Horizon scan of priorities for European marine pilot accounts

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Table of Contents

Executive Summary

There is a need to advance methodologies for constructing natural capital accounts of Europe's marine environment in order to facilitate tracking toward Target 2, Action 5, of the *EU Biodiversity Strategy to 2020* (COM(2011) 244) as well as objectives established by the 7th Environmental Action Programme of the EU (7EAP).

To this end, this document provides an initial horizon scan of the current state of knowledge, as well as priorities to inform a high-level feasibility assessment of marine accounts in Europe. Challenges and opportunities were identified through a review of the scientific, legislative and technical documents and interviews/discussions with experts, conducted between May and June 2017.

A review of the current state of knowledge on the marine environment within Europe revealed a large quantity of knowledge and ongoing work to understand European seas at the assessment level. However, the underlying spatial data required to construct marine ecosystem accounts were often found to be heterogeneous and incomplete at the regional level, deriving from different spatial scales and periods and lacking the temporal continuity to assess changes in accounts consistently (see Section 1).

There is a consensus that certain regional-level initiatives, namely from the OSPAR and HELCOM Regional Seas Conventions, have advanced effectively. Data/information from these Conventions, including OSPAR's upcoming Intermediate Assessment 2017 and HELCOM's just released first version of the *State of the Baltic Sea* Report[1], could therefore support the testing of pilot methodologies for marine accounts. These approaches could later be applied elsewhere as suitable data in other regions become available.

A workshop on developing EU marine ecosystem accounts, held in Paris from the 10th to the 11th March 2017, included a rapid assessment of challenges and options for marine ecosystem accounts, focusing primarily on data and account design. Specific challenges included strengthening our understanding of the link between ecosystem assets and ecosystem services, and improving the classification of marine ecosystem services in the CICES framework. Two of the recommendations from the workshop have been/are being taken forward. Firstly, cumulative impact indexes developed through the DEVOTES and HARMONY projects are being used to inform a seafloor integrity account (aligning with MSFD Descriptor 6 and Target 2, Action 5 of the *EU Biodiversity Strategy to 2020*). Secondly, the representation of marine ecosystem services in the CICES framework has been strengthened. Recent advances have also included the development of a concept and methodology for 'Pilot European fish accounts,' aligning with MSFD Descriptor 3 and Action 5 under Target 2 of the *EU Biodiversity Strategy to 2020* (see Piet et al., 2017) (see Section 2).

[1] Available at: http://helcom.fi/news/Pages/First-version-of-the-HELCOM-%E2%80%98State-of-the-Baltic-Sea%E2%80%99-report-is-now-available.aspx.

Marine accounts would contribute to multiple policy objectives, including several under the *EU Biodiversity Strategy to 2020* and the 7EAP as well as to MSFD implementation by supporting assessments of the cost of marine ecosystem condition and the implementation of an ecosystem-based approach to marine spatial planning and management. The methodological protocols for these accounts would ideally align with the criteria and indicators selected for 'good environmental status' and with the *Mapping and Assessment of Ecosystems and their Services* (MAES) reports. These accounts would also have application across several directives and Regional Seas Conventions, such as OSPAR and HELCOM (see Section 3).

EU-level marine ecosystem accounts could be developed using a three-tiered approach. Firstly, in the short-term, initial "headlines" could be established that identify the current state of knowledge related to the account of interest. Secondly, 'technical' marine accounts that use global and/or European datasets or indicators on critical aspects of the feature's condition (and/or pressures and impacts) could be initiated. Lastly, in the long-term, 'proper' marine accounts derived from national datasets and/or targeted monitoring programmes could be developed, with full stock and service accounts that draw from a portfolio of sources of spatial and contextual information.

Progress is being made towards aligning MSFD reporting requirements with other EU legislative frameworks, such as those of the WFD, the Habitats Directive and Birds Directive, the Common Fisheries Policy and IMAP. Thus, natural capital accounting methodological protocols should also consider how alignment across related data collection processes could be used to facilitate the tracking of long-term ebbs and flows of natural capital stocks and associated ecosystem services (see Section 4.1).

Beyond data drawn from EU policy frameworks, there are opportunities to supplement knowledge required to construct marine natural capital accounts with expertise, data and methodologies applied elsewhere, including from direct measurements (e.g. condition metrics) and indirect (e.g. pressures; associated species) proxies. These external data could help to test methodological approaches and to define requirements for constructing basic and more advanced accounts in a pragmatic fashion (see Section 4.2).

Upcoming work and European calls for data in 2018/2019 are expected to release additional data and information that could be used to inform marine accounts. Collaborations with Regional Seas Conventions could also help to contribute to the development of ecosystem extent and condition protocols and facilitate experimental accounts for specific case studies in these regions.

These case studies could also help to assess opportunities to integrate European marine natural capital pilot accounts. For instance, the horizon scan raised one approach to assessing the feasibility of tracking different parameters related to EU-level marine pilot accounts, as outlined in the document *Background material for KIP INCA proposal for EU-level*

account on ecosystem condition[2] (see 'Priority actions'). Suggestions for "quick wins" include dissolved oxygen, pH, and 'Good Environmental Status' (MSFD), yet others that align with the proposed feasibility criteria may be identified through such an assessment.

Thus, priority actions moving forward include developing methodological approaches for ecosystem extent and condition for a selection of case studies, to be defined based on data availability. This process would include identifying a set of features of interest for the ecosystem(s) considered and associated ecosystem goods and services, as well as consideration of the thresholds of condition required to deliver these services and how these might be measured using available data (see Section 4.3). Furthermore, a more in-depth assessment of the feasibility of proposed accounts could also be conducted (see Annex 1 for suggested approach).

[2] Available at: https://projects.eionet.europa.eu/ecosystem-capital-accounting/library/reflections-ecosystem-condition/eu-ecosystem-condition-account_current-methodological-proposal_eea_5-january.

1 Approach

A horizon scan of our current state of knowledge with regards to the state of and pressures facing Europe's seas, as well as upcoming work to strengthen this understanding, was conducted between May and June 2017. The aim of the horizon scan was to inform a high-level feasibility assessment of proposed parameters for pilot marine accounts. The horizon scan builds on previous work, including the outcomes of an EU workshop on building marine ecosystem accounts, an EEA paper containing *Background material for KIP INCA proposal for EU-level account on ecosystem condition*[3], and a preliminary methodology developed for one set of integrated ecosystem accounts, as part of Target 2, Action 5[4], of the EU Biodiversity Strategy to 2020 (COM(2011) 244).

Challenges and opportunities were identified through a review of the scientific, legislative and technical documents[5], discussions with experts at the European Environment Agency, and attendance at the "Workshop for the delineation of subdivisions relevant for MSFD [Marine Strategy Framework Directive] assessments/reporting in the Mediterranean Sea". The workshop was held in Rome from the 21st to the 22nd of June 2017 with representatives from Mediterranean Member States, DG Environment, the EEA, the European Topic Centre for Inland, Coastal and Marine Waters (ETC/ICM), and Information and Communication Regional Activity Centre (InfoRAC). The results of interviews with marine experts from the Directorate General (DG) of the Environment, which were conducted by The Institute for European Environmental Policy (IEEP) as part of Focal Area 4 ("Integrating NCA into decision making processes, policy support, and other related issues"), were also used to inform the horizon scan.

We would like to thank the following participants for sharing their time and expertise in contributing to the horizon scan:

- **Jan-Erik Petersen,** Team Leader Natural Capital Accounting, EEA
- **Irene Del Barrio Alvarellos**, Project Manager – Marine Data and Reporting, EEA
- **Eva Royo Gelabert**, Project Manager – Marine Ecosystem Accounts, EEA
- **Johnny Reker**, Project Manager, EEA
- **Cécile Roddier-Quefelec**, Project Coordinator, ENI SEIS Support Mechanism South, and European neighbourhood policy activities – Mediterranean area cooperation.

[3] Available at: https://projects.eionet.europa.eu/ecosystem-capital-accounting/library/reflections-ecosystem-condition/eu-ecosystem-condition-account_current-methodological-proposal_eea_5-january.

[4] Target 2, Action 5: "Map and assess the state and economic value of ecosystems and their services in the entire EU territory; promote the recognition of their economic worth into accounting and reporting systems across Europe."

[5] For example, the *Background material for KIP INCA proposal for EU-level account on ecosystem condition* and the report from the *Developing an EU Ecosystem Accounting System: Focus on marine ecosystems (10-11 March 2016)* workshop. Available via: https://projects.eionet.europa.eu/ecosystem-capital-accounting/library/

The author would also like to thank to the participants of the workshop for the delineation of subdivisions relevant to MSFD assessments, and to Günther Hörmandinger (DG Environment) and Camino Liquete (DG Environment; previously, Joint Research Council) for their contributions concerning the EU policy utility of marine accounts, and data or initiatives that could inform these accounts.

2 State of knowledge

While there is a significant body of knowledge established with regards to Europe's seas, the contributing information is heterogeneous and incomplete, with existing data and information (e.g. assessment products, such as status classifications) deriving from different spatial scales and time frames. The recent *State of Europe's Seas* (EEA, 2015) and *Marine messages: Our seas, our future – moving towards a new understanding* (EEA, 2014) reports provide helpful overviews of the current state of knowledge with regards to Europe's seas, yet also highlight areas of limited data/information coverage, particularly in the Mediterranean and Black seas. This is *inter alia* because the widest ranging EU legislation for the protection of Europe's sea, the Marine Strategy Framework Directive (MSFD), is in its first implementation cycle, and the first set of EU-level reported information on the state of Europe's seas (within that cycle) was rather poor (see below).

However, for issues such as the status of fish stocks or the condition of the seafloor (from fishing pressure), where other EU policy—in this case, the Common Fisheries Policy (CFP)—drives data collection, the availability of EU-level data/information is better. Nevertheless, the current situation with regard to the availability of EU-level data/information linked not only to EU legislation/policy implementation but also to other EU-level initiatives makes it challenging to obtain one complete picture of the state of Europe's seas at any single point in time, and to assess change in natural capital and associated ecosystem services. However, it is hoped that the second set of EU-level reported information on MSFD implementation, due October 2018, would improve this situation (see below).

As acknowledged and used in the above-mentioned EEA reports and confirmed through several EEA-led activities in the context of the MSFD EU-level Common Implementation Strategy (CIS), there is a consensus that certain regional-level initiatives, namely from the OSPAR and HELCOM Regional Seas Conventions, have advanced effectively. This relates to existing monitoring programmes (i.e. CEMP and COMBINE), clearly defined reporting guidelines (e.g. Environmental Reporting Format version 3.2) and cross-border cooperation, which have strengthened data coverage and assessment quality[6]. Data/information from these Conventions, including OSPAR's upcoming Intermediate Assessment 2017 and HELCOM's just released first version of the *State of the Baltic Sea* Report[7], could therefore support the testing of pilot methodologies for marine accounts that could be applied elsewhere as suitable data in other regions become available. On the other hand, the Integrated Monitoring and Assessment Programme (IMAP) of the Mediterranean Sea under the Barcelona Convention was noted to be in earlier stages of development with regards to data collation and reporting, and is likely to be informed by progress achieved in

[6] Noted by Johnny Reker (EEA), Camino Liquete and Günther Hörmandinger (DG Environment), as well as by those attending the "Workshop for the delineation of subdivisions relevant for MSFD assessments/reporting in the Mediterranean Sea."

[7] Available at: http://helcom.fi/news/Pages/First-version-of-the-HELCOM-%E2%80%98State-of-the-Baltic-Sea%E2%80%99-report-is-now-available.aspx.

strengthening the MSFD reporting process[8]. Collectively, this would help to harmonise the reporting requirements and encourage accounting approaches that are applicable across Europe.

A workshop on developing EU marine ecosystem accounts, held in Paris from the 10th to the 11th March 2017, included a rapid assessment of challenges and options for marine ecosystem accounts, focusing primarily on data and account design. Specific challenges included strengthening our understanding of the link between ecosystem assets and ecosystem services, and improving the classification of marine ecosystem services in the CICES framework. Two of the recommendations from the workshop have been/are being taken forward: cumulative impact indexes developed through the DEVOTES and HARMONY projects are being used to inform a seafloor integrity account, and the representation of marine ecosystem services in the CICES framework has been strengthened. While modelling ecosystem services was proposed as one option, this was primarily a means of filling gaps in knowledge and could not fully replace *in situ* data. While modelling provides an option for projecting changes in the availability of ecosystem services, this is frequently limited to assessments of habitat suitability in the absence of cumulative impacts. The workshop concluded that data availability was sufficient to begin with the construction of marine ecosystem accounts, recommending that efforts focus on case studies as a first step.

The first round of EU-level reporting of the Article 8 'Initial Assessments' under Article 12 of the MSFD demonstrated large variations in information availability, parameters used, and scales at which these were applied. There was also limited coherence and comparability across reported data/information by each Member State (i.e. limited data/information is comparable and can be used at the EU-level) (ETC/ICM, 2014). The results yielded a high amount of 'unknown', 'not reported,' and/or 'not assessed' outcomes (e.g. 80% 'unknowns' for marine biodiversity at the EU-level)[9], and the underlying data used to compile the assessments were very often not made available[10]. Where information exists, it is also difficult to obtain spatially explicit datasets disaggregated to the level required for account development. Thus, there is no spatial support for the bulk of the MSFD assessment information available at the EU level, which are assessment products, i.e. status classifications. This is an issue when developing accounts, as these tend to favour the detection of spatially explicit changes in ecosystem condition. Thus, the immediate priority to support the development of EU-level accounts is to obtain the spatially-supported datasets from each Member State that underpin the MSFD assessment products reported at the EU level[11].

[8] Discussed by David Connor (DG Environment) and member state representatives at the "Workshop for the delineation of subdivisions relevant for MSFD assessments/reporting in the Mediterranean Sea."

[9] From EEA (2015), cited in the workshop report from *Developing an EU Ecosystem Accounting System: Focus on marine ecosystems (Paris, 10-11 March 2016).*

[10] Noted by Johnny Reker and Irene Del Barrio (EEA).

[11] Noted by Eva Royo Gelabert (EEA).

Despite these challenges, the process has initiated the steps required to implement comprehensive monitoring across Europe's seas, complementing other existing policy frameworks and Conventions. The two-year "Support Mediterranean Member States towards coherent and Coordinated Implementation of the second phase of the MSFD" (MEDCIS) project, supported by DG Environment, seeks to improve the management of and access to data and information used in the MSFD assessments, in accordance with the INSPIRE Directive and Article 19(3)[12]. The INSPIRE Directive and Article 19(3) stipulate that Member States shall provide the data and information used to derive the assessments submitted under Article 8 of MSFD reporting. The MSFD CIS Working Group on Marine Data (TG DATA) has also developed and is currently operationalising a long-term strategy for the implementation of Article 19(3)[13]. Hence, it is expected that additional datasets that could support the development of marine accounts are likely to be mobilised through MSFD over the next two years.

On the other hand, the European Neighbourhood Instrument (ENI) Shared Environmental Information System (SEIS) South[14] and the Horizon 2020 ODYSSEA ("Operating a network of integrated observatory systems in the Mediterranean Sea") projects are seeking to collaborate with countries in the southern Mediterranean to increase spatial coverage of marine data across data-limited regions. These would have direct application to multiple policy frameworks (e.g. MSFD and IMAP) and potential relevance to the development of marine accounts.

While marine natural capital accounts are still in the early stages of development, there have been recent advances towards developing methodological approaches, in particular several initiatives linking to relevant MSFD objectives but tested using EU-level data reported from other policies, such as the CFP. A recent study by the EEA and its European Topic Centre on Inland, Coastal and Marine waters (ETC/ICM) developed a concept and methodology for, as well as tested, 'Pilot European fish accounts', with a focus on accounting for the CICES[15] provisioning service 'wild animals and their outputs' (see Piet et al., 2017). This account aligns with the MSFD Descriptor 3 and Action 5 under Target 2 of the EU Biodiversity Strategy to 2020. In addition, a concept and methodology for, as well as

[12] Art 19. 3. "With regard to access to environmental information, Directive 2003/4/EC of the European Parliament and of the Council of 28 January 2003 on public access to environmental information (1) shall apply. In accordance with Directive 2007/2/EC, Member States shall provide the Commission, for the performance of its tasks in relation to this Directive, in particular the review of the status of the marine environment in the Community under Article 20(3)(b), with access and use rights in respect of data and information resulting from the initial assessments made pursuant to Article 8 and from the monitoring programmes established pursuant to Article 11. No later than six months after the data and information resulting from the initial assessment made pursuant to Article 8 and from the monitoring programmes established pursuant to Article 11 have become available, such information and data shall also be made available to the European Environment Agency, for the performance of its tasks."

[13] EEA, ENV D2. (2013). Marine Strategy Framework Directive Common Implementation Strategy: 7th meeting of the Working Group on Data, Information and Knowledge Exchange (WG DIKE). DIKE-7/2013/05.

[14] Coordinated by Cecile Roddier-Quefelec (EEA), and discussed with Michael Assouline (EEA).

[15] Common International Classification of Ecosystem Services

the testing of, a 'Pilot European seafloor integrity account' based on the condition of seabed habitats resulting from fishing pressure is currently being developed by the EEA and its ETC/ICM[16] (to be completed by the end of 2018). This account aligns with the MSFD Descriptor 6 and Action 5 under Target 2 of the EU Biodiversity Strategy to 2020.

The EEA and its ETC/ICM also intend to develop a biophysically mapped assessment of the condition of marine (seabed) habitats from 2018 onwards, through a combination of methods developed under the DEVOTES and HARMONY projects (e.g. North Sea Impact Index and North Sea Pressure Index[17]), which could render relevant marine accounts. There is also an opportunity to build on the work achieved through the pan-European *Streamlining European Biodiversity Indicators (SEBI)* process (see Biała et al., 2012), specifically when considering the use of the proposed indicators relevant to the EU Biodiversity Strategy to 2020, as well as other EEA indicators (e.g. oxygen content of seawater), as accounts. Finally, there are examples of marine accounts from other locations, using other sources of data, which could be used to inform a methodological approach (e.g. Eigenraam et al., 2016).

One recent review of available data conducted by the EEA in collaboration with the European Topic Centre on Biological Diversity (ETC BD) and the European Topic Centre on Urban, Land and Soil Ecosystems (ETC-ULS) yielded few marine sources, particularly long-term time series, which could be used to generate marine accounts. However, the reporting under EU water, marine and/or nature directives, alongside advances made through European projects, as noted above, has yielded a series of data portals and datasets that could, in particular once updated through forthcoming EU-level reporting rounds from the relevant directives, fill gaps in our knowledge, and could be used to trial methodological approaches (see **Table 1**). A full catalogue of spatial layers is scheduled to be released during the course of 2018, which could reveal further sources.

Table 1. *Examples of available, long-term EU data resources (spatial and non-spatial) that could inform marine pilot accounts.*

Source	Examples of relevant data/indicators	Coverage	Status
Biodiversity Information System for Europe (BISE)	Links to entry points for reference data and information related to biodiversity in Europe (e.g. EEA's Biodiversity Data Centre, GBIF, Copernicus), but does not host data directly.	Europe-wide	Accessible online
JRC STECF	Non-spatial, country-level data on EU aquaculture, fleet economic performance, fisheries-dependent information, fish processing industry, etc.	Europe-wide	Accessible online
ICES-DOME	OSPAR CEMP and HELCOM COMBINE data used for biological and chemical	Northeast Atlantic	Accessible online

[16] Currently being developed by Gerjan Piet (WMR) under the management of Eva Royo Gelabert (EEA).

[17] HARMONY. (2011). The North Sea Impact Index. 5th HARMONY workshop, December 2011. Göteborg, Sweden. Accessed 4 July 2017.

Source	Examples of relevant data/indicators	Coverage	Status
	assessments (e.g. ocean acidification)		
DATRAS	Fisheries trawl surveys	Northeast Atlantic	Accessible online
EMODnet	Broad-scale seabed habitat maps (EUSeaMap) and 757 biological datasets	Europe-wide	Accessible online
DCRF	Fisheries-related data	Mediterranean	Data not online
ODIMS	OSPAR habitats in the North-east Atlantic Ocean; contaminants; bottom fishing intensity; underwater noise	Northeast Atlantic	Accessible online
EEA's Biodiversity Data Centre	Oxidised nitrogen concentrations; Article 17 data; dissolved inorganic nitrogen; Proportion of habitat assessments in each conservation status class per marine region; Waterbase (contains information on water quality in transitional, coastal and marine waters)	Europe-wide	Accessible online
Copernicus	CORINE Land Cover (e.g. saltmarshes); satellite-observations. Also hosts marine environmental data (e.g. sea surface temperature, sea surface salinity, etc.).	Europe-wide	Accessible online

In addition to long-term data associated with EU-level reporting requirements, there are also regional experts whose knowledge could be drawn on for additional data and information with regards to specific, priority accounts (e.g. David Vaughan from JNCC; Guilia Mo from ISPRA, and also linked to EUSeaMap I and II; and Jesper Harbo Andersen from NIVA DK)[18].

The *EEA Marine Road Map 2016-2022* outlines upcoming work and areas of focus, such as reports on *Contaminant's in Europe's seas* (2018) and *Pressures and impacts in Europe's seas* (2018), towards which additional, account-relevant information could be mobilised. These and other planned assessment reports aim to draw primarily from the above-mentioned data/information held by the Regional Sea Conventions and other EU-level information (as an alternative to using information generated from the implementation of the MSFD and the Habitats Directive due to the unsuitable timing for the next round of EU-level reporting on those directives). A further discussion on data that may become available, both from governmental and non-governmental sources, follows under **Section 4 (Recommendations)**.

[18] Experts suggested by Johnny Reker (EEA).

3 EU policy utility of accounts

In addition to tracking progress towards meeting the overall objective and several targets of the EU Biodiversity Strategy to 2020, marine accounts may help to track progress towards the fulfilment of a range of policy objectives across existing EU directives as well as marine spatial planning efforts. For instance, marine accounts could have the potential to inform MSFD implementation by supporting assessments of the cost of marine ecosystem degradation and, in turn, support the implementation of an ecosystem-based approach to marine spatial planning and management[19]. However, the data and information required to develop 'proper' accounts—beyond indicators—are still limited, constraining our ability to inform these objectives through full accounts.

Natural capital accounting methodologies would ideally align with the criteria and indicators selected for assessing 'good environmental status', and with the guidance documents provided in the *Mapping and Assessment of Ecosystems and their Services* (MAES) reports. These reports, developed by the Working Group MAES, provide EU-level support to the implementation of Action 5 under Target 2 of the EU Biodiversity Strategy to 2020. As noted earlier, this is the approach followed in the pilot marine accounts developed/under development by the EEA and its ETC/ICM. The corresponding (level 3 onwards) habitat typologies under EUNIS are also currently being revised; for more information, a crosswalk between European marine habitat typologies is outlined by Evans et al., 2014, which are currently under revision by the EEA and its European Topic Centre on Biological Diversity (ETC/BD) and ETC/ICM, to be completed between 2017 and 2018[20].

Discussions centred primarily on alignment with MSFD as the foremost consideration in the development of marine accounts, given its relevance as one the key policies in relation to marine assessments and accounting[21]. However, this did not exclude use of data/information derived from other sources beyond MSFD (e.g. data/information submitted under other directives and Regional Seas Conventions, such as OSPAR and HELCOM; long-term observed or modelled datasets resulting from European projects or observation systems), which were also recommended[22]. Indeed, multiple sources of data/information would need to be considered in the development of policy-relevant methodological approaches for natural capital accounting, aligning with current attempts to harmonise policy frameworks (e.g. MSFD, Common Fisheries Policy, Water Framework Directive, Habitats and Birds directives, and the Barcelona Convention through IMAP[23]). An

[19] Noted by Camino Liquete and Günther Hörmandinger (DG Environment).

[20] Noted by Camino Liquete and Günther Hörmandinger (DG Environment), as well as Eva Royo Gelabert (EEA). From IEEP's interview summary with DG Environment: "[M]arine accounts nee[d] to start off with some basic accounts showing consistency with MSFD and GES."

[21] Highlighted during discussions with Irene Del Barrio and Eva Royo Gelabert (EEA) and a representative of the European Commission, as well as interviews conducted by IEEP with Camino Liquete and Günther Hörmandinger (DG Environment). This was also raised by those attending the "Workshop for the delineation of subdivisions relevant for MSFD assessments/reporting in the Mediterranean Sea."

[22] Recommended by Eva Royo Gelabert and Johnny Reker (EEA).

[23] Highlighted by David Connor (DG Environment).

early crosswalk between the MSFD indicators and monitoring parameters required by other policy frameworks produced by JRC-IES could help in consideration of this alignment (Zampoukas et al., 2012). These datasets would also need to include long-term time series, and be collected using comparable methodological approaches and at similar spatial scales.

4 Recommendations

In addition to providing a stronger understanding of our current knowledge on Europe's seas and the EU policy application of marine accounts, the horizon scan yielded a recommended approach for conducting a feasibility assessment of the proposed accounts (outlined in Annex 1), suggestions for "quick wins," and insight into expected advances in the coming years that could strengthen these accounts.

4.1 Opportunities through alignment with MSFD and other EU policy frameworks

While it was felt that limited availability of spatially explicit data (beyond assessment products) currently constrains our ability to produce comprehensive marine accounts, many agreed that test methodologies could be developed proactively based on a combination of existing information and expected improvements in the coming years[24]. In particular, it was recommended that existing data and information from Regional Seas Conventions that are at an advanced stage of implementation (e.g. OSPAR and HELCOM Conventions) could be used as input for testing these methodologies and developing pilot marine accounts. The hope is that these draft methodologies could then be populated with new data, including those underpinning the assessments carried out under the next cycles of the implementation of EU water, marine, and/or nature directives that are likely to be obtained over the next few years.

All data and information reported under the MSFD during the first and second (2018) reporting cycles—the latter marking the first update of articles 8, 9 and 10—will become accessible through WISE-Marine in 2018. These will include data on the emissions to water and contaminants, pH, nutrient pressure from nitrogen and phosphorus, and yearly data on biology quality, based on the 'ecological quality radius' classified according to five statuses under 'Good Environmental Status' (del Barrio et al., 2016). Spatial data from monitoring programmes and assessments performed in compliance with Article 8 of the MSFD will be discoverable through WISE-Marine via a metadata catalogue, in accordance with Article 19.3[25]. As noted above, ongoing work by the EEA and ETC/ICM will establish a seafloor integrity account and develop new indicators, including one on marine litter to be derived through the Marine LitterWatch, tentatively planned for 2018[26]. Long-term plans include the development of a map of the biophysical condition of seabed habitats.

Progress is being made towards aligning the MSFD reporting requirements with other EU legislative frameworks, such as those of the WFD, the Habitats Directive and Birds Directive, the Common Fisheries Policy and IMAP. To this end, methodologies for developing natural capital accounts should consider how this alignment, which could, *de facto*, be an alignment across assessments and their timings—and, therefore, of the data used for each—could best be used to strengthen our capacity to track the long-term ebbs and flows of natural capital stocks and associated ecosystem services.

[24] Expressed by Eva Royo Gelabert, Johnny Reker and Irene Del Barrio (EEA).
[25] Noted by Irene Del Barrio (EEA).
[26] Noted by Irene Del Barrio and Eva Royo Gelabert (EEA).

The horizon scan also raised one approach to assessing the feasibility of tracking different parameters related to EU-level marine pilot accounts, as outlined in the document *Background material for KIP INCA proposal for EU-level account on ecosystem condition*[27] (see Annex 1). Suggestions for "quick wins" include dissolved oxygen, pH, and 'Good Environmental Status' (MSFD), yet others that align with the proposed feasibility criteria may be identified through such an assessment. For example, seagrasses and deep-sea corals were also mentioned as "keystone habitats" that could be measured to provide a stronger understanding of the status of ecosystems and associated services[28]. In this regard, it was suggested that the condition of certain ecosystems could be described (e.g. for seagrasses, eutrophication and any existing designations, such as Natura 2000, could be used).

EU-level marine ecosystem accounts could be developed using a three-tiered approach. Firstly, in the short-term, initial "headlines" could be established that identify the current state of knowledge related to the account of interest. Secondly, 'technical' marine accounts that use global and/or European datasets or indicators on critical aspects of the feature's condition (and/or pressures and impacts) could be initiated. Lastly, in the long-term, 'proper' marine accounts derived from national datasets and/or targeted monitoring programmes could be developed, with full stock and service accounts that draw from a portfolio of sources of spatial and contextual information (most relevant to benthic ecosystem accounts) (Gelabert and Reker, 2016).

For data-poor regions, qualitative accounts based on changes in management measures (e.g. overlap with protected areas) or existing indices (e.g. European Red List of Habitats) could be developed as proxies for ecosystem condition and capacity to deliver services. However, this would offer general (?) assessments of relative change in condition rather than quantifiable, spatially explicit measurements, which would be necessary to develop full stock and service accounts.

4.2 Opportunities to develop marine accounts beyond using information from EU policy frameworks

In identifying options for developing marine accounts, a balance between scientific integrity and pragmatism was noted as being necessary to accommodate differences in technological, financial and human capacity across Member States. Thus, accounts would need to be flexible to accommodate differences between the datasets available to inform the accounts (i.e. different methodologies, scales, data quality, metrics), particularly when the underlying data used to form assessments do not necessarily align one-to-one with the 'structural elements' in the relevant EU legislation/policy. Given the challenges surrounding the availability of spatial data of consistent and suitable quality to develop full marine accounts across Europe's seas, there may be opportunities to draw from expertise, data

[27] Available at: https://projects.eionet.europa.eu/ecosystem-capital-accounting/library/reflections-ecosystem-condition/eu-ecosystem-condition-account_current-methodological-proposal_eea_5-january.

[28] Indicated by Camino Liquete and Günther Hörmandinger (DG Environment).

and methodologies applied elsewhere, including from direct measurements (e.g. condition metrics) and indirect (e.g. pressures; associated species) proxies.

From a policy reporting perspective, data would need to be approved and submitted by government focal points. However, these data could potentially derive from non-governmental sources (challenges noted below), so long as they are spatially explicit and 'sustainable' (i.e. monitored and reported consistently) to ensure comparability and to support long-term accounting. However, this is frequently not the case as European research projects are often based on available knowledge at the time and/or short-term monitoring initiatives, neither of which support long-term, comparable accounts linked directly to EU policy.

Ecological models could provide opportunities to fill current knowledge gaps, and to project changes in the status and condition of ecosystems and associated services (e.g. Piroddi et al., 2015). Indices such as the Wetland Extent Trends Index (Dixon et al., 2016)—which is being updated for inclusion in the upcoming Ramsar's Global Wetland Outlook, GEO-6 and IPBES assessments—could also be used to supplement incomplete and heterogeneous data. Moreover, recent outputs from the Horizon 2020 *Marine Ecosystem Restoration in Changing European Seas* (MERCES) project offer a review of the state of knowledge on European marine habitat mapping and degraded habitats (D1.1), including spatial data, and current marine pressures and mechanisms driving change in marine habitats (D1.2). These could be used to inform the development of ecosystem accounts within Europe's seas, focusing on a selection of integrated accounts, for example. Again, this could follow the three-tiered approach proposed above, drawing in and harmonising data from multiple sources as our state of knowledge improves.

Following the MAES ecosystem condition workshop in June 2017 the representative from France recommended that a combined set of indicators be developed to represent ecosystem condition, including:

- an exhaustive set of features of interest for the ecosystems considered;
- a list of all of the dimensions of biodiversity for which no-net-loss policy objectives are specified;
- a list of ecosystem goods and services be produced, with several indicators that reflect the capacity of ecosystems to sustain these goods and services; and
- a selection of relevant indicators representing the risk of an irreversible degradation of the ecosystems considered and their determinants[29].

These recommendations align with the current work being done under MERCES, and could be used to guide the development of a pilot account in relation to ecosystem condition. There may also be benefits from reviewing potential alignment with Global Ocean Observing System's (GOOS') development of Essential Ocean Variables (EOVs) (e.g. Constable et al., 2016), and also exploring the possibility of establishing indicators that

[29] Background document: "French contribution to the definition of the ecological condition of ecosystems in the context of the working group for the mapping and assessment of ecosystems and their services (MAES) of the European Commission." (9 June 2017)

align with those of the Biodiversity Indicators Partnership, or submitting new indicators[30]. These initiatives seek to standardise global, regional and national approaches to biodiversity monitoring and assessment in a similar way to the policy frameworks and guidelines developed within the EU.

However, challenges associated with using non-governmental, project-based data and information often include the longevity of the data sources (i.e. often completed as 'one-off' studies, with little opportunity for repetition), the risk that the outputs may not align directly with legislative requirements, and the limited comparability between data due to differing methods). Thus, if complementary methods for developing ecosystem accounts are identified, appropriate mechanisms for sustaining these methods are necessary.

4.3 Priority actions

Priority actions in the immediate future are proposed to include developing methodological approaches for ecosystem extent and condition for a selection of case studies, to be defined based on data availability. This process would include identifying a set of features of interest for the ecosystem(s) considered and associated ecosystem services, as well as consideration of the thresholds of condition required to deliver these services and how these might be measured using available data. This would help build experience on how to develop ecosystem accounts for the marine environment.

Furthermore, a more in-depth assessment of the feasibility of proposed accounts could also be conducted (see Annex 1 for suggested approach). This would provide a basis for planning the development of more comprehensive marine natural capital accounts and estimate associated resource requirements.

[30] Discussed with Eva Royo Gelabert and Irene Del Barrio (EEA).

Annex 1. Proposed feasibility assessment workflow

Step 1. Assess the feasibility of each of the proposed accounts[31] based on available data that comply with the following set of criteria:

a. Scale suitable for European- and/or national-level assessment;
b. Spatially explicit;
c. Suitable for detecting **change in extent or quantity**;
d. Suitable for detecting **change in 'condition' (or state)**, or the associated capacity to deliver associated services; and
e. Representativeness of coverage across Europe.

Step 2. Consider use of indicators relevant to existing policy frameworks (i.e. primarily MSFD, but also CFP, WFD, IMAP, and Habitats Directive) to develop these proposed accounts;

Step 3. Propose alternative accounts based on the above criteria, where suitable; and

Step 4. Based on the above, produce recommendations regarding the data that governments would require to produce these accounts, considering a balance between scientific integrity and pragmatism as well as the recent updates to the MSFD reporting guidelines[32].

The review and resulting recommendations are to be informed by previous work conducted by the European Environment Agency and other KIP INCA partners, such as the *Mapping and Assessment of Ecosystems and their Services (MAES)* guidance documents from 2013 and 2014, alongside the *SEEA Experimental Ecosystem Accounting (SEEA-EEA)* guidelines[33].

[31] Adapted from the list constructed during the KIP INCA marine workshop, 'EU (marine) ecosystem accounting system' (10-11 March 2016, French Ministry of Environment, Energy and the Sea, Paris). Background material available here: https://projects.eionet.europa.eu/ecosystem-capital-accounting/library/reflections-ecosystem-condition/eu-ecosystem-condition-account_current-methodological-proposal_eea_5-january

[32] Available at: http://cdr.eionet.europa.eu/help/msfd

[33] Available at: https://unstats.un.org/unsd/envaccounting/eea_white_cover.pdf

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