of reporting of protected features and mobilise efforts to improve the coverage for OSPAR threatened and/or declining features and broad-scale habitats.

[7] Decision X/2 by the tenth Conference of Parties (COP10, 2010) to the Convention on Biological Diversity (CBD) provided a revised and updated Strategic Plan for 2011-2020 in which Aichi Target 11 under Strategic Goal C states that by 2020, at least 17 per cent of terrestrial and inland water, and 10 per cent of coastal and marine areas, especially areas of particular importance for biodiversity and ecosystem services, are conserved through effectively and equitably managed, ecologically representative and well-connected systems of protected areas and other effective area-based conservation measures, and integrated into the wider landscape and seascapes.

The assessment of ecological coherence within the OSPAR Maritime Area inevitably encounters issues of uncertainty in the quality of data and the thresholds under which the network is assessed. Although recommendations within this report and elsewhere (*e.g.* OSPAR 2008; BDC matrix report) are for efforts to be focused on improving data coverage, quality and consistency. This exercise will take several years to achieve. Therefore it is important for Contracting Parties to be comfortable to continue to use some of the more basic assessment methods including proxies and analogues to help future MPA planning and designation work.

At the geographic scale of the OSPAR Maritime Area, the OSPAR MPA network is arguably the most advanced example in the world. However, notwithstanding adopted Guidelines and the best efforts of Contracting Parties, it has developed in an 'ad hoc' way that predicates (initially at least) against achieving ecological coherence. In other parts of the world (*e.g.* Australia) a more strategic target driven approach is now favoured. OSPAR should be fully engaged in the global debate on how best to proceed noting that international targets are, perhaps due to ease of assessment, focusing more on representativity than other aspects of ecological coherence.

A summary of the tests applied in this assessment, the associated thresholds and indicators, the outcomes and results of each test and the attendant limitations is presented below in **Table 8**.

Table 8: Summary of tests performed

Level	Test		Thresholds	Indicators	Outcome	Assumptions, caveats and uncertainties
1	1	A visual overview of the network to determine if MPAs are generally well-distributed and that there are no major gaps. This is complemented by a basic GIS analysis to quantitatively assess gaps in the network.	Nearshore >250 km Offshore >500 km diameter circle High seas >1,000 km square The criteria are generally set to ten times the value commonly found in scientific literature. For the nearshore the test also examines the network at 80 km and 50 km thresholds.	The GIS analysis shows more accurately which Regions are more likely to be ecologically coherent by identifying the major gaps.	The network is not yet spatially well-distributed across the OSPAR Maritime area and its Regions. Signs of ecological coherence are emerging in Regions II and III.	This is a basic test that can help to identify major gaps at a large scale in a data poor situation. It is a starting point.
1	2	Biogeographic (Dinter provinces) representation	Does the OSPAR MPA network cover at least 3% of most (seven out of 10) relevant provinces	This test provides an indication of representativity of biogeography together with a basic threshold for adequacy.	Seven out of ten provinces pass the 3% threshold and therefore the network can be considered to be covering adequate and/or representative proportions of biogeography.	The 3% threshold is identified as 1/10th of the proportion most commonly found in the scientific literature. Considers 7 out of 10 Provinces only. Risk of being confused with being a target, like the CBD Aichi Targets.
1	3	Representativity of bathymetric zones	The bathymetric distribution was binned into five broad depth classes to represent littoral, shallow shelf, deeper shelf slope and deep sea.	This test provides an indication of representativity of bathymetric ranges.	The shallowest classes have much higher representativity than the deeper classes, with the deepest class (>2000m) being the least represented.	Bathymetry only provides a very rudimentary look at representativity, since habitat types are influenced by many other factors such as currents, shape of the coastline, sediments and morphology of the seabed.
2	4	Representation of threatened and/or declining species and habitats	Most (70%) of the OSPAR threatened and/or declining habitats and species (with limited home ranges) represented in the MPA network. 5% [or at least 3 sites] of all areas within each OSPAR region in which they occur is protected.	This test would show whether the network represented these features and whether it had reached a basic level of adequacy and replication.	Comprehensive spatial data for the distribution of species populations and habitats across the OSPAR maritime area is still being collected in the OSPAR database and is not comprehensive enough at this stage to allow this test to be carried out.	Species records for the OSPAR maritime area are very sparse and habitat data based to a large extent on models.

2	5	Matrix test to assess features, representativity, replication, resilience and connectivity	Representativity: All EUNIS level 3 habitats and OSPAR threatened and/or declining species. Replication: At least two MPAs for each EUNIS level 3 habitat and at least 3 examples of OSPAR threatened and/or declining habitats for which MPAs are considered appropriate	The report (OSPAR, 2013b) shows which EUNIS level 3 habitats (for UK only) and OSPAR threatened and/or declining species are represented and replicated and identifies the proportion protected for EUNIS level 3 habitats.	The matrix approach provides a useful tool to monitor the progress of ecological coherence for threatened and/or declining species and habitats.	The report (OSPAR, 2013b) describes issues and discrepancies between the UK and France in the protection of broad scale habitats, intertidal features and spatial protection for some species.
2	6	Spatial analysis of broadscale habitat representativity and replication	Representativity of broadscale habitats mapped in Regions II and III. A minimum of 2 replicates.	This analysis aims to establish that all habitats within the Region II and III are represented in the network.	71% of broadscale habitats in Region II and 76% in Region III are represented. Of those broadscale represented 2 (in Region II) and 1 (in Region III) are not meeting replication threshold of 2.	Assumptions for broad scale habitat (EUNIS 3) as for Test 4. Minimum patch size criteria needs to be further refined.
2	7	Spatial analysis of adequacy and viability	Thresholds for adequacy set at 5%, 10%, 30% and 40%. No minimum patch sizes were set for viability criteria	The results of this analysis will show at what level adequacy targets are met for broadscale habitats. Viability results show distribution of patch sizes.	One broadscale habitat has achieved an adequacy threshold of more than 40%, and two broadscale habitats are greater than 30% for Regions II and III. There is a strong bias towards small habitat patch sizes.	Assumptions for broad scale habitat as for Test 4. Minimum patch size criteria needs to be further refined.
2	8	Spatial analysis of broadscale habitat connectivity	Three broadscale habitat types were assessed in Regions II and III at thresholds of 250 km and 500 km (offshore); 80 km and 50 km (nearshore).	This test shows the extent to which different broad-scale habitats are proximate to each other. It also shows how realistic basic connectivity thresholds are to achieve for different habitats.	The wide variation between habitat classes suggests varying degrees of potential connectivity.	An initial focus on representativity and replication is likely to be more cost-effective at this stage of planning. Thresholds need refining.

Next steps

The following recommendations to improve both the development and assessment of an ecologically coherent network in the OSPAR Maritime Area go hand in hand. In general they encourage OSPAR to urge Contracting Parties to adopt proportionate assessments and contribute appropriately to build the necessary data sets, carry out a more detailed gap analysis to inform a more strategic approach, and use decision support tools where appropriate to help identify how an ecologically coherent network can be achieved more efficiently.

Proportionate assessments

Both the OSPAR initial spatial tests (OSPAR, 2008) and those introduced in this report have been designed to provide meaningful indications of where along the spectrum the network stands with regard to key components of ecological coherence. Even in ideal situations, it is difficult to be certain that all aspects of ecological coherence are functioning as they ought; and, with limited data, this is simply not realistic.

OSPAR has acknowledged (most recently in the Draft 2012 Status Report) the limitations of data in being able to provide a comprehensive analysis of the network and in particular on the distribution of species populations and habitats in the North-East Atlantic. Since 2008 OSPAR has taken a pragmatic approach to analysing the ecological coherence of the MPA network recognising that the methodology needs to be proportionate to the data available and the developmental stage of the network *i.e*. there is little point in carrying out a sophisticated assessment if the network has failed tests at a more basic level. Further planning and designation needs to take place before a reassessment takes place.

Necessary data sets

One of the main barriers to building and analysing the network is the lack of comprehensive species records for OSPAR threatened and/or declining species. Attempts to build the OSPAR database through 2008 and 2009 were not successful and the conclusion was that this was not a priority for Contracting Parties (OSPAR, 2013a). HELCOM, with a more comprehensive database, has been able to provide much more feedback and more detailed analysis on the status of their network.

Polygon data on the distribution of OSPAR threatened and/or declining habitats is also an important requirement. The lack of these data is both a barrier to identifying sites and also carrying out an assessment of the extent to which adequacy criteria are being met *i.e*. an analysis of adequacy requires a comparison of the proportion of both protected and unprotected habitat.

As one of the first trials of international ecological coherence assessment (Matrix approach, Test 5), the JNCC and French MPA Agency identified a number of issues in the way that the UK and France report and interpret species and habitats within their MPA network.

In summary, the data issues that need to be resolved are as follows:

- Species and habitat records for OSPAR threatened and/or declining species
- An analysis / guidance on which of these are suitable for MPA protection;
- Analysis of additional features (including broad-scale habitats) protected within an MPA boundary and outside of it (Guidelines would help to ensure greater consistency in defining what is protected)

Intertidal data have also been identified as an important data layer currently not available within any OSPAR Region as a whole.

Measures to protect selected deep-water species and habitats adopted by OSPAR in 2010 encourage Contracting Parties to request ICES to provide regular advice on their distribution and, for sensitive species for which there are no reliable estimates on the population size *e.g.* for species such as the Basking shark (*Cetorhinus maximus*), emphasise the need to apply the precautionary principle. The obligations and duties of these Recommendations could be used to focus data collection efforts in MPAs and their adjacent areas. Pragmatically, as recognised within this assessment, data collection to inform ecological coherence must also be linked to MSFD requirements.

A broad-scale habitat classification is one of the basic requirements for systematic MPA planning. EU Seamap currently extends across the Greater North Sea and Celtic Sea in OSPAR Regions II and III. There are plans to extend the geographical scope of EU SeaMap, but there are no defined timelines or geographical scope. A paper released by the JNCC in 2011 (Draft Version 0.3) describes the differences between UK SeaMap 2010 and EUSeaMap and provides guidance on which situations each should be used for. In the OSPAR Maritime Area, EUSeaMap currently extends within the North Sea and Celtic Sea. The report highlights that EUSeaMap substrate layer has coarser resolution and includes some new light (MERIS) and bathymetry (EMODNET Hydrography DEM). (EUSeaMap is being extending via MESH-Atlantic to cover Biscay/Iberian coast, due 2013, and phase II of EMODnet to cover whole of Europe, due 2015). The confidence assessment has been undertaken using simple scoring systems that could be applied at the regional level (JNCC, 2011)

One of the main challenges of achieving ecologically coherent MPA networks in the marine environment is ensuring that the guidance is not only practical, but also scientifically robust. A comprehensive survey and analysis of the features in a proposed area is expected to precede the designation of a single MPA. On the other hand, identifying an ecologically coherent MPA network will rely on meeting a series of explicit objectives on a much broader scale. Throughout, it will be necessary to re-visit and fine-tune results as new data become available.

The Focus Group requested that this consultancy, in addition to carrying out analyses based on currently available data, provide suggestions for future analyses, and these have been presented above, as they arise. Most of these suggestions rest on the acquisition of new data, such as species and habitat distributions; new analyses, such as predictive habitat modelling; or, combinations of the two, such as the GRID-Arendal geomorphic classification. In a few cases, more can be achieved using available data, such as 1) regional bathymetric analyses and 2) the development of indices for benthic complexity (Ardron, 2002). In general, the assessment of ecological coherence is data-limited, and hence new data –of any sort—are likely to generate new approaches for assessing MPA Networks.

Closing the gaps: Ecologically or Biologically Significant Areas (EBSAs)

A specific recommendation from this report is to take forward data collection work within potential EBSAs described in the OSPAR Maritime Area. These include seamounts, spawning grounds, pelagic fronts and areas of high productivity, species richness or high taxonomic diversity. EBSAs described to date are important in that they cover wide depth ranges encompassing deep-sea zonation of species and downslope impacts from human impacts at shallower depths. EBSA work to date could also act as a point of departure for consideration of MPAs in portions of ABNJ in Arctic Waters and other Regions where there are still large gaps.

Internal OSPAR discussion documents (BDC 12/3/11 and ICG-MPA 13/4/1) noted the Dinter provinces in Region I that are not yet represented within the OSPAR MPA Network. This gap/lack of ecological coherence could be addressed in future through an on-going dialogue with Greenland and also by taking forward scientific work in a sub-area of the 'Arctic Ice Habitat – multi-year ice, seasonal ice and marginal ice zone' as described by the Joint OSPAR/NEAFC/CBD Scientific Workshop on the Identification of EBSAs in the North-East Atlantic: Annex 17. With regard to the latter OSPAR Contracting Parties have indicated a preference that any such consideration should be proceeded by a further review by ICES of potential EBSA descriptions and that any area to be considered should not conflict with areas subject to a submission to and consideration by the UN-Commission on the Limits of the Continental Shelf.

An OSPAR Sub-Region specific approach

The entire OSPAR Maritime Area is nearly 14 million km^2 and with a biogeographical range that extends from the Arctic to the Azores. It is 34 times bigger than the Baltic Sea Maritime Area within the HELCOM Convention. The OSPAR Maritime Area is also very different in covering habitats from the shoreline to depths greater than 5600m. Use of smaller planning areas, such as OSPAR Regions, would bring together tighter groups of partners, focusing on similar biogeography in sea areas where they have jurisdiction. Focusing on smaller planning areas would also allow the development of ecological coherence criteria and thresholds that were specific to each Region.

Allowing Sub-Regions to progress at different speeds based on the available data and capacity is an important factor in allowing those with greater biological data coverage to move ahead more quickly. An ecologically coherent network for the OSPAR area is more likely to be achieved through allowing Regions to innovate and adapt according to the characteristics of their regional ecology and cultures. The disadvantage of this approach is that some Regions may be left behind. However, the experiences gained in one region can be shared with others. Additionally, it is within the purview of OSPAR Contracting Parties to begin to take a more systematic approach to identifying MPAs, rather than the ad hoc approach taken to date.

Developing planning scenarios using decision support tools

Decision support tools such as Marxan or Zonation have been developed to support systematic design of MPA networks. They are useful when there is a large amount of spatial data, complex targets and a large planning area. Given sufficient data, the use of systematic conservation planning tools will help contracting parties and planning regions to identify how to meet conservation targets and where options exist for protecting a particular habitat. In some cases, there may be a great deal of flexibility in where a feature can be found, and in other cases options may be limited.

Marxan has been used in the Baltic Sea region as a gap analysis tool to help identify areas where particular ecological targets can be met. It has enormous potential within OSPAR regions to help identify where sites could be located to fulfil ecological coherence criteria. However, it requires more data than are currently available to OSPAR or to this consultancy. As a minimum it would require comprehensive coverage of broad-scale habitats and would be more effective if it also included threatened and/or declining species and habitats.

Suggested Timeline

In future Contracting Parties need to be more explicit about how they will support OSPAR to achieve ecological coherence, and how they will contribute to achieving the different steps. A roadmap would help to identify the work needed and the estimated costs, timelines and organisations that will need to be involved.

Recognising that this advice is outside of the scope of this contract, we would respectfully suggest that proactive efforts by Contracting Parties responsible for under-represented provinces (South-East Greenland-North Iceland Shelf; Norwegian Coast-Finnmark and Skagerrak; and West Norwegian/ South Iceland-Faroe Shelf; Lusitanean-Boreal; Lusitanean-Cool and Warm) be encouraged.

It is important to emphasise that the assessments need to be carried out alongside work to plan and designate new sites. This may be an obvious point, but if the most basic spatial tests are showing that the network is unlikely to be ecologically coherent, then further implementation will need to take place before further assessments are made.

References

Ardron, J.A., 2002. A Recipe for Determining Benthic Complexity: An Indicator of Species Richness. In Joe Breman (ed.), Marine Geography: GIS for the Oceans and Seas (ch. 23, pp 196-175). Redlands, CA, USA: ESRI Press.

Ardron, J.A., 2008a. *The challenge of assessing whether the OSPAR Network of Marine Protected Areas is ecologically coherent*. Hydrobiologica, 606:1, 45-53.

Ardron, J.A. 2008b. Three initial OSPAR tests of ecological coherence: heuristics in a data-limited situation. *ICES Journal of Marine Science*, 65: 1527-1533

Dinter, WP. 2001. Biogeography of the OSPAR Maritime Area. German Federal Agency for Nature Conservation, Bonn, Germany, 167 pp.

Ellis SL, Incze LS, Lawton P, Ojaveer H, MacKenzie BR, et al. (2011). Four Regional Marine Biodiversity Studies: Approaches and Contributions to Ecosystem-Based Management. PLoS ONE 6(4): e18997. doi:10.1371/journal.pone.0018997

Gucu AC., 1997. Role of fishing in the Black Sea ecosystem. In: Özsoy E., Mikaelyan A. (editors), Sensitivity to change: Black Sea, Baltic Sea and North sea. NATO ASI Series, 2. Environment 27. Kluwer Academic Publishers, Dordrecht, Netherlands, 149-162

HELCOM, 2010. *Towards an ecologically coherent network of well-managed Marine Protected Areas – Implementation report on the status and ecological coherence of the HELCOM BSPA network*. Baltic Sea Environment Proceedings No. 124B.

Howell, K. 2010. A benthic classification system to aid in the implementation of marine protected area networks in the deep/high seas of the NE Atlantic. Biological Conservation. 143 (5): 1041–1056.

JNCC, 2011. *UKSeaMap 2010 and EUSeaMap* Draft report Version 0.3 released 21/11/2011

Johnson et al, 2008. What is the future for Marine Protected Areas in Irish Waters? Biology and Environment: Proceedings of the Royal Irish Academy, Vol. 108B, No.1, pp9-15

Margules, CR and Pressey, RL. 2000. Systematic conservation planning. *Nature.* Vol. 405, pages 243-253.

Natural England and the Joint Nature Conservation Committee, 2010. The Marine Conservation Zone Project: Ecological Network Guidance. Sheffield and Peterborough, UK

Olsen, EM, Johnson D, Weaver P, Goni R, Ribeiro MC, Rabaut M, Macpherson E, Pelletier D, Fonseca L, Katsanevakis S, Zaharia T (2013) Achieving Ecologically Coherent MPA Networks in Europe: Science Needs and Priorities. Marine Board Position Paper 18. Larkin KE and McDonough N (Eds). European Marine Board, Ostend, Belgium.

OSPAR, 1998. Sintra Ministerial Statement. OSPAR Commission, Sintra Portugal 22-23 July 1998

OSPAR Agreement 2003-17: Guidelines for the Identification and Selection of Marine Protected Areas in the OSPAR Maritime Area

OSPAR Agreement 2006-3: Guidance on developing an ecologically coherent network of OSPAR marine protected areas

OSPAR, 2007. Background Document to Support the Assessment of Whether the OSPAR Network of Marine Protected Areas is Ecologically Coherent. OSPAR Commission, Publication number 2007/320. ISBN 978-1-905859-59-7

OSPAR, 2008. Background document on three initial spatial tests used for assessing the ecological coherence of the OSPAR MPA network. OSPAR Commission, Publication number 2007/360. ISBN 978-1-905859-99-3

OSPAR, 2010. Quality Status Report of the North-East Atlantic (publication number: 497/2010). 176 pp. ISBN 978–1–907390–38–8 www.qsr2010.ospar.org

OSPAR, 2013a. Status Report on the OSPAR Network of Marine Protected Areas Publication number: 618/2013. ISBN 978-1-909159-51-8.

OSPAR, 2013b. OSPAR meeting of the Intersessional Correspondence Group on Marine Protected Areas (ICG-MPA) Edinburgh, UK: 21-23 January 2013. A matrix approach to assessing the ecological coherence of the OSPAR MPA network: trial of methodology in the Channe is within it. (Document no. ICG-MPA 13/3/3-E)

Palumbi, S. R. 2003. Population genetics, demographic connectivity and the design of marine protected areas. Ecological Applications 13:S146-S158.

Piekainen, H. & S. Korpinen 2008. Towards an Assessment of ecological coherence of the marine protected areas network in the

Baltic Sea region. BALANCE Interim Report No. 25.

Roberts, C.M., Hawkins, J.P., Fletcher, J., Hands, S., Raab, K. & Ward, S. 2010. *Guidance on the size and spacing of Marine Protected Areas in England*. Natural England Commissioned Report NECR037.

Rondinini, C. 2011. Meeting the MPA network design principles of representativity and adequacy: Developing species-area curves for habitats. JNCC Report No. 439, Peterborough

Ross, E.R. and Howell K.L. 2012. Use of predictive habitat modelling to assess the distribution and extent of the current protection of 'listed' deep-sea habitats. Diversity and Distributions (2012) 1-13

WSSD, 2002. World Summit on Sustainable Development, Johannesburg 26 August-4 September 2002. http://www.un.org/events/wssd/ (Accessed 29 March 2013)

Annexes

Annex 1: Note of OSPAR Ecological Coherence Focus Group meeting

1100 22 March 2013, IASS-Potsdam, Berlin

Present:

Jeff Ardron: IASS-Potsdam, Seascape Consultants Ltd, former Secretary ICG-MPA;
Emily Corcoran: OSPAR Secretariat, Ecological Coherence Task Group;
Tom Hooper: Seas-Life Ltd; Seascape Consultants Ltd;
David Johnson: Seascape Consultants Ltd, former OSPAR Secretariat
Kerstin Kröger: Secretary ICG-MPA, Ecological Coherence Task Group
Tim Packeiser: WWF Germany, former Secretary ICG-MPA

The meeting followed the agenda below and was informed by a presentation on behalf of Seascape Consultants Ltd. It was confirmed that the aim of the meeting was to provide advice and direction regarding limitations of the assessment methodology and scope of future ecological coherence possibilities and options.

1. General opening remarks

The Group noted the approach taken and advised on a mention of what the assessment would have liked to do given full information (*i.e*. further tests). At the same time some idea of how far OSPAR might go to inform a useful decision was also needed. It was accepted that this depended in turn on the decisions OSPAR required answering, which became more of a political issue (*i.e*. recognising the needs of OSPAR).

It was noted that international targets are lately focusing more on representativity than a 'comprehensive' definition of ecological coherence, and there was a consensus that this is less complicated to answer than other elements.

2. Considerations on a test by test basis

<u>Test 1</u>: dealing with basic distribution and gaps, needed to:

a. pay attention to map titles and legends (this applies to all other tests);
b. clearly explain the rationale for threshold values; and
c. recognise that the Baltic is in many ways not directly comparable.

<u>Test 2</u>: biogeographic representation, with the addition of replicates (to information already presented in the interim 2012 Status report) should emphasise that this is a coarse (province level) application. A new geomorphological dataset had potential applicability for areas with insufficient data (and for which complete datasets are unlikely to be forthcoming in the foreseeable future). It was suggested that in future geomorphology and habitat mapping might be combined as a future test

Test 3: using bathymetric zones as a proxy showing that the OSPAR Regions are radically different and therefore questioning whether the same ecological coherence criteria should be applied throughout the OSPAR Maritime Area. This was noted and it was suggested to merge the two deep sea classes.

Test 4: Considers representation of threatened and/or declining species and habitats. In the absence of sufficient data, academic habitat suitability predictive modelling of *Lophelia pertusa* had been obtained as an illustration, showing the shelf slope to be very important for this habitat. The Group thought it was:

a. important to stress this should not be misused or perceived as a map of occurrence;
b. perhaps interesting to also consider Norwegian data to inform future work;
c. important to note what is possible at a certain level of data completeness;
d. something to consider with an on-line visual tool (which could potentially overlay bathymetry without becoming visually 'too busy');
e. important to explain why other studies could or could not be used in this way;

The use of *Lophelia pertusa* was supported as it is a better known (iconic) habitat, with a relatively good data set, away from the coast where most information has been gathered and as it is the subject of an OSPAR Recommendation. A check should be made with WCMC on a complementary coldwater coral study. Deep sea sponge aggregation work and an illustrative map of Important Bird Areas were also discussed.

Test 5: the matrix (not discussed in this meeting)

Test 6: Broadscale habitat representativity and replication using EUNIS level 3 categories for Regions II and III only, assuming that proxy protection is provided vis a vis a feature in the MPA. The Group considered that the assessment might recommend that a future OSPAR expert group should look in further detail at specific thresholds and weighting.

Test 7: Broadscale habitat adequacy and viability – prompting discussion on minimum protected patch size area.

Test 8: Broadscale habitat proximity – prompting discussion on whether to super-impose current patterns to aid visualisation.

In considering the tests overall the Group thought the assessment should explain why EUNIS categories had been used rather than Dinter classification (particularly as Norway does not use EUNIS). The Group missed reference to the overlay work undertaken by JNCC in 2011 (the Secretariat agreed to provide this for information). The group also thought it important to emphasise that the lack of a comprehensive dataset compromises the usefulness of any ecological coherence assessment and that this exercise should be used to stimulate contributions. Inclusion of reference to latest research on species area curves was supported.

3. Lessons from PANACHE

Several members of the Group had attended the PANACHE Project meeting in Plymouth held earlier in the week. PANACHE was at an early stage, still exploring methods to assess ecological coherence and would learn from this assessment rather than vice-versa.

4. Possible messages for OSPAR

In future, perhaps a focus on representativity rather than ecological coherence should be recommended. This assessment was viewed as an opportunity to widen the scope of testing. A connection might be made with the 2016 target for a well-managed network. Stimulus was recognised for linkage with potential EBSAs and High Seas MPAs in Region I, as part of strategic gap filling. Timing of any follow-up ecological coherence assessment should take account of when new information was available (*i.e*. only to be triggered if substantial data contributions were received for example), strategic reasons (such as to inform forthcoming integrated assessments *e.g.* MSFD Art. 13 in 2015), and/or in response to emerging legal considerations such as listing of sharks by CITES.

Annex 2: Data sets that have been used within the analyses

Data set	Tests	Geographical extent	Supplier	Version and date
Spatial data describing the OSPAR MPA network	General distribution; bathymetric representativity; broad-scale habitat representativity and replication; broad-scale habitat adequacy and viability; broad-scale habitat connectivity	OSPAR Maritime Area	OSPAR	20/02/2013
Coastline data	General distribution; bathymetric representativity; broad-scale habitat representativity and replication; broad-scale habitat adequacy and viability; broad-scale habitat connectivity	OSPAR Maritime Area	Provided by OSPAR	Accessed 11/07/2012
National jurisdiction boundaries	General distribution; bathymetric representativity, broad-scale habitat representativity and replication; broad-scale habitat qdequacy and viability; broad-scale habitat connectivity	OSPAR Maritime Area	VLIZ (marineregions.org)	Maritime Boundaries Database, version 7 Accessed 11/07/2012
Bathymetry	Bathymetric representativity;	OSPAR Maritime Area	EMODnet (European Marine Observation and Data Network) and SRTM (Shuttle Radar Topography Mission) 30plus.	Accessed 04/03/2013
EU SeaMap broad-scale habitat data at EUNIS level 3	Broad-scale habitat representativity and replication; broad-scale habitat adequacy and viability; broad-scale habitat connectivity	Region II and III	JNCC (jncc.defra.gov.uk/page-5040)	Version 201107, 25/02/2013
Modelled distribution of *Lophelia pertusa*	Representation of threatened and/or declining species and habitats	Region V	Kerry Howell (University of Plymouth)	14/03/2013
Important Bird Areas and candidate sites	Representativity of OSPAR threatened and/or declining species and habitats	OSPAR Maritime Area	BirdLife International	15/03/2013
Global geomorphology/seascapes	Test of representation at biogeographic level	OSPAR Maritime Area	Peter Harris (GRID)	05/03/2013

Annex 3: Assumptions and Uncertainties regarding protection

OSPAR (2007) and this report both assume that the MPA is 'managed in such a fashion to give protection to the features within it.

The Matrix trial report (OSPAR, 2013b) highlights that there is a lack of equivalent information on features presented in OSPAR MPAs. In the trial analysis undertaken by France and the UK it was found that the UK has yet to determine which non-Natura 2000 species (but present on OSPAR threatened and/or declining list) may be protected in OSPAR MPAs. On the French side, an analysis has yet to be undertaken to determine which EUNIS Level 3 habitats are protected in OSPAR MPAs.

The analyses make an assumption that the broad-scale habitat within the MPA boundary is protected either directly or indirectly through its association with a protected feature.

It should also be acknowledged that the underlying data for the EUNIS Level 3 broad-scale habitat data within EU SeaMap are often sparse and the EUNIS classes are based on scientific models. Hence, EUNIS is better seen as a "best assumption", rather than a mapping of actually surveyed features, and carries with it several assumptions about scale, precision, and accuracy. These assumptions naturally transfer over to any analysis using EUNIS, including the one presented here. In this light, we feel it is good practice to remove the "slivers" (as described above) from the MPA assessment, as it is quite unlikely that these very small patches are significant, and on the contrary could provide false assurances.

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