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Can national management measures achieve good status across international boundaries? - a case study of the Bay of Biscay and Iberian coast sub-region

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Abstract

Coastal countries have historically implemented management measures to improve the status of their national marine waters and little effort has been made to take coordinated actions to improve the status of the entire region or sub-region of which they are part. At the European level, the adoption of the Marine Strategy Framework Directive (MSFD) aims to remedy this deficiency and to promote coordination among countries and an integrated management of the marine environment. The MSFD requires each country to propose and adopt a programme of measures to achieve Good Environmental Status of the regional seas. This study compares the programmes of measures of the three countries of the Bay of Biscay and Iberian coast sub-region – France, Portugal and Spain – presenting a novel use of multivariate analyses using semi-quantitative policy information. Among the four North-East Atlantic sub-regions, this study area was chosen because it showed the lowest levels of coherence during the first phase of the implementation of the MSFD, according to the European Commission assessment. The results show the differences among the three programmes, confirming the difficulties that neighbouring countries face when they are required to adopt common approaches in the implementation of this multi-sectoral Directive. Most of the measures developed in the sub-region address marine biodiversity but this is through a wide

range of actions, covering different pressures and different species/habitats. The integration with other legislation is more similar between Spain and France and differs between these and Portugal. The three countries also recognise the lack of knowledge to perform the economic analysis, in particular in quantifying the costs of and social benefits derived from their measures. It is concluded here that a better use of the regional and European coordination structures is needed to fill the gaps in knowledge and to exchange good practices. More political will is necessary to take action at European and international level to mitigate the impact of those socio-economic activities through joint programmes, for which Community funding is available.

Keywords: Marine Strategy Framework Directive, management measures, regional coordination, marine policy coherence

1. Introduction

The European Union (EU) has played a central role in the field of sustainable development in recent decades with the adoption of more than 200 environmental directives and regulations (Beunen et al., 2009; Boyes and Elliott, 2014). In many cases, these statutes were produced historically in a sectoral and uncoordinated manner and so, in 2007, the European Commission (EC) proposed the Integrated Maritime Policy to improve synergies among sectoral maritime policies (Bagagli, 2015). The Marine Strategy Framework Directive (MSFD; EC, 2008) is an important component of the Integrated Maritime Policy and has been adopted to achieve an integrated approach in the exploitation of marine resources and protection of ecosystems, coordinating between EU Member States at the level of region and sub-region. The framework has been transposed into national legislation by specific strategies which started with an initial assessment of the characteristics of marine waters, including a detailed study of the main pressures and impacts and an economic and social analysis. On the basis of such an assessment, Member States defined what they consider Good Environmental Status (GES) and established a set of targets to achieve it. In 2014, monitoring programmes were established to assess the progress towards GES and, two years later, national programmes of measures (PoM) were published to achieve or maintain GES. These phases will be updated during the second cycle starting in 2018.

Management measures are actions to control the marine activities and prevent state changes and impacts on human welfare (Elliott et al., 2017) and, to be successful, these should be focused on the so-called 10-tenets, namely to be ecologically sustainable, economically viable, technologically feasible, socially desirable or tolerable, morally correct, legally permissible, administratively achievable, politically expedient, culturally inclusive and effectively communicable (Elliott, 2013). This paper compares the PoM of the three countries bordering the Bay of Biscay and Iberian coast sub-region – France, Portugal and Spain – to identify the main differences in the reporting, number of human pressures addressed, spatial coverage (national, regional and European), economic analysis and integration with other policies. This sub-region was chosen as it presented very low levels of coherence during the first phase of the MSFD, especially when setting targets and definition of GES (EC, 2014b; Cavallo et al., 2016).

1.1 Requirements of the Programmes of Measures (PoM)

To improve coherence and comparability among national PoM at European level, the EC developed non-legally binding recommendations to be considered by all Member States when preparing their reports (EC, 2014a). At the regional level, the Regional Seas Convention (RSC) OSPAR (2015)

79 complements that of the EC, to guide countries of the North-East Atlantic towards a more
80 coordinated development of their programmes in line with OSPAR work and existing measures.
81 National reports should indicate the link between the proposed measures and the established
82 environmental targets, one or several qualitative descriptors, pressures and expected effect (EC,
83 2014a). Moreover, Article 13 and Article 5(2) of the Directive require Member States to ensure that
84 their PoM are coherent and coordinated across the marine region or sub-region concerned. The
85 RSC, such as OSPAR, play a key role in coordinating measures, mainly as a platform to exchange
86 information and by developing measures at regional level focused on transboundary issues. Hence,
87 a regional approach under the guidance of RSC should be used to manage the marine environment
88 and to mitigate the impact of those pressures that transcend national borders (e.g. chemical
89 contamination and nutrient enrichment, litter, invasive species, underwater noise) and Member
90 States have to indicate the level of implementation of their measures (national, regional,
91 EU/international) and their effects, positive or negative, at supra-national scale (EC, 2014a).
92 National PoM should include existing measures from other national, EU and international
93 legislative instruments, and new measures, when existing ones are not sufficient to meet the
94 environmental targets and GES. New measures can be identified through consultation with
95 stakeholders, the scientific community, other Member States, and from RSC, or they can even
96 expand or reinforce existing measures (EC, 2014a). Both EC and OSPAR guidelines provide a
97 comprehensive list of policies and agreements that can be integrated within the scope of the MSFD
98 (see also Boyes et al., 2016). For example, the Water Framework Directive (WFD) and the MSFD
99 have several aspects in common and a geographical overlap for the coastal area (Borja et al., 2010).
100 The first cycle of the MSFD is being implemented simultaneously with the second cycle of the
101 WFD and PoM had to be adopted for both directives by December 2015 with the existing WFD
102 PoM being updated while MSFD PoM are developed for the first time (EC, 2014a). In both
103 directives, the measures have to be aggregated under a predefined set of Key Type Measures (e.g.
104 KTM 29 - Measures to reduce litter in the marine environment) (EC, 2014a) and, considering that
105 many of the pressures on the EU seas are land-based, most of the WFD KTM need to be included in
106 the MSFD PoM to achieve or maintain GES and to enable an integrated approach between policies
107 (the complete list of KTM is presented in the Appendix).
108 Member States are also required to carry out an impact assessment of their measures, including a
109 Cost-Effectiveness Analysis (CEA) and Cost-Benefit Analysis (CBA). CEA aims to identify the
110 'least-cost approach' among a number of measures designed to meet the same objective. A CBA
111 evaluates and compares the present value of social benefits and costs of a measure or policy
112 intervention (EC, 2014a). Several authors have discussed the requirements (Bogaert, 2012; Bertram

and Rehdanz, 2013; Bertram et al., 2014; Börger et al., 2016) and limitation of the MSFD economic analysis (Oinonenetal et al., 2016).

The CEA and CBA are required for new measures and, when needed, these analyses should be conducted at regional and sub-regional level (EC, 2014a). The EC recommendation document recognises that a limited knowledge of the functioning of marine ecosystems complicates the assessment of the effects of policy measures on ecosystem services flow and the quantification of the impacts that these have on human well-being (EC, 2014a).

The MSFD text also requires Member States to identify clearly any instances or exceptions in their PoM within their marine waters where the GES cannot be achieved (Article 14) or when actions at EU and international level are necessary to address environmental issues through joint programmes (Article 15). There can be some situations where Member States are not required to take specific steps (Long, 2011; Boyes et al., 2015; Elliott et al., 2015; Saul et al., 2016). For example, "provision should be made where it is impossible for a Member State to meet its environmental targets because of action or inaction for which it is not responsible, (…) or because of actions which that Member State has itself taken for reasons of overriding public interest which outweigh the negative impact on the environment (…)" (Article 14).

2. Methodology

The PoM of Spain and France were published on the EIONET web page[1] (MAGRAMA, 2015; Ministère de l'Environnement, de l'Énergie et de la Mer, 2016a; 2016b). The PoM of Portugal consisted of two reports published in the DGRM web page[2] (MAM, SRMCT, SRA, 2014). The comparative analysis of national reports focused on the requirements described in the previous section, namely: the type of GES descriptors or groups of descriptors (e.g. Descriptor D2-Non-indigenous species), associated KTM, level of implementation (e.g. national, (sub)regional, EU and international), effect at supra-national scale, integration with other EU and international legislation, CBA and CEA. For this study, measures were arranged into six categories relating to particular MSFD Descriptors: Biodiversity (D1, D4, D6), Non-indigenous species (D2), Commercial fish and shellfish (D3), Introduction of nutrients/contaminants (D5, D8, D9), Marine litter (D10) and Other measures, covering Hydrological conditions (D7), the Introduction of Energy (D11) and Transverse measures. Transverse or horizontal measures are considered by the three countries to include

[1] http://rod.eionet.europa.eu/obligations/612/deliveries?id=612&id=612&tab=deliveries&tab=deliveries&d-4014547-p=1&d-4014547-o=1&d-4014547-s=1

[2] https://www.dgrm.mm.gov.pt/xportal/xmain?xpid=dgrm&actualmenu=1470807&selectedmenu=1641550&xpgid=genericPageV2&conteudoDetalhe_v2=1641651

legislative barriers, financial and methodological support, innovation, social and economic aspects, employment, training and others but were not included in the statistical analysis since they cover all descriptors and integrate mostly national legislation. For each category of descriptors, the measures were classified by key type (KTM).

In order to analyse how the three countries integrated existing policies in their PoM, a data matrix was prepared using the Sørensen similarity coefficient considering as samples the categories of descriptors per country and as variables the pieces of legislation (presence-absence data). This similarity matrix was viewed in a 2-dimensional ordination diagram obtained by non-metric multidimensional scaling (nMDS) and submitted to hypothesis testing under the null hypothesis of no significant difference among the countries, using Analysis of Similarities (ANOSIM). ANOSIM produces the statistic R, varying from -1 to +1. R is equal to +1 when all the categories of descriptors from one country are more similar to each other than to any from another country, rejecting the null hypothesis. R approaches 0 when the null hypothesis is true, and significance is assessed by calculating the probability of the observed R within a series of R values obtained by permutation (Clarke, 1993). The nMDS diagram is accompanied by a stress value quantifying the mismatch between the distances among samples measured in the 2-dimensions ordination diagram and in the resemblance matrix. Empirical studies have shown that stress values below 0.1 indicate a good to very good representation of the samples and below 0.2 still corresponds to a useful 2-dimensions representation. All multivariate analyses were performed with PRIMER v7 (Clarke and Gorley, 2015).

3. Results

3.1 Coherence in the information reported

The three programmes differ in the type of recommendations provided, the number of measures proposed for each descriptor and in the way each measure is presented (Table 1). For example, the Portuguese programme lacks relevant information and does not indicate the exact number of measures, if and when the consultation with other Member States took place and the descriptor/s, the spatial coverage, the KTM and the targets associated with each existing measure. The three countries mention the EC recommendations, while France and Spain also consider the OSPAR recommendations. None of the countries referred to exceptions under Article 14 and Article 15.

Table 1

List of the requirements provided in the PoM of France, Portugal and Spain in the Bay of Biscay and Iberian Coast sub-region.

Country	*France*	*Portugal*	*Spain*

Year of publication	2016	2014	2016
Public consultation (national)	Yes	Yes	Yes
Consultation with other countries	Yes	No	Yes
Number of measures in the sub-region	121 (12 new)	85 approx. (11 new)	319 (79 new)
Number of measures per category:			
Biodiversity (D1, D4, D6)	37	19	176
Non-indigenous species (D2),	8	5	26
Commercial fish and shellfish (D3)	14	23	57
Introduction of nutrients/contaminants (D5, D8, D9)	36	13	67
Marine litter (D10)	16	6	63
Other measures (D7, D11)	18	4	24
Transverse (all descriptors)	17	3	22
Descriptor	Yes	Yes *	Yes
Integration with other policies	Yes	Yes	Yes
Number of Spatial Protection Measures	7	1	31
Indication of the level of implementation	Yes*	Yes*	Yes
Number of measures with effect at supra-national scale	39	0	50
KTMs (Key Types of Measures)	Yes	Yes*	Yes
CBA and CEA	Yes**	Yes ***	Yes*

*information provided mostly for new measures; ** CEA only; *** one measure

3.2 Coordination among the three national PoM

There are differences in the scope of the three programmes and their contribution to improve the environmental quality of the sub-region taking into consideration the following aspects for each category: KTM, level of implementation (e.g. national, (sub)regional, EU and international), expected effect at supra-national scale and spatial protection measures (if any).

3.2.1 Biodiversity

This category includes measures covering at least one of these MSFD descriptors, D1-Biodiversity, D4-Foodweb and D6-Seafloor integrity, but they are often associated with other descriptors since all the actions will contribute, directly or indirectly, to achieving GES for marine biodiversity. The details and information provided in each PoM vary among the three countries (Table 1 and 2). Spatial Protection measures were also included in this group, which, in some cases, involve the creation of new protected areas or the expansion of existing ones.

Table 2

Biodiversity related measures and their spatial application. In brackets is given the number of measures proposed.

Country	*KTM*	*Level coordination in implementation*	*Effect at supra-national scale*

France	5 (5) 14 (1) 27 (14) 35 (5) 37 (3) 38 (7) other (5)	Sub-regional (8)	(8)
Portugal	37 (2) 38 (1) Other (2) KTM not provided in many cases	All national/local	not specified for any measure
Spain	14 (14) 20 (25) 27 (2) 35 (23) 37 (53) 38 (31) 39 (4) other (27)	regional (42) EU/International (21)	(24)

At the level of the sub-region, most of the measures are focused '*on the restoration/conservation of marine ecosystems, habitats and species*' (KTM 37) (Table 2), but with differences in the level of detail. For example, Portugal presents 2 new measures which generically refer to the protection of seabirds and sea mammals in national waters, while Spain reports 24 measures where the name of the species and habitats is clearly indicated, together with the related conventions, mainly OSPAR. Another 28 measures are identified in the sub-region to '*reduce biological disturbance in the marine environment from the extraction of species*' (KTM 35). Broader measures are presented in the French reports (e.g. framework for the reduction of by-catch), while Spain is more specific in reporting 12 new measures to address this issue, e.g. risk assessment of the accidental catch of protected turtles, cetaceans and seabirds and elasmobranchs. Moreover, the existing measures included in the Spanish PoM consider six recommendations of the International Commission for the Conservation of Atlantic Tunas (ICCAT), to reduce the by-catching of turtles and birds. France and Spain present new and existing measures on '*research, improvement of knowledge base reducing uncertainty*' (KTM 14). In particular, Spain describes one measure to promote studies aimed at improving the knowledge on species, habitats and the human impacts on marine biodiversity.
The measures vary not only in the details provided but also in their focus. For instance, France mostly focuses on '*regulating dredging activities and sediment management*' (KTM 27) with 14 measures (only 2 from Spain and none from Portugal) while Spain presents 25 measures to '*prevent/control the adverse impacts of fishing*' (KTM 20) (none from Portugal and France).

Among the 232 measures established in the sub-region for the three biodiversity descriptors, Spain specifies that 63 require regional and/or international/EU coordination, France indicates that 8 measures require coordination at level of sub-region and Portugal indicates none (with all measures recognised to require only national or local coordination).

France and Spain identify the measures (respectively 8 and 24) that should have a positive impact in the waters beyond national borders. Most of them aim to reduce the impact of fisheries or consider the benefits of Spatial Protection measures (Table 2).

The three countries describe measures related to the creation or expansion of protected areas (KTM 38 - *Spatial Protection Measures for the marine environment*) and more recently these have been termed Maritime Spatial Planning and are the subject of a recent EU Directive (MSPD, 2014/89/EU). In particular, Portugal introduces a new measure to expand the network of Marine Protected Areas (MPA) covering high sea habitats mainly (OSPAR seamounts) in line with the targets of Natura 2000 and the UN Convention on Biological Diversity. France presents seven existing spatial protection measures in its programme, considering them sufficient to meet the GES under the MSFD. These include, for example, the creation and management of MPAs under national legislation, to complement the offshore Natura 2000 network to protect mammals (great dolphin and harbour porpoise), birds and reefs. Spain includes 31 new and existing spatial protection measures in its programme, including the proposal for the creation of new MPAs and several specific regulations to manage human activities (professional fishery, scientific research, aquaculture, mammal observation, material extraction).

The OSPAR recommendation document provides a list of species/habitats to guide its EU contracting parties towards a coherent development and implementation of management measures. This presents 44 species/habitats that occur in the Bay of Biscay and Iberian coast sub-region, including invertebrates, birds, fish, reptiles and mammals, mostly highly mobile species (Table 3). Among the three countries, Spain reports on specific (existing) measures which refer to these species while France makes a more generic reference to the red list of species of IUCN and OSPAR.

Table 3

The OSPAR list of species/habitats that occur in the Bay of Biscay-Iberian Coast sub-region (region IV according to OSPAR regional classification)

*Category (total number)**	*Species/habitat mentioned in the three PoM*	*Country*
Invertebrates (3)	None (explicitly mentioned)	-
Birds (4)	Balearic shearwater	PT, ES
	Roseate tern	ES
	Iberian guillemot	FR, ES
Fish (19)	Sturgeon	FR, ES
	Allis shad	ES
	European eel	FR, ES

	Portuguese dogfish	ES
	Leafscale gulper shark	ES
	Basking shark	ES
	Cod	FR
	Long-snouted seahorse	ES
	Short-snouted seahorse	ES
	Sea lamprey	ES
	North-East Atlantic spurdog	ES
	Angel shark	ES
Reptiles (2)	Loggerhead turtle	FR, PT,
	Leatherback	FR, PT, ES
Mammals (3)	Blue whale	PT, ES
	Northern right whale	ES
	Harbour porpoise	FR, PT
Habitats (12)	Coral gardens	ES
	Cymodocea meadows	ES
	Deep-sea sponge aggregations	PT, ES
	Lophelia pertusa reefs	ES
	Maerl beds	FR, ES
	Modiolus modiolus beds	ES
	Ostrea edulis beds	FR
	Seamounts	PT, ES
	Zostera beds	FR, ES

* OSPAR (2015)

Abbreviations: FR: France, PT: Portugal, ES: Spain

3.2.2 Non-indigenous species

Nearly 40 measures are described by the three countries to address the impact of invasive species (Table 1), of which 18 are exclusive to this descriptor and the remaining ones are associated with other descriptors (mainly biodiversity). Most of the measures aim '*to reduce the introduction and spread of non-indigenous species in the marine environment and for their control*' (KTM 34). France and Spain include some actions to prevent new introductions by the early detection, and eradication. Portugal does not report specific measures for this descriptor and this pressure is mainly addressed by measures covering all descriptors.

The level of coordination to implement such measures is mainly national and only Spain describes measures that require regional and EU/international coordination (4 in total). Six measures are expected to have a positive effect beyond national waters.

3.2.3 Commercial fish and shellfish

A total of 94 measures are described in the sub-region, 14 of which exclusive to this descriptor (D4), while most are also associated with biodiversity descriptors. It was not possible to establish the exact number of measures of Portugal for this descriptor (approx. 20) and the KTM is specified for 3 measures (which refers to 'KTM 39 - *Other measures'*). France and Spain present 10 and 12 measures respectively '*to reduce biological disturbance in the marine environment from the extraction of species, including incidental non-target catches*' (KTM 35). For example, these

include a new certification system for fisheries products and the development of new practices for commercial fisheries to limit their impacts on marine ecosystems. Two new measures are presented by Spain: *"Permanent cessation of the activity of 569 fishing boats in the period 2016-2020"* and *"national funding for a temporary stop to fishing"*. Some measures from Portugal also aim to reduce and readjust the fisheries pressures. Only Spain includes 24 existing measures '*to prevent/control the adverse impacts of fishing and other exploitation/removal of animal and plants*' (KTM 20). Most of the measures are in line with OSPAR requirements, covering particular species (e.g. Red tuna, some sharks). Portugal also describes in detail actions to recover the population of sardine and hake (according to ICES recommendations).

All French and Portuguese measures require national coordination, while Spain specifies that 16 measures require an international/EU and regional level of coordination. France and Spain consider that 14 of their measures should have a positive impact at supra-national level.

3.2.4. Introduction of nutrients and contaminants

A total of 116 measures were identified, covering the three descriptors. In particular, 4 exclusively address Eutrophication (D5), 27 Contaminants (D8) and 4 Contaminants in seafood (D9). These are grouped into 24 types of KTMs, including '*construction or upgrades of wastewater treatment plants*' (KTM 1), '*reduce nutrients and pesticides pollution from agriculture*' (KTM 2 and 3), and '*phasing-out or reduction of emissions, discharges and losses of priority (hazardous) substances*' (KTM 15). France and Spain also respectively propose 15 and 10 measures '*to reduce contamination by hazardous substances in the marine environment from sea- and air- based sources*' (KTM 31) and another 14 each '*to reduce sea-based accidental pollution*' (KTM 32). The level of coordination is mainly at national and/or local levels. Spain implements 16 measures at regional level (i.e. supra-national) with reference to OSPAR in many cases, and France indicates one measure requiring sub-regional implementation. Eleven measures are considered to have an effect at supra-national level, mostly related with the pollution caused by maritime activities and port operation.

3.2.5. Marine litter

Of the 85 measures addressing contamination by litter, 58 are exclusive for this descriptor and the others are linked with descriptors addressing contamination and biodiversity. The three countries present measures on '*research, improvement of knowledge base reducing uncertainty*' (KTM 14) on litter. In particular, Portugal includes two new measures; one aims to develop a database to characterise marine litter on the coast (e.g. the quantity, the distribution, the composition and the

304 origin). This agrees with OSPAR requirements and is the basis of litter data collection. Another
305 measure aims to determine bioindicators of litter, including litter content in fish and birds. Portugal
306 also has developed a measure for the collection and management of litter in ports and to
307 reduce/prevent the illegal discharges of contaminants (solid and liquid) in the ocean. Spain has
308 developed similar measures to improve knowledge of occurrence, specifically for microplastics.
309 Spain and France describe '*specific actions to reduce litter*' (KTM 29), respectively 48 and 11,
310 although the strategies differ between the two countries. While France places more effort on
311 promoting the responsible management of litter waste from fisheries and aquaculture (nets and
312 shellfish), on mitigating the effects of dredging operations and another measure on regulating
313 shipping recycling, Spain reports several actions to reduce litter from fisheries and aquaculture,
314 namely the improvement of port structures for the reception and management of litter. Spain has
315 also developed new measures aimed at cleaning and surveillance of beaches and the seabed
316 (including the project *Fishing for Litter*), at reducing the production of plastic and microplastic
317 from source and new sanctions for abandoning and release of solid waste.
318 Spain has 14 measures addressing marine litter requiring international and regional coordination
319 while France has one measure requiring sub-regional implementation. The other measures of the
320 two countries and all the measures of Portugal have national or local level implementation. The
321 actions requiring regional implementation include *Fishing for Litter* initiative, the creation of
322 'beach guardians' and the OSPAR regional Action Plan for the prevention and management of
323 marine litter in the North-East Atlantic. Spain and France specify that 25 of their measures should
324 have a positive effect at supra-national level.
325
326 *3.2.6. Other measures*
327 Other measures (46) are described to address the changes in Hydrological conditions (D7) and the
328 Introduction of energy (D11). Nine of them are exclusive to D7 and seven to D11 and the remaining
329 ones include also biodiversity and eutrophication/contaminants descriptors. The KTM of Spain and
330 France are mainly focused on '*reducing the inputs of energy, including underwater noise, to the*
331 *marine environment*' (KTM 28) and aimed at '*research, improvement of knowledge base reducing*
332 *uncertainty*' (KTM 14) on underwater noise. For descriptors D7 and D11, 5 measures require a
333 regional implementation (mainly related with the OSPAR recommendations) and 3 might have a
334 positive effect at supra-national level. The implementation level of transverse measures is in 4 cases
335 at the EU/regional level and in 10 cases they are aimed at a positive effect at the supra-national
336 level.
337

3.3 Economic analysis

The economic evaluation of national PoM varied greatly across the sub-region. Portugal reports the output of a CBA in a qualitative manner for a single measure (and has no CEA), '*Establishing Marine Protected Areas in the Portuguese marine waters*', admitting that there is poor current scientific knowledge about the deep sea ecosystems and the biophysical changes due to human activities. These make it unable to assess the economic value of the trade-offs between different ecosystem services which can be influenced by the establishment of oceanic MPA.

In contrast, France presents only the CEA for new measures and, even in this case, the lack of scientific knowledge on the social costs associated with their implementation means that this analysis is again mainly qualitative. For example, for the measure '*to improve National Coherence in the Regulation of Recreational Fishing*', the CEA limits state that "*there will be a low cost of implementation and a potentially high effectiveness*". In general, all new actions reported by France are considered to be cost-effective, with a focus on the financial costs of the implementation but ignoring the external cost associated with environmental consequences of the measures.

Spain presents more detailed CBA and CEA for all new measures, but the analysis is again qualitative, with a focus on financial implications, and neglecting the wider social impacts due to their effects on marine and coastal ecosystem services. The costs and benefits of each measure are based on expert judgement. For example, the average cost of measures addressing biodiversity is considered low, while their level of effectiveness is considered from moderate to high. The benefits for nine economic sectors considered to be affected by biodiversity related measures are stated to be very low, except for the tourism sector. The analysis therefore focuses on the recreational benefits, but ignores the contribution of biodiversity to support provisioning, regulating and other (non-recreational) cultural ecosystem services. Moreover, the cost of measures adopted to reduce the impact of a fishery is considered moderate to high, where four of them have a very high cost (corresponding to investments of more than 2 million euros). Their effectiveness is considered moderate or high, with three measures assessed to have a very high effectiveness (those concerning the ceasing/temporary halt to fishing). In general, this group of measures is considered cost-effective and, since social benefits are neglected, market-based benefits for the economic sectors are considered very low.

3.4. Integration with relevant legislation

The three countries report on the relevant policies, agreements and conventions associated with new and existing measures. Figure 1 shows an ordination analysis of the various categories of descriptors per country according to the pieces of legislation mentioned in each measure.

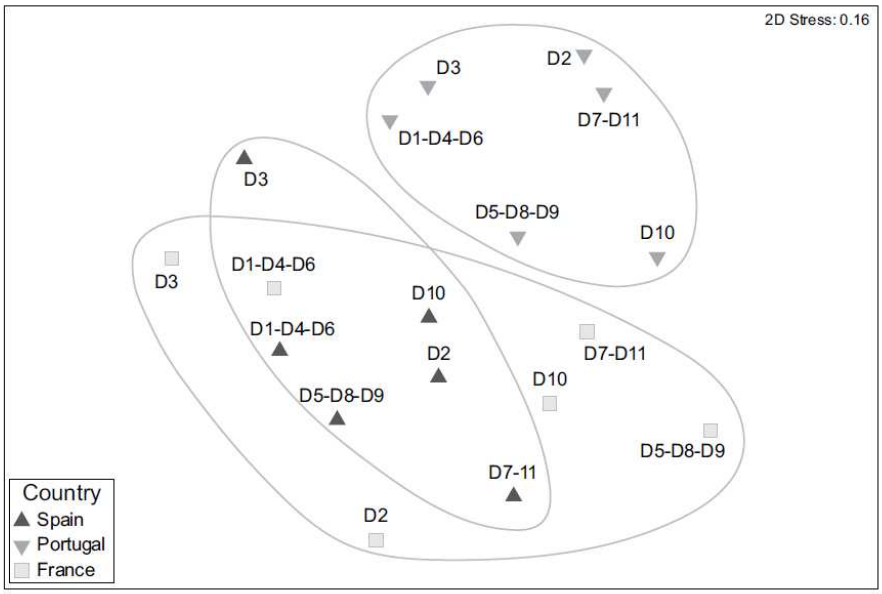


Figure 1
Two-dimensional nMDS showing the distribution of the categories of descriptors per country. The greater the distance among the same category (e.g. D10 – Litter), the less agreement there is among the pieces of legislation mentioned by each country. The circles around each country were drawn by hand to highlight the higher similarity between France and Spain and their separation from Portugal.

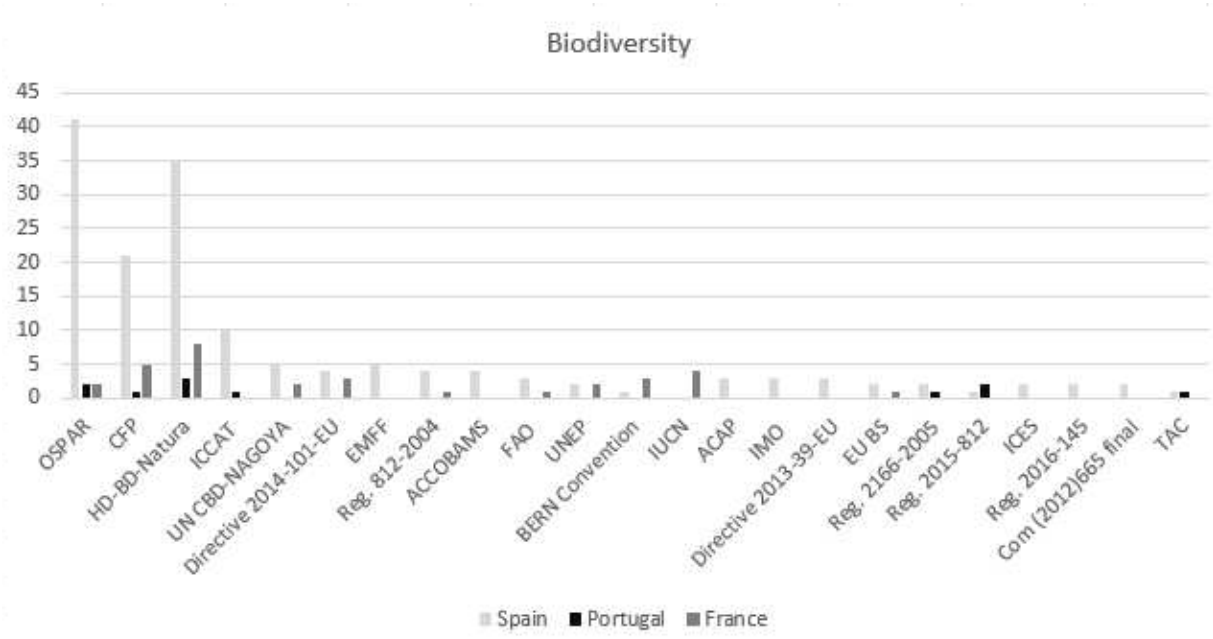
Portugal lists approximately 20 pieces of legislation and agreements in its PoM which are repeated among groups of descriptors (mainly OSPAR and Common Fisheries Policy) while Spain and France integrate approximately 50 different instruments each. In the ordination analysis, Portuguese measures are grouped, while those of Spain and France overlap. In agreement, ANOSIM rejected the null hypothesis of no significant differences in the type of legislation integrated for each category of descriptors by the three countries (p-value <0.01). The pairwise comparisons indicate no statistical significant difference between Spain and France, whereas both differ significantly from Portugal (p-value <0.01) (Table 4).

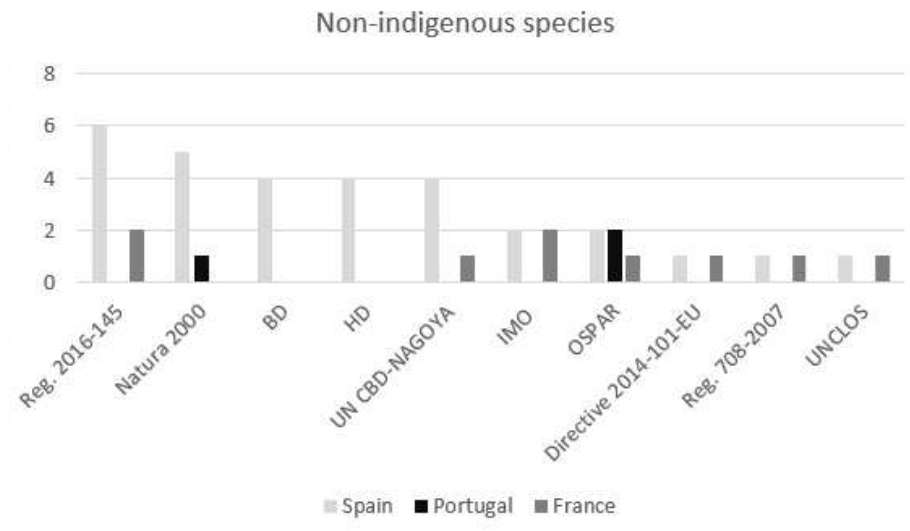
Table 4

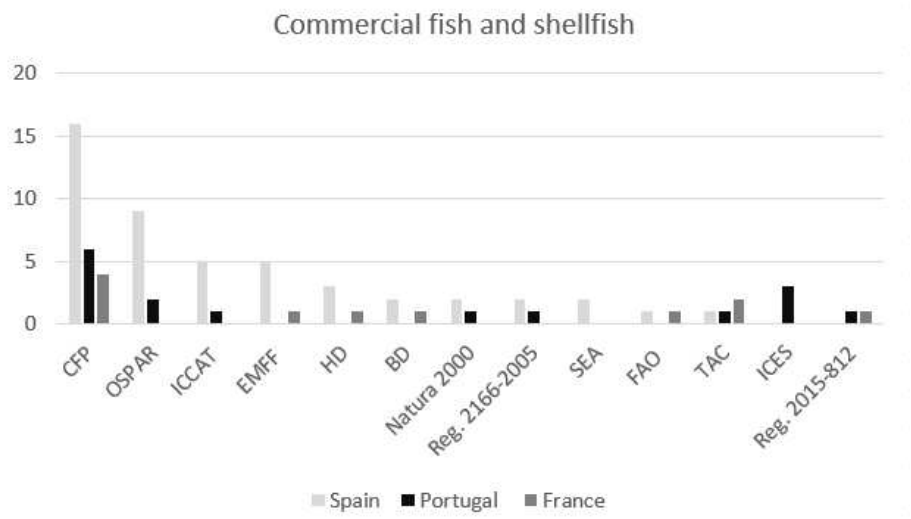
ANOSIM global test and pairwise comparisons R –values with associated significance testing the null hypothesis of no difference among the countries in respect to the pieces of legislations mentioned in their PoM.

Type of test	*R-value*	*P value*
Global Test	0.423	< 0.0003
Pairwise tests among groups:		
Spain, Portugal	0.639	0.002
Spain, France	0.089	0.199(ns)
Portugal, France	0.511	0.002

For the biodiversity descriptors, the OSPAR, Common Fisheries Policy and the Habitats Directive-Birds Directive-Natura 2000 Directives are the most cited by the three countries but with differences in the number of measures (e.g. Spain integrated OSPAR work in 41 measures while Portugal and France mentioned OSPAR in two) (Figure 2). Other legislation related to the protection of biodiversity is rarely mentioned despite its important role, e.g. the United Nation Convention on Biological Diversity (7 measures of Spain and France), the Bern Convention (3 measures of Spain) and the EU Biodiversity Strategy (3 measures of Spain and France).






Commercial fish and shellfish
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CFP
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ICES
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Spain
Portugal
France

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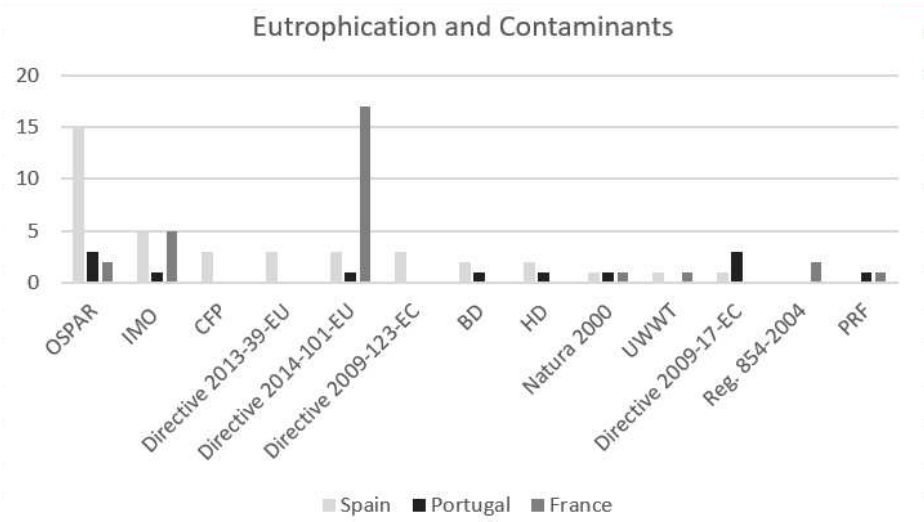
Eutrophication and Contaminants
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CFP
Directive 2013-39-EU
Directive 2014-101-EU
Directive 2009-123-EC
BD
HD
Natura 2000
UWWT
Directive 2009-17-EC
Reg. 854-2004
PRF
Spain
Portugal
France

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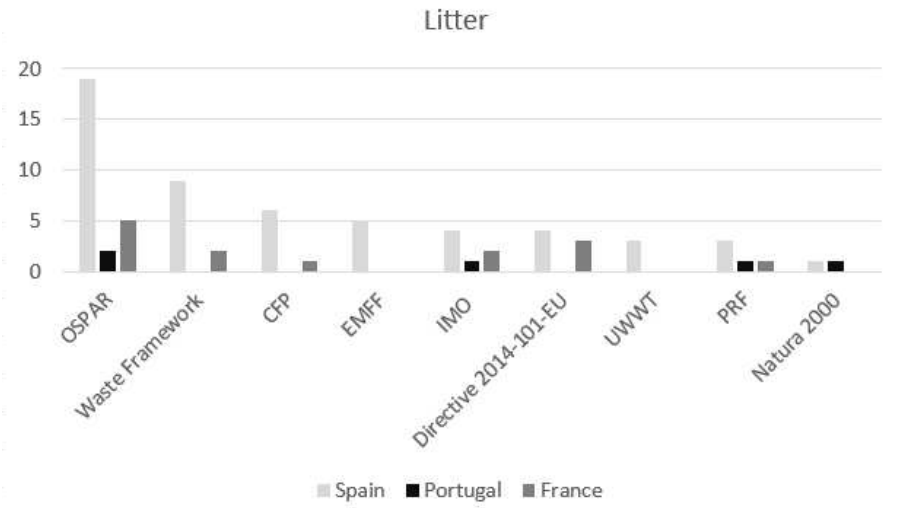
Litter
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Natura 2000
Spain
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France

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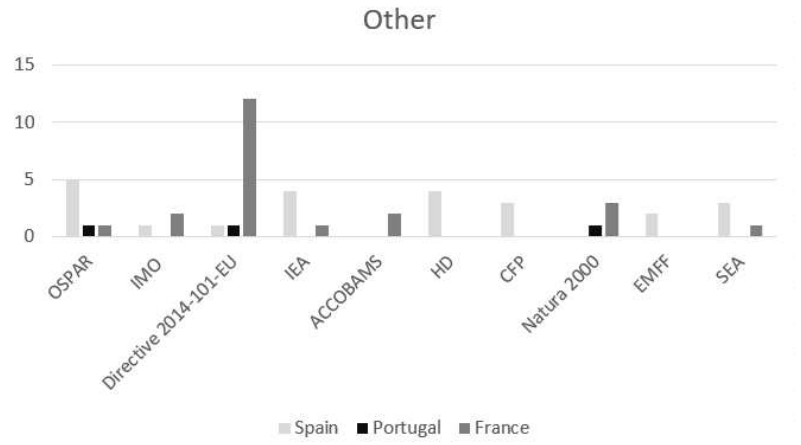

406

407

408 **Figure 2**
409 Main pieces of legislation integrated in the three PoM for each category of descriptors.
410 Abbreviations: ACAP: Agreement on the Conservation of Albatrosses and Petrels; ACCOBAMS: Agreement on the
411 Conservation of Cetaceans in the Black Sea Mediterranean Sea and Contiguous Atlantic Area; Bern Convention:
412 Conservation of European Wildlife and Natural Habitats; BD: Birds Directive; CFP: Common Fisheries Policy (and
413 amendments); Com (2012)665 final: Action Plan for reducing incidental catches of seabirds in fishing gears; Directive
414 2009-17-EC establishing a Community vessel traffic monitoring and information system; Directive 2009-123-EC on
415 ship-source pollution; Directive 2013-39-EU regards priority substances in the field of water policy; Directive 2014-
416 101-EU: framework for Community action in the field of water policy (amending WFD); EU BS: EU Biodiversity
417 Strategy; EMFF: the European Maritime and Fisheries Fund; FAO: UN Food and Agriculture Organization; HD:
418 Habitats Directive; ICCAT: International Commission for the Conservation of Atlantic Tunas; ICES: International
419 Council for the Exploration of the Sea; IEA: Environmental Impact Assessment (and amendments); IMO: International
420 Maritime Organization; IUCN: International Union for Conservation of Nature; PRF: Port Reception Facilities
421 Directive; Reg. 708-2007: concerning use of alien and locally absent species in aquaculture; Reg. 812-2004: laying
422 down measures concerning incidental catches of cetaceans in fisheries; Reg. 854-2004: controls on products of animal
423 origin intended for human consumption; Reg. 2015-812: as regards the landing obligation; Reg. 2016-145: on invasive
424 alien species; Reg. 2166-2005: measures for the recovery of the Southern hake and Norway lobster stocks in the
425 Cantabrian Sea and Western Iberian peninsula; SEA: Strategic Environmental Assessment (and amendments); TAC:
426 Total allowable catches; UN CBD: Convention on Biological Diversity-Nagoya Protocol; UNEP: UN Environmental
427 Protection; UNCLOS: UN Convention on the Law of the Sea; UWWT: Urban Waste Water Directive; Waste
428 Framework (Directive).
429

430 ## 4. Discussion

431 The analysis of the PoM from Spain, Portugal and France showed that there are differences in the
432 reporting, scope of the measures, level of implementation, economic analysis and in the integration
433 with relevant legislation.

434 ### *4.1. Differences in reporting*

435 Member States are allowed a certain degree of flexibility, under the principle of subsidiarity (i.e.
436 taking decisions at the most local level) in developing their programmes but the information must
437 be reported in a consistent and comparable format (EC, 2014a). Using the EC and OSPAR
438 guidelines as reference, more similarities were found between Spain and France, which both
439 provide the most relevant requirements, while important information was missing in the Portuguese
440 PoM. In particular, the descriptor/s and the KTM are not explicit in most of the existing measures,
441 but it is assumed that these will contribute to improving the environmental status of Portuguese
442 national waters. These differences in reporting could be explained by the fact that Portugal

published its programme almost two years (at the end of 2014) before Spain and France as well as the other countries of the North-East Atlantic region (EIONET Report Obligation Database); this has reduced the possibility to learn from others and to fill eventual gaps in information that needed to be reported. Notably, this may have prevented Portugal consulting with the other countries, but allowed Spain and France to cooperate thus enabling a closer reporting and similarity between them.

The lack of information and the differences in the reporting between the countries prevent an understanding of environmental issues in common in the sub-region and that are better tackled by concerted actions. For example, Spain reports on single measures for the protection of species and habitats of the OSPAR list, while France and Portugal mention few species on this list. Differences were also noted in the economic analysis, where Spain gives more detail based on the judgment of experts on the effectiveness, the financial cost and benefits for some sectors considered to be affected by new measures. There was also disagreement between the information provided in the reporting sheets and document from each country, for example in the number of measures or legislation. Moreover, the level of detail provided for each measure varied within national programmes. In fact, some measures are well described while others, mainly existing measures, are reported with little detail and with no clear insight of how they will contribute to the achievement of GES. Loizidou et al. (2017) analyse the PoM of the Mediterranean Sea region and report the same difficulties in comparing national reports and identifying common measures because of the wide range of approaches adopted by the Member States. The same weaknesses are identified by the EC in its recent analysis of the WFD PoM of all the EU countries (EC, 2015b). It highlights the delay by certain countries in submitting the report and "*the lack of detail in defining the measures concretely which may lead to insufficient action to tackle the specific problems of the water bodies and hinder the achievement of the WFD at local level*" (EC, 2015b).

Activities to fill gaps in other phases of the directive, e.g. targets and monitoring, are by definition not measures (EC, 2014a), but rather a means of determining if measures are effective; however, they have been reported by the three countries under different descriptors. For example, the French measure '*Limiting the point and diffuse source of pesticides*' or the Spanish measure '*Improve the knowledge of aspects related to marine pollution*' are more likely to be considered targets.

The differences identified in this analysis highlight the need for a more coherent reporting exercise as the first step for the coordinated implementation of environmental policies and this could be easily achieved if countries are willing to discuss their gaps in knowledge and to exchange information from the early phases of the development of their programmes.

4.2. Differences in scope and spatial application

In the sub-region, measures address all the qualitative descriptors of the MSFD but with differences on the number and focus of the measures. Most measures are directly linked to biodiversity and focused either on the restoration and conservation of biodiversity, through the creation or extension of Marine Protected Areas, or on mitigation of the impact from maritime activities, such as fisheries. It is apparent that the countries have had more than 2 decades of producing measures in relation to the Habitats Directives and that these have then been reported as biodiversity measures. Other actions, aimed at reducing contamination, eutrophication and litter in the ocean, will also contribute to achieve GES for biological diversity. However, measures related to biodiversity are highly variable: from a very general reference to the protection of seabirds and sea mammals to the specific mention of particular species/habitats, associated pressures and international conventions (mainly OSPAR and ICCAT). The integration with the existing lists of threatened species/habitats distributed at sub-regional and regional level is particularly important in this phase of the MSFD since coordinated measures are needed to improve their status effectively. This has been confirmed by a recent survey to the Marine Strategy Coordination Group showing that 70% of participants (mostly Member States representatives) agreed on the need to adopt a common list of the most vulnerable species/habitats/communities within each region which should include and go beyond the lists of other relevant pieces of legislation and agreements (such as the Habitats and Birds Directives and OSPAR) (Cavallo et al., 2017).

The wide differences in the KTM for each group of descriptors are not necessarily a negative aspect, especially when the impact of a given pressure is mitigated through a wide range of actions among countries. For example, the impact of fisheries on biodiversity is addressed by reducing by-catches, by decreasing the number of fishing boats, temporary cessation, and establishing minimum capture size for several species. Similarly, the impact of contaminants and nutrients has been addressed in very different ways: from reducing sea-based pollution to land-based discharge controls. Such a mixture of approaches may be the result of the specific characteristics of each country and not the lack of political will to develop coordinated measures. It is suggested here that when one or more local pressures may have an impact on the waters beyond national borders (e.g. introduction of nutrients and contaminants from land) they can be jointly addressed by countries through different measures. When several pressures act at the same time in a given area, their impact can be cumulative, producing synergistic or antagonistic effects (Griffith et al., 2011, 2012; Elliott et al, 2017). For this reason, it is valuable to determine the interaction between different measures, whether they can increase or decrease each other's effects (Judd et al., 2015). For example, Uusitalo et al. (2016) demonstrated that nutrient reductions produce more positive effects

511 in the marine ecosystem than the decrease of fishery effort and that the greatest benefit is reached
512 by joint reductions of these two pressures.
513 Despite this, in some cases, coherence among measures is needed to tackle those pressures that have
514 effects on the waters of the entire region, such as contamination from ships, or to protect threatened
515 species that have a wider distribution. In these cases, countries should set coherent limits, e.g. in the
516 catches of red tuna, or to integrate targets of other legislation. For example, oil tanker accidents,
517 such as the Erika (France, 1999) and Prestige (Spain, 2002), received public attention at an
518 international level to find a solution for minimising the risks related to such events (Vanem et al.,
519 2009). As a consequence, several international regulatory and preventive measures have been
520 developed to reduce the environmental risk associated with oil spills related to either operation or
521 tank design (Vanem et al., 2009).
522 Although France and Spain have developed several measures that need to be implemented at sub-
523 regional and regional level, none of the countries examined here identified any issue that require
524 actions at EU and regional level and that cannot be tackled by measures adopted at national level
525 (Article 15). Unfortunately, the interconnected nature of the seas, and the public good nature of
526 many of the marine ecosystem services and their resulting societal benefits (Turner and Schaafsma,
527 2015), makes it difficult for the States to remedy environmental problems unilaterally (e.g. Sandler
528 2004, Touza and Perrings 2011, Perrings, 2016). Similar levels of ambition in the implementation
529 of marine policy need to be reached by each country (Borja et al., 2010) and each have to contribute
530 to the achievement of the GES of the (sub)region.
531
532 *4.3. Differences in policy integration*
533 The analysis of policy integration showed that a wide range of international, regional and EU (and
534 national) legislation was mentioned by the three countries in their programmes. However, the
535 implicit types of legislation were more similar for Spain and France than for Portugal. Differences
536 were also observed in the number of times a given legislative instrument was mentioned. There
537 were major similarities in the integration of policies regarding D3–Commercial Fish and shellfish,
538 where the three countries integrate measures from the CFP and using TAC (Total Allowable Catch
539 limits) while Spain and Portugal also considers the work under ICCAT and the OSPAR
540 Commission. Despite the relevant role of ICES in fisheries management, only Portugal integrates its
541 related measures. On the other hand, there were many differences in the type of legislation
542 integrated with the descriptors for Contaminants (D8, 9) and Eutrophication (D5). This could be due
543 to the fact that, for instance, Portugal focuses more on preventing sea-based pollution caused by
544 ships (integrating mainly European legislation), Spain focuses more on the reduction of nutrients

545 and contaminants from land and air (integrating mainly OSPAR work) while France addresses the
546 reduction of nutrients from agriculture (integrating Directive 2014-101-EU amending the WFD).
547 However, in some cases, even when countries address the same type of pressure, e.g. reduction of
548 nutrients from land or protection of a given species, different pieces of legislation have been
549 integrated.
550 The same selective approach was identified during the definition of GES, establishment of targets
551 and initial assessment (EC, 2014b; Cavallo et al., 2016). We previously (Cavallo et al., 2016)
552 suggest that this could be due to the Member States having a limited knowledge of the real
553 connection between such policies and the MSFD. In recognition of this, either the EC (EC, 2014a)
554 or OSPAR (OSPAR, 2015) provided recommendations with a comprehensive list of the pieces of
555 legislation whose work should be considered in the MSFD PoM. This analysis has shown that some
556 important pieces of legislation have not been mentioned by the three countries. For example, for the
557 biodiversity descriptors, the ACCOBAMS is mentioned only by Spain, while the CITES
558 Convention only by France; for Eutrophication, the UWWD is mentioned only in two measures by
559 France and Spain.
560 The purpose of the MSFD is to integrate and not to replace other related environmental legislation
561 (Boyes and Elliott, 2014) and several pieces of legislation are clearly mentioned in its text regarding
562 the protection of biodiversity – CBD, HD and BD – and the prevention of pollution – UNCLOS,
563 WFD and others. When implementing the future steps of the MSFD and other multi-sectoral
564 policies, Member States should put more effort into integrating the objectives of other legislation.
565 The consequences of the failings in policy integration could be duplication of work, contradicting
566 policy outcomes and a waste of economic resources (Maier, 2014).
567 Although achieving the final objective of GES is strongly linked to the success of other EU (van
568 Leeuwen et al., 2012; Ounanian et al., 2012) and international legislation, in some cases, existing
569 measures are not sufficient to reach this objective and it is valuable to identify and resolve gaps and,
570 where necessary, take further actions (Boyes et al., 2016).
571
572 *4.4. Gaps in the economic analysis*
573 The EC, through its Common Implementation Strategy Working Groups, provides support to
574 Member States to exchange information and to identify best-practices in the application of CBA and
575 CEA (EC, 2015a). However, there are no specific guidelines indicating the methodologies to be
576 adopted for the economic valuation of marine ecosystem services (EC, 2015a) and, as a result, the
577 approaches used to perform this analysis vary among the three Member States. Moreover, the lack
578 of biophysical information on the type and magnitude of the change in ecosystem services derived

579 from the implementation of measures, limits the economic analysis on how society can benefit from
580 them (see also Börger et al., 2016; Balvanera et al. 2017). Economic analysis presented for the three
581 countries was mainly qualitative, and often lacks the social considerations that should characterise
582 environmental decision making. Similar considerations are made in the analysis of the PoM of
583 Finland, the UK and Spain (Börger et al., 2016) and Germany (Bertram et al., 2014). In particular,
584 comments provided by the Spanish public participation process recognise that the benefits of the
585 programme of measures would have been much higher if a broader range of ecosystem services
586 would have been considered in the analysis (MAGRAMA, 2015).
587 Global biodiversity continues to decline, undermining ecosystem functions and thus compromising
588 the flow of ecosystem services and societal benefits (De Groot et al., 2012; Turner and Schaafsma,
589 2015). Environmental appraisal tools, such as cost-benefit analysis and cost-effectiveness, are
590 valuable to raise awareness about the importance of marine ecosystems and biodiversity to policy
591 makers (Atkinson and Mourato, 2008; De Groot, et al., 2012; Turner and Schaafsma 2015; Elliott et
592 al., 2017). This approach is recommended to make a more effective use of limited financial
593 resources, identifying where protection is economically most important and can be achieved at
594 lowest cost (Crossman and Bryan, 2009; Crossman et al., 2011, Borja and Elliott, 2013). Assessing
595 the benefits of a sustainable use of marine resources is necessary to determine the economic loss
596 caused by the degradation of ecosystems for the maritime industry sectors (Borja et al., 2017). A
597 coordinated effort at regional and EU level could help countries to address these gaps and
598 eventually to establish the compensation that should be paid for the loss of biodiversity and the
599 related services provided. The UNEP project, TEEB for Ocean & Coasts, aims to bridge the gaps in
600 knowledge on ocean ecosystem services and functions and to draw attention to the social non-
601 market benefits deriving from the maintenance of marine biodiversity[3]. Despite the increase in
602 economic valuation as a tool for decision making, when dealing with the management of
603 environmental resources, it is especially difficult to value financially the cultural value of
604 ecosystems due to social complexity, diversity, spiritual significance on human health and well-
605 being (Bryce et al., 2016; Turner and Schaafsma, 2015; Elliott et al., 2017).
606 It is emphasised here that Member States included in the same marine region and/or sub-region
607 should cooperate to identify those measures that are more effectively implemented in collaboration
608 with other countries (under Article 15) to share the costs and the benefits of such actions. To
609 promote this kind of actions, the EC provides financial support through the European Maritime and
610 Fisheries Fund (EMFF) and Cohesion Funds (CIS, 2013).
611

[3] http://www.teebweb.org/areas-of-work/biome-studies/teeb-for-oceans-and-coasts/

5 Concluding Remarks

The Programmes of Measures developed by the three countries of the Bay of Biscay and the Iberian coast sub-region are, in general, difficult to compare and the lack of relevant information does not allow a complete understanding of how each programme will contribute to achieve the GES of the sub-region. Despite that, the numerical analysis here has used a novel method to compare these PoM and show that Spain and France are similar whilst both differ from Portugal in the implementation. Among the three countries, Spain has mainly adopted a sub-regional (or even regional) approach to the development of its national programmes. This specifies the level of implementation of new measures, their effect at supra-national level and includes almost 60% of the OSPAR list of species/habitats that have sub-regional distribution and that require coordinated and wider-scale effort in order to be protected.

As yet, and as shown here, the countries have only recently proposed their programmes while at the same time (in 2017-2018) repeating the assessment of Good Environmental Status (the first was performed in 2012). Therefore it is not yet possible to show whether those PoM have had a desired effect of improving the GES or causing it to be achieved. This could be regarded as a failing of the timing of the MSFD actions whereby the production of the PoM, the monitoring strategies and the second assessment of GES have all overlapped. Such an analysis of the efficacy and effectiveness of the PoM will therefore be required at the time of the 3rd quality assessment (probably in 2024). As the 2020 deadline for GES is approaching, it is shown there that more effort is required by all the parties involved in the implementation of this Directive to achieve this goal. As such it is concluded that:

- countries need to make better use of the EC and OSPAR coordination structures and the guidelines they provide, to improve coherence in the programmes of measures and in all the phases of the MSFD;
- more political willingness is essential to identify common gaps in knowledge and exchange best practices, even with the Member States of the other regions and sub-region;
- Member States need to work together to develop joint programmes of measures to address transboundary issues and to perform joint economic analysis where costs and benefits can be shared across the sub-region.

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