OSPAR Convention for the Protection of the Marine Environment of the North-East Atlantic

Meeting of the Working Group on Marine Protected Areas Species and Habitats (MASH)

Baiona (Spain): 21-24 October 2008

A matrix approach to assessing the ecological coherence of the OSPAR MPA network

Presented by the UK

This document invites MASH to consider a feature-level assessment approach for assessing the ecological coherence of the OSPAR MPA network, to agree that this should be used for the OSPAR network and to agree on arrangements to support this.

Background

1. At the Meeting of the Intersessional Correspondence Group on MPAs in February 2007, the UK proposed a straightforward 'matrix approach' to the assessment of the ecological coherence of the OSPAR MPA network (ICG-MPA 07/3/3).

2. A revised matrix and supporting paper was presented to MASH in 2007 for further consideration (MASH 07/6/9-E). MASH 2007 noted that an adaptation of the MPA database, as well as the submission of additional data types by Contracting Parties, would be required to implement this matrix approach and invited the UK to come forward with guidance on these modifications. The UK was also asked to define the success criteria for ecological coherence elements assessed through this approach. This paper, presented to MASH 2008, addresses these three requests from MASH 2007.

Action requested

3. MASH is invited to:

   a. recommend to BDC that a feature-level assessment is required to adequately assess ecological coherence of the OSPAR MPA network.

   b. consider the proposed method for assessment of ecological coherence, and recommend the approach for use by OSPAR.

   c. consider the proposed success criteria, which are based on previously recommended guidelines to OSPAR, and recommend them for application by OSPAR

   d. recommend Contracting Parties should submit additional information on features being protected within existing and future OSPAR MPAs (i.e. additional to the data on Initial OSPAR list features and Natura 2000 features) in order to adequately assess network coherence, and that the OSPAR MPA database be modified to accommodate these additional data.

A matrix approach to assessing the ecological coherence of the OSPAR MPA network

Background

1. Over the last four years, OSPAR Contracting Parties have worked to develop a common understanding of MPA network ecological coherence. Agreement on the key components of ecological coherence was reached in 2006, when BDC approved an OSPAR guidance paper listing five elements (also called 'Criteria') of Ecological Coherence: **Features (1), Representativity (2), Connectivity (3), Resilience (4),** and **Management (5)** (OSPAR, 2006). These five elements sat under 13 agreed MPA network design principles, outlined in the same paper (OSPAR, 2006). **Replication (6)** was also considered within OSPAR (2006), expressed as a contributory factor towards network Resilience. However, in subsequent OSPAR papers and published literature, Replication is noted as an element of ecological coherence in its own right (ICG-MPA 07/3/2-E; MASH 07/6/6-E; CBD, 2004) and will be considered as such in this paper. Finally, **Adequacy/Viability**[1] **(7)** is widely accepted as an additional element of ecological coherence, as identified by HELCOM in collaboration with BALANCE and considered in ICG-MPA 07/3/1-E and ICG-MPA 07/3/2-E, as well as CBD (2004).

2. In summary, all **seven elements** have been recognised as important constituent parts of ecological coherence. This paper does not intend to duplicate OSPAR (2006) (and other papers on this subject) in outlining why these elements are critical to an assessment of ecological coherence; rather Contracting Parties are advised to refer to OSPAR (2006) and other scientific papers in the list of references prior to a consideration of this document, if further explanation is required.

3. Having agreed on the critical elements of network ecological coherence, OSPAR Contracting Parties are now tasked with assessing how these elements might be evaluated both individually and in combination. Several papers to this end have been submitted to OSPAR working groups by both the UK and Germany. They include a self-assessment approach (based on expert knowledge), a matrix approach (as presented in this paper), and a spatial assessment (based on the spatial configuration of the network). All these approaches are considered valid methods through which elements of ecological coherence can be assessed. The latter approach (published as part of the OSPAR Biodiversity Series (OSPAR, 2008) involves three initial spatial tests which evaluate whether the network is: i) spatially well distributed, without more than a few gaps, ii) covers at least 3% of most (seven of the ten) relevant Dinter biogeographic provinces and iii) represents most (70%) of the OSPAR threatened and/or declining habitats and species (with limited home ranges), such that at least 5% [or at least three sites] of all areas in which they occur within each OSPAR region is protected. Given that MPAs are spatial management tools, an assessment of the spatial configuration of sites within the network is important. A secondary and wholly complementary approach to assessing ecological coherence focuses on the way in which representative features (i.e. species and habitats) are incorporated within the network, and is the focus of this paper.

4. The two previous iterations of this paper, submitted to (ICG-MPA, 2007 and MASH, 2007) have focused on the assessment of three elements of network ecological coherence: Representativity, Replication and Connectivity. It is now proposed that the matrix approach can also go some way to assessing network Adequacy/Viability and Resilience (Section 1). The paper also addresses the Features Contracting Parties may wish to incorporate within the OSPAR MPA network to ensure network ecological coherence.

5. As noted by MASH 2007, it is not sufficient to document how elements of ecological coherence might be evaluated at an OSPAR level. Clear success criteria are now required to assess the likelihood that these elements are adequately represented within the OSPAR MPA network. These success criteria, drawn from both agreed OSPAR guidance on developing an ecologically coherent network of OSPAR MPAs (OSPAR, 2006), international scientific literature and expert judgement, are presented herein (Section 2).

6. Effectively applying this matrix methodology requires both additional datasets on MPA features, and adjustments to the OSPAR MPA database to allow the submission of this data in a consistent form. As requested by MASH (2007) we make recommendations as to how this might be achieved in the final two sections of this paper (Sections 3 and 4).

[1] The term 'Sufficiency' is sometimes used instead of Adequacy/Viability (for example in a Natura 2000 network context) with a similar intended meaning.

1. Assessing six elements of ecological coherence through the matrix approach

This matrix addresses six elements of network ecological coherence as identified by OSPAR (2006): i) Features ii) Representativity, iii) Replication, iv) Connectivity, v) Resilience and vi) Adequacy/Viability. Management is not assessed through this approach, and will require a separate evaluation, for example through the tool presented to the ICG-MPA in 2007 by the UK (ICG-MPA 07/5/2-E(L).

The matrix approach to assessing ecological coherence is illustrated in Figure 1. Species and habitats of interest are listed vertically and OSPAR biogeographic regions laterally within a matrix. Where Contracting Parties have contributed a site to the network which affords protection to a particular feature (species or habitats[2]) this is noted in the matrix under the relevant biogeographic region. Details of which Contracting Parties have submitted sites can be documented (as shown), or excluded to simplify the matrix. The matrix approach can be applied at the OSPAR Maritime Area level (see Figure 1), and at a biogeographical level (see Figure 2). At present, we assume that the Dinter biogeographic regions (Dinter, 2001) will form the basis for assessments of network ecological coherence. However, should new regions be developed for the purposes of EU Marine Strategy Framework Directive reporting and are adopted by OSPAR, these could be used as an alternative framework (providing they have a biogeographic basis and sufficiently represent medium-scale biogeographic variation).

A full list of **Features** which represent the range of marine biodiversity in the OSPAR Maritime Area has not been included in the example matrices (Figures 1, 2 and 3) in order to maintain clarity; however, it is anticipated that EUNIS level 3 habitats[3] and Initial List Threatened and Declining habitats and species would be incorporated as a minimum (see Section 2). Presence of these feature types in each biogeographic region gives an indication of network **Representativity**. Habitats and species targets can be set, which align with the **Adequacy/Viability** 'Success criteria'. These ensure that a sufficient proportion of selected **Features** are incorporated within the network[4] (see Section 2). Whether these targets are met is assessed in the final column. **Replication** is achieved where more than one site per feature is present in a given bioregion (with a caveat for mobile species) (see Section 2). Achieving adequate feature **Replication** will support the **Resilience** of the network by spreading the risk of both damaging events and long term environmental change (OSPAR, 2006). The third matrix (Figure 3) addresses **Connectivity** within the network for those threatened and declining species which form aggregations and for which spatial distribution data is available. Ecologically significant sites will be sought based on categories listed under the OSPAR MPA selection criterion 'Ecological Significance' (for example important areas for feeding, breeding or wintering). Where a series of sites support a particular species throughout their lifecycle, this indicates that **Connectivity** is being achieved within the network. Further detail on success criteria for network Connectivity is documented in Section 2.

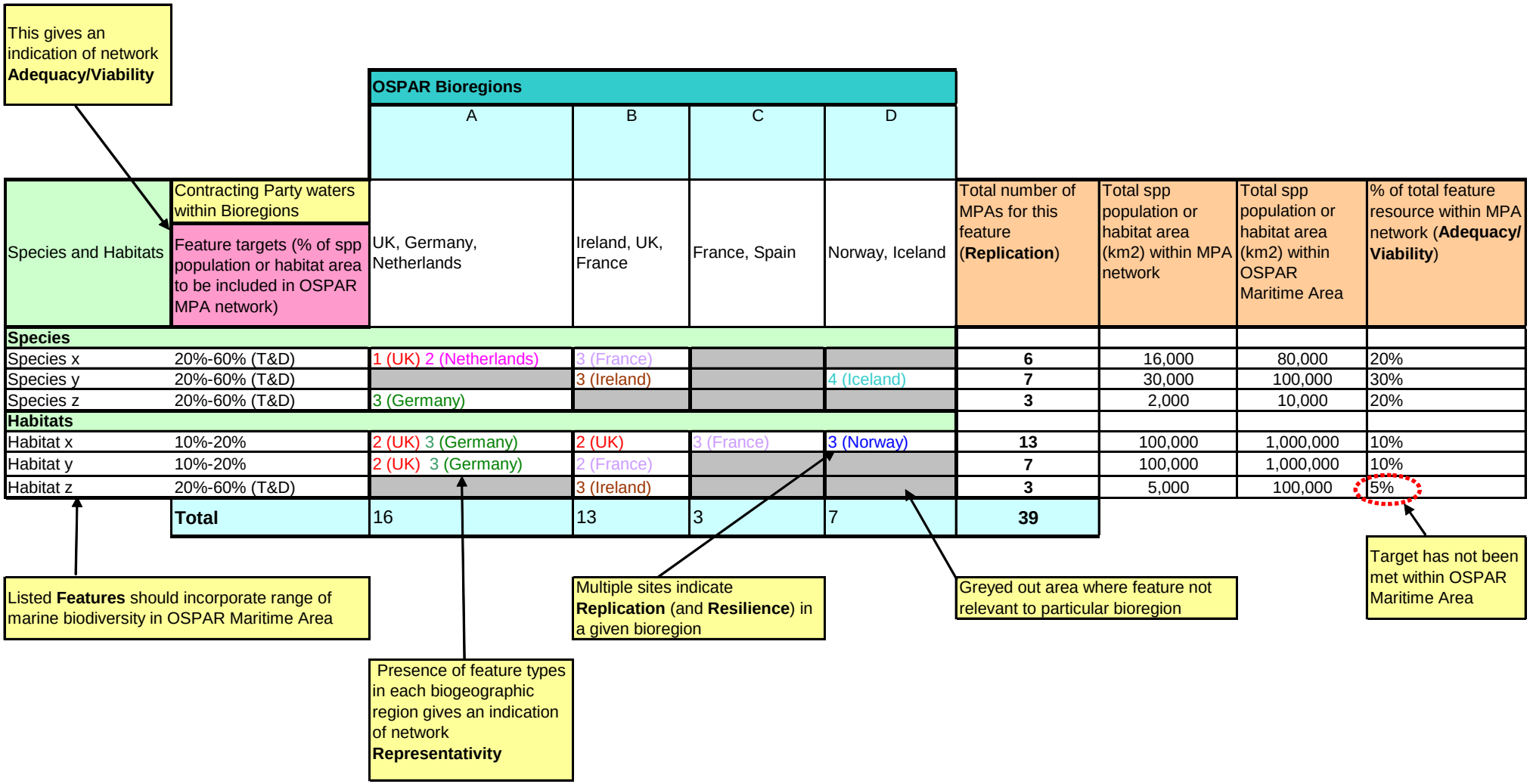
In terms of its practical use, it is anticipated that the ecological coherence assessment matrices would be populated [by the Secretariat or Germany as ICG-MPA lead] using data submitted by Contracting Parties via the OSPAR MPA database (See Sections 3 and 4). A periodic assessment could be made as part of the current process of reporting on OSPAR MPA network progress.

[2] Given that OSPAR has not yet developed a definition or list of ecological processes, this element has been omitted pending further consideration of this issue.

[3] BDC in 2004 agreed that the EUNIS habitat classification scheme would be a working habitat classification system for characterising the OSPAR maritime area (BDC 04/14/1-E). It is therefore appropriate that it forms the main system for characterising the marine environment for the purposes of establishing the OSPAR MPA network.

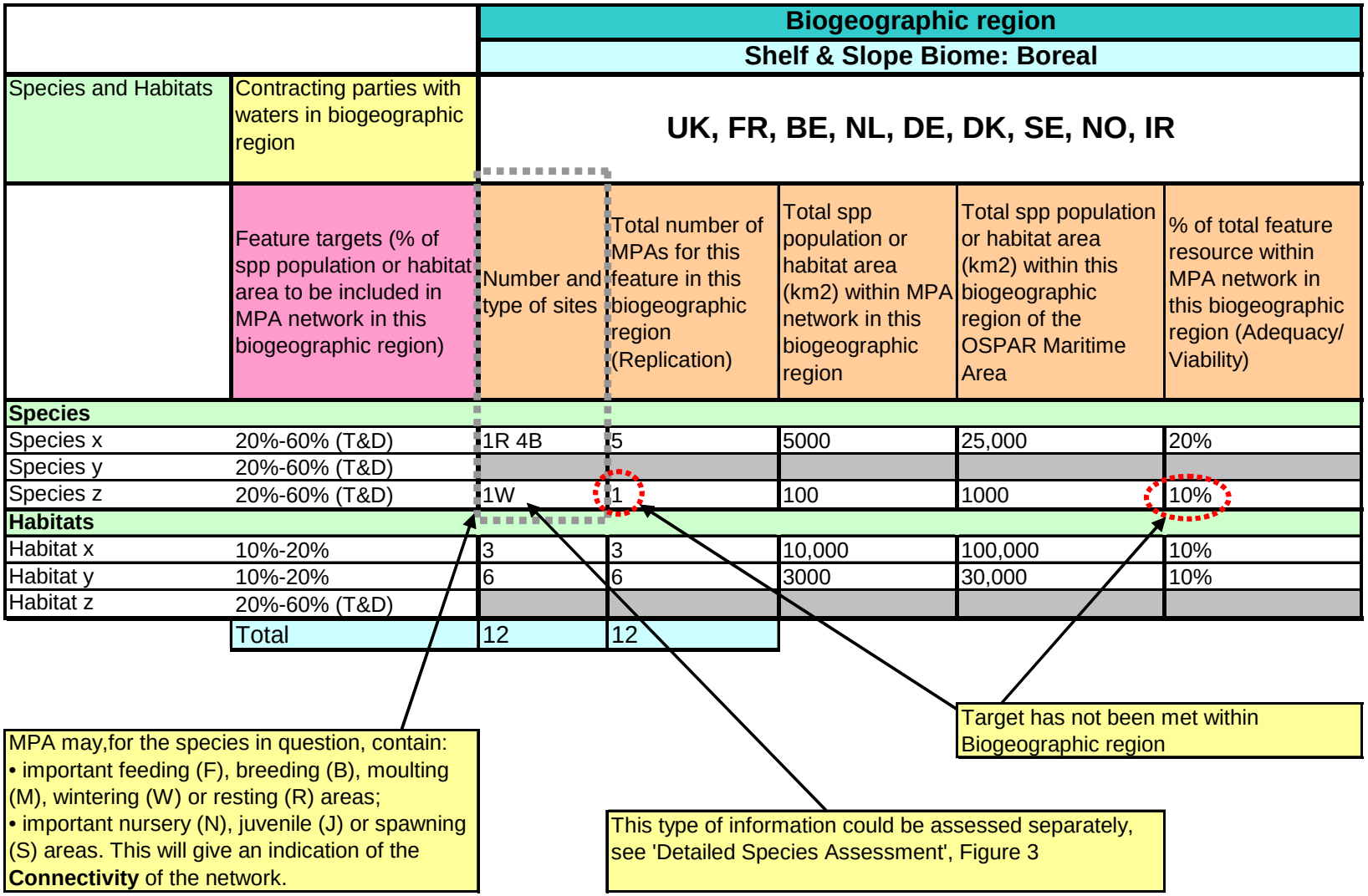
[4] The term 'Sufficiency' is sometimes used instead of Adequacy/Viability (for example in a Natura 2000 network context) with the same intended meaning.

Figure 1: A matrix approach to support the assessment of six elements of ecological coherence i) Features ii) Representativity, iii) Replication, iv) Connectivity, v) Resilience and vi) Adequacy/Viability.



		OSPAR Bioregions							
		A	B	C	D				
Species and Habitats	Contracting Party waters within Bioregions	UK, Germany, Netherlands	Ireland, UK, France	France, Spain	Norway, Iceland	Total number of MPAs for this feature (**Replication**)	Total spp population or habitat area (km2) within MPA network	Total spp population or habitat area (km2) within OSPAR Maritime Area	% of total feature resource within MPA network (**Adequacy/ Viability**)
	Feature targets (% of spp population or habitat area to be included in OSPAR MPA network)								
Species									
Species x	20%-60% (T&D)	1 (UK) 2 (Netherlands)	3 (France)			**6**	16,000	80,000	20%
Species y	20%-60% (T&D)		3 (Ireland)		4 (Iceland)	**7**	30,000	100,000	30%
Species z	20%-60% (T&D)	3 (Germany)				**3**	2,000	10,000	20%
Habitats									
Habitat x	10%-20%	2 (UK) 3 (Germany)	2 (UK)	3 (France)	3 (Norway)	**13**	100,000	1,000,000	10%
Habitat y	10%-20%	2 (UK) 3 (Germany)	2 (France)			**7**	100,000	1,000,000	10%
Habitat z	20%-60% (T&D)		3 (Ireland)			**3**	5,000	100,000	5%
	Total	16	13	3	7	**39**			

Figure 2: Example assessment for a single biogeographic region



		Biogeographic region				
		Shelf & Slope Biome: Boreal				
Species and Habitats	Contracting parties with waters in biogeographic region	UK, FR, BE, NL, DE, DK, SE, NO, IR				
	Feature targets (% of spp population or habitat area to be included in MPA network in this biogeographic region)	Number and type of sites	Total number of MPAs for this feature in this biogeographic region (Replication)	Total spp population or habitat area (km2) within MPA network in this biogeographic region	Total spp population or habitat area (km2) within this biogeographic region of the OSPAR Maritime Area	% of total feature resource within MPA network in this biogeographic region (Adequacy/ Viability)
Species						
Species x	20%-60% (T&D)	1R 4B	5	5000	25,000	20%
Species y	20%-60% (T&D)					
Species z	20%-60% (T&D)	1W	1	100	1000	10%
Habitats						
Habitat x	10%-20%	3	3	10,000	100,000	10%
Habitat y	10%-20%	6	6	3000	30,000	10%
Habitat z	20%-60% (T&D)					
	Total	12	12			

Figure 3: Detailed species assessment to assess network Connectivity for species which form aggregations. [Depending on the population distribution and mobility of the species in question, this assessment can either be made at a biogeographic region or across the network as a whole.]

		Biogeographic region							
		Shelf & Slope Biome: Boreal							
Species	Contracting parties with waters in biogeographic region	UK, FR, BE, NL, DE, DK, SE, NO, IR							
	Feature targets (% of spp population to be included in MPA network)	Number and type of sites							
Species		Feeding area	Breeding area	Moulting area	Wintering area	Resting area	Nursery area	Juvenile area	Spawning area
Species x	20%-60% (T&D)	1	2		1		1		1
Species y	20%-60% (T&D)		1		1			1	
Species z	20%-60% (T&D)	1	3		1			3	

Note: This detailed approach is relevant for species which form aggregations and for which we have sufficient data. Priority species for this type of approach would be those under greatest threat.

May indicate a gap in the network?

Greyed out where area not relevant to particular bioregion or species

2. Developing success criteria for elements of ecological coherence

MASH 2007 asked that success criteria be defined for those elements of ecological coherence which could be evaluated through the matrix approach (presented to MASH 2007). While this is an important step in the planning of an MPA network, determining when a network is truly ecologically coherent is not a straightforward task. As stated in MASH 07/06/06-E, the assessment of ecological coherence is a new area and there is nothing known to currently exist on this specific topic in the published literature. Where agreed quantitative targets for elements of network ecological coherence are available, or where guidance has already been provided by OSPAR, these have been used to generate success criteria as listed below.

Meeting the success criteria for Features, Representativity, Replication[5] Connectivity and Adequacy/Viability does not guarantee achievement, but it does indicate that the OSPAR MPA network is on its way to attaining ecological coherence. This paper presents *one approach* to assessing these ecological coherence elements, and other methods exist. Specifically, our assessment does not consider all attributes of the listed ecological coherence elements; for example, one additional way to evaluate both the Adequacy/Viability and Resilience of a network is by considering the size of MPAs (OSPAR, 2006) (for example, ensuring that each MPA is appropriately sized for the feature for which it has been designated). The size and spacing of sites is also a means through which network Connectivity might be measured. As the size and spacing of individual MPAs is not considered herein, Adequacy/Viability, Resilience and Connectivity can only be partially evaluated through the matrix approach. Applying the different ecological coherence assessment methodologies proposed by Contracting Parties *in combination* (particularly employing a parallel review of the spatial configuration of the network using GIS as outlined in OSPAR, 2008) is likely to generate greatest confidence in the final evaluation of ecological coherence. Finally, MPA management is not assessed through this approach. For the purposes of this paper, it is assumed that sites submitted by Contracting Parties as OSPAR MPAs are appropriately managed to ensure features' long-term viability.

Note that the assessment of success criteria for OSPAR MPA network Representativity, Replication and Adequacy/Viability are dependent on Contracting Parties agreeing to use the same classification system for MPAs habitat features, so assessment is consistent across the OSPAR maritime area.

Features Success Criteria
A feature is the specific aspect(s) of interest (i.e. its biodiversity or ecological character) for which a site is designated. An ecologically coherent network is one which affords protection to the range of marine biological variation (habitats and species) within the area under consideration, as well as those which are currently under threat or in decline, thereby fulfilling OSPAR MPA network aims (a) to (c). However, MPAs are not necessarily an appropriate method for protection for all features of the OSPAR maritime area (OSPAR, 2006).

- **Habitats:**
  At a broad scale, marine habitat variation can be adequately evaluated at EUNIS level 3 (example categories include: high energy littoral rock, sublittoral biogenic reefs and deep-sea mud), and therefore it is recommended that OSPAR MPAs are identified for the full range of these features (see Appendix I). A lower level in the EUNIS habitat classification system (e.g. Level 4) is considered too complex for Contracting Parties to report against at present. It would also be valuable to use a topographic/physiographic method of characterising the marine environment (for example, lagoons, estuaries and seamounts) and ensure these features are included within the network. This is recommended because the EUNIS habitat classification system alone does not capture the range of structural configuration and diversity of the marine environment in the OSPAR maritime area. [Moreover, given that EUNIS level 3 categories provide no biological information, it would be precautionary to consider additional parameters which influence marine biological community distribution. This approach is particularly well suited for areas away from the coastline where biological information is likely to be lacking.] However, this method cannot be taken forward until a full list of topographic/physiographic features in the OSPAR maritime area is agreed at an OSPAR level.

[5] Resilience will be assessed directly through the Replication success criteria

Success criterion: It is recommended that each EUNIS level 3 habitat be protected within the network, in addition to each Initial List threatened and declining habitat (for which MPAs are appropriate), so as to meet OSPAR MPA network aims (a) (b) and (c).

- **Species:**

A broad range of species also occur in the OSPAR Maritime Area, only some of which are suitable for protection through spatial management measures (i.e. MPAs). It is not the intention of this paper to provide a comprehensive list of species for which MPA identification is appropriate in the OSPAR maritime area, though the production of such a list at an OSPAR level is encouraged. Broadscale 'representative' species groups cannot be used in the same way as habitats; as an alternative, a list of species should be generated for OSPAR MPA selection, focusing on species which are of particular conservation interest i.e. species of global importance, regional importance, rare species, sensitive species and keystone species (as identified through the application of the Texel-Faial criteria). This will go some way to meeting OSPAR MPA network aim (c).
Success criterion: It is recommended that, as a minimum, initial list threatened and declining species (for which MPAs are appropriate) be protected within the network, so as to meet OSPAR MPA network aims (a) and (b).

Note: Some sessile/low-mobility species may be partially represented through protection of their habitats. However, this is not possible to ascertain with any confidence using the proposed level in the habitat classification (EUNIS level 3); it is too coarse to be able to incorporate known relationships between species and habitats.

Representativity Success Criteria

As biological communities' characteristics vary according to biogeographic parameters[6], feature representation is recommended within each biogeographic region. It is acknowledged that the biogeographic regions used to assess the OSPAR MPA network ecological coherence may be modified so they are in line with the new reporting regions for the Marine Strategy Framework Directive and that the Dinter biogeographic regions (Dinter, 2001) may no longer be relevant in this regard. Whichever areas are used to assess ecological coherence, these will need to be based on valid biogeographic information and be at a suitable scale so as to effectively incorporate ecological variation within the network.

- **Habitats:**

Proposed Success Criterion: Within each OSPAR biogeographic region, it is recommended that the OSPAR MPA network contain one example **of each EUNIS level 3 habitat** present within that region.

- **Species:**

Biogeographic regions are not necessarily a relevant basis on which to assess species Representativity, as biogeography may not determine important or 'representative' areas for species. Contracting Parties are therefore encouraged to identify MPAs for threatened and declining features within each OSPAR biogeographic region only where this is felt to be ecologically appropriate.

Adequacy/Viability Success Criteria

Network Adequacy/Viability centres on a sufficient proportion of habitat area and species populations being protected within the MPA network so as to secure their long-term maintenance (and recovery). It is recommended that species and habitats already in decline or at risk of decline be afforded comparatively greater protection than representative features for the network to be considered Adequate or Viable for these features (OSPAR, 2006). Success criteria for Adequacy/Viability are presented as ranges: below the minimum percentage targets, it is less likely that ecological coherence is being achieved. [The following success criteria can be compared to other international targets and scientific recommendations for habitat and species protection within MPA networks in Appendix II.]

- **Habitats**

EUNIS Level 3 habitats

In the OSPAR MPA Guidance (2006-3), it is stated that, 'Contracting Parties may wish to aim to include 20% of the total extent of each EUNIS level 3 habitat, with at least 10% included within the

[6] For instance, the biological character of EUNIS level 3 type 'high energy littoral rock' will be completely different in northern Norway compared with the Azores.

network.' The UK proposes that the success criteria for habitat representativity using EUNIS level 3 should therefore be as follows:

Proposed Success Criterion: Within each OSPAR biogeographic region, it is recommended that the OSPAR MPA network contain between **10-20% of each EUNIS level 3 habitat** present within that region. This target should also be applied at an OSPAR maritime area level.

OSPAR threatened and declining habitats

OSPAR threatened and declining habitats are finer-scale features (for example, maerl beds, seagrass beds and *Sabellaria spinulosa* reefs). In most cases it will not be possible to ensure their protection by fulfilling EUNIS level 3 targets as this is a relatively coarse-scale classification system. Distinct Adequacy/Viability success criteria are presented for these features, in line with the OSPAR Guidance on developing an ecologically coherent network of OSPAR Marine Protected Areas (OSPAR, 2006). This guidance states that 'where MPAs are an appropriate measure for threatened and/or declining habitats or species, Contracting Parties may wish to aim to include up to 60% of the total extent (of a habitat) with 20% regarded as a suitable minimum threshold.' It is acknowledged that these figures are based on the European Commission's guidance for terrestrial habitats to be included within the Natura 2000 MPA network and should be kept under review in terms of their relevance to the development of the OSPAR network of MPAs.

Proposed Success Criterion: Within each OSPAR biogeographic region, Contracting Parties may wish to aim to include **between 20% and 60% of the total extent of each OSPAR threatened and declining habitat** within the OSPAR MPA network, in the absence of information on individual habitats that points to more specific levels of protection.

Note that the above targets for vulnerable habitats can be 'nested' within Adequacy/Viability targets for EUNIS Level 3 habitats. For example *Ostrea edulis* beds always occur within EUNIS level 3 'Sublittoral mixed sediments' so protecting between 20-60% of this OSPAR Initial List feature contributes towards meeting the representativity target for 'Sublittoral mixed sediments' (i.e. 10-20%).

- **Species**

The proposed matrix methodology can solely test network Adequacy/Viability in relation to species identified as meriting protection through MPAs. Whilst there is OSPAR guidance on percentage targets for populations of species that should be protected within MPAs, which species these targets refer to is not specified (2006-3). The guidance simply states that, 'Contracting Parties may wish to aim to include 20% of the total species population, where considered appropriate, with at least 10% of the population be included within the network'. The identification of these species is the responsibility of individual Contracting Parties (as outlined under the 'Features' section). Until a list of such species is generated, Adequacy/Viability success criteria cannot be developed or applied, other than in relation to threatened and declining species.

OSPAR threatened and declining species

The Guidance OSPAR MPAs (2006-3) states that, 'where MPAs are an appropriate measure for threatened and/or declining habitats or species, Contracting Parties may wish to aim to include up to 60% of the total population (of a species) with 20% regarded as a suitable minimum threshold'. Once again, it is acknowledged that these figures are based on the European Commission's guidance for terrestrial features to be included within the Natura 2000 MPA network and should be kept under review in terms of their relevance to the development of the OSPAR network of MPAs.

Proposed Success Criterion: Within each OSPAR biogeographic region, Contracting Parties may wish to aim to include **between 20% and 60% of the known population of each OSPAR threatened and declining species** within the OSPAR MPA network, in the absence of information on individual species that points to more specific levels of protection. Only OSPAR threatened and/or declining species which are likely to benefit from spatial protection within each biogeographic region should be considered. As outlined above, biogeographic regions are not necessarily a relevant basis on which to set species targets, as biogeography may not determine important or representative areas for species. Contracting Parties are therefore encouraged to identify MPAs for threatened and declining features within each OSPAR biogeographic region only where this is felt to be ecologically

appropriate. Where biogeography is not relevant, Contracting Parties may wish to aim to achieve the 20-60% population protection objective at the OSPAR Maritime Area level. Furthermore, for some mobile species which form aggregations, it may not be possible to assess the proportion of the population present at a specific site, particularly if this varies temporally. In this case, it is proposed that Contracting Parties focus on identifying significant areas for the protection of these species based on existing information and consider meeting percentage targets at a later stage in network development.

Replication Success Criteria

In order to ensure sufficient Replication of habitat types and species populations within the network, it is recommended that more than one example for each feature be selected in each biogeographic region. This principle is expressed in the Guidance on developing an ecologically coherent network of OSPAR Marine Protected Areas (OSPAR, 2006) as follows: 'Replication of habitats, species and ecological processes in separate OSPAR MPAs in each biogeographic area is desirable where it is possible'. Replication not only increases the likelihood of the range of marine biological variation present in each biogeographic area being incorporated within the network, but also enhances network Resilience (by reducing feature susceptibility to catastrophic events). As such, network Resilience will be assessed on the basis of achievement of the Replication success criteria in this paper. Replication of sites for certain species can also assist in meeting the network's Connectivity objectives (this is explored further under 'Connectivity Success Criteria' below).

The degree to which protected features need to be replicated within different biogeographical regions depends both on the scale of feature classification used and the size of the biogeographical regions[7]. As such, there are few concrete international targets or scientific recommendations on feature replicates which are applicable to the OSPAR MPA network. The success criteria presented below are believed to represent a minimum level of replication.

- **Habitats**

Given the relatively coarse scale at which marine habitats can be assessed in the OSPAR maritime area (EUNIS level 3) Replication within the network will only concern broadscale variation in habitat types. Finer-scale replication will be possible for threatened and/or declining features, where habitat distribution data supports this. Suitable examples may not be present in each biogeographic region.
Proposed Success Criterion: Within each OSPAR biogeographic region, it is recommended that **at least two MPAs for each EUNIS level 3 habitat** be selected where possible. In establishing the appropriate number of MPA replicates in each biogeographic region, the vulnerability of the feature being protected should be taken into account. As such, a greater number of replicates **(at least three MPAs in each biogeographic region) for threatened and declining habitats** would be precautionary.

- **Species**

The proposed matrix methodology can solely test network Replication in relation to species identified as meriting protection through OSPAR MPAs. Until a list of such species is generated, Replication success criteria cannot be developed or applied, other than in relation to threatened and declining species (below).

Proposed Success Criterion:
Biogeographic regions are not necessarily a relevant basis on which to set species Replication targets. Contracting Parties are therefore encouraged to identify MPAs for threatened and declining features within each OSPAR biogeographic region only where this is felt to be ecologically appropriate. If this is felt to be a useful framework, **three replicate sites for each threatened and declining species** (which is likely to benefit from spatial protection) **per biogeographic region** is recommended. Where biogeography is not relevant, it is recommended that the Replication target of **five sites per threatened and declining species** be met at the OSPAR Maritime Area level (where appropriate sites exist).

[7] Note that if the Dinter biogeographic regions (Dinter, 2001) are replaced by an alternative biogeographic framework, the success criteria for Replication presented below will need to be reviewed.

Connectivity Success Criteria

Connectivity is one of the most complex elements of network ecological coherence to measure in a robust way. In the Guidance on developing an ecologically coherent network of OSPAR Marine Protected Areas (Reference number 2006-3), it is stated that, 'the network should have regard to the different aspects of connectivity but not be focussed on one element or one species to the detriment of others. Habitat linkages and species movements can inform decision-making for the location of sites where information is available but, it should be accepted that in most cases our understanding of the connections between sites would emerge over time, especially for species whose ecology is poorly understood.'

We therefore propose a simple means of measuring connectivity, focused on connections between sites for threatened and declining species for which sufficient detail is known about movements and life history stages. [Connections between habitats are not assessed at this stage. Equally species that are not threatened or declining are not considered here, for reasons outlined in the Features and Adequacy/Viability sections above].

For threatened and declining species, it is recommended that a variety of sites (where appropriate) be included within the OSPAR Maritime Area in line with the OSPAR MPA ecological selection criterion 'Ecological Significance': Important feeding, breeding, moulting, wintering, resting, nursery, juvenile and/or spawning areas (See Figure 3). The inclusion of such sites for key species (particularly threatened and/or declining species, but also for other important species as identified by Contracting Parties) should be prioritised. This approach will be particularly relevant for mobile species which form aggregations.

Proposed Success Criterion: Within the OSPAR Maritime Area, it is recommended that sites be selected to support threatened and declining species at key stages of their lifecycle. Obvious gaps in protection of populations of species at particular points in their lifecycle (where suitable sites exist) should be addressed. No quantitative target can be set for this success criterion at the present time, as the most appropriate target will vary according to the species considered. Contracting Parties are encouraged to apply this success criterion at an OSPAR biogeographic region level where this is felt to be ecologically appropriate.

3. Guidance on additional data types needed to test the matrix approach

In order to be able to assess the elements of MPA network ecological described in Sections 1 and 2, it is recommended that the following additional datasets are submitted to OSPAR by Contracting Parties. It is important to emphasise the need for all Contracting Parties to use the same habitat classification system to enable a robust network analysis of network coherence at the feature level.

Essential

- Data on EUNIS Level 3 habitats in OSPAR MPAs in order to assess network **Representativity, Adequacy/Viability** and **Replication**[8]**.** Work is underway to extend the mapping of EUNIS habitats within the OSPAR Maritime Area and this exercise will support the collation of habitat data[9].
- Data on species which occur in OSPAR MPAs (not only threatened and declining species) in order to assess network **Representativity, Replication, Adequacy/Viability** and **Connectivity.** Standard European checklists are available to this end. [Note: the intention is to record presence of species for which MPAs have been identified. Although this data may not be used in an assessment of ecological coherence at present (for reasons outlined in the sections above) it is essential that Contracting Parties have the opportunity to record relevant species when sites are submitted].

[8] BDC in 2004 agreed that the EUNIS habitat classification scheme would be a working habitat classification system for characterising the OSPAR maritime area (BDC 04/14/1-E). It is therefore appropriate that it forms the main system for characterising the marine environment for the purposes of establishing the OSPAR MPA network.

[9] An EU tender (July 2008) requires preparation of broad-scale EUNIS habitat maps for the North Sea and Celtic Seas regions (together with the Baltic and western Mediterranean Seas) by late 2010. EUNIS maps are already available for north-west Europe (www.searchMESH.net/webGIS). An INTERREG IV proposal is currently being developed to extend broadscale EUNIS mapping south of the MESH area to other parts of Atlantic France, Spain and Portugal. For specific sites proposed by CPs, it is anticipated that more detailed habitat maps will be available as part of the site identification process and that derivation of EUNIS level 3 data will be straightforward.

- Data on the area of habitats (EUNIS Level 3) and size of species populations (where available) within OSPAR MPAs in order to assess network **Adequacy/Viability**.
- Data on the ecological significance of the site (where relevant) for all listed species, for example: important juvenile, or spawning areas. This data can be used to assess network **Connectivity** for these species.

Optional

- Data on topographic/physiographic marine features.
  Justification: The EUNIS habitat classification system does not capture the range of structural configuration and diversity of the marine environment in the OSPAR maritime area. The UK recommends that a topographic/physiographic feature categorisation be developed and this information be collated to allow for a parallel assessment of network ecological coherence.
- Data on EUNIS Level 4 habitats in OSPAR MPAs in order to better assess network **Representativity, Adequacy/Viability** and **Replication.**
  Justification: At level 3, the EUNIS habitat classification system contains no biological information, only information on the substratum type, depth (light) and energy levels of the habitat (which is used as a coarse proxy for biological data, as these parameters influence biological communities). It is only possible to *directly* assess biological **Representativity, Adequacy/Viability** and **Replication** using the EUNIS classification level 4 or higher levels. However, at Level 4 in the hierarchy there are approximately 150 classification types. It may not be possible at this stage for Contracting Parties to provide data at this level of resolution for all their MPAs.

4. Guidance on associated changes required to the OSPAR MPA database to support an assessment of ecological coherence

Essential

- A desegregation of the 'Threatened or Declining' and 'Ecological Significance' criteria within the database, so that Contracting Parties can note whether a site is ecologically significant for species or habitats which are *not* threatened or declining.
- The inclusion of a drop-down menu listing all EUNIS Level 3 habitats. The OSPAR MPA database currently only accepts data for habitats on the OSPAR Threatened and Declining List or on Annex I of the Habitats Directive. It was agreed at BDC 2007 that the database should be modified to accept data on a suitable set of additional habitat types.
- The inclusion of a drop-down menu listing all species which occur in the OSPAR Maritime Area (with a facility to 'bring up' relevant species by typing first few letters of Latin name).
- A facility to record the (estimated) area of habitats and populations of species in each MPA. Contracting Parties could choose their preferred unit of measure for area, for example: hectare, km^2 or % cover on site.

Recommended

- A facility to record whether a species or habitat within the OSPAR MPA meets additional Texel-Faial criteria (for example: global importance, regional importance, rarity, sensitivity, and/or keystone species).

Optional

- The inclusion of a drop-down menu listing topographic/physiographic marine features in the OSPAR Maritime Area.
- The inclusion of a drop-down menu listing EUNIS Level 4 habitats.

References

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Appendix I: Marine habitat types at Level 3 in the EUNIS classification system[10]

Littoral rock (A1) Littoral rock includes habitats of bedrock, boulders and cobbles which occur in the intertidal zone (the area of the shore between high and low tides) and the splash zone.	High energy littoral rock
	Moderate energy littoral rock
	Low energy littoral rock
	Features of littoral rock
Littoral sediment (A2) Littoral sediment includes habitats of shingle (mobile cobbles and pebbles), gravel, sand and mud or any combination of these which occur in the intertidal zone.	Littoral coarse sediment
	Littoral sand and muddy sand
	Littoral mud
	Littoral mixed sediments
	Coastal saltmarshes and saline reedbeds
	Littoral sediments dominated by aquatic angiosperms
	Littoral biogenic reefs
	Features of littoral sediment
Infralittoral rock (A3) Infralittoral rock includes habitats of bedrock, boulders and cobbles which occur in the shallow subtidal zone and typically support seaweed communities.	High energy infralittoral rock
	Moderate energy infralittoral rock
	Low energy infralittoral rock
	Features of infralittoral rock
Circalittoral rock (A4) Circalittoral rock includes habitats of bedrock, boulders and cobbles which occur in the subtidal zone, and are characterised by animal dominated communities (a departure from the algae dominated communities in the infralittoral zone).	High energy circalittoral rock
	Moderate energy circalittoral rock
	Low energy circalittoral rock
	Features of circalittoral rock
Sublittoral sediment (A5) Sediment habitats in the sublittoral near shore zone (i.e. covering the infralittoral and circalittoral zones), typically extending from the extreme lower shore down to the edge of the bathyal zone (200m). Sediment ranges from boulders and cobbles, through pebbles and shingle, coarse sands, sands, fine sands, muds, and mixed sediments.	Sublittoral coarse sediment
	Sublittoral sand
	Sublittoral mud
	Sublittoral mixed sediments
	Sublittoral macrophyte-dominated sediment
	Sublittoral biogenic reefs
	Features of sublittoral sediments
Deep-sea bed (A6)	Deep-sea rock and artificial hard substrata
	Deep-sea mixed substrata
	Deep-sea sand
	Deep-sea muddy sand
	Deep-sea mud
	Deep-sea bioherms
	Raised features of the deep-sea bed
	Deep-sea trenches and canyons, channels, slope failures and slumps on the continental slope
	Vents, seeps, hypoxic and anoxic habitats of the deep sea
Ice-associated marine habitats (A8)	Sea ice
	Freshwater ice
	Brine channels
	Under-ice habitat
Coastal dunes and sandy shores (B1)	Sand beach driftlines
Coastal shingle (B2)	Shingle beach driftlines
Rock cliffs, ledges and shores, including the supralittoral (B3)	Supralittoral rock (lichen or splash zone)

[10] Pelagic water column features (EUNIS A7) have been excluded from the list above, as insufficient data is available across the OSPAR Maritime Area to support identification of sites for these features. In addition, management of water column features within MPAs has not been sufficiently explored in an OSPAR context.

Appendix II: Targets for MPA networks

A summary of recommended targets for the proportion of features, or total sea area, to be protected within MPA networks from international fora, selected countries and peer reviewed literature. After Nevill (2006) and CBD (2004).

Source	**Recommendation**
Convention on Biological Diversity	'At least 10% of each of the world's ecological regions effectively conserved'.
IUCN World Parks Congress	MPA networks 'should be extensive and include strictly protected areas that amount to at least 20-30% of each habitat'.
European Commission	Between 20 and 60% of the national extent (of a habitat) or population (of a species) of an EU Habitats Directive Annex I habitat or Annex II species should be included within a Member State's contribution to Natura 2000.
Germany	Germany has nominated ten offshore sites to the European Commission covering approximately 31% of German offshore waters, which when combined with the area of coastal MPAs results in more than 41% of German marine waters under site protection.
BALANCE Interreg project	The BALANCE project in the Baltic Sea recommended a minimum level of protection of 20% for the extent of coarse-filter features, with a lower ambition of 10% and a higher ambition of 30%.
California	California has established 29 MPAs with varying degrees of protection; covering approximately 18% of Californian State waters in the central coast region.
Australia (Great Barrier Reef Marine Park)	No-take areas cover approximately 30% of the Great Barrier Reef Marine Park. The zoning plan was produced through the Representative Areas Program (RAP), which aims to protect 'representative' examples of all the different habitats and communities and was based on a bioregional classification of the marine park.
Scientific literature	Figures from scientific literature for total area set aside under MPAs range from 10% to 80% of the environment, but most recommendations suggest that a minimum of 20% and an optimum of 30–50% of the total management area be set aside in MPAs or no-take zones. This literature pertains to both protection of marine ecosystems in both tropical and temperate zones: See for example: Airame et al. 2003, Ballantine (1991), Beger et al. 2003, Bellwood et al. 2004, Bohnsack et al. 2000, Botsford et al. 2003, Hughes et al. 2003, Sala et al. 2002