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Conventions and Action Plans
Montego Bay, Jamaica 30th September - 1st October 2013

Indicator Report

Review of ecosystem-based Indicators and indices on the State of Regional Seas

Introduction

1. UNEP initiated a study of indicator/index systems employed for regular regional state of the marine environment reporting and associated ecosystem-based instruments to measure progress. An overview of such systems in various parts of the world including already agreed sets of indicators should inform any proposal on a set of indicators from which each of the Regional Seas Conventions and Action Plans could associate their own respective sets of indicators associated with ecosystem-based management.

2. The study process was started in May 2013. A questionnaire was sent to individual regional sea entities including all the Regional Seas Conventions and Action Plans during the period May-June 2013. Feedback from the Regional Seas Programme will lead to subsequent drafting with the intention of publishing the report as a UNEP Regional Seas Report and Study.

3. Analyses of responses and information drawn from publically available sources demonstrates the significant efforts that regional entities have dedicated to this work and the variety of indicators in place or proposed. Anticipating future development of the World Ocean Assessment process there is an opportunity for the Regional Seas Programme to provide effective support at the regional scale and input to more quantitative assessments in the future.

4. The report also make suggestions for possibly linkages of the regionally-based indicator systems with the ecosystem-based objectives and targets and monitoring of their associated achievements.

5. Presentation of a first draft of the report to this meeting seeks to initiate an initial strategic discussion on the interests of Regional Seas Conventions and Action Plans in working collectively on this topic.

Action requested

6. The 15th Global Meeting of Regional Seas Conventions and Action Plans is invited to:

   a. Consider and comment on the draft report during and after the meeting;
   b. Discuss in principle whether the Regional Seas Programme is collectively interested in a global 'coordinated set' of indicators to be used for contributing the global effort to establish and monitor the state of the marine environment and for communicating progress against agreed global and regional objectives and, wherever applicable, targets; Adoption of such a core set of indicators will lead to the development of global, regional seas based indicator monitoring programme on a regular basis, possibly supporting the World Ocean Assessment in the future;
   c. Advise on the suggestion of the organization of a technical meeting in 2014 involving scientific and technical representatives of all Regional Seas and associated scientific institutions to review and agree on such a core set of indicators;
   d. Debate the role of Regional Seas as the mechanism to discuss and determine regional objectives and targets, noting the linkage between targets and indicators as well as the contribution that measurement of parameters against agreed objectives can make to good governance.

Review of ecosystem-based indicators and indices on the state of the Regional Seas

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6 September 2013

Executive Summary

[to be added]

1. Introduction

This chapter sets out some fundamental definitions and an interpretation of concepts that underpin this report. Basic information is drawn from secondary sources in a body of literature reflecting ideas debated over the past decades. Although some aspects are the subject of on-going research, and different terms are used by different organisations and regions, it is generally accepted that these terms are in common use as defined in various inter-governmental forums.

What is an indicator?

Definitions of the term 'indicator' are drawn from the Latin verb '*indicare*', meaning to disclose or point out, to announce or make publically known, or to estimate or put a price on (Hammond *et al.*, 1995, p1). The intention is to simplify, quantify, standardize, and communicate. In other words, to rationally explain complex information as a contribution to assessing conditions (Figure 1). For a given issue information can be measured, weighted, aggregated and may be presented within a composite index over time. The result of such an exercise is generally a set of compressed data demonstrating any trend, with the objective/purpose of being understandable to and raising awareness among policymakers and civil society (UN, 2007).

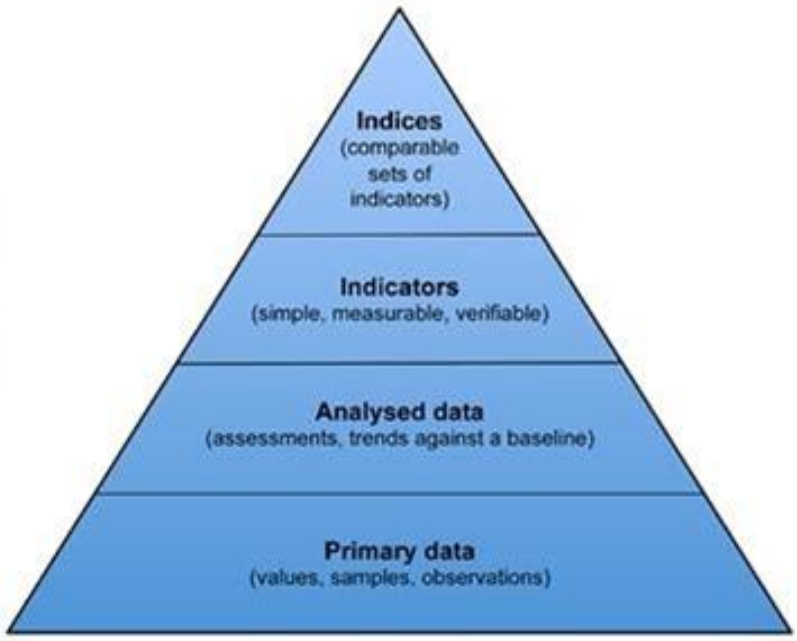

Figure 1: The information pyramid of environmental indicators

In 2010 the Biodiversity Indicators Partnership (UNEP-WCMC, 2010) set out the following definitions, amplified here from UNEP (2011a):

- **Measure**: a value that is quantified against a standard at a point in time;
- **Metric**: a set of measurements or data collected and used to underpin each indicator e.g. GDP per capita. Metrics usually have units;
- **Indicator**: a measure or metric based on verifiable data that conveys information about more than itself. It is information packaged to communicate something important to decision-makers. Generally a combination of two or more metrics (e.g. economic dependency on water resources). Indicators may or may not have units, depending on how they are formed;
- **Index**: a numerical scale used to compare variables with one another or with some reference number. A combination of two or more indicators (e.g. socioeconomic index). Indices are generally dimensionless and usually have normalized scores.

From a range of possible indicators, it is important to select the most relevant for each situation. Desirable characteristics are (Hammond *et al*., 1995; IOC, 2006; Johnson, 2008; Vilares, 2010; Douvere and Ehler, 2011):

- political relevance (governance performance);
- data and information are readily available (i.e. cost-effectiveness;
- context sensitivity: sensitive to changes in aspects being monitored and allowing the detection of trends or impacts resulting from plan implementation (i.e. specific and responsive);
- comparability (in time and space allowing for interregional or international comparisons);
- robustness and scientific credibility;
- show trends over time (i.e. interpretable);
- scientifically sound (i.e. grounded in theory);
- concrete, and easily understood;
- measurable, specific, and capable of being updated regularly; and
- adapted to intended users, so that they answer the needs of their different target-groups.

Selected indicators should satisfy the greatest possible number of criteria, so as to contain costs and maximize resources and promote greater efficacy of the monitoring/evaluation system to be implemented (Diedrich *et al*., 2010; Vilares, 2010). They should also contain consistent information to allow reporting at different scales (national, regional and international) and across different jurisdictions (Diedrich *et al*., 2010). “While not all criteria are likely to be met on every occasion, the main themes or messages that emerge are that indicators have to be simple, measurable and responsive.” (Gubbay, 2004, p.16).

In turn, these can be grouped in two main categories (MAOT, 2010b; Vilares, 2010):

- **Efficiency indicators**, measuring the performance of different programme components and the progress and quality of interventions and of the governance process itself; and,
- **Efficacy indicators** (ecological and socio-economic), reflecting tendencies in the state of the environment and in the state of the human component of coastal and marine ecosystems (economic activity). They help measure to what extent an instrument is contributing to manage human pressures in a way that results in an improved natural environment as well as in sustainable socio-economic benefits.

Where do indicators stand in the planning/management cycle? A coordinated system of objectives, indicators, limits and targets

Indicators constitute the link between policy and operational objectives and action in management (FAO, 1999; Day, 2008; Ehler and Douvere, 2009; Government of Canada, 2007; IOC, 2006; Douvere and Ehler, 2011). As such, they are fundamental tools to monitor and evaluate plans, programmes and policies and to inform their adaptations and revisions (Degnbol, 2005), and, thus, should be clearly related with the specific issues that triggered each particular planning/management process (IOC, 2006). This link as part of a management strategy is illustrated below in Table 1.

Strategic goals	To phase out pollution in the marine environment
Ecological objectives	Reduce impact of contaminants
Operational objectives	Reduce contaminant levels in shellfish species x
Targets and limits	Concentration of contaminant = a (target) or < b (limit)

Table 1: Role of indicators in a management system (ICES, 2005)

So that changes in the "behaviour" of any given indicator are meaningful and interpretable for managers and decision-makers, **indicator specific reference points** need to be developed (Blanchard et al 2010; ICES, 2012; IOC 2006, Vilares, 2010). The definition of references "against which to measure the success or failure of management actions" is paramount to assist decisionmakers in designing better policies and instruments (Ecologic Institute and SERI, 2010).

Although there is some terminological confusion in the literature (with the same terms being used with different meanings), there are three main types of reference points/values:

- baseline value: the indicator's value at time zero (keeping in mind that such values may be well below historic values) (Pauly, 1995; Roberts, 2007);
- target or optimum value: the desired value for the indicator over a given period of time; and
- limit or threshold value (to control negative tendencies). Threshold values correspond to tipping points "beyond which serious and/or irreversible - and usually negative or undesired - changes in environmental systems occur" (Ecologic Institute and SERI, 2010, p.13).

A further refinement on the definition of threshold levels might be the determination of an alert level or value, being "the critical value beyond which there is no safe distance from dangerous thresholds" and of danger zones as "the range of values outside the safe operating zone, which indicate a high probability and subsequently a high risk to reach the threshold levels (Ecologic Institute and SERI, 2010, p.7).

Transboundary indicators /indicators of transboundary effects

The establishment of transboundary or cross-border indicators is particularly challenging but their definition is extremely important as it promotes the establishment of a common understanding of transboundary ecosystem priorities for action (Wong et al., 2011, p.1) and monitoring. Such a common understanding is particularly pressing in times of scarcity of resources (including funding sources),

when it is especially important to establish and maintain sustained monitoring efforts of key management aspects that may have cross-border implications.

Across political borders and physical interfaces there will be different plans/policies relevant for marine governance, each with different goals and sets of objectives, and concurrently, proposing different sets of actions (management measures). “For an assessment to have impact, it needs to carry clear, high-level messages about the issues raised, and point towards interventions in governance that can help mediate the relationship between humans and the oceans, improving human well-being”(IOC-UNESCOc, 2011b, p.2).

Linking effects with causes

The selection of relevant indicators should be able to link measured metrics with specific activities (taking place in specific areas of the maritime space) or causes. Of course, the relation of top holistic indicators with causes of pressure or impact on marine ecosystems or their components may be blurred or difficult to pinpoint due to the fluid/dynamic nature of the marine environment and as a result of the interconnectedness of ecosystem components. This means that such top indicators must be based or be coupled to more detailed or underlying traceable indicators/data that may provide a more explicit link to causality.

It should be possible to establish common broad indicators that may be identically measured/monitored (comparable methodologies) within a given region and between regions. These broad indicators will hopefully allow for the detection of changes in the measured parameters, which, in turn, should elicit adapted management actions to respond to/correct the changes detected. Conversely, these management actions need not be identical since they will have to be adapted to the existing governance scheme on either side of the border/boundary.

Highlighting vital common management issues will help to assist in the selection of a reduced set of indicators. In turn, a reduced set of indicators is a key condition for the actual implementation of the monitoring efforts and it is a better way to draw attention to key issues, as, in order for an assessment to have impact “the number of key indicators and key messages has to be limited” (IOC-UNESCOc, 2011b, p.2).

To support management at the regional level and between regions hierarchies of indicators are desirable feeding into larger scale (pan-regional) reporting. For example this might consider the proportion of a region with 100% of habitat impacted < target %, as compared to the proportion of all habitat types impact < target % within an individual region.

Sustainable development indicators

In a context of planning and management based on a paradigm of sustainable development three main types of indicators have to be considered - governance, socio-economic and ecological - as well as the linkages or interactions between them (IOC, 2006; Pintér et al., 2012).

Recognizing that these three pillars are irrevocably linked, the Organization for Economic Co-operation and Development (OECD) proposed, in 1993, a framework for their integrated consideration known as Pressure-State-Response (PSR). It is “based on a concept of causality”, where **pressures** exerted by human activities on the environment (ecological, chemical or physical indicators), lead to changes in its **state** (quality and quantity of natural resources described by ecological indicators), triggering societal/management **responses** through environmental, economic and sectoral policies

(technical and institutional indicators) (OECD, 1993). These should, in turn, influence initial pressures. An illustrative matrix of such indicators is shown below in Table 2.

Climate change	GHG emissions	Concentrations	Energy intensity; environmental measures
Ozone depletion	(Halocarbon) emissions; production	(Chlorine) concentrations; O_3 column	Protocol sign.; CFC recovery; Fund contribution
Eutrophication	(N, P, water, soil) emissions	(N, P, BOD) concentrations	Treatment connections; investments/costs
Acidifcation	(SO_x, NO_x, NH_3) emissions	Deposition; concentrations	Investments; signed agreements
Toxic contamination	(POC, heavy metal) emissions	(POC, heavy metal) concentrations	Recovery hazardous waste; investments/costs
Biodiversity	Human uses esp. fishing	Species abundance compared to pristine area	Protected areas
Fish resources	Fishing effort	Sustainable stocks	Quotas
Oceans/Coastal Zones	Emissions, oil spills, depositions	Water quality	Coastal zone management; ocean zoning
Environmental index	Pressure index	State index	Response index

Table 2: Illustrative matrix of environmental indicators (adapted from OECD and UNEP in Hammond et al., 1995)

There are several variations on this approach, including the DPSIR framework adopted by the European Environment Agency (EEA), where **D = drivers** (human activities) lead to **P= pressures** (emissions, fish captures), that change **S = State** (of the environment), and result in **I = impacts** (pollution, health related issues, erosion). Such impacts are counteracted by **R = Responses** (policy, conventions, regulations), which aim to control/act on Drivers (EEA, 2005; IOC, 2006). The DPSIR framework informed the structure of the World Ocean Assessment (see Chapter 2) and is illustrated in Figure 2.

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evaluation of environmental and ecological conditions and trends - ultimately of ecosystem health. However, several types of indicators have been used to measure ecosystem health.

Environmental indicators

Different types of environmental [1] indicators have been identified depending on what is being measured as shown in Table 3.

Type	Indicators	Measures
A	Descriptive 'What is happening?'	Trends
B	Performance 'Are we reaching targets?'	The distance between current situation to desired situation
C	Efficiency 'Is there improvement?'	The relationship between drivers and pressures in order to look for change (positive or negative)
D	Policy effectiveness 'Are measures working?'	Identifies actual change of environmental variables in response to policy efforts
E	Welfare 'Are we better off?'	Identifies the balance between economic, social and environmental development

Table 3: Types of environmental indicators (Based on Stanners et al., 2007)

Ecosystem-based indicators

The ecosystem is the functional building block of ecological systems (as the cell is the building block of life). It includes the biotic (living) community and the non-living environment that supports it. Many of the interactive processes critical to all life take place at the ecosystem level. Large ecosystems, to which ecosystem-based management applies, correspond at least roughly to biogeographical units. Ecosystem-based indicators therefore relate to the environmental 'health' of a region as a whole (resilience, structure and vigour) as affected by a range of human interactions. A pre-requisite for ecosystem-based indicators is that they relate to spatially referenced data and/or policies for a particular region or ecosystem. Ecosystem-based indicators are, for example, at the core of the Ecological Quality Objectives (EQO) system developed by the OSPAR Commission to obtain an overall picture of the state of the marine environment. The rationale of this system is:

1st - to identify ecosystem components that reflect high ecological quality (e.g. seabirds);

2nd - to identify human impacts on this component and how they can be monitored (e.g. oiled marine birds found dead or dying on beaches) (ecological element or ecosystem-based indicator); and

[1] Environment can be defined simply as "what surrounds us".

3rd - Taking into account existing policies, define objectives/limits (e.g. max. proportion of such birds found in such conditions, in a given area) (ecological quality objectives).

Ecosystem service indicators

An emerging consideration is the attention now being given to define and measure ecosystem services and their functioning. Ecosystem services (e.g. food, fuel, air production, climate regulation, water purification, i.a.) are "the benefits human populations derive, directly or indirectly, from ecosystem functions" (Costanza et al 1997, p.253). These benefits are provided by nature at no cost to humans. However, human use of these services is rapidly contributing to deteriorate ecosystem health. The consideration of ecosystem services represents a step higher in the ladder of integrative/systems' thinking of ecosystem-based management.

Inter-governmental efforts to assess ecosystem services status and trends are being led by the Convention on Biological Diversity (CBD) linked to the Aichi targets contained within the CBD Strategic Plan (2011-2020) as well as the emerging Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES).

A common challenge is the choice of ecosystem services to assess informed by indicators as determined by policy objectives and data availability, further complicated by the need to establish not only the integrity of the ecosystem (to provide services) but also the benefits derived from the ecosystem services concerned. However, the language is different, identifying indicators for provisioning services (e.g. food, biomass fuel), regulating services (e.g. climate regulation, water purification) and cultural services (e.g. tourism and recreation), drawing upon linkages set out in the Millennium Ecosystem Assessment conceptual framework (MEA, 2005) and followed-up by The Economics of Ecosystems and Biodiversity initiative (TEEB, 2010).

Currently this topic is the subject of further research (methodologies, metrics and data sources), thus uncertainty remains regarding how these indicators will be taken forward and/or integrated with other frameworks. Recommendations from a review of relevant sub-global assessments (UNEP-WCMC, 2011) included encouragement to adopt a small set of specific, policy-relevant indicators; utilize existing data and proxies; and monitor multiple services over time allowing for a better understanding of synergies and trade-offs. Geographic scale is another factor for consideration as indicators applicable at the national or regional scale may not be aggregated into or disaggregated from global datasets.

Summary

Indicators can provide information to guide sustainable management. Ecosystem-based indicators can apply both to the state of the marine environment and to considerations of performance against environmental targets and/or limits in a defined geographical area. In order to guide management, indicators should be set within a reference framework and hierarchies of indicators can provide coordinated support. In time current ecosystem-based indicators are likely to embrace ecosystem service indicators and synergies should be considered when considering any relevant strategic development.

References

Belausteguigoitia JC (2004) Causal Chain Analysis and Root Causes: The GIWA Approach. AMBIO: A Journal of the Human Environment 33(1):7-12. 2004

CEC (2007) COM(2007)575 final, Brussels, 10.10.2007 -An Integrated Maritime Policy for the European Union -Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions

Ecologic Institute and SERI (2010) *Establishing Environmental Sustainability Thresholds and Indicators.* Final report to the European Commission's DG Environment, November 2010.

Hammond, A, Adriaanse, A, Rodenburg E, Bryant D and Woodward R (1995) Environmental Indicators: A Systematic Approach to measuring and Reporting on Environmental Policy Performance in the context of Sustainable Development. World resources Institute, May 1995

ICES. 2005. Guidance on the Application of the Ecosystem Approach to Management of Human Activities in the European Marine Environment, ICES Cooperative Research Report, No. 273. 22

IOC, 2006. A Handbook for Measuring the Progress and Outcomes of Integrated Coastal and Ocean Management. IOC Manuals and Guides, 46; ICAM Dossier, 2. Paris, UNESCO.

Lyytimäki, J., Rosenström, U., 2008. Skeletons out of the closet: effectiveness of conceptual framworks for communicating sustainable development indicators. *Sustainable Development*, 16: 301-313.

MEA (2005) Millenium Ecosystem Assessment: Ecosystems and Human Well-being: Synthesis. Island Press, Washington DC, 155pp.

Pauly, D. (1995) Anecdotes and the shifting baseline syndrome of fisheries. *Trends in Ecology and Evloution* 10 (1): 430.

Pew Oceans Commission. 2003. America's Living Oceans: Charting a Course for Sea Change. A Report to the Nation. May 2003. Pew Oceans Commission, Arlington, Virginia.

Ramos, T.A., Caeiro, S., 2010. Meta-performance evaluation and sustainability indicators. *Ecological Indicators,* 10:157-166.Roberts, C (2007) *The unnatural history of the sea: the past and future of humanity and fishing*. Gaia Thinking, London.

Shin, Y-J. and Shannon, L. J. 2010. Using indicators for evaluating, comparing and communicating the ecological status of exploited marine ecosystems. 1. The IndiSeas project. - ICES Journal of Marine Science, 67: 686-691

Stanners et al 2007 Frameworks for Environmental Assessment and indicators at the EEA. In T Hak, B Moldan and A Lyon Dahl (eds) Sustainability Indicators: A Scientific Assessment, pp127-144, Washington, Island Press

TEEB (2010) The Economics of Ecosystems and Biodiversity: Mainstreaming the Economics of Nature: A Synthesis of the Approach, Conclusions and Recommendations of TEEB. Available online:http://www.teebweb.org/our-publications/teeb-study-reports/synthesis-report/#.UihyGrRRqZY [Accessed 5 September 2013]

UN (2007). Indicators of sustainable development: Guidelines and methodologies. Third Edition. United Nations Publication, New York. 93p. October 2007. ISBN 978-92-1-104577-2

UNEP (2005) Challenges to International Waters-Regional Assessments in a Global Perspective, University of Kalmar (Sweden).

UNEP, 2011. L. Jeftic, P. Glennie, L. Talaue-McManus, and J. A. Thornton (Eds.). Methodology for the GEF Transboundary Waters Assessment Programme. *Volume 1. Methodology for the Assessment of Transboundary Aquifers, Lake Basins, River Basins, Large Marine Ecosystems, and the Open Ocean,* UNEP, x+60 pp.

UNEP (2011)b. the other 70% - UNEP Marine and Coastal Strategy: Executive Summary. United Nations Environment Programme, 15p.

UNEP-WCMC (2010) Biodiversity Indicators Partnership. Guidance for national biodiversity indicator development and use. UNEP World Conservation Monitoring Centre, Cambridge UK, 40pp

UNEP-WCMC (2011) Developing ecosystem service indicators: Experiences and lessons learned from sub-global assessments and other initiatives. Secretariat of the Convention on Biological diversity, Montreal, Canada. Technical series No. 58, 118 pages.

World Ocean Assessment (2013): The basics. Available online: www.worldoceanassessment.org/?page_id=6 [Accessed 4 September 2013]

2. Regional application of the Ecosystem Approach

The concept of an ecosystem approach and its relevance to Regional Seas Conventions and Action Plans was discussed at the 14th Global Meeting of the Regional Seas and Action Plans held in October 2012 (UNEP (DEPI)/RS.14/WP.2.RS). This chapter introduces the ecosystem approach and its application by several organisations and initiatives that carry out indicator-based assessment in a regional context. The intention is to provide context for later discussion on the use of assessment of state of the marine environment and monitoring of progress in achieving ecological objectives or targets.

Defining the Ecosystem Approach

The Ecosystem Approach (and a range of synonymous terms such as ecosystem-based management) is a conceptual framework incorporating human activities undertaken at sustainable levels as an accepted element of ecosystem functioning. Seen as a paradigm shift away from highly focused short-term sector-by-sector resource assessment, it origins date back to management applied to the Great Lakes Basin Ecosystem in the 1970s (Sherman and Duda, 1999). Emphasis is placed on balancing environmental elements and equity, recognizing that ecosystem health relies on key interactions and accepting that ecosystems are resilient but have thresholds or tipping points.

Inspired by the 1992 Earth Summit and Agenda 21 the Ecosystem Approach has become the primary implementation framework of the Convention on Biological Diversity (CBD) defined as 'a strategy for the integrated management of land, water and living resources that promotes conservation and sustainable use in an equitable way' and based on the CBD definition of an ecosystem set out in Article 2 of the Convention as 'a dynamic complex of plant, animal and micro-organism communities and their non-living environment interacting as a functional unit' (CBD, 2013). Elaborated explanations promote the framework as the basis of 'an adaptive management strategy recognizing that ecosystem processes are often non-linear, fluctuate spatially and temporally and frequently show time lags creating a high level of uncertainty' (JNCC, 2013).

As an outcome of the World Summit on Sustainable Development in 2002, the Johannesburg Plan of Implementation associated the Ecosystem Approach with integrated coastal management. It was recognized that sectoral approaches have not yielded the progress needed to protect and restore marine ecosystems and enhance livelihood security. Subsequently the UN General Assembly and associated processes have continued to promote and apply this in a marine context (UNDOALOS, 2010). Thus the Ecosystem Approach continues to underpin the latest policy initiatives including the CBD Strategic Plan for Biodiversity 2011-2020 and its Aichi Biodiversity Targets (2010, Decision X/2, COP10)(CBD, 2010); the UNEP Marine and Coastal Strategy (UNEP, 2011); the Rio+20 outcome document (UNCSD, 2012); and the UN Ocean Compact (UNDOALOS, 2012).

The Millennium Ecosystem Assessment undertaken in 2005 was influential in making explicit the link between status of natural resource systems and ecosystem services. Interdependent interactions between ecosystems and social, economic and cultural factors are acknowledged. Thus impacts of human activities are recognized as a matter of social choice and a key objective is to ensure that governance mechanisms balance use of natural resources with their conservation, a focus more on integrity of the ecosystem and less on site-based approaches or on recovering target species. Tradeoffs between management priorities for different ecosystem services must be made transparent and explicit, requiring involvement of all stakeholders and a clear understanding of desired ecosystem health or status.

In developing a European Marine Strategy the European Union specifically placed humans as part of natural ecosystems, defining the Ecosystem Approach as 'a comprehensive integrated management of human activities based on the best available scientific knowledge about the ecosystem and its dynamics, in order to identify and take action on influences which are critical to the health of the marine ecosystems, thereby achieving sustainable use of ecosystem goods and services and maintenance of ecosystem integrity' (ICES, 2005 p.4).

Murawski (2007) argued that ecosystem approaches to marine management are emerging as best practice. However, it is still unclear what kind of governance structure and institutions are most capable of delivering the Ecosystem Approach and sustaining flows of ecosystem services in the longer term (POST, 2011).

Application of the Ecosystem Approach to regions

Considerable thought was given to applying the Ecosystem Approach at a regional scale in the context of developing the EU Marine Strategy Framework Directive (MSFD). Setting out guidance for a seven-step process, ICES (2005) emphasized that:

1. As a framework embedded in the concept of sustainable development, implementation of the Ecosystem Approach should take into account:
   - linkages between the terrestrial and marine environment;
   - environmental variation and natural change; and
   - long-term perspectives.

2. Ecological objectives to protect ecosystem structure and function, and associated operational objectives, should be set on geographical scales comparable with economic and social objectives.

3. Appropriate management regions should be dictated by biogeographic and oceanographic characteristics whilst taking into account existing political, social and economic divisions.

4. A coordinated system of objectives, indicators, limits and targets (as described in Chapter 1) is needed; and

5. Management tools to achieve adaptive management include input controls, output controls, spatial and temporal distribution controls, integrated planning tools, remediation tools, and economic incentives.

The seven-step process proposed (as summarized in Table 1), effectively a variation on the standard cyclical environmental management system, was transposed into the MSFD and incorporates the derivation of operational objectives with indicators and reference points as a constituent element or step within that system.

1	**Scoping the current situation**: evaluate status, relevant policy context, an inventory of human activities and relevant economic and social policies
2	**Contrasting with the vision**: identify discrepancies between vision and current status
3	**Identifying important ecosystem properties and threats**: cross tabulation of ecosystem properties and components with major human activities impacting on the ecosystem
4	**Setting ecological objectives**: adequate coverage of valued ecosystem components and threats, as well as inter-compatibility and compatibility with social and economic objectives
5	**Deriving operational objectives with indicators and reference points**: assemble an appropriate suite and relate to the 'vision'
6	**Ongoing management**: apply management tools, monitor and assess
7	**Periodic updates**: re-evaluate to account for environmental change and changing societal needs

Table 1: Seven steps to apply the Ecosystem Approach at a regional scale (adapted from ICES, 2005)

Key marine regional and global governance initiatives using and developing indicators and indices are set out below.

Regional Seas Programme (RSP)

Launched in 1974 with a remit to address the accelerating degradation of the world's oceans a total of 18 Regional Seas Conventions and Action Plans across the world provide a legal framework and reflect political will for coordinated action to tackle common marine environmental issues. Of these 13 are established under UNEP auspices and 5 are partner Programmes (see Table 2). Some are more 'mature' than others with reference to their use and adoption of indicators for assessment and monitoring.

1.Mediterranean	Barcelona	1976/1995	1978/2004	22
2. ROPME[3] Sea Area	Kuwait	1978	1979	8

[2] It should be noted that the number of countries covered in the Programme does not necessarily correspond with the number of countries that have ratified the respective Conventions.

[3] The Regional Organisation for the Protection of the Marine Environment Sea Area covers 8 states that joined together in 1978 to adopt the Kuwait Regional Convention for Cooperation on the

3. Western and Central Africa	Abidjan	1981	1984	29
4. South-East Pacific	Lima	1981	1986	4
5. Red Sea and Gulf of Aden	Jeddah	1982	1985	8
6. Wider Caribbean	Cartagena	1983	1986	28
7.Eastern Africa	Nairobi	1985	1996	10
8.South Pacific	Noumea	1986	1990	19
9.Black Sea	Bucharest	1992	1994	6
10.North-East Pacific	Antigua	2002	Action plan in force	8
11.East Asian Seas	None	1984 (Revised in 1993)	Action plan in force	9
12. North-West Pacific	None	1994	Action plan in force	4
13. South Asian Seas	None	???	Action plan in force	6
14. Baltic Sea	Helsinki	1974/1992	1980/2000	10
15. North-East Atlantic	Oslo-Paris (OSPAR)	1974/78/92	1998	16
16. Antarctic	Antarctic Treaty/CCAMLR[4]	1959/1980	1961/1982	32
17. Caspian Sea	Tehran	2003	Not in force	5
18. Arctic/PAME	None but Arctic Council working group(s)			8

Table 2: Summary of the Regional Seas Programme and implementing Conventions (1-13 UNEP auspices, 14-18 Partners)

For those entities within the RSP, joint coordination is generally engendered through an Action Plan, or collectively agreed Strategy, which for most is legally underpinned by a regional Convention and associated Protocols (or Annexes). Thus whilst each Regional Seas Convention and Action Plan (RSCAP) is part of a common global family with a collective mandate, and each is ratified by relevant States or in the case of some adopted Action Plans recognized by States as a soft legal instrument, their work programmes and approaches to management are based upon the region's particular environmental concerns and challenges as well as its socio-economic and political situation (UNEP, 2005). Evaluations of the Regional seas experience (e.g. Rochette and Chabason, 2011) highlight

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Protection of the Marine Environment from Pollution, otherwise known as the Kuwait Convention and 4 associated Protocols.

[4] The Commission for the Conservation of Antarctic Living Resources (www.ccamlr.org)

significant achievements, but also place emphasis on differences between regional arrangements and variations resulting from intrinsic limitations reflecting fragmented international governance (for example in all regions the International Maritime Organisation is the competent organization for regulation of international shipping but in some regions the pressure and volume of shipping traffic merits specific regional attention). The latter has fuelled calls for an improved global legal regime as well as the expansion of existing and new regional agreements and mandates for managing the high seas (e.g. Ban et al., 2013).

Successive efforts to set common Strategic Directions for the Regional Seas Programme (2004-2007, 2008-2012, 2013-2016) have recognized the value of an action-orientated approach to common integrated priorities based on an ecosystem approach. Most RSCAPs have undertaken transboundary diagnostic assessments and some prepared strategic action programmes. Most have also carry out regular assessments of the state of the marine environment and issue state of the regional marine environment reports.

However, the differing levels of implementation of individual regional Action Plans (reflecting variation in governance arrangements, funding, activity and influence) have so far not been systematically centrally monitored to indicate the level of achievement of the implementation of Action Plans in different regions. Thus there is a need for enhanced result-based monitoring and evaluation of policies, programmes and projects based on measurable indicators of success. The ecosystem-based approach, object and target setting and associated monitoring are inter-related. As explained in Chapter 1 any management response (and it effectiveness as measured by the status of Actin Plan implementation) can form part of an indicator-based assessment package.

Each set of Strategic Directions has emphasized the need to take up and adopt an Ecosystem Approach but UNEP have recognized barriers present in some current arrangements (see Table 3).

Geographical coverage respects ecological functions and continuity as well as political boundaries
Assessment considers all ecosystem processes and functions including human socioeconomic activities
Optimal use of ecosystem goods and services is combined with equitable benefit sharing
Sources of stress and threats are addressed to maintain ecosystem integrity
Political considerations determine geographic coverage
Failure to identify drivers for ecosystem change
Lack of integration with governance of key sectors (e.g. fisheries)
A focus on normative action rather than pollution sources and threats to ecosystem functioning

Table 3: Ecosystem Approach common elements and barriers (adapted from UNEP 2012)

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Linkages between the 5 LME Modules and the TDA/SAP processes are shown in Table 4. The intention of the GEF-LME Projects is ultimately to create an adaptive, self-financing, management regime for LMEs located within or in relation to Regional Seas areas[5]. Periodic assessments (TDA updates) are envisaged. The assessment and management cycle fosters an adaptive management approach by establishing monitoring and evaluation indicators. However, GEF funding was always intended as a catalytic means to address degradation of coastal waters in developing countries and the long-term viability of GEF Projects is uncertain.

1. Productivity	Transboundary issue, identify threats and root causes	Regional and national reforms to maintain productivity
2. Fish resources and Fisheries	Transboundary issue, identify threats and root causes	Regional and national reforms to sustain fisheries
3. Pollution and Ecosystem Health	Transboundary issue, identify threats and root causes	Regional and national reforms to reduce pollution and sustain ecosystem
4. Socioeconomics	Socioeconomic impact analysis, including prioritization of issues	Economic instruments, investments etc., as tools for SAP implementation
5. Governance	Governance analysis, stakeholder analysis	Legal, policy and institutional reforms; ministerial level adoption; stakeholder involvement (private sector and civil society)

Table 4: Linkages between 5 LME Modules and TDA/SAP processes (Olsen et al., 2006)

Olsen (2003) developed a framework suggesting 'sets of indicators to trace the evolution of an LME management system as it progresses from the baseline conditions documented by the TDA to (hopefully) progressively more sustainable conditions and patterns of use' (Olsen et al., 2006 p.27). Four sets of indicators identified were indicators serving as markers for the preconditions needed for ecosystem-based management; stress reduction indicators; environmental status indicators; and indicators showing a dynamic equilibrium between both social and environmental qualities.

Global marine policy initiatives with regional dimensions using indicators

A number of marine policy initiatives initiated at the global level as a response to internationally agreed obligations have given consideration to the use of indicators or may influence indicator development as follows:

[5] Some of the LMEs, such as the Somali Current LME, cover geographic areas outside the Regional Seas Programme geographic boundaries

1. The World Ocean Assessment (Regular Process for Global Reporting and Assessment of the State of the Marine Environment Including Socioeconomic Aspects, UNGA resolution 64/71): is compiling existing information from regional and sub-regional state of the environment assessments (assessments listed in the GRAME database) to provide a baseline against which it is expected regular chronological assessments will take place. In December 2010, the United Nations General Assembly (resolution 65/37, paragraph 209) established a Group of Experts to produce the first World Ocean Assessment by 2014 (under the supervision of the Ad Hoc Working Group of the Whole). A series of regional workshops are being held as a means of identifying regional expertise, collating an inventory of existing assessments and building capacity for integrated assessment, with the aim of securing coherence, consistency and comparability (to date these have covered the Eastern Pacific Ocean, East Asia Seas, North Atlantic/Baltic/Mediterranean/Black Sea, Wider Caribbean, Western Indian ocean and South-West pacific (UNDOALOS, 2013)). In advance of scaling up existing assessments the Group of Experts will take account of:
    a. types of data, experiential knowledge, indicators and the reasons for their selection;
    b. trends and methods used;
    c. integration methods;
    d. sources of any evaluation benchmarks, reference levels or ecotoxicological assessment criteria;
    e. extent and sources of any forecasts, projections and scenarios
    f. data assessment limitations (e.g. data-extrapolation errors, uncertainties and/or information gaps)

    At a global scale the World Ocean Assessment seeks to address fundamental questions relevant to ecosystem-based indicators and indices, namely:

    a. what is the overall state of the world's oceans and seas?
    b. are marine ecosystems around the world improving or declining?
    c. What benefits do we get from the world's oceans and seas, how are they distributed?
    d. How can we measure the state of the oceans and seas? And what threatens them?

    The World Ocean Assessment started from a DPSIR systems-analysis view (UNEP, IOCUNESCO, 2009) with the Group of Experts deciding on a combination of pressures, marine habitats and ecosystem services as the basis for its structure.

2. The Global Coral Reef Monitoring Network (GCRMN): supports the International Coral Reef Initiative to document the status and trends of coral reefs around the world. The aim is to enhance scientific understanding by linking biophysical monitoring with social, economic and environmental data. Status reports present global (Wilkinson, 2008) and regional analyses (Chin et al., 2011) of patterns and processes based on available data sets consider temporal trends (percentage cover, density) and multivariate analyses to examine intra-regional differences (e.g. coral trajectories within and among individual coral taxa). Work is frustrated by the lack of a universal standard for monitoring. However, in addition to the status reports, based on the success of the 2012 Tropical Americas Coral Reef Resilience Workshop in the Caribbean (ICRI, 2012), GCRMN is embarking on similar resilience evaluations in all regional seas where coral occurs (Australia and Melanesia, Coral triangle and East Asia, North Pacific and South Pacific, Indian Ocean and Red Sea) to achieve a global synthesis report.

3. The Transboundary Waters Assessment Programme (TWAP): is directed at the most serious global water issues, using indicators as a tracking tool to assess the impact of interventions and to provide a means for more effective use of resources in addressing transboundary concerns and conflicts between countries. TWAP defines five categories of transboundary water systems - aquifers, lakes / reservoir basins, river basins, LMEs and open ocean. The

marine modules designed for assessment of LMEs (module 5) and Open Ocean (module 6) provide a possible framework (IW: LEARN, 2009).

4. Rio+20 Sustainable Development Goals (SDGs): are under development with discussion about which indicators might measure their achievements. Agreement to develop a set of SDGs was one of the main outcomes of Rio+20 and is intended to converge with the post 2015 development agenda as summarized on the UN Sustainable Development Knowledge Platform (UN DESA, 2013). A 30-member Open Working Group is preparing a proposal. Current ideas on SDGs and indicators have been summarized by the UNCSD Secretariat and are explored further in Chapter 6 of this report. Attention is being given to the CSD indicators, originally developed on the basis of the pressure-state-response model, that currently contains a core set of 50 indicators as part of a larger set of 96 indicators of sustainable development (UNDESA, 2007) with an acknowledgement that many other indices exist as developed by UN-entities, Foundations and civil society (e.g. OECD Green Growth indicators). It has been suggested that there is merit in using an internationally agreed statistically framework, such as the SEEA developed by the UN Committee of Experts on Environmental Accounting, as the basis for indicators.

Related initiatives

The above initiatives have not proposed a comprehensive measure covering ocean systems and internal ocean interactions. However, two recent initiatives have been proposed as solutions for assessing the state of the human-ocean system.

The Ocean Health Index (OHI) presents an average of 10 human goal scores to evaluate the condition of marine ecosystems for each Exclusive Economic Zone (EEZ) for 171 States (Halpern et al., 2012a and 2012b). Calculating the OHI is explained in relation to present status based on a reference point and future trend as influenced by pressures and resilience. These different dimensions (status, trend, pressure, resilience) are informed by components (e.g. total counts of alien species according to data from the Global Invasive Species Database). The issues covered by the 10 human goals overlap significantly with those promoted by the Global Ocean Partnership for Oceans (an alliance of governments, international organisations, civil society groups and private sector interests) as essential to tackle (Global Partnership for Oceans, 2013).

The Environmental Vulnerability Index (EVI) has been developed by the South Pacific Applied Geoscience Commission, UNEP and the Secretariat of the Pacific Community. It is designed as a rapid and standardized method to assess sustainable development progress and to be used with economic and social indices. The specific focus is on (and for) small island developing States in response to the Barbados Programme of Action (Section C5: 113-114). The EVI uses 50 ‘smart’ indicators, classified into types (weather and climate, geology, geography, resources and services, human populations), aspects (e.g. hazards) and a range of sub-indices (EVI, 2013). Whilst not specifically marine, this synthesis framework groups countries according to five vulnerability classification (from extremely vulnerable to resilient).

Summary

The Ecosystem Approach is widely accepted in international and national policy as a valuable framework to guide the sustainable development of marine and coastal ecosystems. In addition to factoring in human activities and social choices more emphasis is placed on integrity of the ecosystem

than previous site-based and/or target species approaches to conservation. Application of the Ecosystem Approach to marine regions relies on establishing a coordinated system of ecological and operational objectives, informed by indicators, limits and targets. Such applications have been implemented in the marine context with varying success by UNEP RSP, GEF-LME Projects and a number of global initiatives with regional dimensions. A better understanding of which indicators are being used, and their utility in demonstrating application of the Ecosystem Approach at the regional scale, would help make more explicit the value of regional entities and strengthen arguments to support their work. Furthermore it makes sense to avoid duplication. Regional indices should ideally nest within and feed global initiatives established to measure environmental condition or change (these range between using 4 - 260 indicators) with the intention of reporting on sustainable development progress and/or state of the environment.

References

Ban, NC, Bax NJ, Gjerde KM, Devillers R, Dunn DC, Dunstan, PK, Hobday AJ, Maxwell SM, Kaplan DM, Pressey RL, Ardron JA, Game ET and Halpin PN (2013) Systematic conservation planning: a better recipe for managing the high seas for biodiversity conservation and sustainable use. Conservation Letters 00(2013): 1-14.

Convention on Biological Diversity (2010) Strategic Plan for Biodiversity 2011-2020, including Aichi Biodiversity Targets. Available online: http://www.cbd.int/sp/ [Accessed 3 July 2013]

Convention on Biological Diversity (2013) Ecosystem approach. Available online: (http://www.cbd.int/ecosystem/) [Accessed 2 July 2013]

Chin, A., Lison De Loma, T., Reytar, K., Planes, S., Gerhardt, K., Clua, E., Burke, L., Wilinson, C. (2011) Status of Coral Reefs of the Pacific and Outlook: 2011. Global Coral Reef Monitoring Network 260pp

Duda, A.M. and Sherman, K. (2002) A new imperative for improving management of large marine ecosystems. Ocean & Coastal Management 45 (2002): 797-833

EVI (2013) The EVI Indicators. Available online: http://www.vulnerabilityindex.net/EVI_indicators.html [Accessed 9 July 2013]

Halpern, B.S., Longo, C., Darren, H., McLeod, K.L. et al. (2012a) An index to assess the health and benefits of the global ocean. Nature, 488: 615-620

Global Partnership for Oceans (2013) Available online: http://www.globalpartnershipforoceans.org/about?active=3. [Accessed 7 July 2013]

Halpern, B.S., Longo, C., Darren, H., McLeod, K.L et al. (2012b) An index to assess the health and benefits of the global ocean. Supplementary Information. Nature, 488: 615-620 doi:10.1038/nature11397

ICES (2005) Guidance on the Application of the Ecosystem Approach to Management of Human Activities in the European Marine Environment, ICES Cooperative Research Report, No. 273, 22pp

ICRI (2012) Tropical Americas Coral Reef Resilience Workshop Report. Available online: www.icriforum.org/sites/default/files/GCRMN_Tropical_Americas_Coral_Reef_Resilience_Find_Workshop_Report.pdf [Accessed 4 July 2013]

IW:LEARN (2009) Development of Methodologies for GEF Transboundary Water Assessment Programme (TWAP). Available online: http://twap.iwlearn.org/publications/databases/view [Accessed 7 July 2013].

Joint Nature Conservation Council (2013) Twelve Ecosystem Approach Principles. Available online: (www.jncc.defra.gov.uk/page-6380) [Accessed 2 July 2013].

Murawski, S.A. (2007) Ten myths concerning ecosystem approaches to marine resource management. Marine Policy 31 (2007): 681-690.

Olsen, S.B. (2003) Frameworks and indicators for assessing progress in integrated coastal management initiatives. Ocean & Coastal Management 46: 347-361

Olsen, S.B., Sutinen, J.G., Juda, L., Hennessey, T.M. and Grigalunas, T.A. (2006) A Handbook on Governance and Socioeconomics of Large Marine Ecosystems. University of Rhode Island, 96pp

POST (2011) POSTNOTE 377 May 2011 The Ecosystem Approach. UK Houses of Parliament, Parliamentary Office of Science and Technology

Rochette J and Chabason L. (2011) A regional approach to marine environmental protection: the regional seas experience, in Jacquet P., Pachauri R., Tubiana L. (eds) A planet for life 2011, TERI Press, pp111-121

Sherman, K. and Duda, A.M. (1999) An ecosystem approach to global assessment and management of coastal waters. Marine Ecology Progress Series Vol. 190: 271-287, 1999

Sherman K and Hempel G (eds) (2008) The UNEP Large Marine Ecosystem Report: A perspective on changing conditions in LMEs of the world's Regional Seas. UNEP Regional Seas Report and Studies No. 182. UNEP, Nairobi Kenya.

UNCSD (2012) The Future We Want. Available online: http://www.uncsd2012.org/thefuturewewant.html [Accessed 4 July 2013]

UNDESA (2007) Indicators of Sustainable Development: Guidelines and Methodologies. Third Edition.

UNDESA (2013) Sustainable development Knowledge Platform. Available online: http://sustainabledevelopment.un.org [Accessed 7 July 2013]

UNDOALOS (2010) Ecosystem Approach. Available online: (https://www.un.org/depts/los/ecosystem_approaches/ecosystem_approaches.htm). [Accessed 2 July 2013]

UNDOALOS (2012) Oceans Compact. Available online: https://www.un.org/Depts/los/ocean_compact/oceans_compact.htm [Accessed 22 August 2013]

UNDOALOS (2013) A Regular Process for Global Reporting and Assessment of the State of the Marine Environment, including Socio-economic Aspects (Regular Process). Available online: http://www.un.org/depts/los/global_reporting/global_reporting.htm [Accessed 30 August 2013]

UNEP (2005) Regional Seas Partnerships for Sustainable Development, UNEP, 2005. 60pp.

UNEP (2011) Marine and Coastal Strategy. Available online: http://www.unep.org/ecosystemmanagement/Portals/7/Documents/UNEPs_Marine_&_Coastal_Strategy_Executive_Summary.pdf [Accessed 6 September 2013]

UNEP, IOC-UNESCO (2009) An Assessment of Assessments, findings of the Group of Experts. Startup phase of the Regular Process for Global Reporting and Assessment of the State of the Marine Environment including Socio-economic aspects. UNEP and IOC-UNESCO, Malta.

Wilkinson, C. (ed.) (2008) Status of Coral Reefs of the World: 2008. Global Coral Reef Monitoring Network and Reef and Rainforest Research Center, Townsville, Australia 296pp

3. The purpose and remit of this study

At a time when ocean governance is coming under increasing scrutiny it is appropriate to consider how best to align regional initiatives with international developments and reflect on the appropriate level of commonality between measurements of the effectiveness of regional entities. Previous chapters in this report have considered the evolution of related considerations and developed a clear rationale as to why the examination of regional ecosystem-based indicators is needed. The aim and objectives of this report are set out below together with the methodology adopted upon which conclusions are drawn and recommendations proposed.

Aim and objectives

The aim of this report is to consider the relevance of a set of indicators capable of comparing a number of common regional marine ecosystem issues and major sources of stress and threats to the functioning of those ecosystems. The intention is to elicit a standardized approach that is both repeatable in different regions and over time (i.e. one that would also input to comparative global assessments as currently envisaged on a periodic basis).

The objectives of this report are to explore:

a) If it is feasible for regional organisations to agree to adopt and monitor a common set of indicators and indices (a so-called 'coordinated set'), with the possibility of developing a future associated sub-set of suggested parameters. If so how would this relate to global indices in operation or currently under design?
b) Whether the indicators and indices being monitored by regional entities are sufficiently linked to the goals and objectives they have set themselves or those which have been set globally?
c) How the indicators and indices differ between those used to track down the state of the marine environment and those to gauge success against marine environmental performance targets?

In order to meet these objectives the report therefore aims:

a) To collect and collate information on the marine ecosystem-based indicators and indices currently being measured by regional entities for the purposes of state of the environment reporting and tracking down the achievements of regionally agreed, ecosystem-based objectives and targets;
b) To analyse these indicators to find common elements to be used for continuing regional state of the environment reporting in order to formulate recommendations to the ongoing discussion on the global state of the environment reporting; and
c) To scope a generic set and/or sub-set of indicators, with associated scientific background that the UNEP Regional Seas Programme (RSP) may consider adopting. In this way the report is also intended as a contribution to future direction setting for the RSP.

Methodology

Initial consideration was given to 'which regions' - ecoregions, RSCAPs, LMEs, global ocean assessment regions, regions comprising EEZs of groups of States - should be examined for their use of marine ecosystem-based indicators.

Marine 'ecoregions' based on biogeographic characteristics have been defined by Spalding et al. (2007 p575) as 'areas of relatively homogeneous species composition, clearly distinct from adjacent systems" dominated by "a small number of ecosystems and/or a distinct suite of oceanographic or topographic features'. The Marine Ecoregions of the World (MEOW) classification, developed within the Census of Marine Life (www CoML), identifies 232 marine ecoregions nested into 62 provinces which in turn fit into 12 major realms. Both RSCAPs and LMEs have been determined partly on a biogeographic basis but influenced by administrative (practical) and political considerations. The regions adopted for the Global Ocean Assessment are much larger and more like MEOW realms.

Entities/target programmes to be researched for this study include the Regional Seas Programme, GEF-LME projects in operation and key global marine assessment programmes with regional dimensions (see Chapter 2). As the report's main objective is to provide recommendations for regional seas in setting core and their specific indicators, the information collection targeted the 18 regional seas programmes under the UNEP Regional Seas Programme as well as the GEF funded regional marine projects were Startegic Action Programmes were adopted in which the regional state of the marine environment reporting and regional management objectives/goals are described. Specifically therefore information was sought from:

Northwest Pacific	Northwest Pacific Action Plan	NOWPAP	http://www.nowpap.org/
Black Sea	Black Sea Commission (BSC)		http://www.blacksea-commission.org/
Red Sea and Gulf of Aden	The Regional Organization for the Conservation of the Environment of the Red Sea & Gulf of Aden	PERSGA	http://www.persga.org/
Bahrain, I.R. Iran, Iraq, Kuwait, Oman, Qatar, Saudi Arabia and the United Arab Emirates	Regional Organization for the Protection of the Marine Environment	ROPME	http://ropme.org/home.clx
South Pacific	Secretariat of the Pacific Regional Environment Programme	SPREP	http://www.sprep.org/
Antarctic	Commission for the Conservation of Antarctic Marine Living Resources	CCAMLR	http://www.ccamlr.org/
Caribbean	Caribbean Large Marine Ecosystem Project	CLME	http://www.clmeproject.org/
Baltic Sea	Helsinki Commission	HELCOM	http://www.helcom.fi/
Bay of Bengal	Bay of Bengal Large Marine Ecosystem Project	BOBLME	http://www.boblme.org/
South China Sea	South China Sea Project	SCS	http://www.unepscs.org/
East and Southern Africa	Nairobi Convention		http://www.unep.org/nairobiconvention/
Aghulas and Somali Currents	Aghulas and Somali Currents Large Marine Ecosystem Project	ASCLME	http://www.asclme.org/
South Asian Seas	South Asian Seas	SASP	http://www.sacep.org/html/s

	Programme		as.htm
Wider Caribbean	The Caribbean Environment Programme	CEP	http://www.cep.unep.org/
South East Pacific	Comisión Permanente del Pacifico Sur	CPPS	http://www.cpps-int.org/
North East Atlantic	OSPAR Commission	OSPAR	http://www.ospar.org/
East Asia	Partnerships in Environmental Management for the Seas of East Asia	PEMSEA	http://www.pemsea.org/
Arafura-Timor Seas	Arafura and Timor Seas Action Plan	ATSEA	http://www.atsea-program.org/
Humboldt Current	Towards Ecosystem Management of the Humboldt Current Large Marine Ecosystem	HCLME	http://humboldt.iwlearn.org/
Mediterranean	Mediterranean Action Plan	MAP	http://www.unepmap.org/
West and Central Africa	Abidjan Convention	WACAF	http://abidjanconvention.org/ /
Benguela Current	Benguela Current Commission	BCLME	http://www.benguelacc.org/
Guinea Current	Guinea Current Large Marine Ecosystem Project	GCLME	http://gclme.iwlearn.org/
Gulf of Mexico	Integrated Assessment and Management of the Gulf of Mexico Large Marine Ecosystem	GOMLME	http://gomlme.iwlearn.org/en
Yellow Sea	UNDP/GEF Yellow Sea Large Marine Ecosystem Project	YSLME	http://www.yslme.org/
Arctic	Arctic Council		http://www.arctic-council.org/index.php/en/
Celebes-Sulu-Sulawesi Seas	Celebes-Sulu-Sulawesi LME		

Table 1: List of organisations / projects from which information was sought

Ecosystem-based indicator data was obtained for these organisations through secondary sources (website, state of the environment reports). Once compiled summaries of the indicator sets being used were sent to each organization, together with a simple self-completing questionnaire (as at Annex x), for validation. As the regional organisations selected are predominantly using a modified DPSIR approach, an initial grouping was also made of the ecosystem-based indicators into PSR categories.

The indicators being used were then grouped by themes. Initially indicators were allocated to the following principal areas:

a. Living and non-living resources
b. Coastal resource availability
c. Water quality and contaminants
d. Physical parameters

e. Drivers, pressures and stresses
f. Socio-economic parameters
g. Management responses

Further allocation of indicators being used by selected entities was also made into one of 67 sub-topic themes (see Table 2).

This audit of indicators and indices was then analysed drawing upon individual organisations' responses to the questionnaires to determine commonality and critically evaluated to highlight good practice.

Fishing effort	Fishing
Climate - general	Compliance
Climate change	Certification
Sea level rise	Human activities other than fishing
Biodiversity	Ecosystem Goods & Services
Distribution/phenology/abundance/interactions	Ecosystems - general
Species composition / number /richness	Coast
CO2	Coral
SST	Mangroves
Sea Ice	Wetlands
Other Physical	Seagrass
Primary Productivity	Halophytes
Threatened species & habitats	Algae / Macroalgae
Habitats - general	Freshwater vegetation
Protection	Birds
Bathing water quality	Turtles
Eutrophication	Fish
Sediment	Reef Fish
Erosion	Marine mammals
Nitrogen / Phosphorus / Nutrients	Invertebrates
HAB	Soft--bottom communities
Pesticides	Non--coral reef hard substrate
Oxygen / Hypoxia / HS	Shipping
Chl / Chl a	Indices
Bacteria / Coliform	Monitoring & Evaluation
Water quality / Waster water – general	Tourism
Pollution - general	EEZ
Marine Litter	Social
Hazardous Substances	Commuity
Oil / Petroluem	Human health
NIS / IAS	Economic
Jellyfish	Management
Zooplankton	Forests
Trophic Status	

Table 2: Sub-topic themes

Structure of this report

This remainder of this report sets out the information researched as follows:

a) Chapter 4 - analyses the indicator systems in use or being developed in order to determine levels of commonality and pragmatic considerations such as the use of publically available global datasets;
b) Chapter 5 - presents the marine and coastal ecosystem-based indicator datasets collated from the 27 organisations/entities sampled and individual case studies illustrating specific aspects of how regional indicators and indices have been developed and are being used;
c) Chapter 6 - sets out a critical evaluation and proposal / justification for what is most suitable for the collective RSP taking into account scientific rigour, future needs, practicality and costeffectiveness; and
d) Chapter 7 - draws conclusions and recommendations.

References

Spalding, M.D., Fox, H.E., Allen, G.R., Davidson, N. Ferdana, Z.A., Finlayson, M., Halpern, B.S., Jorge, M.A., Lombana, A., Louroe, S.A., Martin, K.D., McManus, E., Molnar, J., Recchia, C.A., and Robertson, J. (2007) Marine Ecoregions of the World: A Bioregionalization of Coastal and Shelf Areas. Bioscience Vol. 57 No. 7, July/August 2007: 573-583

www CoML Available at:www.comlmaps.org/how-to/layers-and-resources/boundaries/marine-ecoregions-of-the-world [Accessed 30 July 2013]

4. Assessment of regional indicator systems developed to date

This chapter provides discussion of the research results drawing particularly upon the questionnaire responses. A distinction is made between State of the Environment reporting and indicators for specific targets and/or objectives. An assessment of why indicator data is collected, how often information is collated and whether the indicator systems that have evolved are fit for purpose is presented. Finally, opinion on constraints applying to indicator selection, application and communication are considered.

State of the Environment Reporting

A number of entities within the Regional Seas Partnership have now produced a succession of periodic State of the Environment reports as a means of summarizing complex information for policy makers. These summary documents convey information on multiple pressures acting simultaneously, often drawing upon and aggregating individual assessments and accounting for cumulative impacts (e.g. UNEPMAP, 2012). Complementary topic specific reports are also published by some RSCAPs (e.g. HELCOM Pollution load reports; SPREP State of Pacific Coral reef Reports).

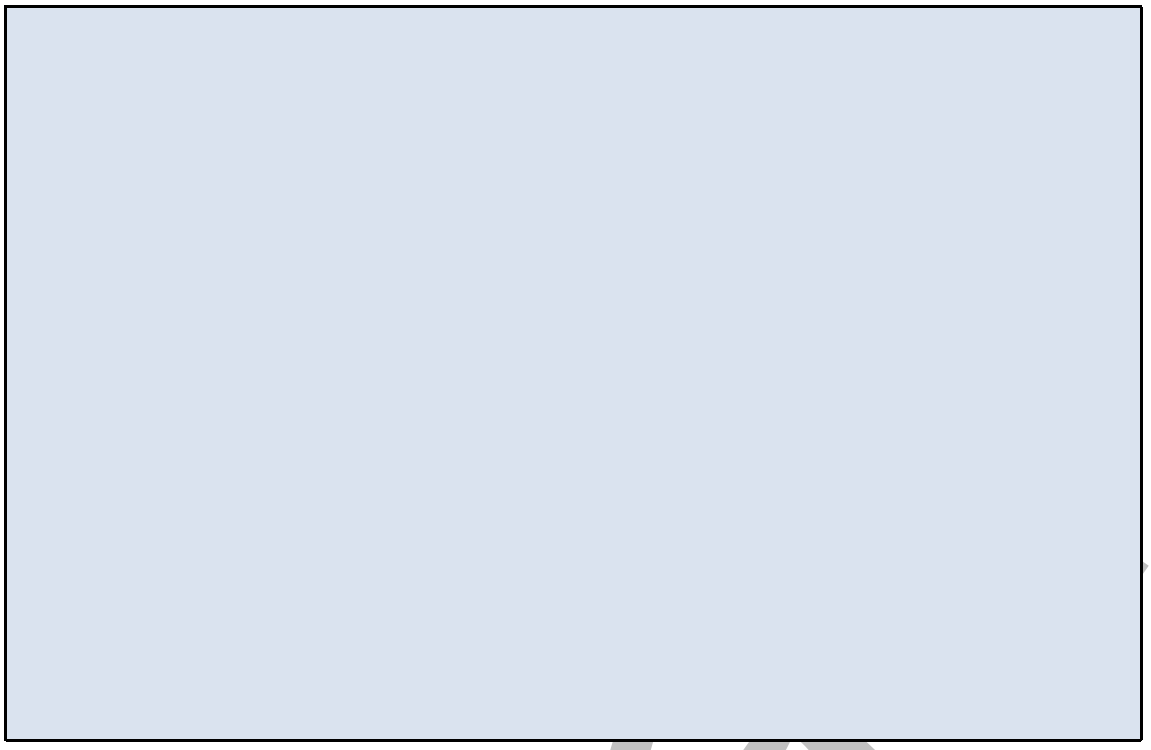
For other RSCAPs where such a reporting mechanism is not in place, plans to develop State of the Marine Environment reports are underway or envisaged. For example, some countries within the Abidjan Convention have a Pilot Project to develop a reporting template that seeks to adapt the UN Global Ocean Assessment (Regular Process) to the West African context (see draft template as at Annex x). ore in some instances, where no regular comprehensive state of the environment report has yet been produced, interim reports on specific aspects have been produced. For example, the CEP has produced two comprehensive reports to date on pollution loading to the marine environment of the Wider Caribbean.

Similarly during the first phase of LME Programmes a main objective is to develop Transboundary Diagnostic Analyses (TDAs) as well as establishing Demonstration Pilot Projects and Regional Institutional Mechanisms. Information on current status of marine resources and the environment (both biophysical and socio-economic aspects) is gathered to establish a baseline that informs the condition/quality assessment presented in the LME's regional Strategic Action Programme (SAP). Again this is often based on benchmark studies (e.g. BOBLME study on Performance in managing hilsa and Indian mackerel in the Bay of Bengal). Following this 'initial assessment' in some cases subsequent evaluations are undertaken. For example, the Arafura-Timor Seas plan to undertake a mid-term evaluation/update (after 5 years) of implementation progress and a final evaluation (after 10 years) of changes to process, pressure and state in the ATSEA region resulting from the implementation of their SAP.

However, both the quality and frequency of these reports varies. Efforts to achieve greater consistency of national reporting as a basic input to consolidated assessments and reports have generally concentrated on development and refining reporting formats.

The frequency of State of the Environment reporting is a political decision (see the example of OSPAR below). Some RSCAPs set a regular period (e.g. Black Sea every 5 years) but others are more flexible. For example, ROPME has produced State of the Marine Environment Reports in 1999, 2000, 2003 and a fourth is scheduled for 2013. As a consequence political agreement can trigger the start of State of the Environment reporting. For example, entry into force of the CEP Land Based Sources

of Marine Pollution Protocol has led to approval of an outline for a first State of Convention Area Report.



Some entities, such as CCAMLR, whilst not producing a State of the Environment report, instead periodically assess the status and trends of marine resources. For CCAMLR this applies to components of the Southern Ocean marine ecosystem with a focus on living resources that are the target of harvesting activities together with associated and dependent species.

All entities are aware of the UN Global Ocean Assessment (Regular Process) and have variously contributed to a round of Regional Workshops. For example, within this process CPPS have compiled and digitized 158 assessment documents for their region (CPPS, 2013).

Indicator systems linked to State of the Environment reporting

Predominantly, State of the Environment reporting is underpinned by 'state' indicators. Jennings (2008) considered these state indicators most suited to long-term policy-focused feedback on the effects of management action with pressure and response indicators rather guiding short-term management decisions. State indicators generally describe an ecosystem-based component or process and that parameter's quality relative to the baseline and/or previous assessments.

A number of entities have well-established indicator systems (see HELCOM case study in Chapter 5). For others the development of an indicator system is a dynamic process. For example, traditionally

[6] http://www.ospar.org/content/content.asp?menu=00650830000000_000000_000000

[7] http://qsr2010.ospar.org/en/index.html

[8] 10 OSPAR Contracting Parties are EU Member States bound by the MSFD.

OSPAR has not articulated its monitoring and assessment activities around the 'indicator' notion (but rather on a basis in which parameter monitoring data and other information would be combined into more integrated assessments). However, this is now changing. The OSPAR Commission and its Secretariat have been preparing over the last two years the existing regularly reported data streams for more extensive use, including in the context of OSPAR Assessment Sheets and indicators, i.e. 'smaller units of assessment'. The OSPAR Commission meeting of 24-28 June 2013 agreed a first set of common indicators and of candidate indicators which will become a more important component of the Joint Assessment and Monitoring Programme (JAMP), which is OSPAR's umbrella programme for such activities. The next JAMP is due to be adopted by OSPAR 2014 and should cover the period from 2014 until the next QSR (2021).

And for several entities development of an indicator system is work in progress. For example, NOWPAP has devised draft indicators as part of Ecological Quality Objectives to be presented to the 18th NOWPAP Intergovernmental Meeting in December 2013. Use of indicator systems is generally also becoming more sophisticated, moving from descriptive qualitative approaches to more quantitative assessments (e.g. PERSGA).

Humbolt Current LME are using the Ocean Health Index and are encouraging the governments of Chile and Peru to look closely at the indicators where they currently have a zero score. In addition they use the Management Effectiveness Tracking Tools for IW and BD as designed by GEF. There is also an Insignia Species list with species selected to reflect the state of the HCLME health in terms of population dynamics. Further indicators are to be selected as a consequence of the CCA work.

Selection of State of the Environment reporting indicators

Considerable technical discussion by region specific assessment and monitoring working groups has been undertaken to date and continues to underpin proposals for indicator systems.

For some entities this can be project-based. For example, CPPS SPINCAMproject identified a series of national indicators, and five regional indicators (coastal population dynamics, marine water quality, marine protected areas coverage, biodiversity, and advances in Integrated Coastal Zone Management using different approaches). These indicators were selected through workshops in participative processes with most relevant stakeholders of CPPS member states in the region (Chile, Colombia, Ecuador, Panama and Chile).

For PEMSEA the process of developing the set of indicators for their State of the Coasts reporting entailed a series of consultations with experts on environmental assessments, and the compilation, analysis and preparation of a matrix of indicators from various environmental assessments and management programs conducted within and outside the East Asia Seas (EAS) region. From the matrix, a total of 160 indicators were selected based on the following criteria: a) simple and meaningful; b) easy applicability in the EAS region; and c) complementary to the indicators identified in relevant international instruments. The selected indicators for the SOC were organized in accordance with the Sustainable Development of Coastal Area Framework. From the 160 indicators, 35 core indicators were determined as the essential information needed to evaluate the progress in ICM implementation based on PEMSEA's experience in developing and implementing ICM programs at the local government level. Details on the indicators can be accessed through http://www.pemsea.org/publications/guidebook-state-coasts-reporting.

For the RSP indicator selection has been generally regionally specific, with each entity giving due consideration to methodologies (e.g. PERSGA Standard Survey Methods for key habitats and species groups). European entities have sought commonality on the basis of selection criteria linked to monitoring parameters with the potential for use in the context of EU MSFD 'good environmental

status' (either its determination or as a tool to evaluate progress towards a target) and an important factor has been the degree of (sub) regional transboundary interest. Selection is also influenced by the availability of monitoring data tempered by economic reality as well as scientific justification. HELCOM, for example, stated that most of the indicators they have selected are based on traditional monitoring activities, not targeted to note small-scale pollution sources or pressures. HELCOM are also engaged in a process to evaluate how well remote sensors or automatic buoys could be used to replace ship-based monitoring.

Many LMEs have had a tendency to adopt TWAP indicators, thus their selection process is more prescribed and generic. In addition CLME state that work to be initiated in the second half of 2013 (to include process, stress reduction, environmental and socio-economic status indicators) will make reference to Causal Chain Analysis of environmental degradation and development under their TDAs.

Specific management targets and/or objectives

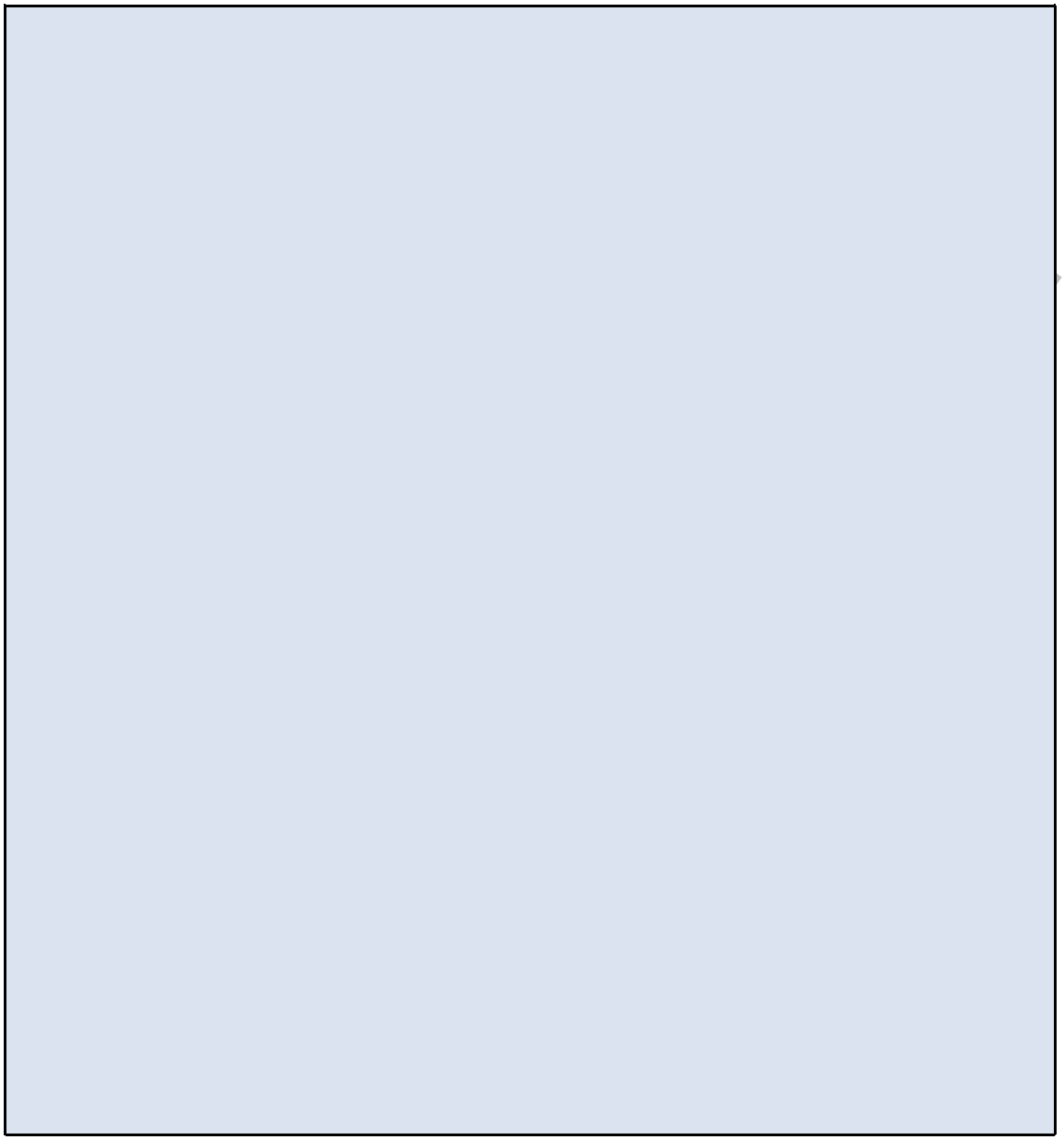
The effectiveness of any Strategic (or Regional) Action Plan, to improve and/or maintain the state of the environment, is generally measured in terms of rate of progress against specific targets or quantitative thresholds. Diagnostic reports also feed into any revisions of the SAPs.

Such targets stem from the adoption of Protocols and/or Annexes to Regional Conventions and dictate and/or inform Programmes of Work. For example, the Bucharest Convention has five associated Protocols and has adopted two Strategic Action Plans (one in 1996 based on policy actions and the second in 2009 based on Ecosystem Quality Objectives and respective management targets). HELCOM has established a vision, four strategic goals and ecological objectives: assessment of the implementation of Baltic Sea Strategic Action Plan 2009 (which will be completed provisionally in 2015) relies on three sets of monitoring and evaluation indicators. The Nairobi Convention takes due account of the West Indian Ocean SAP alongside its Protocols which together provide the mandate for developing indicators. OSPAR adopted a North-East Atlantic Environment Strategy at ministerial level and a set of Ecological Quality Objectives, originally adopted under the Ministerial North Sea Conferences, is still being mainstreamed into the overall OSPAR monitoring and assessment approach.

Targets therefore are largely driven by the national and regional requirements of Contracting Parties. For example, UNEP-MAP set an outlook for sustainable development while the achievements are tracked using agreed indicators (Plan Bleu, 2012). Such targets should also be informed by and compatible with marine-related intergovernmental targets such as the marine-related Aichi Targets and ecosystem-related fisheries targets and pan-regional obligations such as the EU MSFD. The level of commitment (aspirational / legally binding) varies across different contexts. For example, the 'good environmental status' objective of the EU MSFD is a driver for development of assessment methods and criteria, as this is a legally binding objective (subject to MSFD-internal qualifications).

The Sustainable Development Strategy for the Seas of East Asia (SDS-SEA, 2003), which was adopted by 12 countries in the EAS region in 2003, consists of 6 strategies and 227 action programs that Countries commit to implement for the sustainable development of coastal and marine areas. It also serves as a platform for Countries to achieve the goals of key international agreements and action plans. In line with SDS-SEA implementation, key sustainable targets were identified in the Haikou Partnership Agreement (2006), Manila Declaration (2009) and the Changwon Declaration (2012), which were adopted by the countries in the EAS region. At the local government level, targets for the sustainable development of coastal and marine areas are embodied in their Coastal Strategy, Coastal Strategy Implementation, Strategic Environmental Management Plans, and Local Development Plans.

CPPS stated that there are several programs associated to the Southeast Pacific Action Plan generating information and assessments that eventually would allow defining a set of monitoring and management indicators of global scope.Within their region a regular monthly newsletter has been published for more than 20 years for monitoring of climate conditions in the South Pacific related to El Niño. Bulletins are available on: http://cpps-int.org/images/BAC/bac_eng/BAC%20Issue251-%20ABSTRACT%20VERSION.pdf



Thus target setting for the RSP contains a strong political dimension. This is also true for LMEs as their SAPs must be endorsed by Ministers, a Regional Mechanism then becomes the overall body responsible for monitoring and evaluation of the SAP with annual reporting of implementation progress and key indicators and 3-yearly reporting on the SAP Implementation Plan. For example, ATSEA have 5 Ecosystem Quality Objectives and 7 Operational Objectives each with quantitative targets to

be achieved within a fixed time period (linked to other agreed actions e.g. IUU Fishing regional Plan of Action) (see Box 2).

Many LMEs are still establishing performance indicators e.g. BOBLME draft indicators currently under review in the draft SAP.

Periodic collection of information

For regional entities with more established indicator systems most data streams have an annual reporting requirement with specific reporting formats. For example, CCAMLR requires annual submission of data, which is then reviewed and presented to their Scientific Committee. The HELCOM Monitoring and Assessment Strategy (HELCOM, 2013) includes a six-year assessment cycle. Therefore each core indicator must be assessed at least once in six years to give input to integrated assessments. Depending on core indicators, the frequency of updating varies from 1 to 6 years, but most core indicators are updated annually. Baltic Environment Fact Sheets are updated mainly annually. OSPAR has a Coordinated Environmental Monitoring Programme, which prescribes agreed reporting procedures for Contracting Parties to submit data annually to qualified data centres. CPPS has a programme of annual cruises that have now been ongoing for 14 years.

LMEs stipulate what must be collected and analysed as part of their SAP implementation. This means that data is not necessarily collected periodically. BOBLME and ATSEA confirmed that data and information were collected for the purpose of developing TDA and SAP (and NAPs). Subsequent collection can be region specific and not necessarily driven by any annual cycle. For example, ASC stated that many ocean-atmosphere data are collected on a near real time basis.

Iterative development

Considerations of whether indicator systems are 'fit for purpose' sought to understand whether systems in place are working or not. This was clearly not relevant for those entities whose indicator systems are still under initial development and/or yet to be implemented (e.g. Abidjan Convention, ATSEA, ASC, SPREP). For those not currently at the point of regular, targeted reporting - the aim of current efforts is to streamline indicators and build capacity in State of the Environment reporting.

Some entities considered any judgement of the effectiveness of indicator systems to be an on-going process. For example, technically, and in so far that OSPAR monitoring and assessment in the past was not indicator-based, OSPAR indicators are not yet 'working'. The (expected or actual) performance of indicators will be part of the discussion during development and will also be examined alongside their application. As any activity, monitoring and assessment activities also lead to 'learning by doing' and hence changes can be made as necessary. The decision basis of the indicators is quite flexible (a so-called 'agreement' in OSPAR, not a formal Recommendation or Decision) so that the set of indicator or the technical description of indicators can be amended at the Committee or OSPAR Commission level. For the Black Sea Commission testing is progressive: once the relevance of indicators selected so far is proved, work will continue for development of other indicators. Likewise PEMSEA consider their indicator development as an iterative, evolving process that will be enhanced to capture indicators covering emerging issues, key developments in various international instruments and site-specific requirements. Several LMEs stated that the effectiveness of their indicators will be tested as part of the TWAP 2nd level assessment.

For HELCOM, in principle each core indicator has been tested against real data and time series. HELCOM state the main difficulty is to judge whether the dynamics is caused by anthropogenic pressures or natural variation and where to place the threshold for good environmental status (GES). The expert groups responsible for the core indicators are tasked to evaluate the performance of the core indicators and the GES thresholds and adjust them if necessary. Some other entities, such as PERSGA, problems with lack of time series and limited spatial coverage made indicator systems less effective (see constraints below). For entities whose indicators are linked to compliance (e.g. CCAMLR, CPPS) agreed standards are also regularly reviewed by an expert group.

Constraints on indicator selection and application

For all regional entities the development of indicator systems is a technical and financial burden. These related factors have impacted on indicator system choice and effectiveness. For example, SAS stated that the agreement on indicators tailor-made to the conditions of South Asia as well as monitoring them depends on financial and technical support as well as political commitment from member governments. Technical capacity to undertake periodic monitoring and survey activities was frequently cited as a limiting factor, not only by regional entities currently developing indictor systems but also by those with established processes (e.g. PERSGA). In some cases this is exacerbated by limited access to data, particularly from State organisations (e.g. HCLME; ROPME). Regions with diverse governance arrangements face particular challenges in this respect (e.g. SPREP).

Similarly the cost of marine monitoring programmes is a significant current concern in many regions and this has been an important factor in the decision making process so far. Some indicators may require (a combination of) (1) expensive sampling or observation platforms and equipment; (2) highly specialised analytical or observation equipment; (3) highly qualified personnel. Another limiting factors is that the scale at which any of these can apply limit the application of 'economies of scale' and progressive cost-reduction with upscaling of operation. This is an area of great current concern not only for regions dominated by developing States but also, for example, in several European starting and on-going projects with which OSPAR, HELCOM and UNEP-MAP have links.

Efforts to work around these principle barriers include the application of technological solutions and capturing regional dimensions of global datasets. An example of the former is the Black Sea Commission who face financial constraints limiting their monitoring capacity (e.g. eutrophication indicators). Enhanced use of satellite observations and automated systems for monitoring respective parameters is therefore being explored. Special algorithms for use of satellite images to calculate Chlorophyll concentration for coastal and open-ocean waters are under development.

In terms of the latter in the BOBLME due to limited funds available in view of the vastness of the area (6.2 million km2) the productivity and fish and fisheries indicators (LME modules) will not be covered; this is mitigated by a) joining the IOGOOS (UNESCO-IOC) and b) establishing the ecosystem characteristics and developing an ecosystem model (CSIRO and UBC-SAUP). The Global Ocean Observing System (GOOS) is a scientifically designed permanent, international system for gathering, processing, and analyzing oceanographic observations on a consistent basis, and distributing data products. It gathers data by remote sensing, sea surface, and sub-surface instrumentation, from the openocean, coastal and shelf seas. GOOS products describe the state of the ocean globally at regular intervals. Data and data products are available to all States (GOOS, 1993).

Within this research study twelve entities reported the use of global datasets (Table 1).

Entity	Data sets	Purpose
BSC	http://oceancolor.gsfc.nasa.gov/	Environmental indicators (for state, pressure, impact) are calculated and used in the assessment
	http://www.enviport.org/meris/lv3_main.htm	
	http://www.myocean.eu/	
	http://www.emodnet-hydrography.eu/	
	http://www.emodnet-chemistry.eu/portal/portal/	
	http://bio.emodnet.eu/portal/index.php	
PERSGA	UNEP and others	Status of marine biomes (coral reefs, mangroves etc.)
	NOAA, and several other data types available from IOC, GOOS, GLOSS	Climate
ROPME	ESRI	For world base map
	UNEP World Conservation Monitoring Centre	For monitoring parameters
	World Database on Protected Areas (WDPA)	Area and location of PA sites within the ROPME Sea Area
	IOC-UNESCO	Reference for Taxonomic List of Harmful Micro Algae
	Global Ocean Observing System (GOOS)	Data parameter reference and sourcing of marine indicators
	Ocean Data Standards Pilot Project (ODS)	Data parameter reference
Nairobi Convention	UNEP Global Environment Outlook (GEO) Data Portal	Used for integrated environmental assessments and is accessible on http://geodata.grid.unep.ch/;
	The IUCN Red List	To track status of endangered or threatened flag ship species in the WIO coastal and marine environment
	UNEP Global Resource and Information Database (GRID)	Environmental alerts and atlases
	UNEP World Conservation Monitoring Centre (WCMC)	information on biodiversity and ecosystems
SACEP-SAS	Indicators developed by CBD, Biodiversity Indicator partnership, Protected planet, World Bank , FAO	
CEP	Data from the World Database of Protected Area Also OBIS, WOD/NOAA	Were used for some MPA datasets of the Caribbean Regional MPA Database
OSPAR		For issues of global interest e.g.

		MPAs, ocean acidification), on-going developments of data management take account of the global context. Where global datasets are available that can aid in OSPAR monitoring and assessment activities, the experts involved in the OSPAR work will endeavour to take this into account
BOBLME	SAUP	Fish and Fisheries MPA Satellite data (oceanography, hydrography)
	WDPA-WCMC	
	NOAA	
CLME		Global datasets are being used by CLME stakeholders. However the amount of CLME stakeholders is vast, and their data needs are substantial and diverse. Usefulness of global datasets is high, but detailed reporting on its full usefulness and applicability falls outside the scope of a questionnaire like this. We do see great utility however in undertaking such detailed analysis in due time.
ASCLME	Many global data sets	See: www.africanmarineatlas.org
CPPS	GOBI and CBD	Maps for the Atlas
HCLME	http://www.oceanhealthindex.org/	Please see areas for Chile and Peru

Table 1: Entities using global datasets

Collation and communication of indictor information

For most regional entities publications and assessments based on indicator information are uploaded on respective websites. However, databases and information portals are at various stages of development and not all allow open access. For example, CPPS has an ATLAS of metadata for different databases including biodiversity (distribution of whales, sharks, marine turtles), oceanographic data from regional cruises, pollution, and MPAs. ROPME is developing an online web application called the ROPME Integrated Information System (RIIS) located at www.riis-ropme.org, which will be formally launched in November 2013. RIIS databases are a compilation of ROPME's data on oceanographic cruises, contaminant surveys, satellite images and specific resources from Members States on their human resources, scientific studies and periodically updated environmental indicators. The RIIS is a map-based application with default general public domain access but special privileges are accorded to Member States to have more access and rights to update and modify data

The Black Sea Information System (BSIS) includes a database, developed recently within a project funded by EC-DG Environment (Baltic2Black). The database is dedicated to the collection of data for pollution; it is hosted by its developer, Ukrainian Scientific Centre for Ecology of the Se (UkrSCES) that functions as the Regional Activity Centre for Pollution Monitoring and Assessment (PMA RAC) and is available online at http://rdbp.sea.gov.ua/. Other databases have limited online accessibility for the time being. More efforts (financial, human resources) are considered necessary to maintain the already created system and databases functional.

CCAMLR has a database of CEMP sites, parameters and indices and although this is not available to the public, extracts can be released on request. For regional entities in Africa the African Marine Atlas acts as a repository for spatial data, and the Nairobi Convention Clearing house Mechanism for metadata. www.africanmarineatlas.org, http://gridnairobi.unep.org/CHMPortal/ptk

Several entities have databases under development and/or they are consolidating data and realigning information systems. Often this is in partnership with collaborative national scientific and research institutes as well as NGOs and specific donor assisted capacity building projects (see Box 3). For example the Abidjan Convention is working with GRID-Arendal, and in the same region the Spanish Oceanographic Institute developing a geo-referenced database on water quality, habitat and biodiversity of CCLME countries. For CLME a pilot project called "Prototype Information Management System/Regional Environmental Monitoring Programme" (see also www.clmeproject.org was executed by IOC of UNESCO. Preliminary results from this pilot project are currently available, but the final reporting (including on a proposed indicators set) has not yet been delivered. A prototype "Atlas and Information Booklet on the Status of the Marine Environment" is also envisaged.

Summary

For State of the Environment reporting ecosystem-based indicator systems have developed in an ad hoc way influenced by regional pressures and priorities. Indicator systems linked to targets and objectives have been more coordinated (TWAP and LMEs) and the EEA is an example of pan-regional coordination associated with regulatory requirements. Indicator information is most usually collected on an annual basis but this is not always the case with the possibility of some near real time data collection. Most indicator systems in place are being adapted and refined based upon evaluations of their usefulness and practicality. However, all regional entities regard them as costly and technically challenging. There is something of a mismatch between expectations of policy and ability to achieve reporting needs and an opportunity to consider which global data and information streams can best serve to support the needs of the RSP.

References

CEP Technical Report Number 33 and CEP Technical Report 52. Available online: http://www.cep.unep.org/publications-and-resources/technical-reports/technical-reports [Accessed 7.8.13]

Changwon Declaration (2012): Available online - http://www.pemsea.org/publications/toward-ocean-based-blue-economy-moving-ahead-sustainable-development-strategy-seas-east[Accessed 7.8.13]

CPPS (2013): Available online http://cpps.dyndns.info/cpps-docs-web/planaccion/biblioteca/pordinario/[Accessed 7.8.13]

GOOS (1993) The case for GOOS, GOOS publication No.1, 1993. GOOS Regional Alliances

Haikou Partnership Agreement (2006) - Available online http://www.pemsea.org/publications/haikou-partnership-agreement[Accessed 7.8.13]

HELCOM, 2013: Available online http://www.helcom.fi/groups/monas/en_GB/Draft_MonitoringStrategy_2013/

Manila Declaration (2009): Available online - http://www.pemsea.org/publications/manila-declaration[Accessed 7.8.13]

OSPAR (2010) Quality Status Report 2010. OSPAR Commission. London. 176pp.

Plan Bleu (2012) 20 years of Sustainable Development in the Mediterranean: Review and Outlook. Blue Plan Notes No 22 June 2012

SDS-SEA (2003): Available online - http://www.pemsea.org/publications/putrajaya-declaration-regional-cooperation-sustainable-development-seas-east-asia[Accessed 7.8.13]

UNEP-WCMC (2011) Developing ecosystem service indicators: Experiences and lessons learned from sub-global assessments and other initiatives. Secretariat of the Convention of Biological Diversity, Montreal, Canada. Technical Series No. 58, pp118

UNEP/MAP (2012) State of the Mediterranean Marine and Coastal Environment, UNEP/MAP - Barcelona Convention, Athens, 2012, pp92

5. Use of indicators to monitor progress in achieving targets and/or objectives

The aim of this chapter is to review existing indicators, currently being used by the entities identified. Of the 27 entities selected for the study (Table 1, Chapter 3), 18 provided responses to the questionnaire. Of these 9 were selected as case studies to illustrate different approaches and applications. As explained in Chapter 1, indicators and indices by their nature aggregate and simplify complex information. Explaining the choice of indicator suites can therefore easily miss important detail and underpinning scientific rationale for their adoption. To avoid this, supporting information can be found in to this report and by referring back to specific publications of individual entities.

Analysis revealed that over 1,250 indicators are either being used or are under consideration by the entities that provided information. For each of the topics the approximate number of indicators is given in Table 1. Some indicators have been assigned to more than one topic. In particular for the categories 'Water Quality and Contaminants', 'Socioeconomic Parameters' and 'Management and Response' indicators could be applicable to more than one category, for example BSC's 'lists of emissions developed' or ROPME's 'percentage of annual budget allocated for biodiversity issues'. Where this is the case the indicators have been assigned to both categories. Notwithstanding these complexities with allocation to category, living and non--living resource indicators are the most used category.

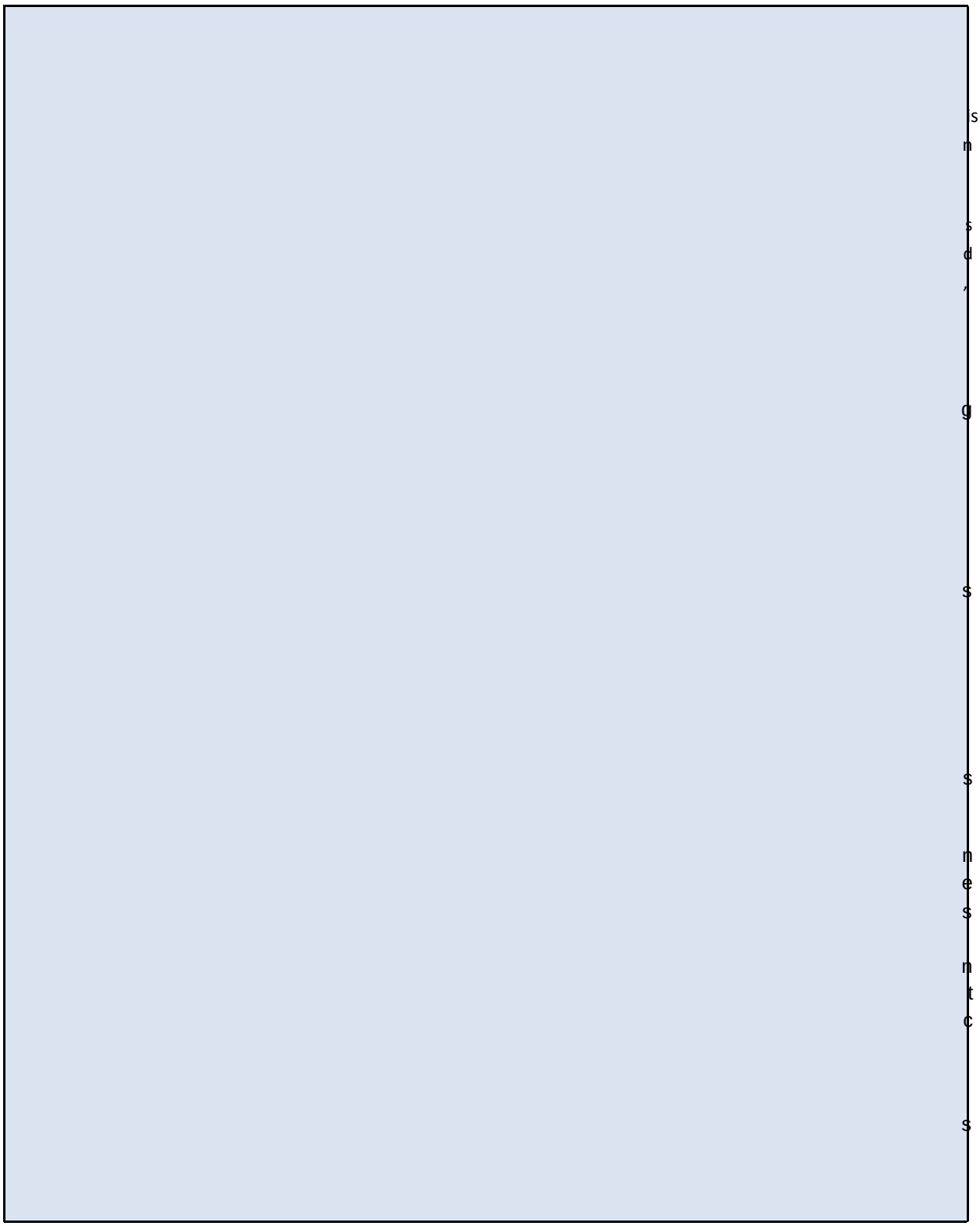
Category	No. of indicators
Living & Non-living Resources	451
Water Quality and Contaminants	270
Coastal Resource Availability	45
Physical Parameters	62
Drivers, Pressures and Stresses	118
Socio-economic parameters	197
Management and Response	228

Table 1. Number of indicators assigned to each category

Specificity

There was wide disparity between indicators. Some comprised an individual parameter such as 'number of strandings', 'bycatch', 'sea surface temperature', 'fishing gear': while other indicators comprised a combination of parameters, for example OSPAR's 'changes in proportion of large fish' or EEA's 'nutrients in transitional, coastal and marine waters'.

In some cases only very specific types of indicators are used when the entity is focused on one particular aspect of the environment such as biodiversity, e.g. CCAMLAR (Case Study 1).

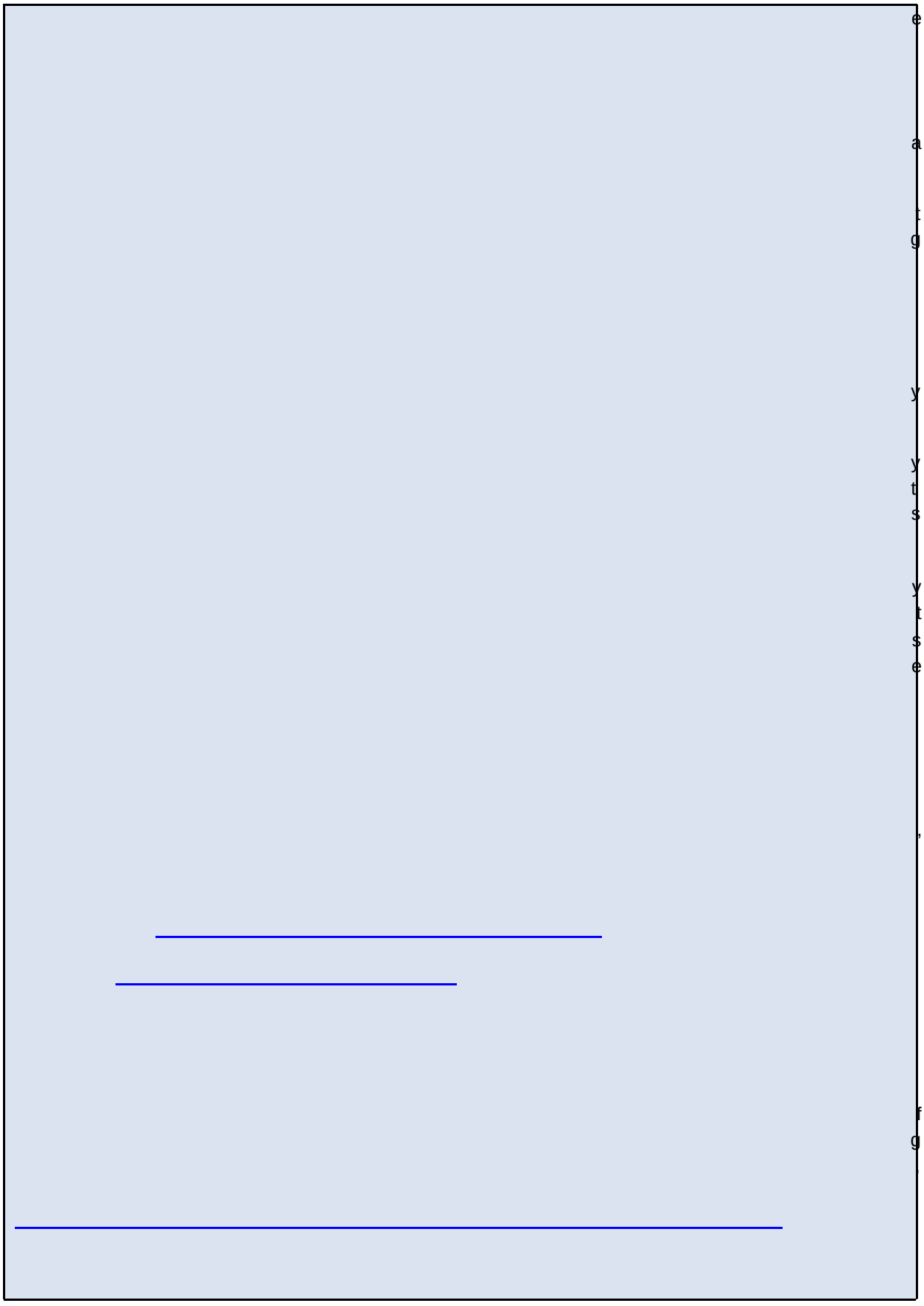


[9] Source: CCAMLR, 2004. Standard Methods. CCAMLR Ecosystem Monitoring Programme, CM 22-06 and CM 22-07)

[10] CCAMLR Standard Methods: http://www.ccamlr.org/en/system/files/std-meth04.pdf

[11] CM 22-06 (2012): Bottom fishing in the Convention Area http://www.ccamlr.org/sites/drupal.ccamlr.org/files//22-06_3.pdf

[12] CM 22-07 (2010): Interim measure for bottom fishing activities subject to Conservation Measure 22-06 encountering potential vulnerable marine ecosystems in the Convention Area http://www.ccamlr.org/sites/drupal.ccamlr.org/files//22-07.pdf



Numbers of indictors being used

The number of indicators being used by entities ranged from 5 for CPPS , derived from the SPINCAM Project[13] with a broad, generic coverage e.g. biodiversity, marine water quality, to 15 and 16 respectively for the Caribbean Environment Programme and Nairobi Convention, to many, in the case of the PERSGA, 158 (Case Study 2), very detailed, species-specific indicators.

[13] http://www.spincamnet.net/

In some, but not all, cases this may reflect not only the level of focus (e.g. CCAMLR application of indicators to VMEs) but also the level of maturity of indicator systems being used. Thus some entities only have indicators that are either proposed or under development (e.g. Caribbean Environment Programme) whilst others have been applying their systems over several years or decades. In the latter case the indicators have been and continue to be honed over time.

Some suites of indicators are very detailed (e.g. PERSGA, Case Study 2).

While very detailed metrics tend to complicate the 'bigger' picture they are vitally important for 'region specific' analyses to add specific information.

The most detailed suites of indicators relate primarily to particular aspects of biodiversity (living resources) but also to litter. For example, OSPAR lists 12 litter-types under the 'beach litter' category and a further 8 under the 'tourism and recreational activities' litter. Within all OSPAR categories of litter approximately 50 litter-types are listed.

Underlying rationale for indicator selection

Responses to the questionnaire show that there is a wide range underlying rationales for indicator selection. These include availability of data, scientific needs, local and regional government priorities, SAP requirements, environmental monitoring and monitoring implementation action plans.

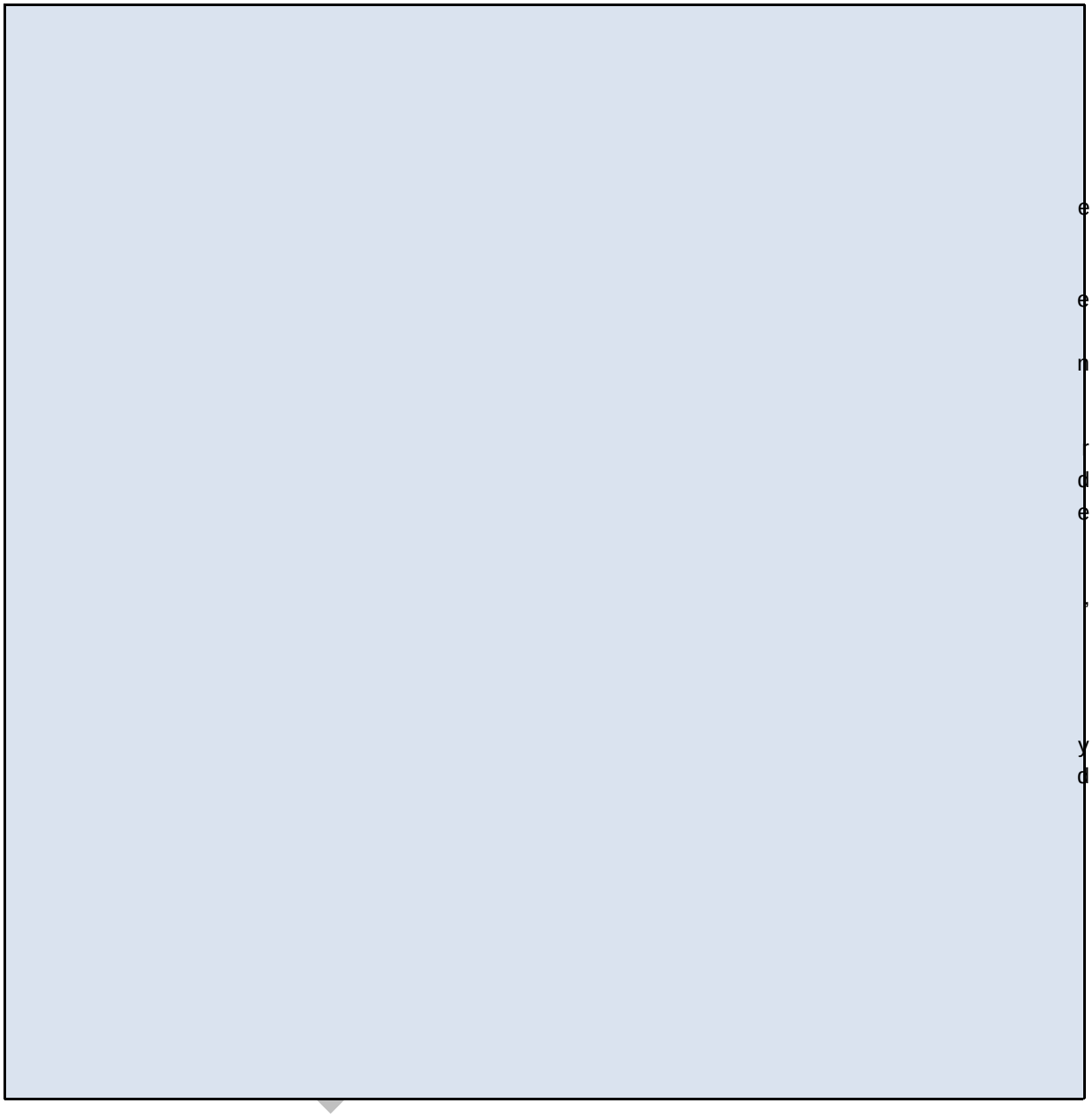
The very large number of indicators and the level and range of detail within the sets (presence/absence versus properties) made it difficult to gain a clear picture of the common themes being addressed. Grouping under the 6 original broad topic headings (Living/Non-living Resources; Water Quality and Contaminants; Coastal Resource Availability, Drivers, Pressures and Stresses; Socioeconomic Parameters and Management and Response) failed to clarify common themes. However, while working through the indicators an initial suite of 67 sub-topics became apparent - although further work is needed to refine this, particularly for general headings of fisheries, pollution and management, is necessary (Table 2, Chapter 3).

While some entities' indicators address a very focused range of issues - such as, for example, biodiversity, others address a broader array with their indicators falling into different thematic groupings. For example, PEMSEA has groups of indicators falling into categories including i) policy, strategies and plans, ii) institutional arrangements, iii) legislation, iv) information and public awareness, v) capacity development, vi) financing mechanisms, vii) natural and man-made hazard prevention and management, viii) habitat protection, restoration and management, ix) Water use and supply management, x) food security and livelihood management and xi) pollution and waste management.

Analysis of the indicators showed that, apart from some basic indicators such as, for example, fishing effort (appearing 10 times) and Chlorophyll (appearing 8 times) there was very little overall commonality. Even where the issue being address was essentially the same, slightly different approaches made commonality difficult to assess. For example, the 8 chlorophyll-related indicators are: 'chlorophyll concentration' (OSPAR), 'chlorophyll a' (CEP, BSC, TWAP, CAFF), 'Chlorophyll in transitional, coastal and marine waters' (EEA), 'Chlorophyll level' (BOBLME), 'Chlorophyll a concentration (area-specific) Elevated maximum and mean level' (OSPAR).

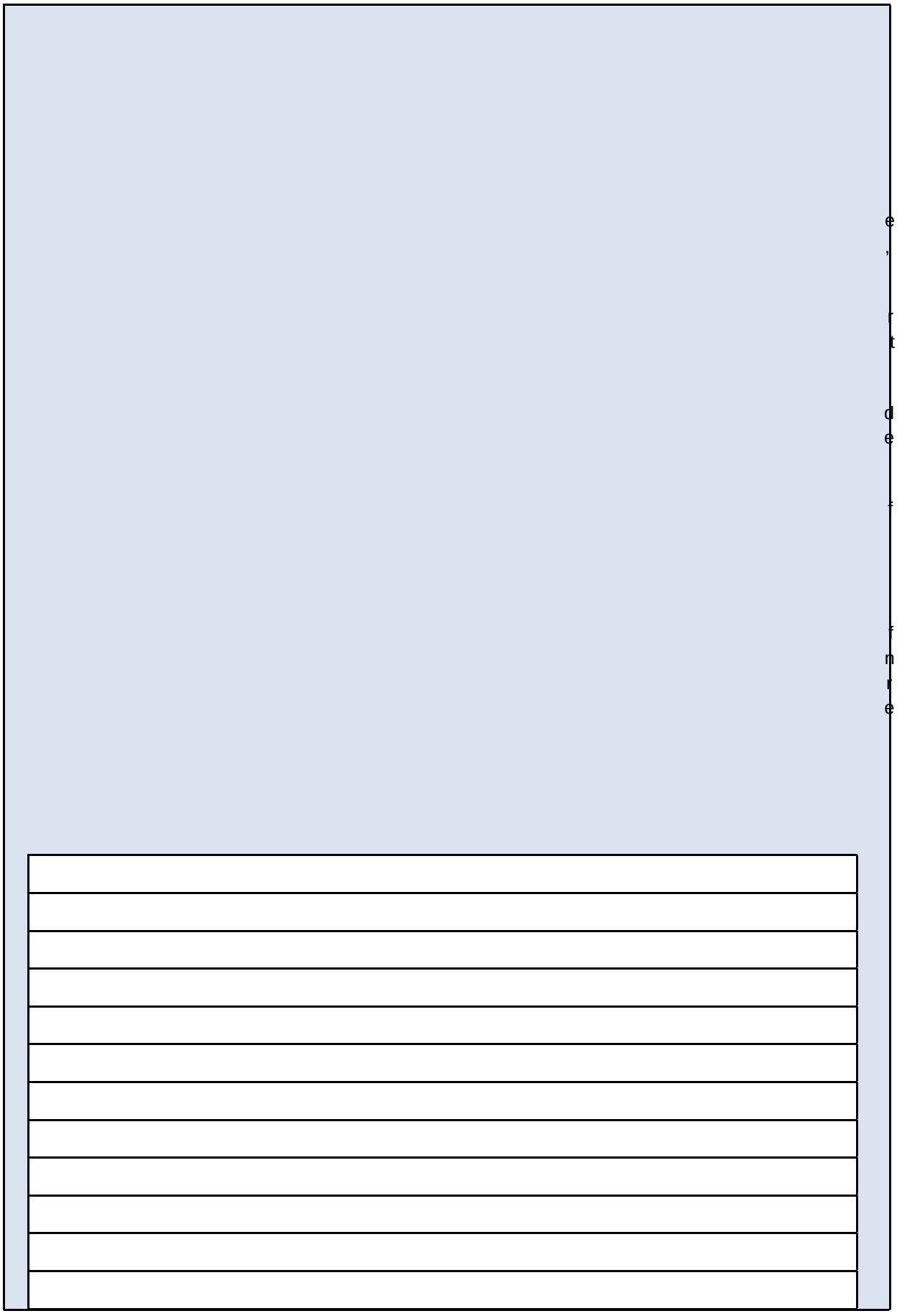
For some entities, the selection of indicators is driven by a clear political direction. For example, HELCOM's choice of indicators was derived from the decision to develop indicators with targets to follow-up both the implementation of the Baltic Sea Action Plan (BSAP)(HELCOM, 2007) and

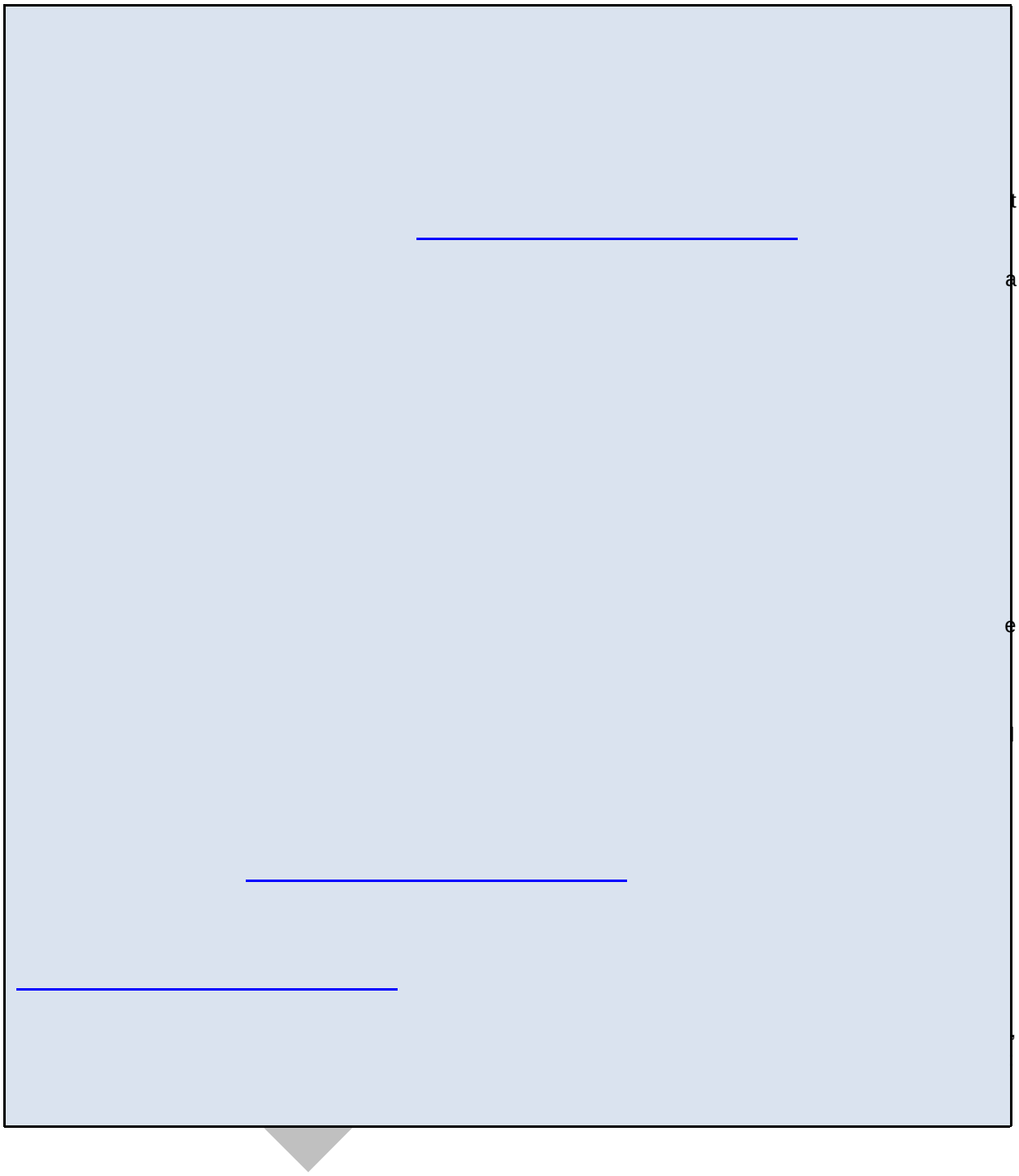
European Union Marine Strategy Framework Directive (MSFD)(European Union, 2008) (HELCOM, Case Study 3).



[14] 'good environmental status' means the environmental status of marine waters where these provide ecologically diverse and dynamic oceans and seas which are clean, healthy and productive within their intrinsic conditions, and the use of the marine environment is at a level that is sustainable, thus safeguarding the potential for uses and activities by current and future generations (MSFD, Article 3 [5]).

[15] Core indicators for eutrophication have been developed in a separate HELCOM Monitoring and Assessment Group process.





State of the Environment v Progress reporting

The emphasis of the categories of indicators being used varies but broadly there is a distinction between:

1. Regional Seas Conventions and Action Plans where the emphasis is on State of the Environment. Here it is predominantly water quality and living/non living resources that dominate the indicator suites together with associated management indicators. (Black Sea, Case Study 4.)

[16] Protocol on the Protection of the Marine Environment of the Black Sea from Land-Based Sources and Activities (2009) [entry into force pending]

Protocol on Protection of the Black Sea Marine Environment Against Pollution from Land Based Sources (1992)Protocol on Cooperation in combating pollution of the Black Sea Marine Environment by Oil and Other Harmful Substances in Emergency Situations

Protocol on The Protection of The Black Sea Marine Environment Against Pollution by Dumping

Black Sea Biodiversity and Landscape Conservation Protocol to the Convention on the Protection of the Black Sea Against Pollution

[17] http://www.blacksea-commission.org/_bssap2009.asp#_Toc222222296

[18] http://www.blacksea-commission.org/_bssap1996.asp

[19] http://www.blacksea-commission.org/_publ-SOE2002-eng.asp

http://www.blacksea-commission.org/_publ-BSSAPIMPL2002.asp

[20] http://www.blacksea-commission.org/_publ-SOE2009.asp

http://www.blacksea-commission.org/_publ-BSSAPIMPL2009.asp

[21] http://www.blacksea-commission.org/_publ-BSDiagnosticReport2010.asp

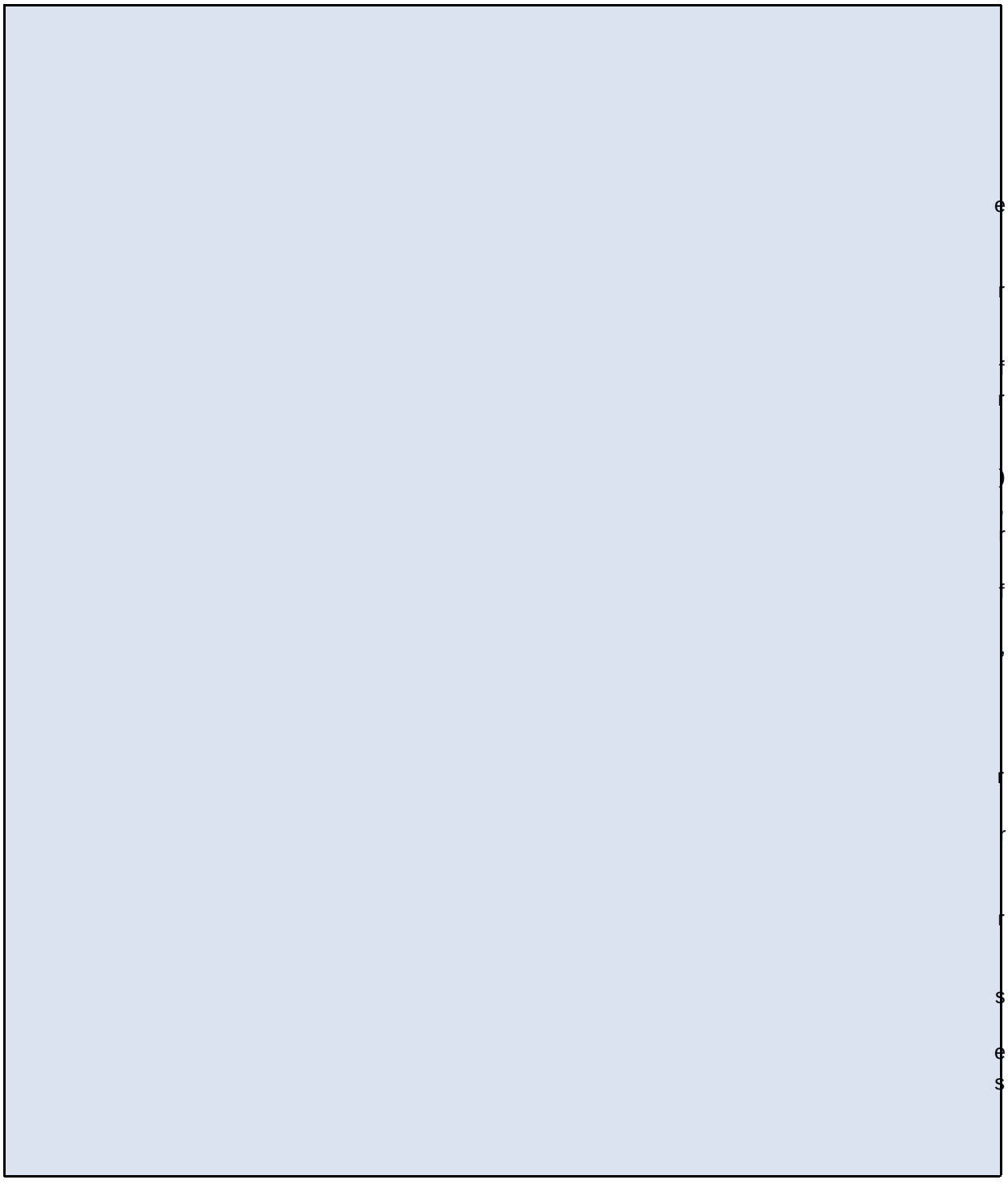
[22] http://iwlearn.net/iw-projects/397/reports/bserp-tda/view

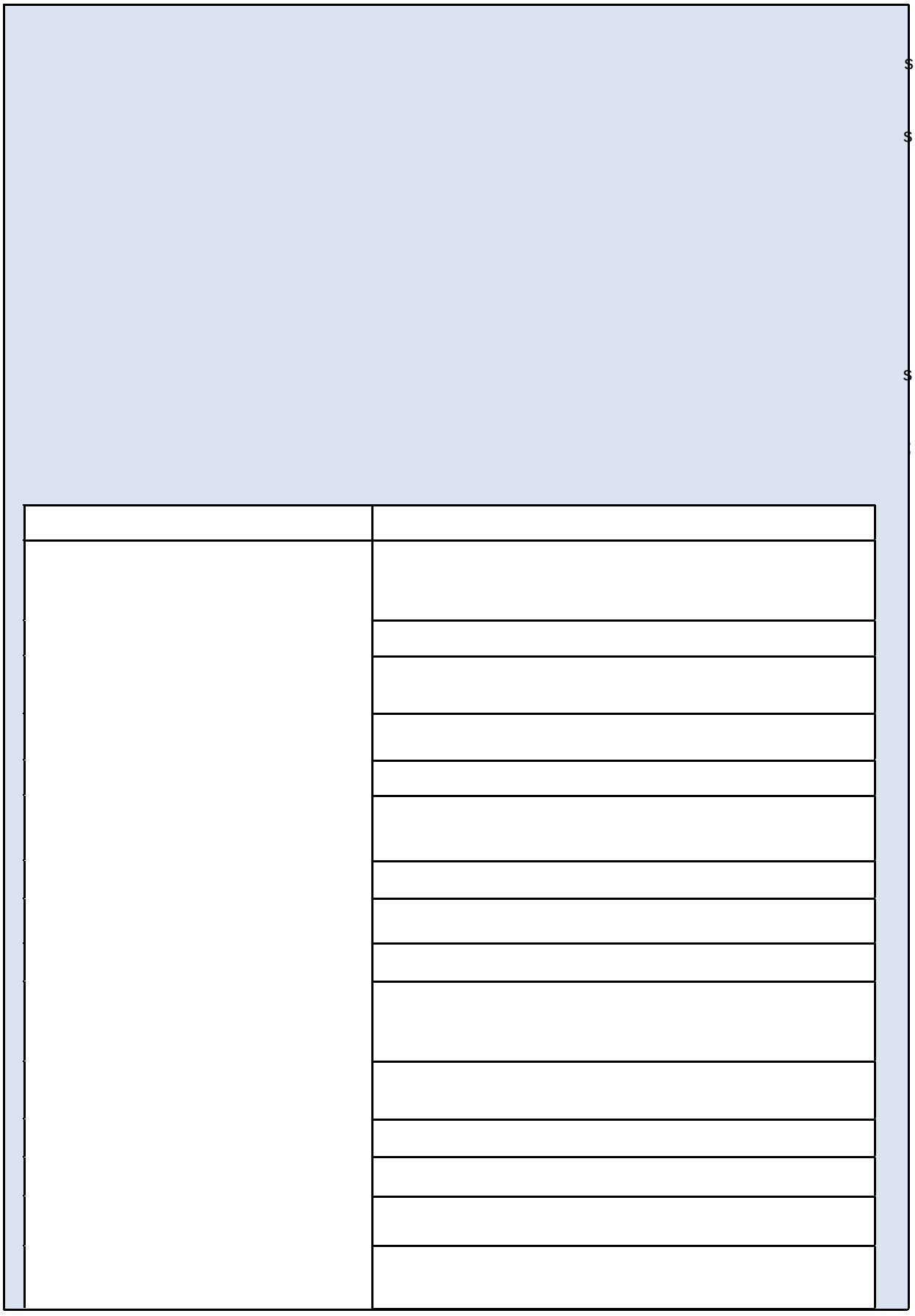
[23] *The Diagnostic Report' to guide improvements to the regular reporting process on the state of the Black Sea environment*, 2010 (The Diagnostic Report)

2. Progress reporting was exemplified by thematic frameworks developed for projects such as the large marine ecosystem projects (TWAP and Bay of Bengal LME project, Case Study 5). The TWAP framework allows for differentiation between different systems (river basins, lake

basins, aquifers, large marine ecosystems and open oceans. The framework provides a basis for a common terminology (Tables 1 and 2 in Case Study 5) with the additional benefit that most parameters are relatively easy to monitor/collect requiring, for example limited sea time.

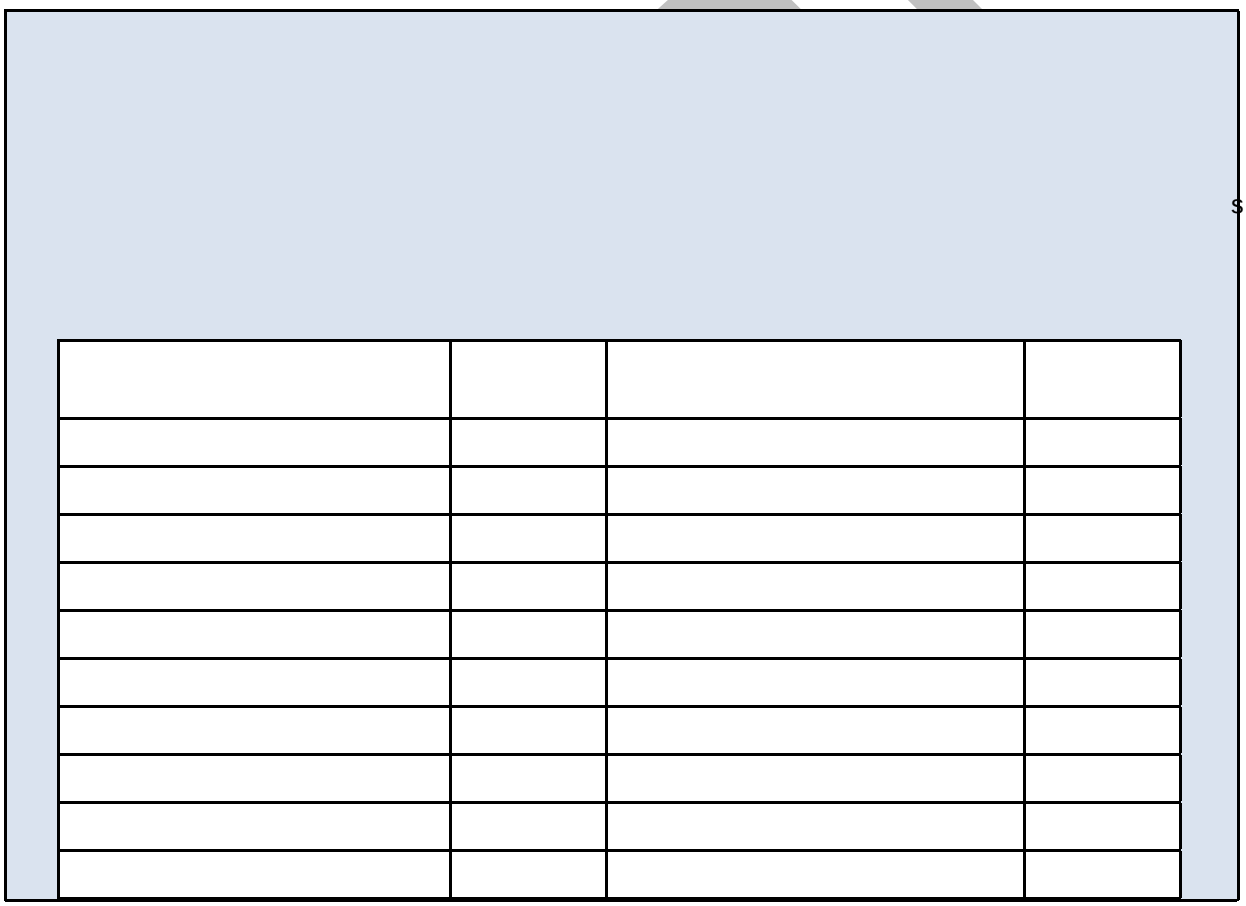
The indicators can be further developed in terms of progress monitoring and performance reporting by a specific region e.g. the BOBLME (See Case Study 5) and others such as ATSEA monitoring against SAP targets.





Level of sophistication

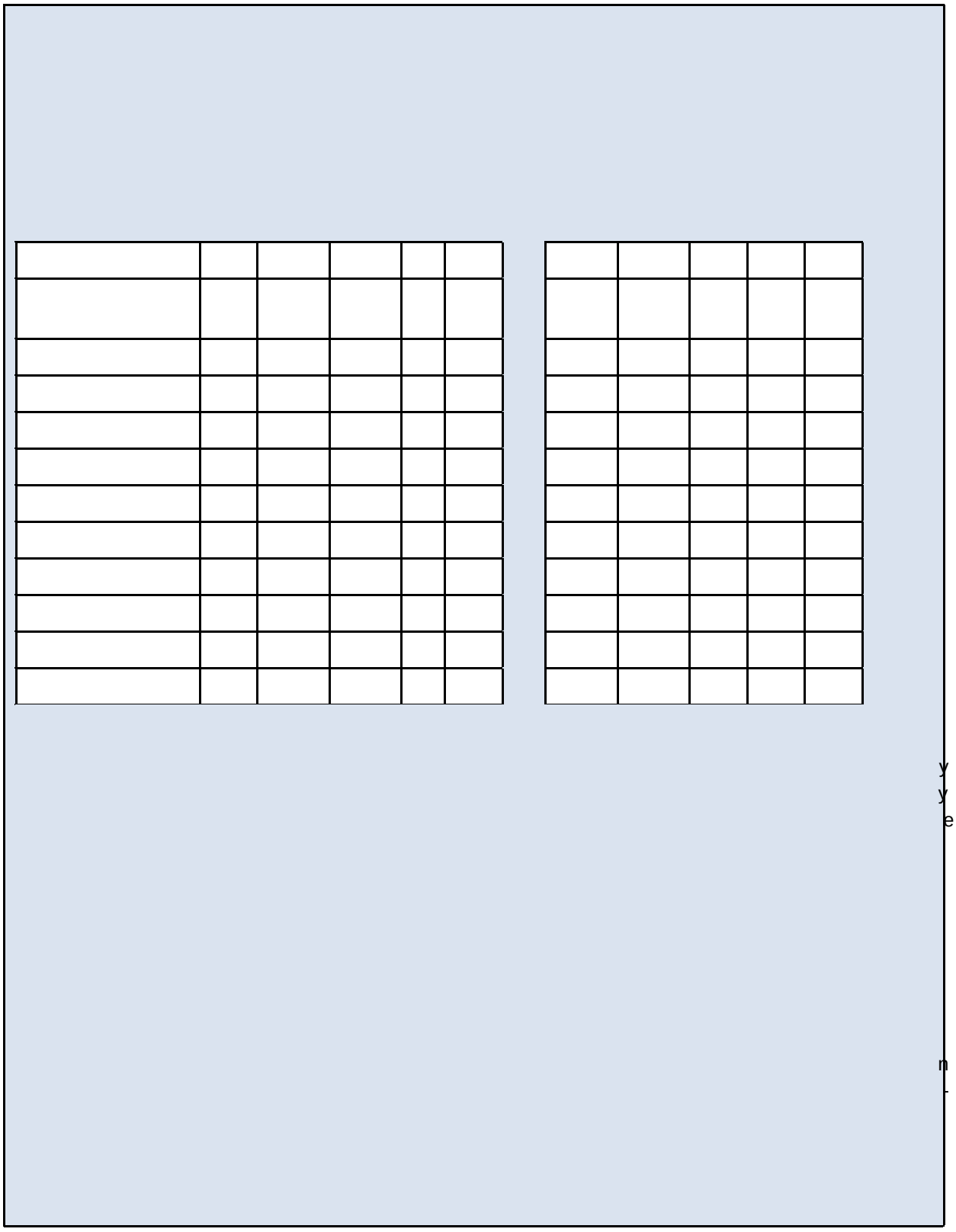
While other entities have developed indicators incorporating the DPSIR or PSR categories (for example the Black Sea Commission), the most developed approach is that of the European Environment Agency (Case Study 6) which provides comprehensive scientific underpinning for each indicator. For example, the EEA core indicator CSI 023 'Chlorophyll in transitional, coastal and marine waters' provides justification for the indicator selection. This includes an explanation of pollution-pathways, elevated nutrient concentrations and the resulting eutrophication. It explains that the primary effect of eutrophication is excessive growth of plankton algae, which increases the concentration of chlorophyll-a. It goes on to describe the negative effects of eutrophication. An explanation of how chlorophyll a can be used to estimate phytoplankton biomass is provided as well as its use in assessing the effectiveness of measures to reduce eutrophication. An explanation of the use of ocean colour to measure chlorophyll a concentrations is also included as are inks to the scientific references are provided.



[24]At 16 July 2013 the EEA maintains 242 indicators

[25]http://www.eea.europa.eu/data-and-maps/indicators/#c5=&c7=all&c0=10&b_start=0

[26] European Environment Information and Observation Network http://www.eionet.europa.eu/



[27] The criteria comprise: i) policy relevance, ii) progress towards targets, iii) available and routinely collected data, iv and v) spatial and temporal coverage, vi) national coverage and representativeness of data, vii) understandability of indicators, viii) methodology well founded and ix) EU priority policy issues.

Alternative approaches

The overall results show that indicators of 'State', for example, 'conductivity', 'pH', 'salinity', 'temperature', 'Chl a', 'fish biomass' and 'abundance of dietary functional groups', 'sea ice extent', 'sea surface temperature', in the 'Living and Non-living Resources', 'Water Quality and Contaminants' and 'Physical Parameters' categories are the most prevalent However, in the 'Drivers, Pressures and Stresses' and Management and Response' categories 'Pressure' and 'Response' indicators prevail respectively. Examples of 'Pressure' indicators include 'illegal fisheries', 'illegal discharges of oil at sea', 'tourism'. It is often problematic to assign an indicator to a specific category. For example, the TWAP indicator 'bycatch/discards' could be viewed purely as an indicator of 'Pressure' but could also be viewed as an indicator of 'State'.

Another approach to assessing the marine environment is causal chain analysis (CCA) (GIWA, Case Study 7). This approach provides a descriptive, qualitative method to identify priorities for remedial and mitigatory actions. While addressing similar issues there is no common terminology.

[28] http://www.unep.org/dewa/giwa/giwafact/giwa_in_brief.asp

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[30] Domestic and Industrial Pollutant Loads and Watershed Inflows in the Wider Caribbean Region (2012) (CEP Technical Report 52 - Updated Technical Report 33) and Regional Overview of Land-Based Sources of Pollution in the Wider Caribbean Region (1994) (CEP Technical Report No. 33). Available at: http://www.cep.unep.org/publications-and-resources/technical-reports/technical-reports

Summary

[31] http://www.carrcu.org/meetings-events/meeting_info/4

The current use of marine ecosystem-based indicators and indices by regional entities is both overwhelming in terms of numbers being used and disparate in terms of the different indicators, systems and terminology employed. When trying to compare regions, rather than clarifying, this complexity clouds and confuses any underlying messages that may emerge.

6. Critical evaluation: a proposed way forward for the RSP

This chapter sets out a series of arguments in favour of Regional Seas Conventions and Action Plans recognising a collective set of ecosystem-based global pressures and management responses that entail the collection of regionally specific information contributing to global commitments. The intention is to build upon what is in place whilst also making reference to work on developing sustainable development measures and, as far as possible, taking into account future commitments that regional entities will be required to deliver and/or contribute to. In this context suggestions are advanced concerning identification of suitable specific indicators to provide a reference point likely to support global and regional targets.

The need to build upon existing efforts

As an individual entity each RSCAP is responsible to its own Contracting Parties. Thus whilst all regions reflect a similar overall vision it is understandable that regional specificities and collective targets of the States concerned are reflected in the ecosystem-based indicator systems that have developed. In addition to tailoring to suit particular regional challenges, different regions have varying capacities and are at varying stages of development in terms of data collection, monitoring and assessment to implement the ecosystem approach. This explains the considerable variation in range and detail of the indicators and indices currently in place.

For several individual RSCAPs development of ecosystem-based indicator systems has involved intensive processes of consultation with appropriate stakeholders (Parties, partners, technical experts). Examples can be found in the Case Studies set out in Chapter 5 of this report, such as CEP's initiative to introduce a standardized reporting template on the Cartagena Convention and its Protocols. Within Europe the EU Marine Strategy Framework Directive has served to further harmonise effort. For example, in addition to those entities highlighted earlier in this report, the UNEP/MAP Barcelona Convention has since 2008 made a concerted effort to articulate a Mediterranean Ecosystem Approach (EcAp) comprising a set of 11 ecological objectives (see below), 28 operational objectives and 61 indicators.

UNEP/MAP Ecological Objectives (EOs)	
1	Biological diversity is maintained or enhanced. The quality and occurrence of coastal and marine habitats and the distribution and abundance of coastal and marine species are in line with prevailing physiographic, hydrographic, geographic, and climatic conditions
2	Non-indigenous species introduced by human activities are at levels that do not adversely alter the ecosystem
3	Populations of selected commercially exploited fish and shellfish are within biologically safe limits, exhibiting a population age and size distribution that is indicative of a healthy stock
4	Alterations to components of marine food webs caused by resource extraction or human-induced environmental changes do not have a long-term adverse effects on food web dynamics and related viability
5	Human-induced eutrophication is prevented, especially adverse threats thereof, such as losses in biodiversity, ecosystem degradation, harmful algal blooms, and oxygen deficiency in bottom waters
6	Sea-floor integrity is maintained, especially in priority benthic habitats

7	Alteration of hydrographic conditions does not adversely affect coastal and marine ecosystems
8	The natural dynamics of coastal areas are maintained and coastal ecosystems and landscapes are preserved
9	Contaminants cause no significant impact on coastal and marine ecosystems and human health
10	Marine and coastal litter does not adversely affect coastal and marine environments
11	Noise from human activities causes no significant impact on marine and coastal ecosystems

Table 1: UNEP/MAP Ecological Objectives (EOs)

These are included here as they largely mirror the EU Marine Strategy Framework Directive Good Environmental Status Descriptors. This pan-regional obligation has informed scientific justification discussions on targets, scale, reference versus background conditions and target / indicator priorities. To illustrate this, the operational objectives and indicators adopted by the UNEP/MAP Contracting Parties for EO7 are presented in the table below. The table is extracted from the Decision 20/4 of the 17th Barcelona Convention Contracting Parties Meeting in Paris in 2012.

EO7: Alteration of hydrographic conditions does not adversely affect coastal and marine ecosystems	
Operational objectives	***Indicators***
7.1 Impacts to the marine and coastal ecosystem induced by climate variability and/or climate change are minimized	7.1.1 Large scale changes in circulation patterns, temperature, pH, and salinity distribution
	7.1.2 Long-term changes in sea level
7.2 Alterations due to permanent constructions on the coast and watersheds, marine installations and seafloor anchored structures are minimized	7.2.1 Impact on the circulation caused by the presence of structures
	7.2.2 Location and extent of the habitats impacted directly by the alterations and/or the circulation changes induced by them: footprints of impacting structures
	7.2.3 Trends in sediment delivery, especially in major deltaic systems
	7.2.4 Extent of area affected by coastal erosion due to sediment supply alterations
7.3 Impacts of alterations due to changes in freshwater flow from watersheds, seawater inundation and coastal freatic intrusion, brine input from desalination plants and seawater intake and outlet are minimized	7.3.1 Trends in freshwater/seawater volume delivered to saltmarshes, lagoons, estuaries and deltas; desalination brines in the coastal zone
	7.3.2 Location and extent of the habitats impacted by changes in the circulation and the salinity induced by the alterations
	7.3.3 Changes in key species distribution due to the effects of seawater intake and outlet

Table 2: UNEP/MAP Operational Objectives and Indicators for EO7

It is not the intention of this study to undermine regional efforts in place and underway, rather to complement them by proposing a coordinated set of parameters based on the understanding that from a global perspective:

a. Previous chapters have revealed a piecemeal mix of regional indicators;
b. The RSP may learn from the LME experience, where different entities have developed their metrics from a common SAP/TDA starting point;
c. Guidance may be useful for those RSCAPs who have yet to establish indicator systems;
d. Some entities (e.g. Abidjan Convention) are at a stage where a collective discussion and justification for a 'coordinated set' of indicators would potentially help negotiations with Contracting Parties; and
e. Other entities are in the process of considering updating their Action Plans and/or transforming their State of the Environment Report activities to deliver a more quantitative Quality Status Report.

Combining with RSP obligations

Any such 'coordinated set' of indicators should be consistent with obligations in place for the RSP. As explained in Chapter 2, not all RSCAPs are administered by UNEP. However, since 1998 UNEP have convened Global Meetings of the RSCAP Secretariats and the RSP has participated in both Intergovernmental Reviews (IGR) of the Global Programme of Action for the Protection of the Marine Environment from Land-based Activities (GPA) and the Global Conference on Land - Oceans Connection (GLOC). IGR-3 and the first GLOC both took place in January 2012 in Manila, Philippines.

The Regional Seas Strategic Directions (2013-2016) adopted at the 14th Global Meeting of the RSCAPs (1 - 3 October 2012) represent a useful (albeit non-binding) unifying banner for the RSP. These Strategic Directions recognize the priorities of Rio+20 as expressed in 'The Future We Want' Outcome Document with its emphasis on sustainable fish stocks, maintaining and restoring marine and coastal habitats, countering alien invasive species, protecting marine biodiversity in areas beyond national jurisdiction and addressing ocean acidification and adverse impacts of climate change. Ocean health, resilience and ecosystem functioning stand out as overarching goals. The Strategic Directions encompass a need to strengthen capacities, coordination and collaboration.

Within the Strategic Directions is also a commitment to contribute to the Manila Declaration of the GPA. In the Manila Declaration emphasis is placed on the core partnership areas of wastewater, nutrients and marine litter. This focus of the GPA on key pressures for the coastal environment is helpful in that it builds on the development and implementation of agreed Protocols and thematic Strategies on specific problems as adopted over the past 30 years by some individual RSCAPs. Other RSCAPs despite not having, for example, a Land-based Sources and Activities Protocol, support the implementation of the GPA through regional projects targeting one or more of the original GPA pollutant source categories (sewage, marine litter, nutrients, physical alteration and destruction of habitats, persistent organic pollutants, sediments, radioactive materials, oil and heavy metals).

Feeding into agreed global assessment processes

The 'coordinated set' of indicators should also pay due regard to agreed global processes of international cooperation.

The Parties to the Convention of Biodiversity (CBD) at their 10th Conference of the Parties (CBD COP10 2010) agreed that previous biodiversity protection targets were not met. Within a ten-year framework for action by all countries to save biodiversity (Strategic Plan for Biodiversity 2011-2020) the Parties adopted 20 ambitious yet achievable targets, collectively known as the Aichi Targets. The Aichi Targets are grouped into 5 sections (or strategic goals) as summarized below[32].

1	Make people aware about the values of biodiversity
2	Integrated biodiversity values in development & poverty reduction plan
3	Subsidies which are harmful to biodiversity - eliminate them, phase them out or reform them - taking into account national socio-economics
4	Sustainable production and consumption - natural resources within safe ecological limits
5	Reduce the rate of natural habitat loss and forest loss by at least 50%, where feasible close to zero reducing degradation and fragmentation
6	Sustainable fisheries
7	Agriculture, aquaculture and forestry undertaken in a sustainable manner
8	Reduce pollution and excessive use of fertilizer
9	Eradicate or control priority invasive alien species
10	Maintain coral reef integrity and functioning by minimising anthropogenic destruction and impacts of climate change and ocean acidification
11	Conserve terrestrial and inland water, coastal and marine areas through equitably managed, ecologically representative and well-connected systems of protected areas
12	Prevent extinction of threatened species
13	Maintain genetic diversity of cultivated plants and farmed and domesticated animals and of wild relatives
14	Safeguard ecosystems for women, tribal peoples and the poor
15	Combat desertification and restore degraded ecosystems
16	Operationalise the Nagoya Protocol on genetic resources via national legislation

[32] Note the text here is a précis summary. For full text see: www.cbd.int/sp/targets/

17	National biodiversity strategy and action plans - update for participation
18	Integrate the knowledge of tribal communities
19	Scientific and technological knowledge sharing application
20	Financial resources mobilisation

Table 3: Summary of CBD Aichi Targets

The Aichi Targets are inter-related and should be considered as a whole set but Targets 6,8,10,11 and 15 are particularly relevant to marine regions. CBD COP 11 (2012) agreed on a set of indicators to be used as a mid-term review of progress towards the Aichi Targets (CBD, 2012 Decision XI/3). The indicators developed and brought together by the Biodiversity Indicators Partnership are the primary mechanism for monitoring progress towards the Strategic Plan (UNEP-WCMC, 2012).

The Aichi Targets are quite rightly biodiversity driven. The World Ocean Assessment (Regular Process) (WOA) anticipated the need for more emphasis on socio-economics and has specifically stated an intention to identify the linkages between human well-being and marine environmental changes, including those resulting from human impacts, such as the effects of climate change foreseen by the Intergovernmental Panel on Climate Change. It is expected that the first WOA will draw mostly on secondary sources, presenting a mainly narrative analysis. Subsequent WOA activities are likely to need to draw on indicator information in order to evaluate changing conditions. Several regional entities are developing human dimension indicators as a contribution to both widening their status reporting outputs but also feeding into the WOA. Any 'coordinated set' of RSP indicators could therefore develop to serve as a WOA support mechanism, aligning itself with this initiative.

A leading example of a regional entity considering human dimension indicators is the North Pacific Marine Science Organisation (PICES)[33]. A PICES expert workshop (Honolulu 13-15 June 2013) considered a list of candidate human dimension indicators in the context of relevant chapters outlined in the structure of the WOA. The focus was fisheries-related and reflecting topics outlined in Chapter 15 of the WOA structure. The workshop considered the need for a narrative to set out context for understanding values reported in different categories; the need to identify drivers of change in social ecological systems; and data availability. A summary of the workshop results is reproduced in Table 4 below.

[33] PICES comprises a membership of six States (Canada, China, Korea, Japan, United States and Russian Federation) and includes NOWPAP as the appropriate Regional Seas Partnership partner (http://www.pices.int)

Variable	Canada	China	Japan	Korea	Russia	USA	Synoptic	tier

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Table 4: PICES workshop results. X = data presented in slides at mtg; ? = data likely available but not at mtg; x = data sources made available but not presented at mtg

A comprehensive picture of the world's well-being has also been undertaken by the most recent Global Environment Outlook (GEO-5) (UNEP, 2012a). The companion report 'Measuring Progress: Environmental Goals and Gaps' (UNEP 2012b) reviews and illustrates the world's progress towards meeting international environmental goals for a set of critical issues and highlights gaps in our ability to measure progress, including the absence of clear numerical targets and important gaps in many issues.

Anticipating interface with a possible Sustainable Development Goal on Oceans

Chapter 2 of this report also highlights another of the main outcomes of the Rio+20 Conference, namely the agreement by UN member States to launch a process to develop Sustainable Development Goals (SDGs). Ten preconditions agreed at Rio+20 are set out in Table 5 and it was further agreed that SDGs should be action-oriented, concise, easy to communicate, limited in number, aspirational, global in nature and universally applicable to all countries while taking into account different national realities, capacities and levels of development and respecting national policies and priorities.

1. Be based on Agenda 21 and the Johannesburg Plan of Implementation
2. Fully respect all the Rio Principles
3. Be consistent with international law
4. Build upon commitments already made
5. Contribute to the full implementation of the outcomes of all major summits in the economic, social and environmental fields
6. Focus on priority areas for the achievement of sustainable development, being guided by the outcome document
7. Address and incorporate in a balanced way all three dimensions of sustainable development and their inter-linkages
8. Be coherent with and integrated into the United Nations development agenda beyond 2015

9. Not divert focus or effort from the achievement of the Millennium Development Goals[34]
10. Include active involvement of all relevant stakeholders, as appropriate, in the process

Table 5: Preconditions for SDGs agreed by member States at Rio+20

UNCSD (2012) summarized ideas on SDGs and indicators in the run up to Rio+20. Suggestions of focus areas for priority attention at Rio+20 as articulated by member States and major groups in the PrepComs, a proposal by the Governments of Colombia and Guatemala and world Civil Society Organisations respectively included management of the oceans, fisheries and other marine resources; oceans; and healthy seas and oceans as one of their suggested SDGs. The importance of oceans in the discussions on SDGs has subsequently prompted specific proposals building on the momentum of the Rio+20 Conference. A number of countries and organisations have put forward suggestions for integrating oceans into the SDGs, in the form of an oceans SDG or including oceans in various cross-cutting SDGs. Considerations include the principle that nations should benefit from the resources in their EEZs and focus on priorities within a timeframe from 2015 - 2030 (converging with the post 2015 development agenda). Any SDG should be both attainable and aspirational. A UN Inter-government Open Working Group on SDGs will progressively work on proposals to develop SDGs in a unifying manner that is multilateral with detailed targets.

This debate on elements for the development of SDGs has prompted further consideration of a structure that allows targets and corresponding indicators to contribute to the achievement of the goals (CBD, 2013). Contrasting approaches are recognized which either:

a. focus each goal on one dimension of sustainable development and underpin this with different specific targets of the same dimension; or
b. envisage targets under broader development goals integrating the three dimensions of sustainable development.

Different types of goals are also recognized. CBD (2013, p20) suggest that 'goals such as "healthy and productive ecosystems" would, in effect be biodiversity-related goals [or indeed ecosystembased], with supporting targets and indicators [for which] all of the Aichi Targets, especially targets 5 to 15 and in particular Target 14 are relevant'.

This is further reflected in a 'Dashboard Proposal' by Columbia and Guatemala (OWG, 2013) that outlines a basic architecture to differentiate between global goals (focusing on global development priorities) with a core set of targets and indicators for each goal tailored to national priorities and circumstances. In this model each country determines its baseline, milestones, speed and which indicators are relevant and can adjust these to national circumstances

On 21 March 2013 the Palau Mission to the United Nations promulgated a proposed Oceans SDG as a basis for discussion and an exchange of ideas. The proposal for a Goal to achieve healthy, productive and resilient oceans, recalls ocean-related political texts and emphasizes the importance of ocean health, productivity and resilience for Small Island Developing States (SIDS) as well as making a link with capacity building needs. The proposal includes targets, sub-targets and associated indicators with associated financial and/or technical considerations. A summary is presented in the

[34] The MDGs adopted in 2000, focusing on ending extreme poverty, hunger and preventable disease, will conclude in 2015

box below and a full text is available on-line (Permanent Mission of the Republic of Palau to the United Nations, 2013).

[1] OSY is the management threshold most consistent with the ecosystem approach. It is calculated by modifying MSY to account for relevant economic, social or ecological factors. See Cochrane, K. and S.M. Garcia (Eds) A fishery Managers' Guidebook (2nd ed.), FAO and Wiley-Blackwell, 489 (2009).

[2] At each level of state responsibility, to include coastal, port, flag and chartering states, and states of nationality of the beneficial owners.

It is not the remit of this study to prejudge the SDG negotiations, however, the Plan Bleu Regional Activity Centre of the Mediterranean Action Plan Mediterranean Strategy for Sustainable Development (MSSD) has been working with 34 priority indicators to monitor progress made by the Mediterranean countries towards sustainable development in the context of objectives defined for 9 priority issues. Within this established scheme, 4 indicators relate to the objective of 'promoting sustainable management of the sea and coastal areas and take urgent action to put an end to degradation of coastal zones', although other objectives include climate change, cooperation and human

development. In the absence of a composite indicator for sustainable development the MSSD uses a combination of the Human Development Index and Ecological Footprint of each State to differentiate between high and middle income groups of countries. Preliminary results of the 3rd version (UNEP MAP, 2011) of monitoring outcomes only include one coastal indicator fact sheet assessing wastewater (i.e. land-based sources pollution from coastal cities as measured by numbers of coastal cities with and without wastewater treatment plants).

Regional Seas Marine Biodiversity Assessment and Outlook Series

In 2010 a rapid assessment measuring the performance of each RSCAP region against a set of common RSP indicators was undertaken as an input to CBD COP10. Indicators selected were based on the DPSIR model with three main drivers: pollution, fishing and climate change as identified in the Millennium Ecosystem Assessment Report (2005) as well as indicators linked to non-indigenous/invasive species and habitat loss.

This was a first systematic overview at a sub-global scale of the state of knowledge of marine biodiversity in the context of the pressures it currently faces and the management frameworks in place for addressing those pressures. Indicators for outlooks for marine biodiversity in the face of climate change and other continuing and growing pressures from expected increases in human uses and impacts were also considered. Even for this limited set of indicators (22) there were major differences in data availability, analytical protocols and approaches between the different regions. Where possible the exercise drew upon country data (providing a more responsive and detailed perspective) but this was augmented by regional breakdowns of global datasets particularly for the outlook sections. These included the Marine trophic Index (MTI), species index and invasive species indicators developed by the Sea Around Us Project (www.seaaroundus.org) and the acidification indicator (Aragonite saturation) was based on work by NOAA. Emphasis was placed on scientifically robust, peer reviewed facts and figures. The intention was that this collection of assessments should serve as a baseline for future assessments.

A parallel can be drawn with the EU 2010 Biodiversity Baseline (EEA, 2010) that also sought to establish a baseline, recognizing the complexity of ecosystems means that their status cannot be expressed with a single measure or indicator. In this analysis an emphasis was placed on favourable or unfavourable status with a distinction between coastal and marine ecosystems and useful supporting information on percentage change over time as illustrated below.

EU 2010 Biodiversity Baseline			
Conservation status	Favourable	Unfavourable	Unknown
Habitat types	8%	70%	22%
Species	11%	56%	33%
▯ Artificial areas - increase of surface in the coastal zone: +8% (1990-2000) ▯ Percentage of threatened coastal species from Nature Directives (amphibians none, reptiles 16%, mammals 20%, birds 12%) ▯ Change in surface (1990-2006): a. dunes, saltmarshes, salines: -34 km2 (-0.6%) b. intertidal flats, lagoons, estuaries: +43 km2 (+0.3%)			
Conservation status	Favourable	Unfavourable	Unknown

Habitat types	10%	50%	40%
Species	2%	24%	74%

- Percentage of threatened marine species from Nature Directives (marine turtles not assessed at EU-27 level): mammals 15%, birds 12%
- Alien species - total number in marine/estuarine waters: ca 1400

Marine Trophic Index: declining in all European seas

- Percentage of stocks overfished (Maximum Sustainable Yield): 88%

Commercial fish stocks outside safe biological limits: 46%

Table 6: EU 2010 Biodiversity Baseline (extract from EEA, 2010 Annex)

Towards a 'coordinated set' of indicators

In developing a proposal for a 'coordinated set' of indicators for the RSP the suite of indicators adopted for the 2010 UNEP Regional Sea Marine Biodiversity Assessment & Outlook Series has been taken as a point of departure. In Table 7 below the relationship with key indicators associated with the other initiatives explored in this chapter is also indicated (in bold) with supplementary related indicators added (in italics).

Nutrient loading *Phosphorus loading* *Marine litter* [**GPA, Aichi Target 8**]	*Extent of dead zones*	GPA (NAPs, LBS) *Proportion of the coastal urban population connected to a sanitation network* [**MSSD Plan Bleu**]	Nitrogen deposition
Port activity	*Total numbers of alien species*	Ballast Water Convention	Species invasions
Climate change (sea surface temperature; CO2 flux) [**Aichi Target 15**]	Aragonite saturation	National CC adaptation	Aragonite
Fish landings *Aquaculture* [**PICES human dimensions**]	FAO stock status Marine trophic index	Fish stocks agreement *Harvested fish within safe ecological limits* [**Aichi Target 6**]	Potential fisheries MTIs Species invasion Local species extinction *Fisher income* *Seafood exports/imports* [**PICES human dimensions**]
Share of artificialized coastline	Red list Index [**Aichi Target 6**]	Marine Protected Areas *Fishery closures*	*Coverage of equitably managed and*

[**MSSD Plan Bleu**]	Trends in critical habitat (coral reef, mangrove, other coastal vegetation) [**Aichi Target 10**]	[**Aichi Target 6, 11; MSSD Plan Bleu**]	*ecologically coherent networks* [**Aichi Target 11**]

Table 7: UNEP 2010 Marine Biodiversity Assessment & Outlook Indicators

A logical next step is to map the review of existing RSP indicators and indices (Chapter 5) against this basic framework to ascertain the level of commonality with what is currently being measured. As highlighted previously several of the RSCAPs already set ecosystem-based objectives and/or targets particularly those under the SAPs developed under GEF-funded projects (e.g SAP-Med and SAP-Bio within MAP and South China sea as part of the East Asia programme). It seems logical therefore to include the other LME Projects reviewed here, not least as several LMEs have evolved into, or are considering forming, independent Commissions. Furthermore the suite of indicators in Table 7 already incorporates the four TWAP Open Ocean themes, although it is perhaps under-representative of the socio-economic indicators within the LME current indicator suite (i.e. tourism, resident population pressure, human mortality associated with climate change).

Table 8 extends the information presented in Table 7 to include an indication of whether the regional entities considered as part of this research have adopted or are considering using indicators related to the pressures, states, responses or outlooks covered by the 2010 UNEP Regional Seas Marine Biodiversity Assessment & Outlook series. As in Table 7 individual entities are indicated (in bold) with supplementary related indicators added (in italics).

Nutrient loading *Phosphorus loading* *Chlorophyll a-related indicators; N/P ratio, primary production* [**GPA; Aichi Target 8**] [**TWAP Open Ocean theme, EEA, OSPAR, SPREP, BSC, ROPME, ASCLME, BoBLME, ATS, CEP, Yellow Sea LME, Guinea Current LME]** *Marine litter* [**PERSGA, OSPAR, BOBLME litter categories, Yellow Sea**	*Eutrophication status* [**OSPAR**] *Extent of dead zones* [**BSC**] *Concentrations of selected hazardous substances in biota + sediments* [**HELCOM coreset; BSC EcoQO, OSPAR, ROPME, Guinea Current LME**]	GPA (NAPs, LBS) [**BSC, HELCOM** status of pollutants] *Proportion of the coastal urban population connected to a sanitation network* [**MSSD Plan Bleu**] [**BoBLME**] *Port waste reception facilities MARPOL adoption* [**TWAP; SPREP**]	Nitrogen deposition [**TWAP**] ***HELCOM*** *availability of targets* *Value of sustainable financing schemes/leverage* [**BoBLME**]

LME]			
Port activity [**SPREP**] *Shipping density*	*Total numbers of alien species* [**BSC, ROPME**] *Trends in arrivals* [**HELCOM coreset**]	Ballast Water Convention	Species invasions
Climate change (sea surface temperature; CO2 flux) [**Aichi Target 15**] [**SPREP, TWAP, EEA, OSPAR**] *Mortality / losses due to extreme events* [**ROPME, TWAP**]	Aragonite saturation [**EEA, ASCLME, OSPAR**] *Regime shift of species* [**BSC**]	National CC adaptation / region-wide [**BoBLME**] *Incorporation of knowledge into management plans* [**ATS**]	Aragonite
Fish landings / *effort / value / vessel registration* *Aquaculture* *Fisheries employment* *No. of FADS* [**PICES human dimensions**] [**PERSGA, BoBLME, TWAP, ASCLME, Benguela CC, SPREP, EEA, ASCLME**]	FAO stock status (level of exploitation) Marine trophic index [**Black Sea EcoQO, TWAP**]	Fish stocks agreement, assessment, updating *Harvested fish within safe ecological limits* [**Aichi Target 6**] [**Yellow Sea LME; Guinea Current LME; Benguela CC**] *Closed fishing seasons, no-fishing areas, area of buffer zones* [**BSC**] *FAO code of conduct compliance; joint fishing agreements* [**TWAP, Guinea Current LME**] *Certified fisheries* [**Humbolt Current LME**]	Potential fisheries MTIs Species invasion Local species extinction *Fisher income/GDP* *Seafood exports/imports* *IUU fishing reduction* [**PICES human dimensions**]
Share of artificialized coastline [**MSSD Plan Bleu]** **[PERSGA, Humbolt Current LME**]	Red list Index [**Aichi Target 6**] [**CCAMLR VME indicators; HELCOM coreset; Black Sea EcoQO; TWAP Open Ocean theme; Yellow Sea LME; Guinea Current LME; CAFF,**	Marine Protected Areas [**Aichi Target 6, 11**; **MSSD Plan Bleu**] [**Nairobi, Yellow Sea LME; CAFF**] *ICZM guidelines adopted and enabling legislation, budget*	*Coverage of equitably managed and ecologically coherent MPA networks* [**Aichi Target 11**] [**ATS management targets; Humbolt Current LME**]

	SPREP, EEA, ASCLME, OSPAR, Humbolt Current LME], Trends in critical habitat (coral reef, mangrove, other coastal vegetation) [**Aichi Target 10**] [**PERSGA key habitats, CAFF, BSC, ROPME, TWAP, BoBLME, OSPAR, ATS, PEMSEA**]	[**BSC; PEMSEA, Nairobi, CPPS**] *EBSAs described* [**TWAP**] *% critical habitat under protection* [**BoBLME**]	*Seabed mining claims* [**TWAP**]

Table 8: Expanded indicator set reflecting existing regional ecosystem-based indicators and indices

As explained in Chapter 4 the variation in regional indicators and their different detailed specification means this analysis is something of a generalization. However, the balance of existing regional indicators in favour of living and non-living resources and water quality and contaminants is reflected here. Invasive / non-indigenous species is the least populated of the themes and the biodiversity assessment 'outlook' indicators have least commonality with other initiatives and entities. Some regional specifics that can be associated with a theme (e.g. % sea ice cover and climate change) are inappropriate to any generic suite but remain of critical importance to individual regions. Table 9 presents an illustrative first draft 'coordinated set' of 22 indicators as a basis for discussion. The intention of this table is to prompt discussion and to provide a possible framework within which subindicators can be nested. For example, several RSCAPs evaluate the loading of different heavy metals; critical habitat will vary between different biogeographic provinces; and for NAPs it may be appropriate to consider budget available as a sub-indicator.

Total inputs of nitrogen and phosphorus from agriculture, sewage and atmospheric nitrogen	Chlorophyll a concentration as an indicator of phytoplankton biomass
Inputs of marine chemical pollution	Trends for selected priority chemicals (e.g. PCBs)
Overall levels of marine litter	Quantification of beach litter items
Ocean warming Anthropogenic CO2 in the ocean	Annual mean sea surface temperature Carbon dioxide flux (partial pressure of CO2)
Losses due to extreme events	Insurance claims from climate change-related events
Fish landings	Fish catches within EEZs (tonnes) - total capture production
Aquaculture	Application of risk assessment to account for

	pollution and biodiversity impacts
Population pressure / urbanization	% built up coastline
Eutrophication status	% problem areas (including occurrence of nuisance phytoplankton and algal toxins)
Pollution hot spots	Status of selected pollutant contamination in biota and sediments and temporal trends
Ocean acidification	Aragonite saturation
Level of exploitation of commercial fisheries	FAO stock status: % stocks overfished compared to MSY
Species replacement as a consequence of capture fisheries	Marine trophic index
Endangered species	Distribution of Red List Index species
Loss of critical habitat	Trends in critical habitat extent and condition
National Action Plans to reduce input from LBS	% National action plans ratified / operational
Waste water treatment facilities	% coastal urban population connected
Incentive to reduce marine litter at source	% port waste reception facilities available
Climate change adaptation	% national adaptation plans in place
Fish harvested within safe ecological limits	Fisheries measures in place (by-catch limits, area-based closures, recovery plans, capacity reduction measures) and multilateral/bilateral fisheries management arrangements
Critical marine habitat under protection	% Marine protected areas designated
ICZM in place	ICZM guidelines and enabling legislation adopted for the region

Table 9: Illustrative first draft of a RSP 'Coordinated Indicator' set

If consensus towards achieving such a 'coordinated set' can be achieved a cross-check with the structure of the WOA[35] and the balance of different categories highlighting those areas of critical importance[36] (e.g. living and non-living resources, water quality and contaminants, socio-economic factors, and management of global change) to reflect the vision of healthy, productive and resilient seas. Table 10 illustrates such a cross-check.

RSP Pressure and potential associated indicator	**WOA**

[35] Available online: http://www.un.org/depts/los/global_reporting/Outline_of_the_First_Global_Integrated_Marine_Assessment.pdf [Accessed 4 September 2013]

[36] Using the same philosophy employed by TWAP to group LME indicators except that for 'Living Rources' TWAP have split 'Productivity' and 'Fish and Fisheries' (see Chapter 5, Case Study 5)

RSP State and potential associated indicator		
RSP Response and potential associated indicator		

Legend

- Living and non--living resources
- Water quality and contaminants
- Socio--economic considerations
- Management of global change

Table 10: Illustrative first draft of a RSP 'Coordinated Indicator' set cross referenced to WOA structure (chapters) and categories of indicators used to group indicators in this study

Challenges involved in taking this forward

Prioritising indicator choice should combine scientific rigour with pragmatic considerations such as data availability, appropriate technical expertise (knowledge and resources) and political acceptability. Experience to date is that it is very difficult to persuade Contracting Parties (States) to RSCAPs to agree to any 'core set' of regional indicators. This is likely to be even more problematic at a global level. A decade ago Rice (2003) reviewed indicators used for both communication and decision support arguing then that 'the challenge is not to find an indicator of ecosystem status to use. It is to choose the set that will serve the users' needs best.' (Rice, 2003 p236).

In particular data availability can be a constraint to building regional indicator sets. A basic premise of developing any coordinated indicator set from those indicators currently being applied by RSCAPs is that baseline data is likely to be available for these parameters. Where data is not available the decision is whether to invest in monitoring or to use proxy measures and/or draw upon global datasets.

The balance of indicators is another important factor. Any 'coordinated set' of indicators should contribute to global initiatives but cannot be expected to cover every pressure or aspect. Thus for the illustrative set of indicators Table 10 shows a reasonable balance between important categories but omissions of topics to be covered by the WOA include fish stock propagation, ocean food other than fish and shellfish, shipping, ports, cables and pipelines, desalinization, offshore energy, offshore mining, marine genetic resources etc. In several cases these aspects are being considered by individual regional entities for whom that parameter is important: some other aspects (e.g. marine genetic resources) have yet to be considered at the regional scale. In some cases to secure more balanced coverage it may be appropriate to combine indicators. For example, combinations of the indicators suggested in Table 9 are possible such as 'net marine primary production' combining satellite derived Chlorophyll a and sea surface temperatures.

In support of the RSP it seems logical to determine a set of draft Ecological and Operational Objectives to input to / inform the next revision of Regional Seas Action Plans including joint Actions

with a wider range of partners. For example, it is clear from the analysis presented in Table 8 that fisheries indicators are central to any suite. Coordination between the UNEP RSP and FAO/Regional Fisheries Management Organisations would serve to strengthen networking and capacity building. These Objectives combining environmental policy (resource use, pollution releases, ecosystem risk); economic policy (resource use, productivity, poverty and equality, investment); and social policy (education, health, status of women) are also fundamental to global marine spatial planning. However, their determination requires involvement of various stakeholders.

The conclusion of this study is that RSCAPs can contribute effectively to determine trend analysis of time series using key indicators. Where possible it is also logical and cost-effective for regional entities to draw on global data sets - as explained in Chapter 4 more than one entity already draws on UNEP-WCMC World Database on Protected Areas, the Global Ocean Observing System, and IOC-UNESCO (OBIS). UNEP should encourage consistency based on further refining the DPSIR extension, data rich-rapid assessment-type, normative indicator suite outlined in Table 8. In this proposal RSCAPs maintain their specific detailed indicators - e.g. regional Ecological Quality Objectives - but an agreed generic global subset would fit within a predetermined structure. There is a link between state of the environment indicators and management performance indicators, however, the model proposed favours a move toward the production of quality status type report setting out the problem (pressure indicators), status (state indicators) and what is being or has been done together with consideration of management effectiveness (response indicators). To take this analysis forward there is clearly a need for a more technical collective discussion to inform selection, weighting and aggregating of appropriate indicators as well as more detailed consideration of baselines.

Conclusion

This chapter concludes that the current uptake of ecosystem-based indicators by the RSP is uncoordinated and confused from the point of view of a global overview, although individual regions have their own agendas and in some cases well-developed indicator sets. Furthermore, indicators in themselves are not sufficient to describe or understand progress against a baseline. To contribute to governance efforts indicators should inform ecological and operational objectives. The RSP should and can input to regular global quality status and any such reports could interface and complement the World Ocean Assessment as well as contributing (and if appropriate adapting to) an ocean-related Sustainable Development Goal. The draft set of coordinated indicators set out here has sought to identify commonality between approaches already underway within the RSP. In doing so it provides a draft framework that does not impose extra work for RSCAPs but rather proposes the use of existing indicators that fulfill multiple reporting requirements. At the same time it is acknowledged that too many indicators blur any policy message. What is wanted is a process to underpin a communication tool. In other words an achievable limited set of ecosystem-based indicators agreed by the RSP and endorsed by UNEP. Choosing appropriate metrics requires further work and the opportunity for a more substantive collective technical discussion.

References

CBD (2013) Biodiversity in the post-2015 development agenda and Sustainable Development Goals (SDGs): Ecosystem goods and services for human well-being. Available online: www.cbd.Int/sbstta/doc/trondheim-full-paper-2-sdgs-en.pdf [Accessed 28.8.13]

EEA (2010) EU 2010 Biodiversity Baseline: Post-2010 EU biodiversity policy. Technical report No. 12/2010. 19 October 2010. Available online: www.eea.europa.eu/publications/eu-2010-biodiversity-baseline [Accessed 31 August 2013]

OWG (2013) 'Dashboard Proposal' presented to the Open Working Group on Sustainable Development Goals 17 June 2013. Available online: www.stakeholderforum.org/fileadmin/files/DashboardProposalColumbiaGuatemala.pdf [Accessed 28.8.13]

Permanent Mission of the Republic of Palau to the United Nations (2013) Palau outlines oceans sustainable development goal. Available online:

http://palauun.files.wordpress.com/2013/05/oceans-sustainable-development-goal-and-brief-palau-17-april-2013.pdf [Accessed 4 September 2013]

Rice, J. (2003) Environmental health indicators. Ocean & Coastal Management 46 (2003) 235-259

UNCSD (2012) Current ideas on Sustainable Development Goals and Indicators. Rio 2012 Issues Briefs No. 6 Available online: www.uncsd2012.org/content/documents/218issues%20Brief%206%20-%20SDGs%20and%20indicators_Final%20Final%20clean.pdf [Accessed 28.8.13]

UNEP (2012a) Available online: http://www.unep.org/geo/pdfs/geo5/GEO5_report_full_en.pdf [Accessed 31 August 2013]

UNEP (2012b) Available online: http://www.unep.org/geo/pdfs/geo5/Measuring_progress.pdf [Accessed 31 August 2013]

UNEP MAP (2011) Mediterranean Strategy for Sustainable Development Follow-up: Main indicators, 2011 Update. Plan Bleu, Regional Activity Centre, Preliminary version, May 2011. Available online: www.planbleu.org/sites/default/files/publications/indicateurs_smdd_2011_en.pdf [Accessed 30 August 2013]

UNEP-WCMC (2012) Biodiversity Indicators Partnership. Available online: www.bipindicators.net [Accessed 30 August 2013]

7. Conclusions and recommendations

[to be added]

8. Annexes

[to be added]