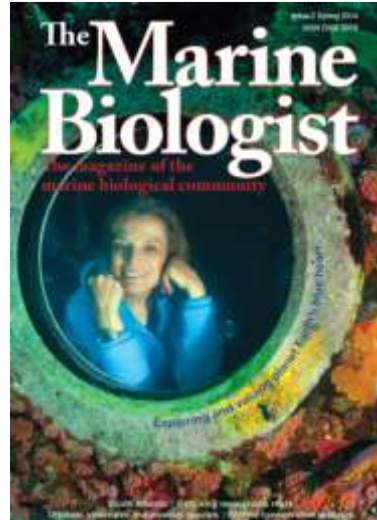


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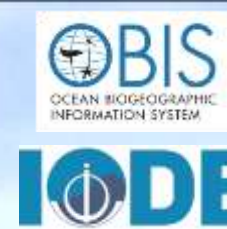


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Acquisition, validation, quality control and access to biodiversity data -

Training course for less experienced users of data products

The use of biodiversity data in national and European directives / Marine protected areas and MSFD

Matt Frost & Herman Hummel , Dan Lear

Marine Biological Association, Plymouth, UK

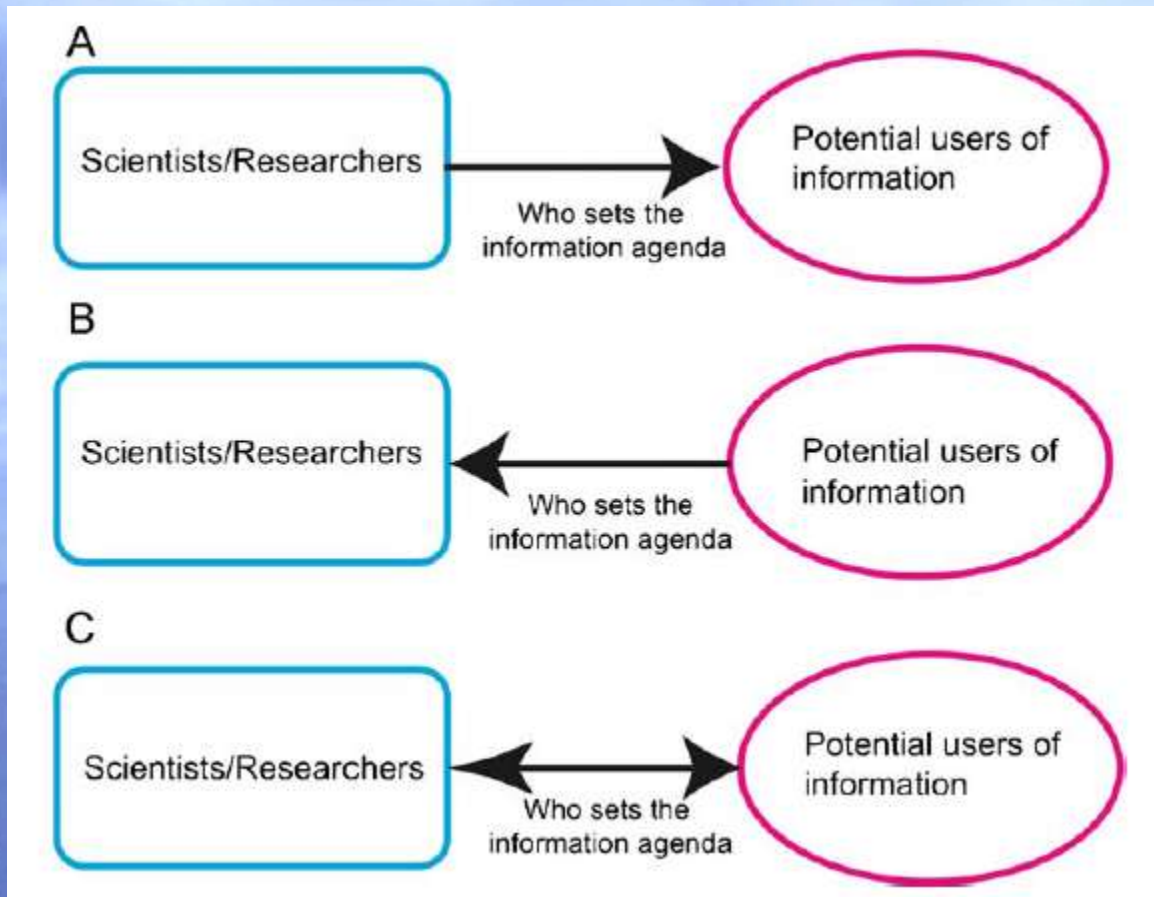
Netherlands Institute for Sea Research, Yerseke, the Netherlands



Talk structure

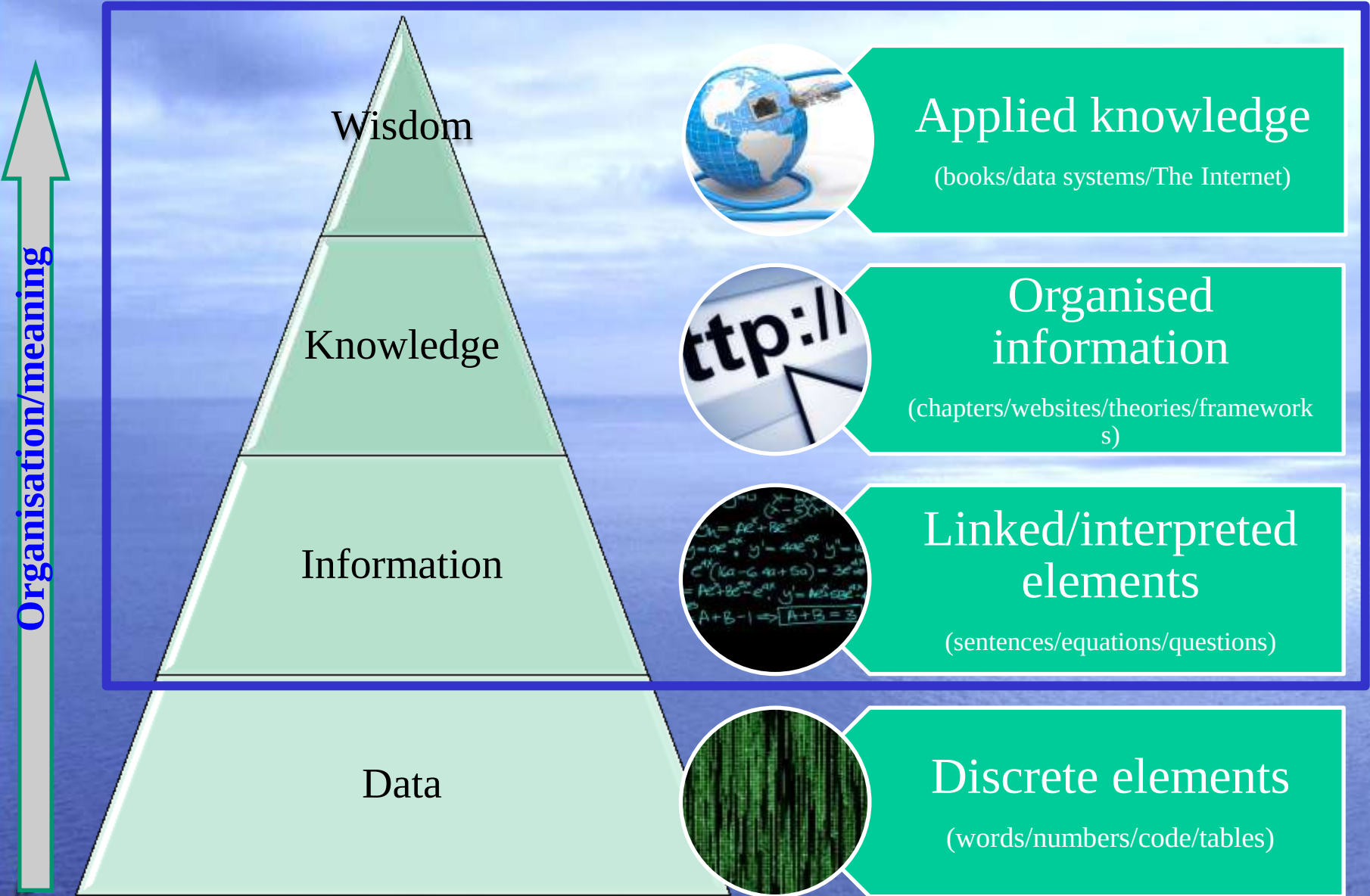
- 1) Data to policy pathways
- 2) Marine protected areas
 - Overview
 - Designation
 - Management
- 3) Marine Strategy Framework Directive
 - Overview
 - Data and target setting
- 4) Final thoughts

1) Data to policy pathways



Dilling & Lemos (2011) Creating usable science: Opportunities and constraints for climate knowledge use and their implications for science policy. *Global Environmental Change*. 21: 680–689

1) Data to policy pathways





INSPIRE

- EU INSPIRE Directive came into force 15th May 2007 with full implementation by 2019
- aims to create a European Union (EU) spatial data infrastructure
- “...will assist in policy-making across boundaries”.

Data should be

- Collected once and stored where it can be effectively maintained
- Easily discoverable
- Readily and transparently available
- Capable of being seamlessly combined across Europe

NB: Focusing on MPAs and MSFD for examples as lots of marine biodiversity legislation exists:

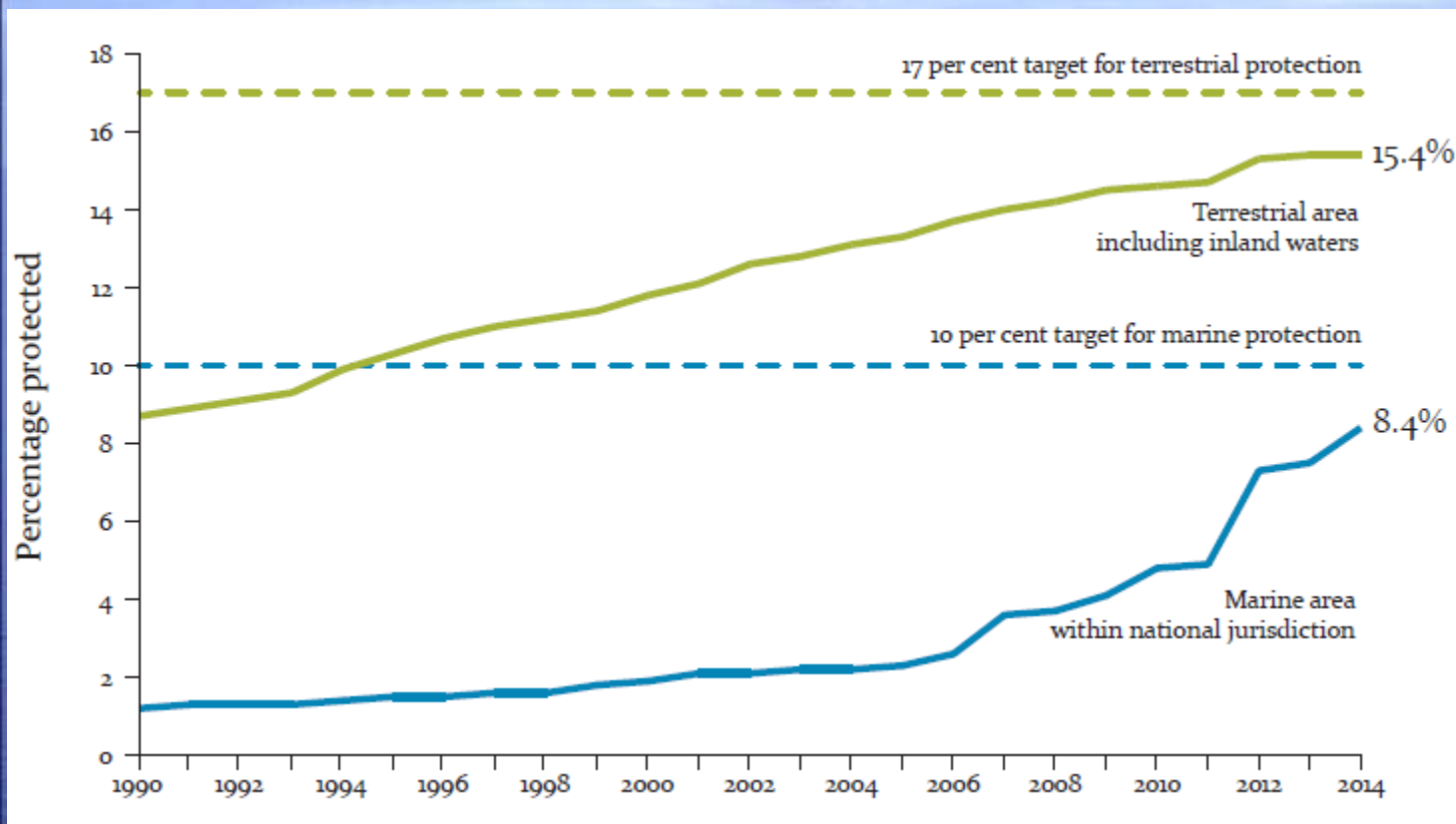
21 obligations (inc. conventions and legislation) relevant to UK marine biodiversity, spanning nearly five decades (1966 - 2013).

International Convention for the Conservation of the Atlantic Tuna (1966)	EC Habitats Directive (1992)
EC Common Fisheries Policy (1970, 1983, 1987, 2002, 2013)	Convention on Biological Diversity (CBD; 1992, 1993)
Ramsar Convention (1971)	EU Water Framework Directive (WFD) (2000)
CITES - Convention on International Trade in Endangered Species of Wild Fauna and Flora (1973)	International Maritime Organisation - Ballast Water Convention (2004)
Bern Convention (1979)	Marine Strategy Framework Directive (2008)
Bonn Convention (Conservation of Migratory Species) (1979)	Climate Change Act (2008)
EU Wild Birds Directive (1979; 2009)	Climate Change (Scotland) Act 2009
UK Wildlife and Countryside Act (1981 and subsequent amendments)	Marine & Coastal Access Act (2009); Marine Act (Northern Ireland) 2013
Convention for the conservation of salmon in the North Atlantic Ocean (1982)	Marine (Scotland) Act (2010)
Straddling Fish Stocks and Highly Migratory Fish Stocks Agreement (1982)	Marine Act (Northern Ireland) 2013
OSPAR Convention- The Convention for the Protection of the Marine Environment of the North-East Atlantic (1992)	

Frost et al (2015) Climate change and the implementation of marine biodiversity legislation in the UK. AQC. DOI: 10.1002/aqc.2628 AQC.

2) Marine protected areas overview

“By 2020, at least 17 per cent of terrestrial and inland water areas **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 seascape” (Aichi Biodiversity Target 11- <https://www.cbd.int/sp/targets/>).



**But mpa cover = 3.4% of total.
Only 0.25% of areas beyond national jurisdiction**

Source: Frost et al 2016. A review of climate change and the implementation of marine biodiversity legislation in the United Kingdom. *Aquat. Cons. Mar. & Fresh. Eco.* DOI: 10.1002/aqc.2628

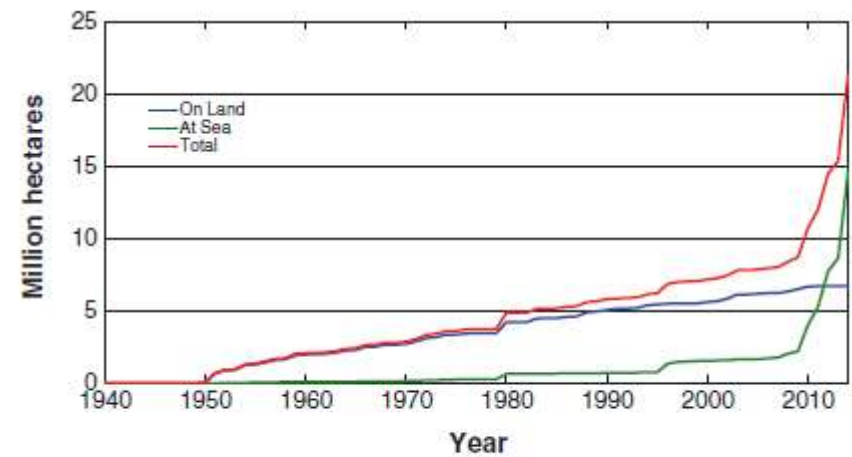
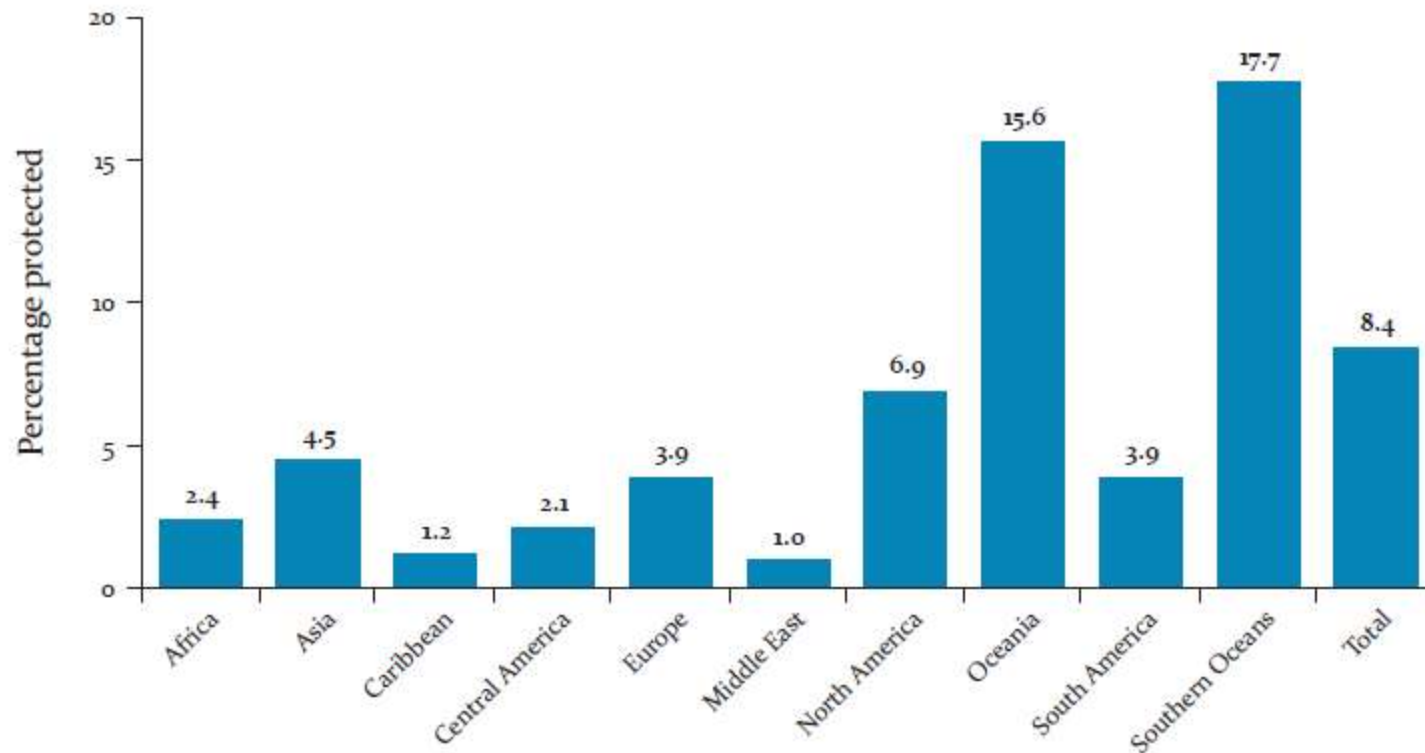


Figure 1. Extent of UK nationally and internationally important protected areas: on-land and at-sea, 1950 to 2014. This is reproduced

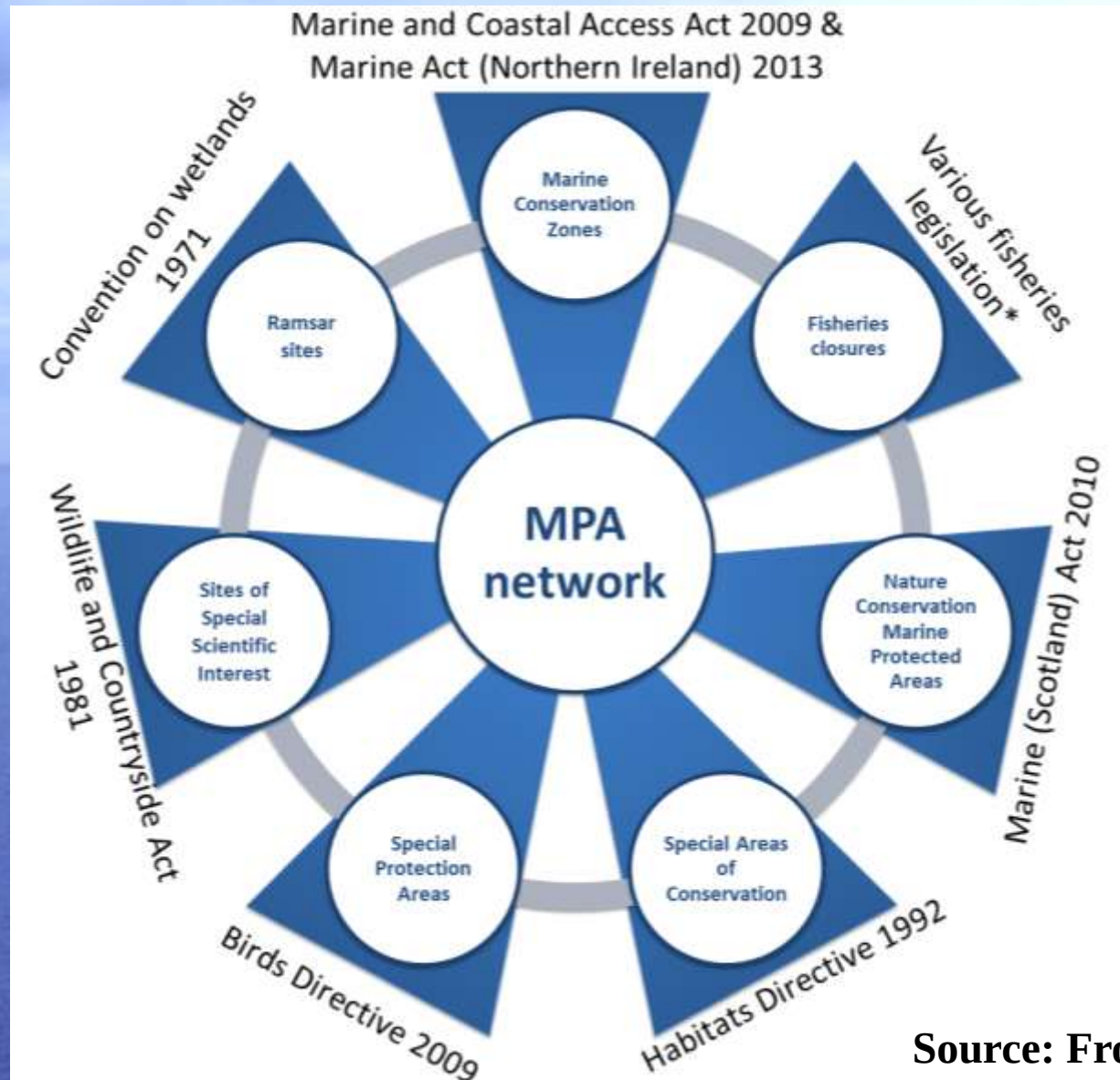
Figure 2.5

Percentage of the marine areas within national jurisdiction (0-200 nautical miles) covered by protected areas for each CBD region. Source: Adapted from Deguignet et al. 2014



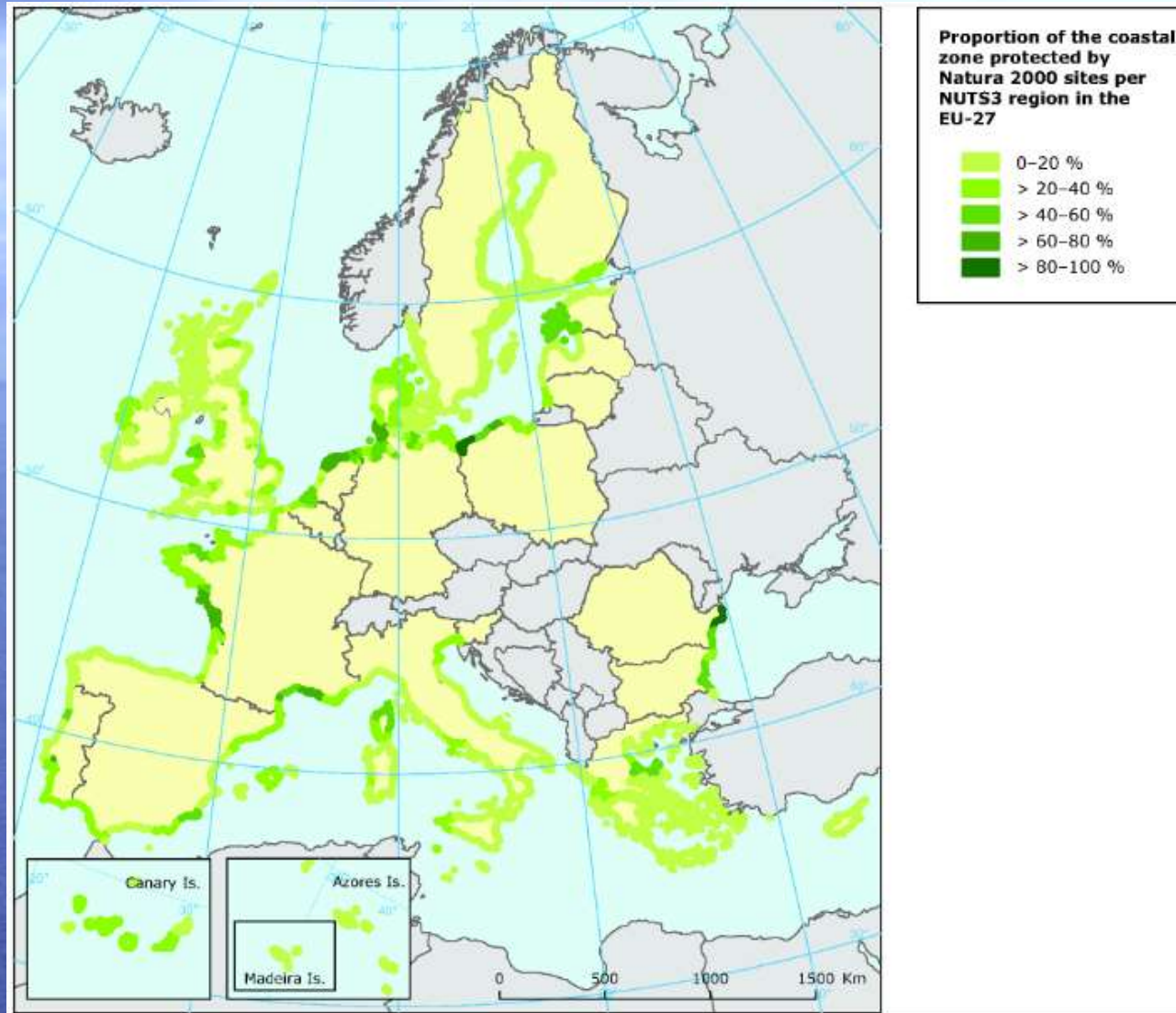
2) Marine protected areas overview

marine protected area networks result of multiple legislative drivers



Source: Frost et al 2016.

Natura 2000 areas along the coast (EEA 2011)



2) Marine protected areas designation

- **Proposed SAC: West Coast of Scotland, UK**
- **Proposed for sandbanks and reefs**

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8 February 2012 Last updated at 19:06

Barra fishermen march on Holyrood in conservation row

Islanders who claim new conservation rules could put their economic future under threat have held a protest at the Scottish Parliament.

Residents on Barra, in the Western Isles, say plans to designate some of their fishing grounds special areas of conservation will hit the industry.

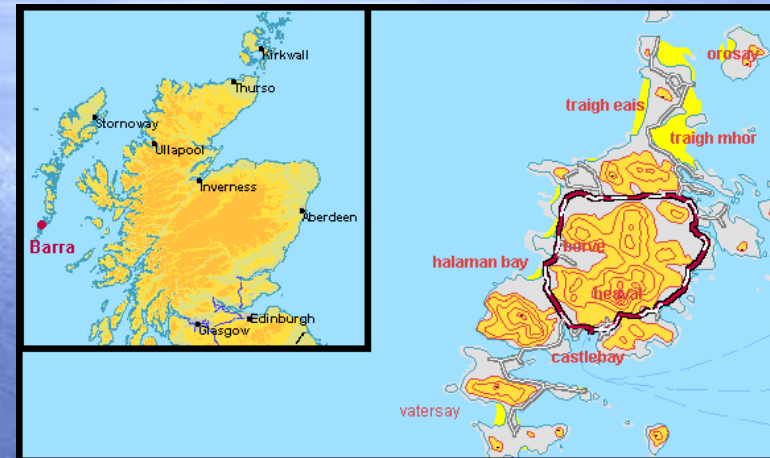
Conservation agency Scottish Natural Heritage says sandbanks, reef and seal habitats need special protection.

Tory MSP Jamie McGrigor led a backbench debate on the issue at Holyrood.

From Democracy Live: Jamie McGrigor leads a debate on the new conservation rules

Related Stories

Barra Special Area of Conservation (SAC)



- Public consultation on designation.
- Responses included negative responses where the **scientific case for designation was not accepted.**
- So agreed independent expert review would be taken into the **scientific case for designation.**

Home World UK England N. Ireland Scotland Wales Business Politics Health Education Sci/Env
Scotland Politics Scotland Business Edinburgh, Fife & East Glasgow & West Highlands & Islands NE

20 November 2012 Last updated at 11:55 21 Share Share

Scientific review of Sound of Barra conservation plan



BARBARA CARR/GEOPHOTOGRAPH

Fishermen and conservationists have clashed over the planned designation for the Sound of Barra

An independent review will examine the scientific case for a proposed special area of conservation (SAC) in the Sound of Barra in the Western Isles.

Scottish Natural Heritage (SNH) said the designation was needed to protect rare and fragile marine life, a move supported by Conservationists.

But fishermen and Rory MacNeil, chief of Clan MacNeil of Barra, fear SAC status will restrict fishing.

The Scottish government said the review would guide its decision on the plan.

Related Stories

- Sound of Barra virtual tour bid
- Barra conservation plan prepared
- Barra fishermen march on Holyrood

Independent expert review of the scientific case for the proposal to designate the Sound of Barra as a Special Area of Conservation (SAC) (Frost & Widdicombe, 2013).

- Main aim of peer review to: “*consider whether the scientific evidence supporting the proposal has been used appropriately and that the assessment correctly reflects the requirements of the EU Habitats Directive*”.
 - Are the quality, quantity and analysis of **biological and geomorphological data** used to support the site recommendation scientifically robust?
 - Assessment of **interpretation of resulting biological and geomorphological findings**, and resultant extent of Annex I and Annex II features proposed?
 - Are boundary **judgements made reasonable given available evidence** and the JNCC boundary guidance (2008)?

Example findings from Frost & Widdicombe (2013)

- *“Proposal supported by a wide range of evidence including multi-beam data, satellite data, video tows, diver video and grab samples”.*
- *“data gathered by SNH provided a comprehensive spatial coverage across the entire area of interest.”*
- *Conclusion: “reviewers were satisfied that there were sufficient data of appropriate quality to provide scientifically robust support for the site recommendation”*



Independent Expert Review of the Scientific Case for the Proposal to Designate the Sound of Barra as a Special Area of Conservation (SAC)

Independent Expert Review of the Scientific Case for the Proposal to Designate the Sound of Barra as a Special Area of Conservation (SAC)

Monday, August 5, 2013

ISBN: 9781782567851

Scottish Ministers approved the scientific case for a public consultation in August 2011. Following receipt of the consultation report and final advice from Scottish Natural Heritage (SNH) in October 2012 this report was commissioned. The aim was to provide Scottish Ministers with an independent review of the scientific evidence base to ensure that it was robust, had been used appropriately, and that the assessment correctly reflected the requirements of the EU Habitats Directive.

Executive Summary

Reviewers, Dr Matthew Frost and Dr Stephen Widdicombe were satisfied that there were sufficient data of appropriate quality to provide scientifically robust support for the SNH recommendation to designate Sound of Barra as a Special Area of Conservation under the EU Habitats Directive.

NEWS HIGHLANDS & ISLANDS

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19 July 2013 Last updated at 15:16



Sound of Barra to be given protected status



BARBARA CARR/GEOGRAPH

The Sound of Barra has been described as one of "Scotland's wildlife jewels"

The Sound of Barra in the Western Isles is to be designated a site of Special Area of Conservation (SAC).

The Scottish government said the move would protect a pristine marine environment and give its wildlife and habitats international recognition.

Related Stories

Review of troubled marine plan

- We were asked to carry out numerous other independent reviews for other government agencies
- Shows importance of data and how it is used

Not all areas have as much data available

- Papahānaumokuākea Marine National Monument (PMNM), Northwestern Hawaiian Islands.
- Recognised for cultural and natural value
- Established 2006 by George Bush
- largest protected area in the US
- >50% seafloor never been mapped in detail
- April 2014, team mapped >15,445 square miles
- Aims: improve understanding of features + identify likely sites of deep-sea coral and sponge beds.



1. Ecol. Evol.
DOI: 10.1002/ece3.1411

Marine habitat mapping in support of Marine Protected Area management in a subarctic fjord: Gilbert Bay, Labrador, Canada

Alison Caporaso · Eric Eklund · Stephanie Devillers · Trevor Bell · Philippe Lefebvre · Joe Wroblewski

Received: 19 November 2014 / Revised: 12 July 2015 / Accepted: 6 November 2015
© Springer Science+Business Media D.V. 2015

Abstract This paper presents an approach that allows production of benthic substrate and habitat maps in fjord environments. This approach is used to support the management of the Gilbert Bay Marine Protected Area (MPA) in southeastern Labrador, Atlantic Canada. Multibeam sonar-derived bathymetry, seabed slope, and acoustic reflectance (backscatter) were combined using supervised classification methods and GIS with ground-truthed benthic sampling in order to derive maps of the substrate and ocean benthic habitats. Six acoustically distinct substrate types were identified in the fjord, and three additional substrate types without a unique acoustic signature were recognized. Ordination by multidimensional scaling and analysis of variance generalized these to four acoustically distinct habitat types. Greatest within-habitat (alpha) diversity was found in the coralline-algae-macrotal gravel habitat. Greatest between-habitat (beta) diversity was found in the mangrove Zores 1 and 2, which have the highest level of protection. The study confirmed the zoning plan for the MPA, which was designed to protect spawning and juvenile

fish habitat for a local genetically distinct population of Atlantic cod, afforded highest levels of protection to areas with highest habitat diversity.

Keywords Marine habitat mapping · Alpha-diversity · Beta-diversity · GIS · Atlantic cod · Habitat mapping · Marine protected area · Multibeam · Fjord

Introduction

Marine protected areas (MPAs) are frequently proposed as an approach to marine biodiversity conservation (Roberts et al. 2003). Many MPAs, however, are designed to fisheries enhancement tools with one or a few target species in mind (Sale et al. 2005). This paper examines the degree to which a small coastal MPA that was established primarily to preserve a local population of a common fishery species can also meet goals of general marine biodiversity conservation. We explore this question using acoustically-derived seafloor habitat maps and biodiversity surveys.

Seafloor mapping using multibeam echosounders (MBES) data has become an integral part of coastal marine science, especially geology, geomorphology, and more recently, benthic conservation (Todd and Green 2005). Seafloor mapping has also been used successfully to identify potential habitat for commercial fishery species (e.g. Kroulev et al. 2011) and charismatic deep-sea coral reefs (e.g. Roberts et al. 2005) and other habitats important for biodiversity. Acoustic seafloor mapping can be used for marine biodiversity conservation, in a manner analogous to the use of ecological land use, e.g. land cover (Heier and Shaw 2003) or bioturbation (Anderson and Farnes 2010) in terrestrial biodiversity conservation, based on the observation that consistent

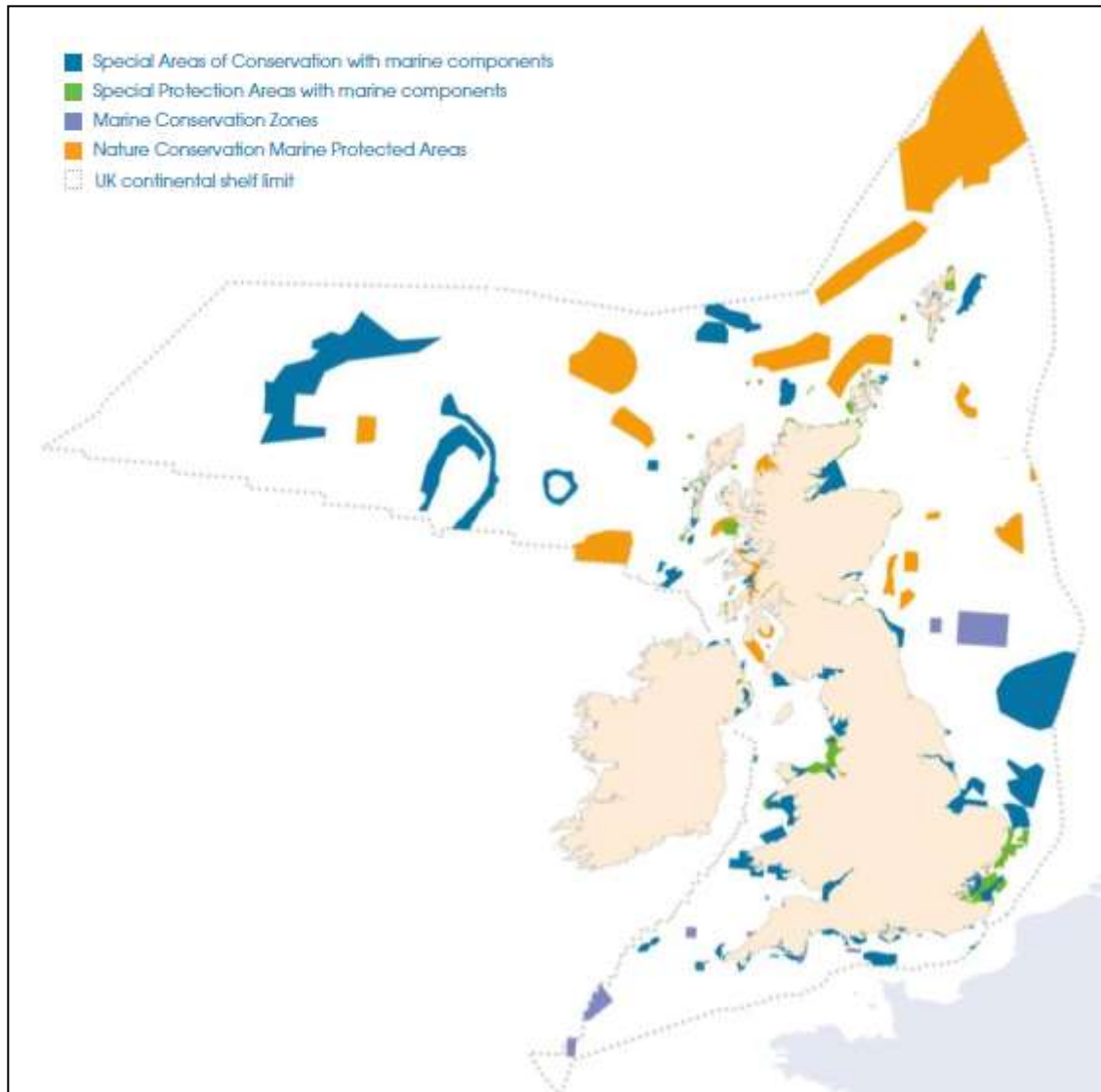
Published online: 24 November 2015

Springer

2) Marine protected areas management

MCCIP Special Topic Report Card 2015

Implications for the implementation of marine biodiversity legislation



16% of UK waters are within marine protected areas including:

- 108 Special Areas of Conservation
- 110 Special Protection Areas
- 29 Marine Conservation Zones
- 30 Nature Conservation Marine Protected Areas



UK marine protected areas are:

- **Within networks**

Individual marine protected areas contribute to broader networks (e.g. Natura 2000, OSPAR).

- **Multiuise**

Marine protected areas are multiuse, rather than closed areas.

- **Feature led**

Across the marine protected area network there are 1,253 designated features, comprising 105 different species and 74 different habitats.

MCCIP Special Topic Report Card 2015

Implications for the implementation of marine biodiversity legislation



What could happen to the features?

- The quality of the feature changes in a marine protected area changes
e.g. cold water coral reefs
- A feature is lost from, or expands within, the UK marine protected area network
*e.g. horse mussel beds (*Modiolus modiolus*)*



MCCIP Special Topic Report Card 2015

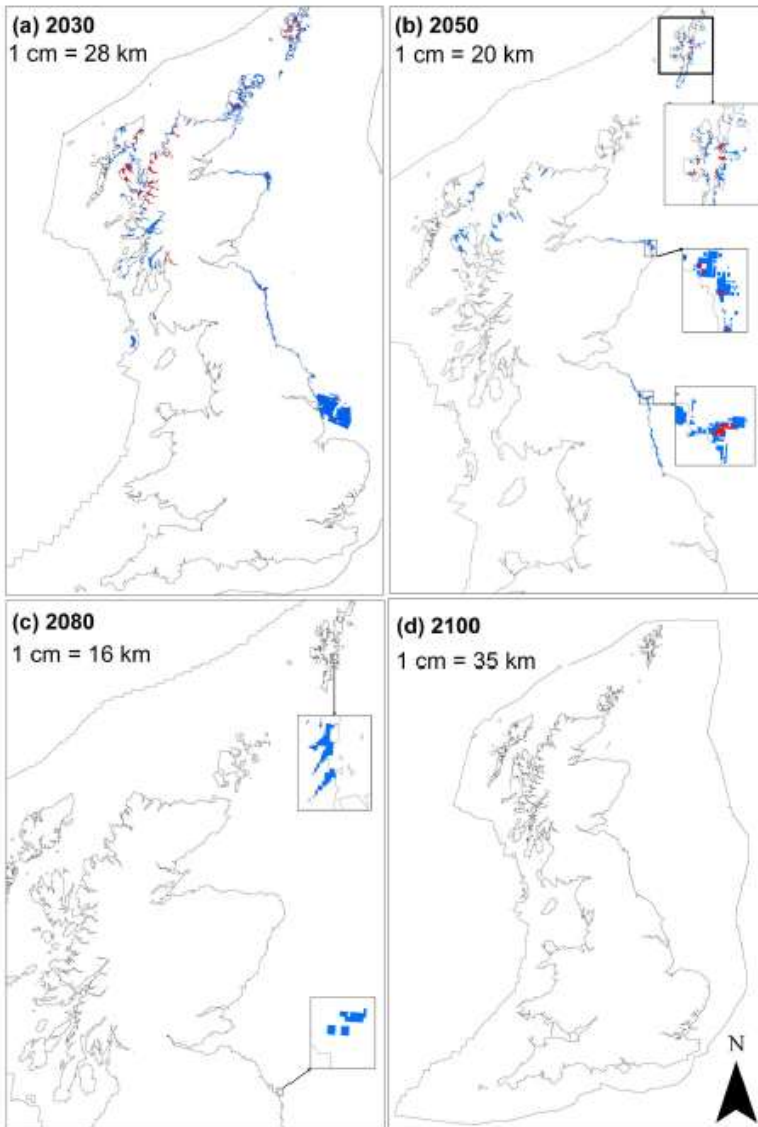
Implications for the implementation of marine biodiversity legislation

Example: Horse mussel beds

- Horse mussel beds designated in 10 marine protected areas.
- Distribution expected to change in response to rising sea temperatures.
- Based on projections, there is a risk that this feature will no longer be represented in the UK marine protected area network by 2100.

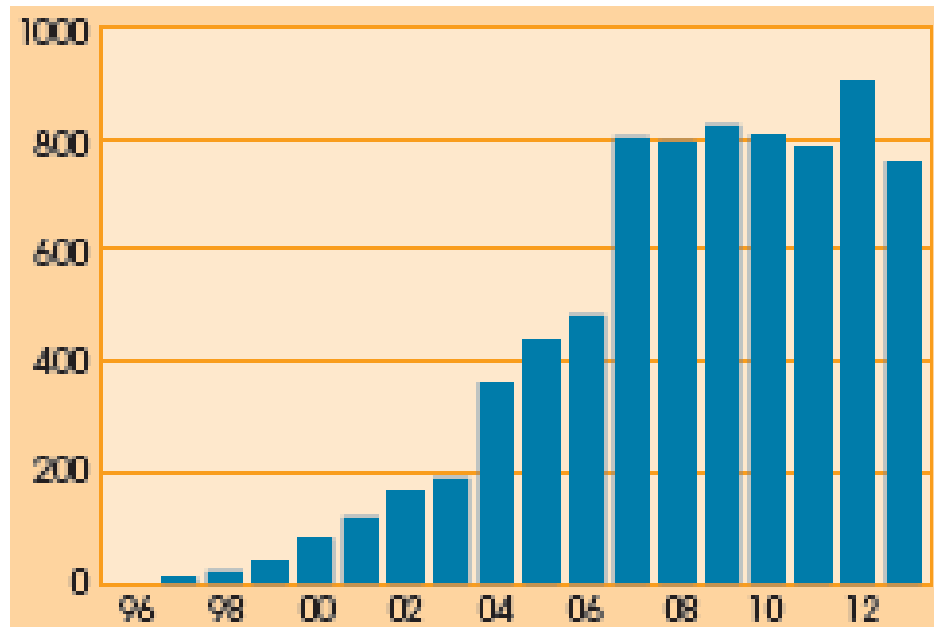


Gormley et al (2013). Predictive Habitat Modelling as a Tool to Assess the Change in Distribution and Extent of an OSPAR Priority Habitat. *PlosONE*. 8 (7)



Impacts on implementation of marine protected area legislation (examples)

- Features designated for protection could expand into other areas*



Number of breeding pairs of little egret in the UK by year. Single record in 1996; >900 by 2012 from all around the UK.

Reproduced with permission from the British Trust for Ornithology.



1 designation in Tamar Estuaries Complex Special Protection Area

What are the management implications for marine protected areas?

- Marine protected area designation orders may need to be revised.

e.g. changes to features within marine protected areas will not be uniform



Example: Small Isles Nature Conservation Marine Protected Area

- Designated for 9 features, including horse mussel beds, northern feather star aggregations on mixed substrata and shelf deeps.
- These features are likely to respond to climate change differently.
- Changes to features may require revision of designation orders.



What are the management implications for marine protected areas?

- Marine protected area designation orders may need to be revised.

e.g. changes to features within marine protected areas will not be uniform

- Marine protected areas may need to be abandoned and/or alternative marine protected areas may need to be designated.

e.g. changes in range and distribution of features

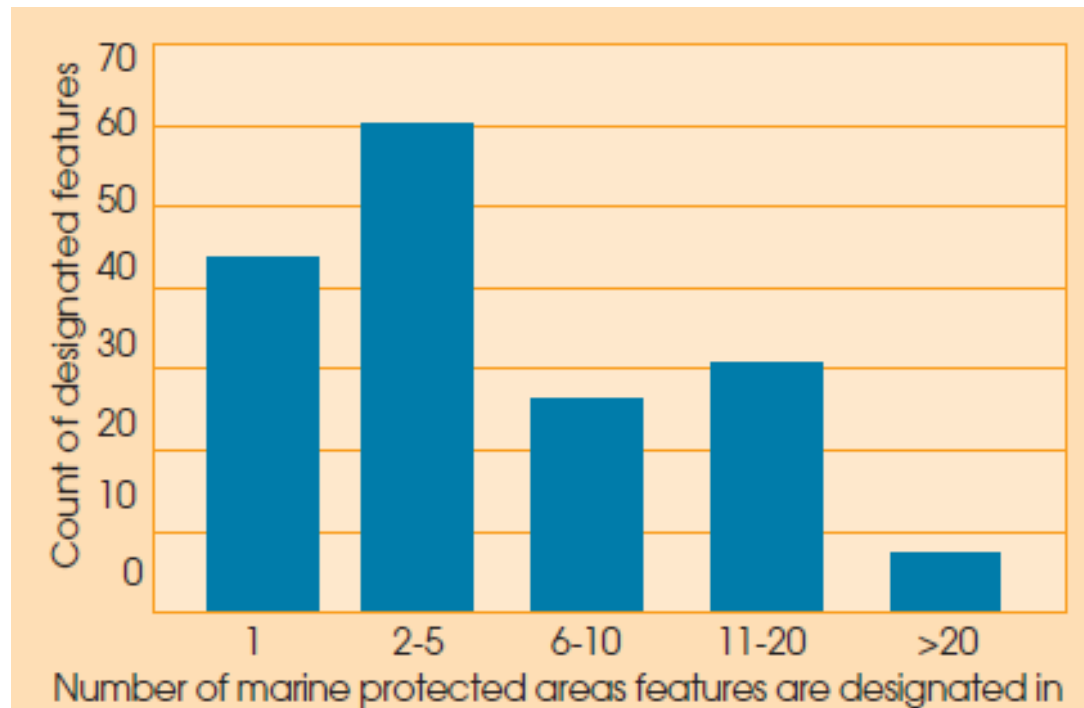


Example: Lesser sandeel

- Sandeels are the only designated feature of Turbot Bank Nature Conservation Marine Protected Area.
- The lesser sand eel (*Ammodytes marinus*) is at risk from climate change and populations may decline in the future with a warming climate.
- This could lead to the loss of this species from marine protected areas, such as Turbot Bank.



- No comprehensive assessment exists of vulnerability of UK protected features to climate change.



- Of the 42 features designated in only one UK marine protected area, a number are known to be sensitive to climate change (e.g. long-snouted seahorses (*Hippocampus guttulatus*), black seabream (*Spondyllosoma cantharus*); Northern sea fan; sponge communities)





MarLIN

The Marine Life Information Network

information on the biology of species and the ecology of habitats found around the coasts and seas of the British Isles

Biodiversity science to underpin the selection of MPAs and management of marine ecosystem

1. What is where?

- Distribution of species and habitats to ensure representativity and replication
- Areas of high biodiversity to prioritise locations

2. Ecosystem structure and function

- Biological traits information for assessing connectivity, adequacy, viability, recovery
- Links from habitats to ecosystem services

3. The human element

- Understanding sensitivity to human pressures to inform levels of protection
- Indicators of change for monitoring

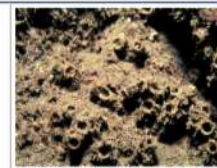
Basic Information	Taxonomy and Identification	General biology	Habitat preferences and distribution	Reproduction and longevity	Sensitivity	Importance
-------------------	-----------------------------	-----------------	--------------------------------------	----------------------------	-------------	------------

Ross worm
Sabellaria spinulosa

Sensitivity

Adult

[Larval sensitivity](#)



Sabellaria spinulosa tubes. Image width ca 2X cm.
Image: Joint Nature Conservation Committee [Image copyright information](#)

Biotope sensitivity assessment

Sensitivity assessment rationale

[Interpretation guide](#) [READ ME](#)

Sensitivity assessment benchmarks

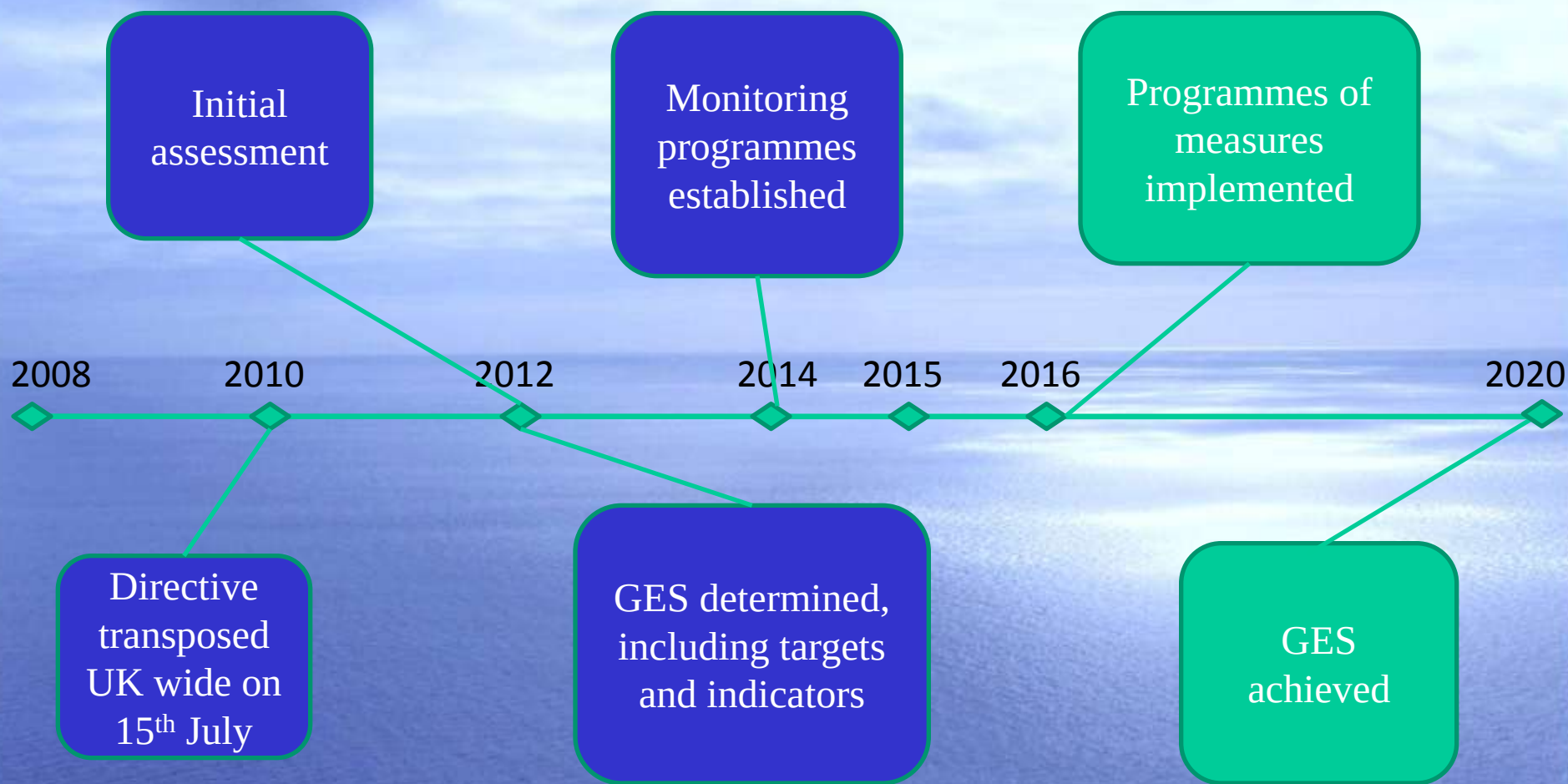
Physical Factors

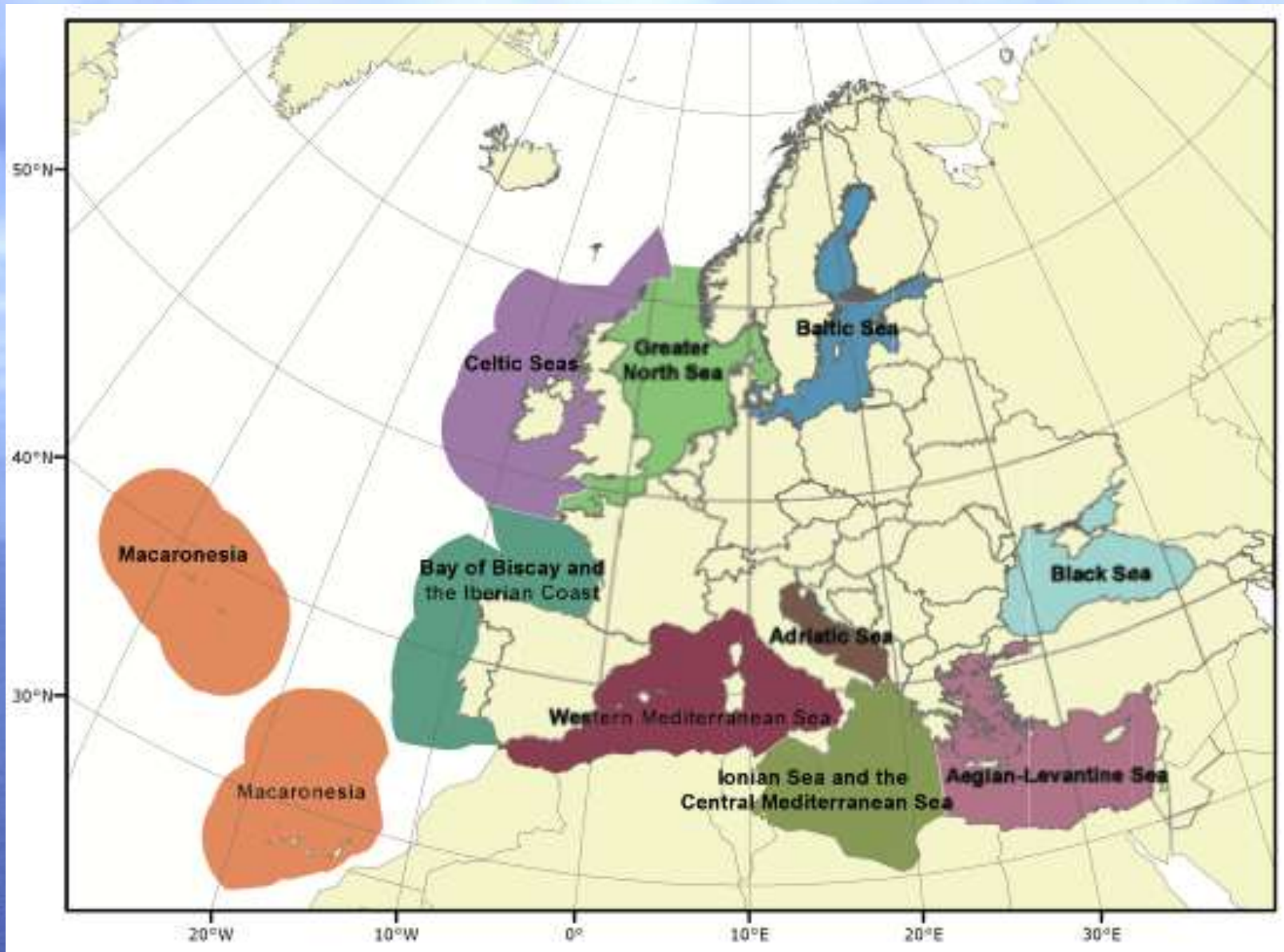
Click factor name to view rationale	Intolerance	Recoverability	Sensitivity	Evidence / Confidence
Substratum Loss	High	High	Moderate	High
Smothering	Low	Immediate	Not sensitive	Moderate
Increase in suspended sediment	Low	Immediate	Not sensitive	Moderate
Decrease in suspended sediment	Intermediate	High	Low	Moderate



3) Marine Strategy Framework Directive overview

- **Came into force 15th July 2008**
- **Environmental pillar of European Maritime Policy.**
- **Aim = achievement by 2020 of ‘Good Environmental Status’ (GES) in the marine environment for all member states.**
- **Annex I of the Directive list 11 descriptors of GES including a number of descriptors explicitly linked to marine biodiversity.**
- **First legislative instrument in relation to the marine biodiversity policy in the European Union.**





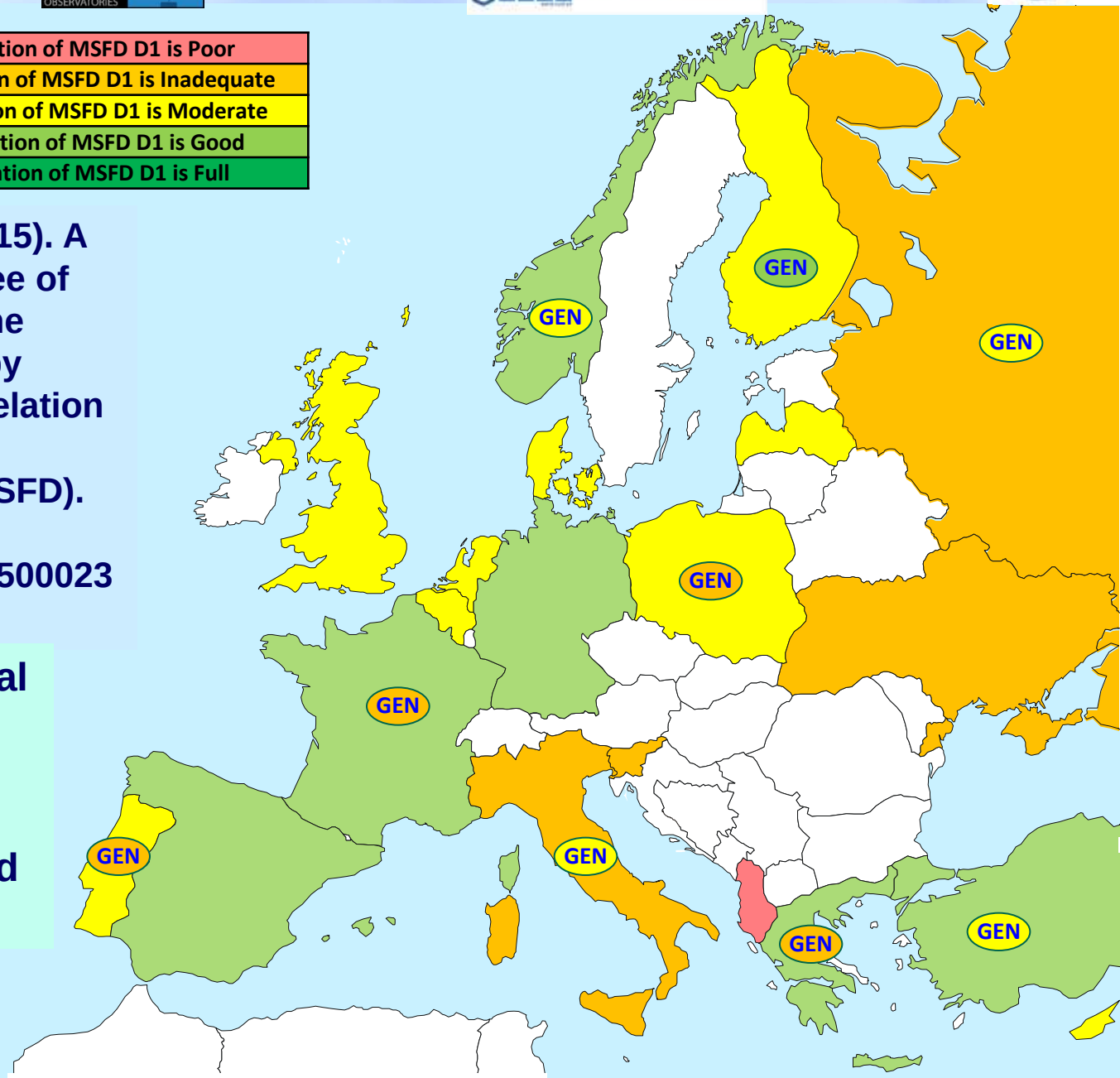
Biodiversity descriptors

No.	Descriptor
1	Biological diversity maintained
2	Non-indigenous species
3	Commercial fish & shellfish
4	Food-webs
5	Eutrophication
6	Sea-floor integrity
7	Hydrography
8	Contaminants
9	Contaminants in seafood
10	Litter
11	Energy, incl. underwater noise

0.0 – 0.8: Implementation of MSFD D1 is Poor
0.8 – 1.6: : Implementation of MSFD D1 is Inadequate
1.6 – 2.4: : Implementation of MSFD D1 is Moderate
2.4 – 3.2: : Implementation of MSFD D1 is Good
3.2 – 4.0: Implementation of MSFD D1 is Full

Hummel, Frost et al. (2015). A comparison of the degree of implementation of marine biodiversity indicators by European countries in relation to the Marine Strategy Framework Directive (MSFD). *JMBA*. doi:10.1017/S0025315415000235.

- degree of ecological relevance
- degree of implementation and operability



Commission Decision – Criteria and indicator classes

D1 Biodiversity

1.4 Habitat distribution

- *Distributional range (1.4.1)*
- *Distributional pattern (1.4.2)*

1.5 Habitat extent

- *Habitat area (1.5.1)*
- *Habitat volume, where relevant (1.5.2)*

1.6 Habitat condition

- *Condition of the typical species and communities (1.6.1)*
- *Relative abundance and/or biomass, as appropriate (1.6.2)*
- *Physical, hydrological and chemical conditions (1.6.3)*

Ecosystem level

1.7 Ecosystem structure

- *Composition and relative proportions of ecosystem components (habitats and species) (1.7.1).*

D6 Ocean Floor Integrity

6.1 Physical damage, having regard to substrate characteristics

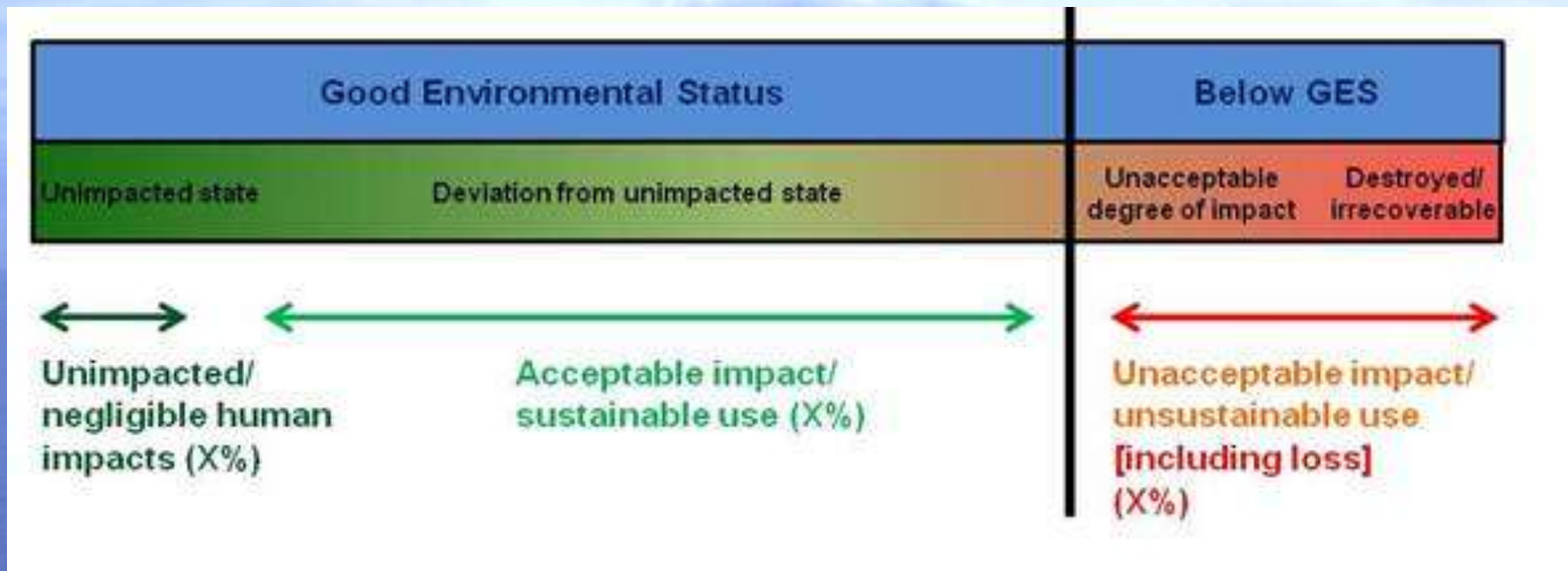
- *Type, abundance, biomass and areal extent of relevant biogenic substrate (6.1.1)*
- *Extent of the seabed affected by human activities for the different substrate types (6.1.2)*

6.2 Condition of benthic community

- *Presence of particularly sensitive or tolerant species (6.2.1)*
- *Multi-metric indexes assessing benthic community condition and functionality, such as species diversity and richness, proportion of opportunistic to sensitive species (6.2.2)*
- *Proportion of biomass of number or individuals above some specified length/size (6.2.3)*
- *Parameters (slope and intercept) of the size spectrum of the aggregate size composition data (6.2.4).*

3) MSFD: Data and target setting

‘good environmental status’ means..... the use of the marine environment is at a level that is sustainable..... ’ (EC 2008)



Source: Moffat et al 2011.

Where do MSFD targets for habitat extent loss / damage come from?

- Ospar: *“The 15% target originates from OSPAR work. It needs further evaluation before the target can be operationalized”*

(MSFD Advice Manual and Background Document on Biodiversity Version 3.2, March 2012).

- Habitats Directive: *“Specific percentage thresholds of change in extent or quality of near shore marine habitats cannot be scientifically supported at this time”*

(Crowe et al, 2011). A framework for managing sea bed habitats in near shore Special Areas of Conservation.

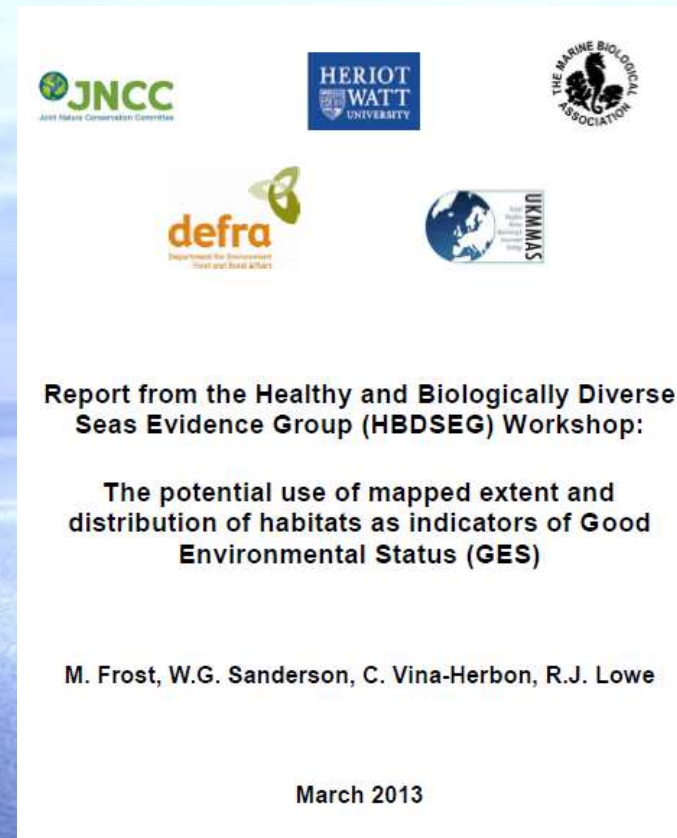
Can habitat extent loss / damage be measured?

- Article 17 example: changes in area of habitats between 2007 and 2013 assessed

Favourable Conservation Status parameter (Habitats Directive)		Commission Decision indicator (MSFD)
Range	=	1.4.1 Distributional range (under 1.4 Habitat distribution)
Area	=	1.5.1 Habitat Area (under 1.5 Habitat extent)
Structure and function	~	1.6. Habitat condition
Future prospects		No equivalent indicator

Source: Beth Stoker, JNCC

- Challenges in comparing reporting periods as:
 - Different and/or improved methods to the mapping of habitats
 - e.g. Annex I sandbanks
 - Different and/ or improved data and information sources
 - e.g. Annex I reefs
 - Different and/or improved habitat definitions
 - e.g. Annex I coastal lagoons



Source: Beth Stoker, JNCC

4) Final thoughts: filling the gaps

- Ensuring efficiency in data use to support policy is vital (QA, Access etc)
- Still huge gaps in marine data / information

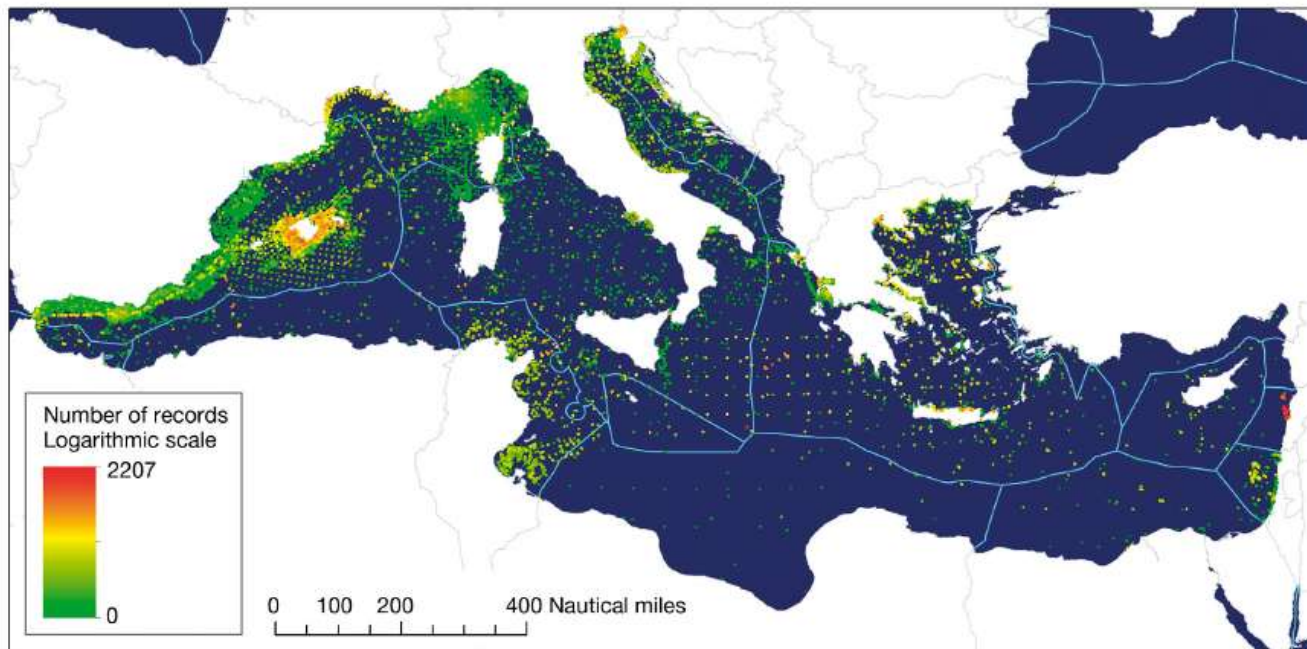


Fig. 4. Number of data records available for the Mediterranean Sea based on the Ocean Biogeographic Information System.
Source: www.iobis.org/mapper

Levin et al (2014). Biodiversity data requirements for systematic conservation planning in the Mediterranean Sea. MEPS: 508: 261–281

4) Final thoughts: filling the gaps

- Ensuring efficiency in data use to support policy is vital (QA, Access etc)
- Still huge gaps in marine data / information



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Marine Pollution Bulletin

journal homepage: www.elsevier.com/locate/marpolbul

Viewpoint

A MSFD complementary approach for the assessment of pressures, knowledge and data gaps in Southern European Seas: The PERSEUS experience

Crise et al (2015). MPB 95: 28–39

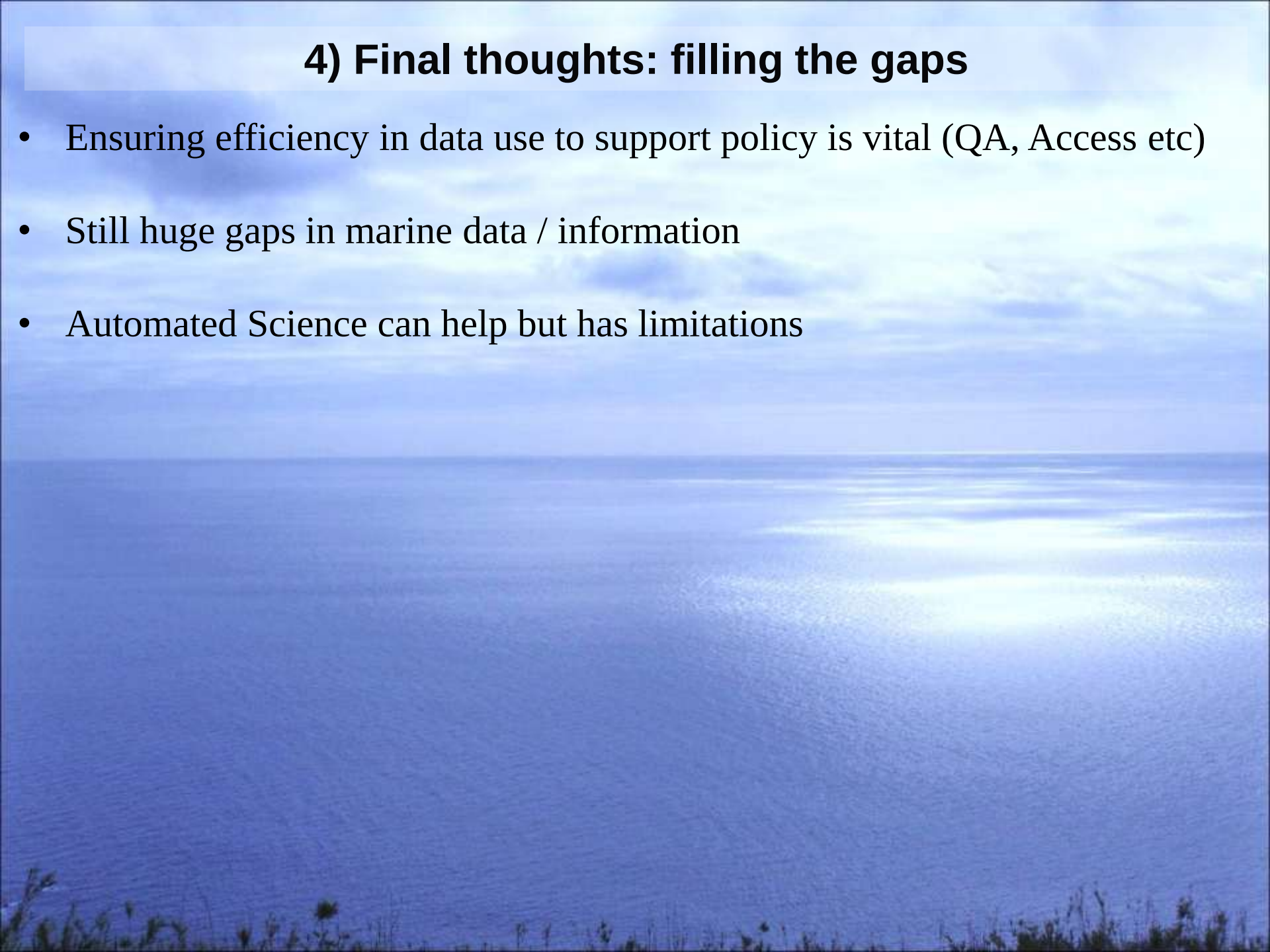
Table 4

Assessment of data availability as derived from the IAs analysis and from the reports produced under PERSEUS. The qualitative scores reflect the grading system based on the prevailing expert opinions.

Data availability in SES per descriptor				
	Descriptor (2008/56/EC)	Initial Assessments	Scientific Evaluation	
		Data availability	Data availability Coastal systems	Data availability Open sea
1	Biological diversity	medium	medium	low
2	Non-indigenous species	low	low	low
3	Commercially exploited fish and shellfish	medium	medium	low
4	Marine foodwebs	low	low	low
5	Eutrophication	high	high	medium
6	Sea-floor integrity	medium	medium	low
7	Hydrographical conditions	low	medium	high
8	Contaminants	medium	medium	low
9	Contaminants in fish and other seafood	medium	medium	low
10	Marine litter	low	low	low
11	Underwater noise and other forms of energy	low	low	low

4) Final thoughts: filling the gaps

- Ensuring efficiency in data use to support policy is vital (QA, Access etc)
- Still huge gaps in marine data / information
- Automated Science can help but has limitations



4) Final thoughts: filling the gaps

- Ensuring efficiency in data use to support policy is vital (QA, Access etc)
- Still huge gaps in marine data / information
- Automated Science can help but has limitations
- Citizen Science can also help but also has limitations



<http://www.ktoo.org/2015/12/01/citizen-scientists-contribute-to-jellyfish-research/>

4) Final thoughts: filling the gaps

- Ensuring efficiency in data use to support policy is vital (QA, Access etc)
- Still huge gaps in marine data / information
- Automated Science can help but has limitations
- Citizen Science can also help but also has limitations

Can Citizen Science be used to deliver policy-relevant marine data?

Marine Theme Objective: Science for Integrated Marine Management

..many years of data collected over wide geographical areas can be required to assess the impact of different pressures (e.g. noise, litter, fishing) on ecosystem health for the Marine Strategy Framework Directive. The funding needed for data collection is considerable and limited, so it is important to look at new cost-effective ways of obtaining and processing data. Citizen science has the potential to add to the marine evidence-base



Questions?

