Ocean & Coastal Management 137 (2017) 185–197

Contents lists available at ScienceDirect

Ocean & Coastal Management

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

A comparative analysis of holistic marine management regimes and ecosystem approach in marine spatial planning in developed countries

Nicolas J.I. Rodriguez

Department of Biology, University of Bergen, N-5020 Bergen, Norway

ARTICLE INFO

Article history:
Received 17 March 2013
Received in revised form
23 December 2016
Accepted 25 December 2016

Keywords:
Marine ecosystem-based management
Comparative analysis
Marine spatial planning
Holistic marine management regimes

ABSTRACT

Internationally marine ecosystem-based management has been embraced as an approach to design holistic marine management regimes. In this article a comparative research strategy is applied in the analysis of the holistic marine management regimes in Norway, Australia, US, Canada and the European Union. How can holistic marine management regimes based on an ecosystem approach contribute to sustainable ocean development? Important in this context is how the origin and theory of an ecosystem-based management is implemented and interpreted, and to what extent this is manifested through policies, strategies and legal frameworks. The results of this research indicate that the implementation of marine-ecosystem based management is heterogeneous. This article discusses the concrete mechanisms that are used to reach the aim of sustainable ocean management. Implementation challenges are related to lack of functional metrics, weak spatial measures, weak integration and lack of adaptive management. Still marine ecosystem-based management is an important step forward for sustainable ocean governance.

© 2016 Elsevier Ltd. All rights reserved.

1. Introduction

Interconnections between human society and the marine environment are complex. Understanding these interconnections, and being able to identify important drivers and pressures are at the forefront of the scientific enterprise (Fath, 2015; Jonge et al., 2012). Several challenges exist due to human induced impacts on the marine environment (Barange et al., 2014; Setälä et al., 2014; Teh and Sumaila, 2014). Marine research and management systems have a central role addressing these challenges. Marine ecosystem-based management (MEBM) is suggested as a solution to improve decision making and marine management (Ehler and Douvere, 2009). MEBM can be defined 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*" (Rice et al., 2005: p. 4). The approach researched here is holistic marine management regime (HMR) and ecosystem approach in marine spatial planning. The concept of regime is here used to describe national and regional ocean governance initiatives, e.g. the set of laws, policies, strategies, institutional arrangements to implement MEBM. These regimes aim at creating a sustainable system for the management of ocean resources, coexistence, integration, cooperation and involvement of stakeholders and institutions. Ideally a HMR based on MEBM should be able to balance between the protection of the environment and multiple human use.

It is estimated that at least 23 countries and four major regions are making efforts in MEBM worldwide (Balgos et al., 2015). HMR addresses human activity and the marine environment applying an ecosystem approach. Issues that are covered range from coordinating and integrating the management of marine habitats and species, fisheries, shipping, offshore petroleum and gas production, marine pollution, renewable offshore energy production, sea bed mining and climate change adaptation.

Ecosystem approach developed within ecology as a discipline, but it is also increasingly – since the 1980s – being used as a management principle in treaties and declarations (CBD, 1993; CCAMLR, 1980; RD, 2001). Within terrestrial systems the principle of ecosystem-based management can be traced back to the 1950s,

E-mail address: nicolas.rodriguez@bio.uib.no.

http://dx.doi.org/10.1016/j.ocecoaman.2016.12.023
0964-5691/© 2016 Elsevier Ltd. All rights reserved.

Abbreviations

HMR	Holistic marine management regimes
MEBM	marine ecosystem-based management
MPA	marine protected area
MSP	marine spatial planning
UNCLOS	United Nations Convention on the Law of the Sea
CCAMLR	Convention on the Conservation of Antarctic Marine Living Resources
CBD	Convention on Biological Diversity
RD	Reykjavik Declaration

but only recently it has been applied to the marine environment (Agardy et al., 2011).

The central question is: How can holistic marine management regimes based on an ecosystem approach contribute to sustainable ocean development?

A comparative method is used to research the development and characteristics of MEBM in developed countries. The cases compared here are the HMRs of Australia, Canada, Norway, the European Union, and the United States of America. The selection of cases is based on some of the first attempts to establish HMR and some of the most recent cases. Australia was one of the first countries to release a policy for MEBM in 1998 (Anonymous, 1998). Canada followed shortly after together with Norway, and both countries published a policy for MEBM in 2002 (Anonymous, 2002a, 2002b). The European Union and the United States of America represent some of the more recent cases to establish MEBM in 2007 and 2010 (Anonymous, 2007b, 2010a, 2010d). The selection of cases consists of completed regimes and plans under development, but ought to be sufficient to answer the question raised here, and being able to characterize the link between theory and practice.

MEBM represents a new turn in management of ocean space (Kidd et al., 2011). Previously marine management has been highly sectoral (Balgos et al., 2015). An extensive theoretical literature has developed addressing characteristics of MEBM, and how such management regimes can be constructed and developed (Jonge et al., 2012). Jones et al. (2016) calls for a more critical and empirical approach to MSP research. The dialogue between theory and practice is important for the scientific development of management systems. Practice is a way of testing theory, and can also be an indicator for the need to develop more robust systems, verifying theoretical insights or handling the implementation differently.

Comparative approaches have been applied in the research on MEBM (Arkema et al., 2006; Balgos et al., 2015; Collie et al., 2012; Jones et al., 2016; Leslie et al., 2015; Olsen et al., 2014; Rosenberg et al., 2009; SAB, 2011), and have given important insight on the design and function of holistic marine management regimes. Arkema et al. (2006) researched US and Australian plans, and discovered a need for better incorporation of ecological principles, explicit management approaches and stakeholder participation. Collie et al. (2012) researched 16 marine spatial plans worldwide. They found that marine spatial planning (MSP) is heterogeneous, but they identified five key characteristics: "1) *legal mandate and political capabilities to implement the plan*, 2) *the need for operational objectives defined early in the process*, 3) *inclusiveness, plans should be worked out in accordance with financial and human resources*, and 4) *the need for feedback and adaptive management*". Olsen et al. (2014) points to "*political will and leadership, process transparency and stakeholder participation*" as critical success factors.

2. Material and methods

This article applies a comparative research strategy and the use of multiple case studies (Blatter and Haverland, 2012; Ragin, 1989, 1992; Sartori, 1991; Stake, 2006; Yin, 1994).

Relevant to the discussion of cases is the theoretical literature developed in the field of MEBM (Arkema et al., 2006; Foley et al., 2013; Grumbine, 1994; Long et al., 2015). A set of elements that underpins MEBM has been identified in the theoretical literature (Grumbine, 1994; Long et al., 2015). These elements can be described as a conceptual model for MEBM, also referred to as the "*architecture*" of MEBM (Fogarty and McCarthy, 2014: p. 7). These can be viewed as essential components of such a system. A conceptual model of MEBM was constructed based on international manuals for conducting MEBM and MSP, and review of literature in the field (Agardy et al., 2011; Ehler, 2014; Ehler and Douvere, 2009).

1. Holistic marine management regime (HMR): This type of regimes is established through either national, bilateral or greater regional initiatives. The aim is integration, bringing together institutions in marine management and create a common framework for understanding of management challenges. Policies, legislation, and strategies are important for establishing these measures. A HMR is not created to replace sector management, but aims to integrate sectors and enhance cooperation between sector authorities, e.g. cooperation between fishery management authorities and petroleum licensing authorities (Misund and Olsen, 2013).
2. Delineation of management area: In the theoretical literature it is assumed that the management area should be moved towards coinciding with the ecosystem as an entity (Bailey, 2014; Crowder and Norse, 2008; Spalding et al., 2007).
3. Knowledge acquisition: To prioritize, set goals and strategies to reach them, the plan must be updated with available knowledge. Integration such as cross-sectoral cooperation, international cooperation and stakeholder involvement also contributes to the knowledge pool. Empirical data on the state of the ecosystem must be collected, and human interactions with the ecosystem must be mapped (Crowder and Norse, 2008). Important here is the assessment of cumulative effects (Foley et al., 2013; Levin et al., 2009).
4. Procedures: Planning and enacting a system involves integrating stakeholders. Procedures are needed to seek integration across sectors. This can be solved either by creating new institutions that have the responsibility to coordinate actions. A more common model is to create a common arena for integration between sector authorities and stakeholders. The role of stakeholders can also be used constructively to ask and propose management questions (Fowler, 2009).
5. Evaluation criteria: Evaluation criteria are important to correct the management system, but also to evaluate if the goals set by the plan is reached, or if other procedures are better shaped to solve a certain problem (Carneiro, 2013; Ehler, 2014). Environmental principles have an important function to set norm and guidelines to evaluate function of the plan. In this connection metrics are important, i.e. indicators or other measures for assessing the state of the ecosystem and the impacts of human activity.
6. Management plan: This is the implementation of policies, legislation and strategies. They include mechanisms to address challenges, set objectives for the state of the environment, create the basis for coexistence, introduces spatial measures, applying monitoring of environmental indicators to inform and evaluating if goals have been reached and the need for actions (Agardy et al., 2011; Ehler and Douvere, 2009).

7. Adaptive procedure: An adaptive approach can be viewed as a basic and important element of any holistic management system. New knowledge that is gained about the state of the ecosystem, new knowledge on important habitat structures or new knowledge about the impact of human activity, can be used to improve the management process and provide a knowledge basis for implementing new measures (Westgate et al., 2013).

Fig. 1 is a distillation of main elements applied in the theoretical literature to describe holistic marine management applying an ecosystem approach.

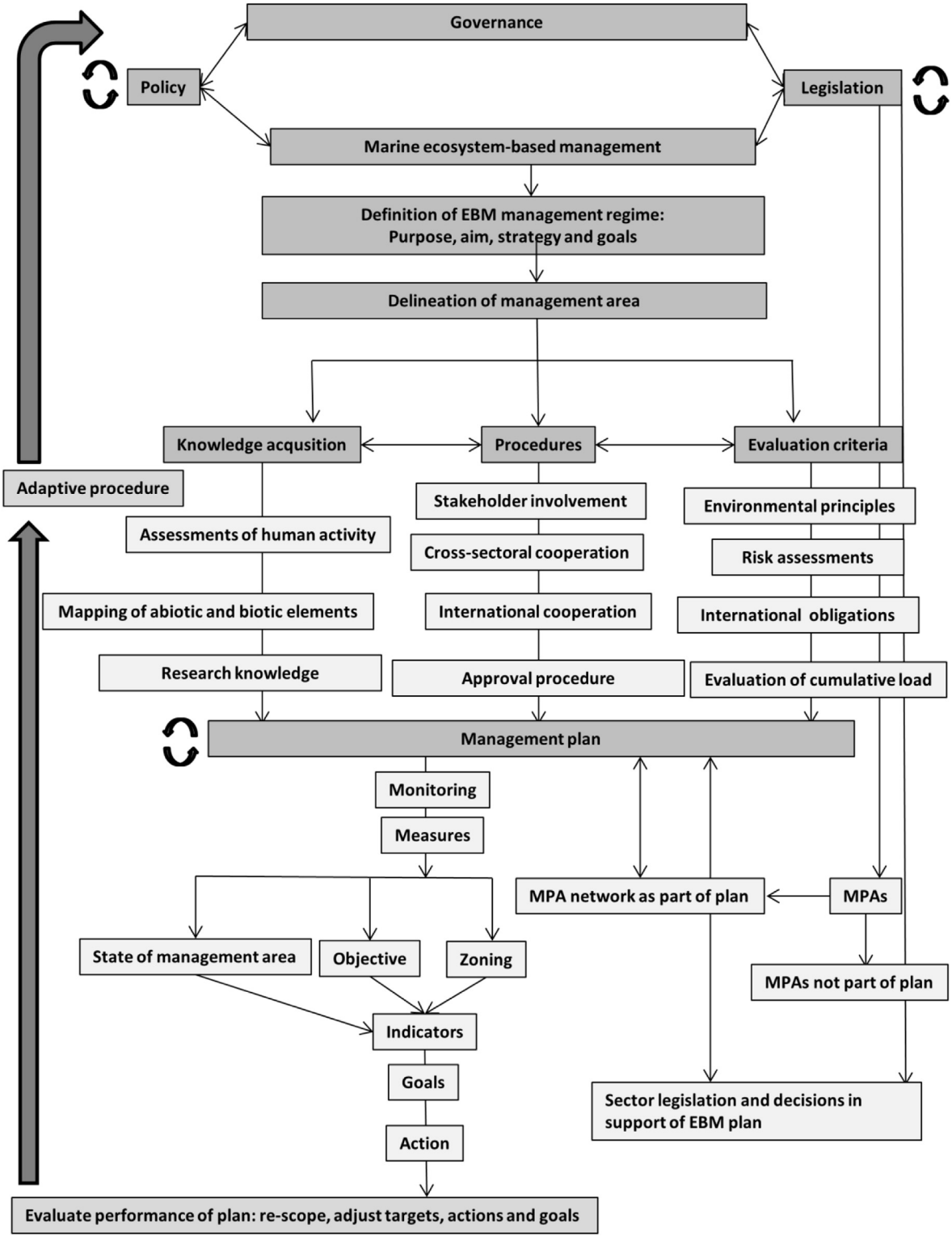

Fig. 1. Conceptual model.

Based on the conceptual model a set of comparative indicators were identified for the elements (Fig. 2).

These comparative indicators can be described and organized using four main themes:

a) Marine governance:

Policy and/or legislation are the starting point for the development of HMR. Ocean policies describe how MEBM should be operationalized through marine management. Important

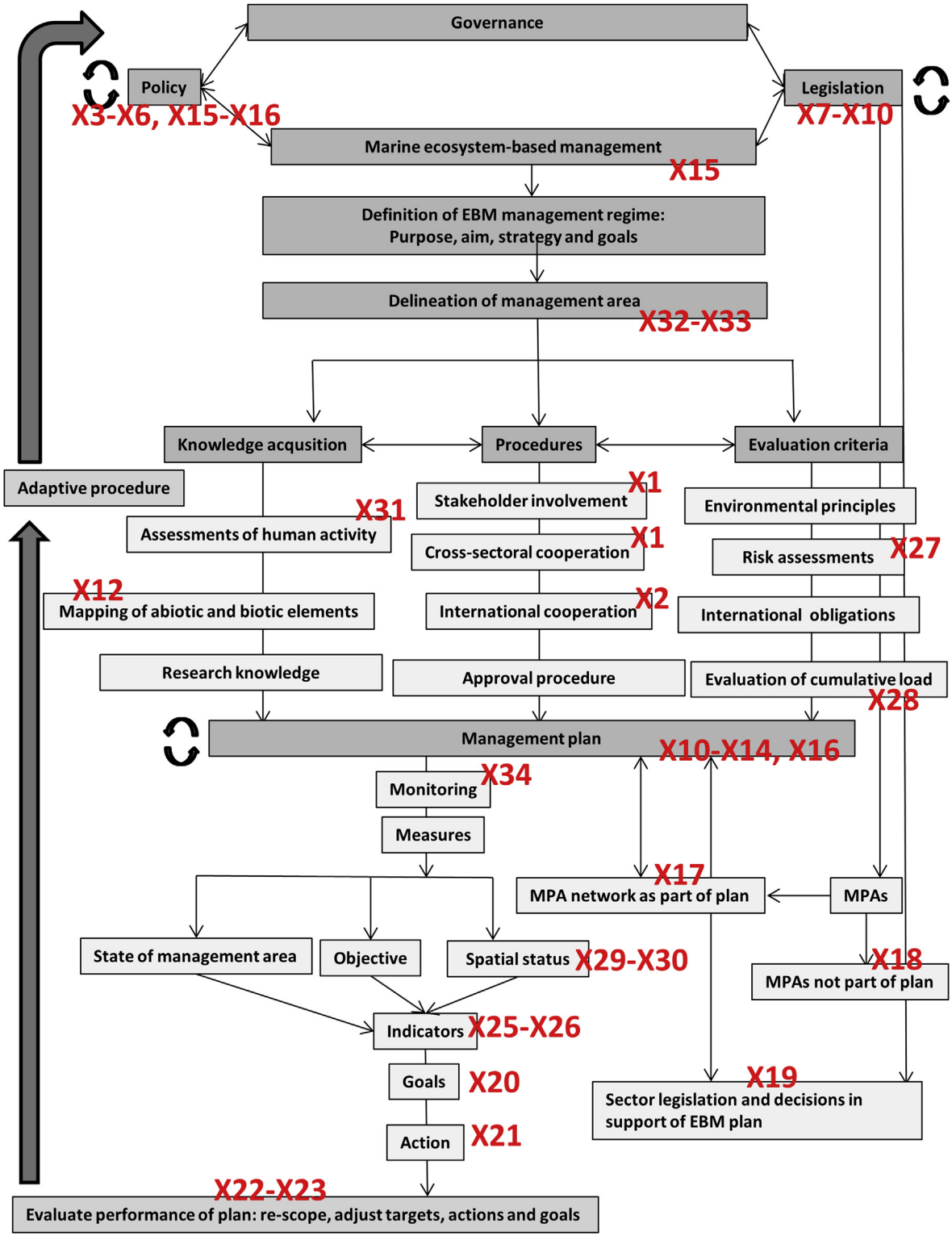

Fig. 2. Conceptual model and comparative indicators.

comparative indicators for the construction of HMR are: a) collaboration between government and user interests, b) integration, c) a system to handle environmental impacts, d) a system to handle multi-use of the ocean, e) cumulative effect assessments, f) how is ecosystem-based management defined and applied. Under certain circumstances there is not a separate legal framework for marine management, and policy is the dominating factor driving MEBM forward. In this instance decisions under sector legislation is important for the development of HMR. Marine management plans ought to set goals, objectives, actions and strategies to fulfill the defined planning priorities.

b) Spatial measures:

After the policy phase a plan must be made. This plan can be guided by a legal framework and/or the policy framework developed. The spatial measures applied is used as comparative indicators: zoning, area identification or spatial objectives. Zoning identify a specific area that has a specific use and that is protected with certain guidelines and that the area has a legal status. Area identification is the identification of an area for a certain purpose or function, and there might be guidelines that signify the use and status of the area. A plan can also contain spatial objectives without identifying specific zones or areas within the planning area. Spatial objectives are general guidelines pertaining to the whole management area, e.g. for specific use, species or habitats.

c) MEBM, multiple use and cumulative load:

Important here is how coexistence is handled. Does the plan develop a framework for ocean industries? Is there an analysis of cumulative effects and is risk assessments used to determine how and where human industrial activities can be performed?

d) Metrics:

Metrics is needed to adjust a plan, inform decision makers, adapt to new circumstances and being able to evaluate a plan. A comparative indicator used here is if the plan intends to apply adaptive management, address revision cycle, has evaluation mechanisms, has developed ecosystem indicators or intend to develop ecosystem indicators and if the plan is knowledge based and applies monitoring.

The materials used in this article are based on policy, legal and planning documents from each of the cases. An overview of the marine management plans used in the case studies:

1. Norway: Integrated Management Plan for the Barents Sea and areas off Lofoten (included the update of the plan in 2011), Integrated Management Plan for the Norwegian Sea and Integrated Management Plan for the North Sea and Skagerrak (Anonymous, 2006b, 2009e, 2011, 2013d).
2. Australia: Marine bioregional plan for the South-west Marine Region, Marine bioregional plan for the North-west Marine Region, Marine bioregional plan for the North Marine Region, Marine bioregional plan for the Temperate East Marine Region (Anonymous, 2004b, 2012c, 2012d, 2012e, 2012f).
3. United States of America:
   3a. State of Massachusetts: Massachusetts Ocean Management Plan 2009 and 2015 (Anonymous, 2009c, 2009d, 2015c, 2015d).
   3b. State of Rhode Island: Rhode Island Ocean Special Area Management Plan (Anonymous, 2010b, 2015c)
   3c. First regional US ocean plan: Northeast Regional Ocean Plan (Anonymous, 2016b)
4. Canada: Eastern Scotian Shelf Integrated Management Plan, Integrated Management Plan for the Beaufort Sea, Placentia Bay/Grand Banks Integrated Management Plan, Gulf of St. Lawrence Integrated Management Plan, Pacific North Coast Integrated Management Plan and Regional Oceans Plan for the Scotian Shelf, Atlantic Coast and Bay of Fundy (Anonymous, 2007a, 2009b, 2012g, 2013b, 2014c, 2014d).
   4a. Marine Plan Partnership for the North Pacific Coast: Haida Gwaii Marine Plan, North Coast Marine Plan, Central Coast Marine Plan and North Vancouver Island Marine Plan and the regional action framework (Anonymous, 2015a, 2015b, 2015e, 2015f, 2016a).
5. EU: Marine Strategy Framework Directive and Directive on a Framework for Marine Spatial Planning (Anonymous, 2008b, 2014a).

The conceptual model was further used as a starting point for a comparative case study of regimes for marine ecosystem-based management. NVivo software version 11 for qualitative analysis was used to code the planning documents. Marine policies, planning and legal documents from the five cases were used to research for presence and absence of characteristics considered essential for marine ecosystem-based management.

Data from the analysis was further coded as an indicator matrix based on the conceptual model and comparative indicators (Fig. 2). The matrix was used as the basis for running a correspondence analysis on similarities and difference between the marine ecosystem-based management regimes developed in the five cases. It is possible to apply correspondence analysis in connection with case studies (Kienstra and Heijden, 2015). Correspondence analysis is a relative of principal component analysis, and belongs to the family of factorial methods (Greenacre, 2013). Correspondence analysis can be used for exploring categorical data; i.e. presence – absence data (Beh, 2004). The insights from the conceptual model and the correspondence analysis are further used as the basis for discussing the research question posed in the introduction. The correspondence analysis was performed using R version 3.2.3.

3. Results

Fig. 3 shows the results of the correspondence analysis. The plot can be used to assess degree of similarity and dissimilarity between the different cases. An overview of the planning cases represented in the plot:

a) Eastern Scotian Shelf Integra8ted Management Plan (*CA1*)
b) Integrated Management Plan for the Beaufort Sea (*CA2*)
c) Placentia Bay/Grand Banks Integrated Management Plan, Gulf of St. Lawrence Integrated Management Plan, Pacific North Coast Integrated Management Plan(draft) (*CA3*)
d) Marine Plan Partnership for the North Pacific Coast (*CA4*)
e) Regional Oceans Plan for the Scotian Shelf, Atlantic Coast and Bay of Fundy (*CA5*)
f) Marine bioregional plan for the South-west Marine Region (*AU1*)
g) The Australian Marine bioregional plans (*AU2*)
h) Massachusetts Ocean Management Plan (*US1*)
i) Rhode Island Ocean Special Area Management Plan (*US2*)
j) North-East regional marine plan (US3)
k) Norwegian Integrated Management Plans (*NO*)
l) European Union directives for Integrated Management (*EU*)

The results in Fig. 3 indicate, based on the selection of cases here, five different applications of MEBMs: 1) Norway, 2) European Union and the Australian bioregional plans, 3) Canadian federal

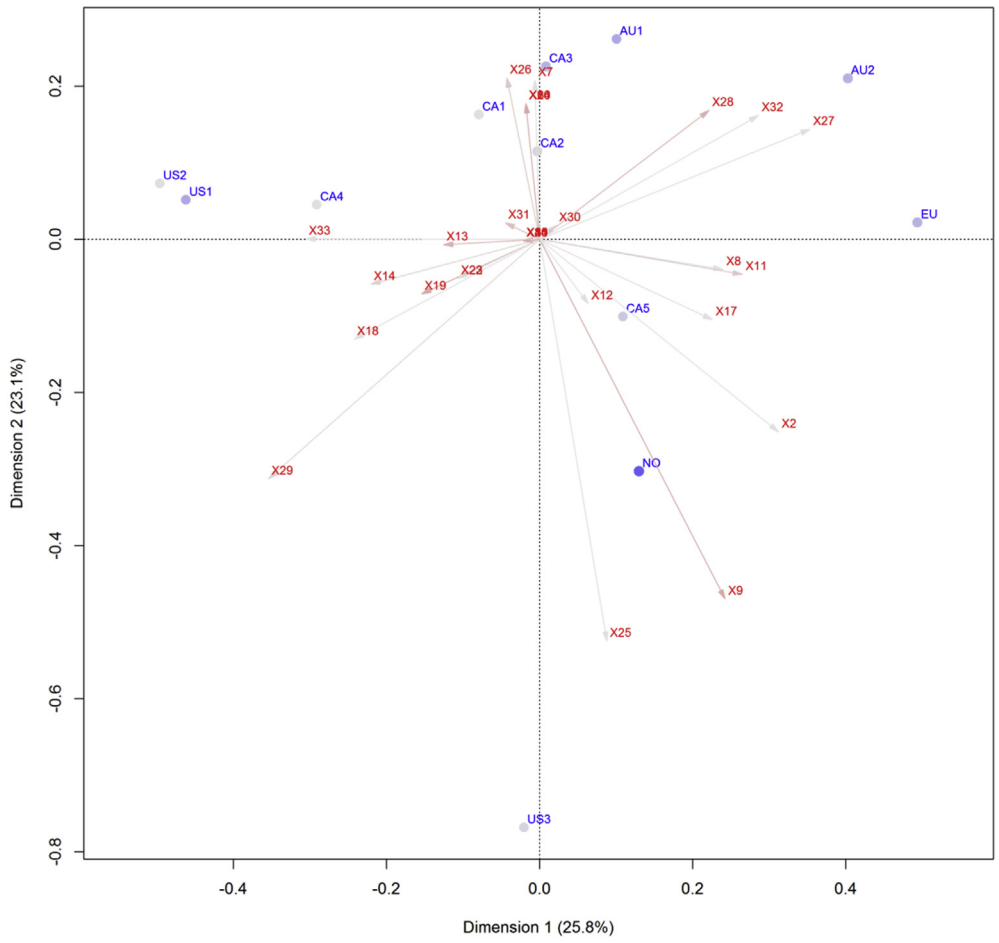

Fig. 3. Correspondence analysis.

plans, 4) the regional effort of MaPP, Canada, and the state marine spatial plans of the US and 5) the regional ocean plans in the US.

4. Discussion

The results indicate that the application of MEBM is heterogeneous. But what does it mean in practice that these regimes are different? In the theoretical literature it is emphasized that there does not exist a general "blueprint" that fits all marine planning situations (Ehler and Douvere, 2009). Even if MEBM might seem as an all-encompassing approach, this management approach requires a prioritization of issues to be handled in the plan. When it comes to goals and aims differences ought to be expected, since there is a variation in regional challenges – e.g. different planning challenges, different ways of organizing bureaucracies and different ecosystems and forms of marine human activities. However, it should be expected a high degree of similarity when it comes to elements of marine ecosystem-based management (Fig. 1). Long et al. (2015) emphasize that there exists a large variety of principles associated with EBM, but that lack of consensus on a common definition of EBM has challenged the practical application and implementation. In the theoretical literature it is argued that MEBM has certain characteristics and elements (Fogarty and McCarthy, 2014; Long et al., 2015). Basic aspects of MEBM, such as integration, ecosystem metrics, spatial measures and adaptive management ought to be present to be characterized as a regime based on MEBM (Fig. 1). Jones et al. (2016) argues, based on cases from Europe, that there is a divergence between the theory for MSP in this field and the practical application. Vince (2015) addresses that lack of integrative capacity can lead to implementation failure. She defines integrative capacity as "*an institutional model that can deal with multiple issues, jurisdictions and sectors holistically*".

The question asked in the beginning is how can such holistic marine management regimes contribute to sustainable ocean development? Mechanisms that can aid coexistence between users – for instance marine governance, spatial measures that can protect marine habitats, performing cumulative impact assessments, assessing the human impact on the environment and the use of metrics in order to be available to evaluate the state of the ecosystem are four factors put forward as important in the theoretical literature (Borja et al., 2016; Samhouri et al., 2013).

The discussion is organized around the following themes that can be used to explain the results achieved in Fig. 3:

4.1 Marine governance.
4.2 Spatial measures
4.3 MEBM, multiple use and cumulative load
4.4 Metrics

4.1. Marine governance

Holistic marine management regimes for the ocean can be viewed as designing rules, procedures for how to govern an area.

Marine governance signifies the interplay between authority to plan, legislation, government, planning system and stakeholders. Marine policies act as a sketch for the construction of holistic marine management regimes in all the cases researched here. They precede the development of marine management systems (Anonymous, 1998, 2002a, 2002b, 2004a, 2006a, 2007b, 2010a, 2010c). These policies outline on a strategic level how use and protection of marine resources can be governed and developed. Rothwell and Stephens (2011) characterizes this as development of "*norms and principles*" for ocean governance that "*reflect new international priorities when it comes to managing ocean spaces*". These new priorities have appeared after the completion of the UN Law of the Sea.

The turn towards marine ecosystem-based management is often attributed to Agenda 21, chapter 17, "Protection of the oceans, all kinds of seas, including enclosed and semi-enclosed seas, and coastal areas and the protection, rational use and development of their living resources" (Rothwell and Stephens, 2011: p. 476). Agenda 21, Chapter 17, also had a clear focus on integrated marine management. Another important outcome of the Rio Conference in 1992, that has impact on the development of ocean governance, is the UN Convention on Biodiversity and the UN Framework Convention on Climate Change (Haward and Vince, 2008: p. 50). But also the different management systems developed within the different cases have influenced each other as research literature has been published on these issues, international guidance and as HMR has developed.

The architecture and the rationale given in the policies are important for the development of marine governance. A common theme is the dependence of marine systems, the need to develop sustainable management systems and to integrate different levels of government. The role and importance of marine economy is also underlined. All the policies suggest balancing between use and protection in the marine environment. They also suggest balancing between multiple users so that conflicts are avoided. Another important aspect is the will to preserve marine biological diversity. Marine policy functions as a platform for the development of policy actions and implementation of programs. Policies are adjusted as they are tested and tried. Common considerations in all the policies include:

1. Acknowledging that there are threats and challenges to preserve marine biodiversity and habitats.
2. Emphasis on using best available marine science.
3. Acknowledging that marine activity and industry are a vital part of the economy.
4. Marine job opportunities and value creation is part of the agenda.
5. Human activity and industry in the marine environment must be controlled in such a manner that they encourage sustainable conduct. National policy therefore seeks to handle multiuse of the ocean space.

But how do the different cases here differ? Policy, legislation and planning take different roles in the construction of marine governance. The marine policies are released at different points in time from 1998 to 2010. Australia was the first country that made a marine policy among the cases here in, 1998. Australia set forward to develop regional marine plans, and first developed a plan for the south-east marine region (Anonymous, 1998, 2004b). During the work on the south-east marine regional plan it was realized that a new approach to regionalisation of the ocean space was needed, and later a system for bioregionalization of the Australian ocean area was developed (Anonymous, 2005b). In most of the cases existing institutions are given the task of coordinating the work with marine governance. An exception is Australia, which chose to organise the work with marine planning by creating new institutional arrangements. Australia later abandoned this arrangement. From 2006 marine planning was instead conducted under the Department of the Environment. Marine management systems are constructed differently, e.g. the first marine plan of Australia was made without a legal basis for marine planning, and similarly the Norwegian marine plans are without a specific legal basis. These two regimes have been based on policy commitments and integration of sector laws. Reliance on sectoral laws are also shared with the regional marine plans developed as part of the US national ocean policy (Anonymous, 2013c).

In 2005 Australia decided to give marine ecosystem-based management a legal basis (Anonymous, 2006a). In Canada a legal basis for integrated ocean management existed through the Canada's Oceans Act since 1996 (Anonymous, 1996). The EU has introduced two directives: the marine strategy framework directive in 2008 and the maritime spatial planning directive 2014 (Anonymous, 2008a, 2014a). Several of the EU countries had already developed marine spatial planning for the offshore marine area. The development in the EU has moved gradually towards creating a normative basis for marine spatial planning. Marine spatial planning was first part of a recommendation, before it developed into the adoption of a directive (Anonymous, 2008a, 2014a). In Massachusetts, USA, separate legislation for marine planning was given. Later a National Ocean Policy set out to create nine marine regions. Planning of these regions is not mandatory, but based on voluntary accession. States that are part of a defined marine region can go together and establish a regional planning body. In the U.S. you will have both the state initiatives for ocean planning and an overarching framework of regional plans (Anonymous, 2013e). The regional plans are not made on the basis of legislation, but are supplemented by sectoral federal laws and state laws (Anonymous, 2016b). Regional plans are sent to the National Ocean Council for review and concurrence (Anonymous, 2013a, 2015g).

The ocean policies and strategies have a high degree of similarity regarding the comparative indicators (Fig. 3). They all score on adopting key elements of MEBM in constructing HMR. However, in the research literature Vince et al. (2015) find that the status of the Australian policy in the long term did not succeed to establish integrated marine management, but that it managed to increase awareness of the marine environment across sectors. A recent review of Canada's ocean policy by Bailey et al. (2016) calls for government to "fully implement" the Ocean's Act and strategy. In Norway marine planning is approved by the national assembly, and thus also differs from the other cases here which are approved by government or responsible bureaucracy.

4.2. Spatial measures

In the research literature spatial measures and place-based management are seen as essential for MEBM (Douvere, 2008). Mapping and knowledge of the ecosystem is important in order to ensure ecological functioning. Foley et al. (2010) identify that MSP must build on ecological principles that can maintain: 1) species diversity, 2) habitat diversity and heterogeneity, 3) populations of key species and 4) connectivity. All of the cases researched here apply place-based management. Place-based management in practical management often means that administrative considerations are part of the limitation of an area, as well as consideration of ecosystem connectivity. The extension and delimitation of the exclusive economic zone, or the jurisdiction of a state in a federal system, is not necessarily consistent with ecosystem connectivity. In the MEBM cases studied here there is a distinction between

coastal zone management and offshore management. In Norway the marine management plans cover the offshore area from the base line and outward.

In Australia the bioregional plans cover the Commonwealth waters, i.e. from 3 to 200 nautical miles. The Australian system covers a large ocean areas of an island continent – and is the largest marine planned area. The federal marine planning system in the US includes the coastal zone and offshore waters, and the Canadian similarly the planning system includes the same area. The state management plans in the US and the regional planning initiatives in Canada the MaPP must be seen in relation to regional marine planning.

A system based on large marine ecosystems have been developed for management purposes, it is a system not based on jurisdictional boundaries (Sherman, 2014). Applying such a system would require nations to work across jurisdictional boundaries. In the cases studied here the place-management naturally are confined to the jurisdictional boundaries in each case. The European Union system for a marine strategy and marine spatial planning directive are important in unifying the jurisdictional boundaries of the member state countries (Anonymous, 2008b, 2014a). Both the marine strategy framework directive and the marine spatial planning directive encourage cooperation with non-member states (Anonymous, 2008b, 2014a). Both United Nations Convention on the Law of the Sea (UNCLOS) and the Convention on Biological Diversity (CBD) also contain encouragement for states to cooperate across administrative boundaries.

The Norwegian integrated management plans build on identification of "particularly valuable and vulnerable areas". They are identified with a spatial extension in the plan and mapped with adhering guidelines for human activity in these areas. These are areas that have an important ecological functions for biodiversity, such as spawning grounds or coral habitats (Anonymous, 2003, 2008c, 2012b). In addition to these areas there are identification of petroleum areas with restrictions and areas opened for petroleum activity. The plan itself is not a legal instrument that can grant or reject applications for petroleum activity. The function of the plan is to ensure a predictable and foreseeable understanding of the ocean area. It is a plan that is approved by the Norwegian national assembly, and is valid until it is reviewed by the national assembly. In practice, licences for petroleum activity must be applied according to sector law, but an application must take into account the integrated management plan. In all the management areas traffic separation schemes for large shipping vessels have been introduced. This cannot be mandated by spatial measures in the plan, but has to follow international application procedures for approval by the International Maritime Organisation. The intention of the integrated management plans has not been to replace sector laws, but instead coordinate sector decisions and make a framework for general sea use and protection that has to be taken into account by the different maritime sectors.

In 2005, the Canadian "Oceans Action Plan" identified five large ocean management areas (Anonymous, 2005a). Integrated management was to be developed in five priority areas: 1) Placentia Bay and the Grand Banks, 2) The Eastern Scotian Shelf, 3) The Gulf of St. Lawrence, 4) The Beaufort Sea and 5) The Pacific North Coast. The Eastern Scotian-shelf Integrated Management Plan (ESSIM) was the first plan to be completed in 2007. The plan was completed, but not formally endorsed according to the Canadian Oceans Act, section 32 (Anonymous, 1996, 2013f: pp. 16–17). Also three other strategic plans have been completed: The Beaufort Sea Integrated Ocean Management Plan, Placentia Bay/Grand Banks Integrated Management Plan 2012–2017 and the Gulf of St. Lawrence Integrated Management Plan. In Canada the focus has been on developing strategic plans for the five priority large ocean management areas. In the plan for the Eastern Scotian-shelf an objective-based management framework is applied (Anonymous, 2007a). The plan does not apply area zoning, but rather uses goals, strategies and actions for ecosystem management in the planning area. Ecologically and biologically significant areas (EBSA) are identified in the plans. The Pacific North Management Plan has not yet been completed (Anonymous, 2014b). The Canadian government has been criticized for not fully implementing the intentions of the Oceans Act (Bailey et al., 2016). In line with the ideas developed in the PNCIMA process another regional initiative has developed. The Marine Planning Partnership for the North Pacific Coast (MaPP) builds further on the work performed under PNCIMA. In 2009 Canada started to prepare a bioregionalization of the ocean area, and left the concept of *large ocean management areas* (Anonymous, 2009a). Canada has now developed a new regional oceans plan for the "Scotian Shelf, Atlantic Coast and Bay of Fundy" (Anonymous, 2014c, 2014d) based on bioregions.

The MaPP has been a collaborative process between 18 member First Nations and the Province of British Columbia. The construction of the MaPP process is interesting in light of the plans developed at the federal level, and also produces new approaches that can be implemented in the federal integrated oceans and management programme. Four sub-regional marine plans have so far been developed and completed (Anonymous, 2015a, 2015b, 2015e, 2015f). The plans are not considered to be having a legal function, but set guidelines in partnership between 18 member First Nations and the Province of British Columbia. The plan has a zoning regime with identification of areas important for biodiversity, general use and for marine industry. The four sub-regional plans have been synthesized into a regional action framework for the whole planning area (Anonymous, 2016a). The plan will only cover the marine area of the province, and not include federal waters.

The federal plans have a supportive legal framework and procedure to endorse plans. The MaPP initiative has been developed in line with the intentions of the Oceans Act, and could potentially be expanded to the federal level, and further develop a marine regional plan for the Pacific Coast. The federal plans can take advantage of the work done in British Columbia and combine strategy plans with the planning framework developed under the MaPP. The MaPP does not address the legal competence that belongs to federal jurisdiction.

The first generation of Australian plans were not connected to the EPBC act. They did not have a legal foundation, but was part of the Australian marine policy as management plans relying on sectoral laws, setting guidelines for the use of the ocean and identifying important areas for biodiversity preservation. The second generation of Australian plans applies area identification, but is closely connected to the EPBC act. This means that it is up to the minister and ministry to decide if a planned project interferes with key ecological functions or marine biota that is protected under the EPBC act. In addition the information that is presented in the Australian plans can be used by actors who plan marine industrial activity to judge if a referral is needed. This is the spatial function of the Australian plan. In the underlying material of the Australian plans there is a lot of spatial information on key ecological features and on habitats for species. In addition there is a full review at the species group level. This is combined with a pressure analysis and a judgement of likeliness for initiating a referral procedure under the EPBC act in connection with planned activity. The plan itself is not a legal instrument.

The state plans of Massachusetts and Rhode Island are concerned with siting renewable offshore energy area in balance with both ecology and other users of the ocean. The Massachusetts Ocean Plan use a similar strategy to declare "Multi-user Area" and "directs new development away from both critical marine

ecosystem components – special, sensitive or unique (SSU) resources – and areas important for water-dependent uses that were identified and mapped in the planning process". The Rhode Island Plan applies MSP explicitly as an approach to implement ecosystem-based management (Boehnert, 2013).

Several of the European Union member states have developed marine spatial planning ahead of the marine spatial planning directive. In this article it is the overarching framework for European marine governance that has been in focus. Individual member countries must comply with these directives.

Spatial measures can have different character and different enforcement. The strongest spatial measurement is zones that can be connected to legal enforcement, for instance if an area is treated with specific protection measures. On the other scale would be measures that are objective oriented, and which set general goals to be reached for the whole planning area. Between these outer points would be the use of spatial categories without any legal enforcement, but where there are political and user agreement on use and protection of the area. In the cases researched here the majority of the plans apply spatial measures that function as guidelines. The role of zoning and spatial measurements contribute to the difference between cases researched here (Fig. 3). On one end the Canadian first generation plans have objectives connected to the whole area or specific areas. In the Norwegian plan there is a zoning framework for petroleum industry in relation to vulnerable areas, which is considered to have an important ecological function. The industry framework is politically approved, and thus also differing from the advisory and regulatory plans. However, a political approved industrial framework has a short horizon and might be more prone to changes. In the EU legislation there is a detailed list of areas that ought to be mapped and considered. In the Australia plans areas that have either a geological, physical, biological or cultural value is identified. In the US there is a clear zoning of spatial areas. The state plans have a regulatory function, which differs from the other plans here being advisory in function. The exception is the regional plans of the US, and the function of the plan is advisory.

So far we have discussed spatial measures as part of the management plan. Other spatial measures can be attributed with a more formalized legal protection status, e.g. marine protected areas (MPA). In Norway a network of MPAs has been planned separately from the marine offshore management plans. In Australia, Canada and EU a network of marine protected areas are seen as part of the MEBM process (Anonymous, 2008b, 2014d; Petrachenko and Addison, 2015). In Australia the creation of the world largest MPA network spurred a political conflict that resulted in a scientific and a bioregional advisory panel review (Beeton et al., 2016). The reviews largely supported the decisions and zoning made when establishing the network of marine reserves. In the US MPAs have been planned ahead of the introduction of MEBM (Anonymous, 2000). It is important to underline the synergy between MPAs and MEBM (Spalding et al., 2013). The differences in approach to assigning MPAs in relation to MEBM also contribute to explain the different groups (Fig. 3).

4.3. MEBM, multiple use and cumulative load

Jones et al. (2016) observe – based on cases from Europe – that there is a tendency that integration is interpreted as user integration ahead of environmental priorities. Relevant to this observation is how MEBM, multiple use and cumulative load are applied in the cases researched here? As we have seen, the theoretical literature argues for scoping, mapping and prioritizing among different user interests. MEBM aims at targeting the main human use and human impacts on the ecosystem, and attempts balancing between use and protection, finding solutions for coexistence or recommend application of best available technology. Another intention is to map the ecological values of the planning area. The plans analysed here build on extensive research knowledge on the areas. All of the marine plans examined here addresses the question of cumulative load (Fig. 3).

The cumulative load principle is viewed as one of the key principles of ecosystem-based management. The cumulative load is evaluated towards properties of the ecosystem. The challenge is to point at which factors cause alone or in combination with other factors the most severe impacts. What type of factors constitute a critical impact, and in which manner? Some impacts create cascades through the food web by bioaccumulation, physical installations at sea in relation to predatory behaviour by species, in rare cases extinction of a whole species group due to overharvesting, and other factors impact at the genetic level or the physiology of species (Cleasby et al., 2015). The challenge is to be able to identify the extent, degree and consequences of human activities that impact species and habitats negatively, and be able to systematically apply this knowledge to make management decisions in a sound manner. Halpern et al. (2007) has devised a method to systematically rank and organise an overview of marine threats that ought to be considered in MEBM. This approach has been suggested to model overlapping human activity at sea in relation to ecosystem function. The results from this analysis can be used to mitigate conflicting interest and reduce human impacts on certain parts of the ecosystem, and it can be applied to inform planning and management.

Other approaches to assess cumulative pressures includes Integrated Ecosystem Assessment (IEA), pressure analysis (dPSIR), evolutionary impact assessment, integrated ecosystem-based risk assessment and network analysis between human use and food webs (Jonge et al., 2012; Judd et al., 2015; Kelly et al., 2014; Laugen et al., 2014; Levin et al., 2009).

The model of human impacts developed by Halpern et al. (2008) has been used in the Baltic Sea, and for the offshore area off Massachusetts ((Korpinen et al., 2012; White et al., 2012)). These methods have especially been targeted towards ecosystem-based management and the application of MSP, but also objectives-based MEBM can apply this method. In the Australian bioregional marine plans pressure analysis are used. The International Council for the Exploration of the Sea (ICES) has developed Integrated Ecosystem Assessment as a method, in cooperation with the National Oceanic and Atmospheric Administration, who has applied this method to federal plans.

In all the cases researched here a balancing between use and protection are performed. Critical and vulnerable habitats are identified according to current knowledge. But still assessing cumulative impacts offer challenges. In the theoretical literature cumulative impacts have been emphasized and methods suggested, but still there are few traces of these methods in current practice.

The Norwegian plans applied a combination of quantitative and qualitative knowledge to make judgments on cumulative load and risk of petroleum accidents. Olsen et al. (2016) contributes with important insights for MEBM when there are issues of risk involved in the assessment and the question of allocating petroleum activity in vulnerable areas. An important insight from their research is that scientific disagreement and the value-laden nature of the question should be made visible in the planning process.

Sectoral management must also be ecosystem oriented in their practices. For instance a review of 1200 fish stocks world wide showed that only 24 of them considered ecosystem drivers in tactical management (Skern-Mauritzen et al., 2015). Skern-Mauritzen et al. (2015) notes that fisheries management still is predominantly single species oriented. HMR must relate to already existing practices and sectoral effort, and attempt to transform

these to sustainable practices. Sectoral efforts to implement MEBM therefore becomes important for the design of HMR.

4.4. Metrics

The "health" analogy is frequently used in theory regarding metrics for holistic management. In the Norwegian system indicators are divided into three types: "status, impact and effect of the impact" (Anonymous, 2012a). Indicators are usually implemented in a monitoring system for establishing long-time surveillance of the environment, to have indicators that can be easily communicated to decision makers, use the indicators as the basis for deciding management actions, and to judge if the goals of the management plan have been reached. Indicators can also be used as part of adaptive management. Metrics in the form of indicators are used to assess "ecosystem status". Elements of the ecosystem are used to infer knowledge about the component itself, but also about the environment were the organism is living. Some heavy metals occur in the benthic environment with natural concentrations, but can also be found at enriched levels due to release from human activity either at land or at sea. The metrics are important for evaluating the outcome of the marine planning, but also to be able to have information on environmental changes due to natural oscillations or other human forcing outside of the selected management site or human pressures inside the management area. In a management context a change in an indicator, for instance the level of pollutants, should give information to act if the source is known. In the cases studied here metrics are used as part of the management system.

In the Norwegian system we find an indicator system consisting of ocean climate, phytoplankton, zooplankton, fish, seabird, sea mammals, benthic trawl catch, human pressures (pollution and harvesting). It is argued that the North Sea is heavier influenced by human activity than the Norwegian Sea and the Barents Sea, therefore also the situation is more complex and there is need for more complex variables. In the North Sea Plan there were suggested 13 indicators connected to sectoral activities. The draft for an Australian ecological indicator system, descriptors and indicators for the EU marine strategy framework directive, the Canadian MaPP proposal for potential indicators and the Norwegian system share many similarities in the approach to marine indicators.

The indicator report for the North Sea pinpoint: "*they are incomplete in relation to life cycles, energy and nutrients cycles. The gaps are large within microbial societies, pathogens and parasites, pelagic invertebrates and organic decomposers. It is not planned to monitor this because of lack of technology and lack of knowledge. It is a need for new development to understand processes in the ecosystem*" (Anonymous, 2012a).

In the Canadian system, indicators were developed for five large ocean management areas. The EU system differs a bit from the other systems. It contains for example biodiversity as a general descriptor. In addition, it also contains food web structures as a descriptor, by including all marine elements that there currently is knowledge about. Even if some of the regional seas conventions have developed their own indicator system, such as under the OSPAR and the Baltic Marine Environment Protection Commission (Helcom), there are differences in the layout of the EU system. The main descriptors in the marine strategy framework directive are expressions for human pressures (Anonymous, 2008b). A recent review of the EU system suggests that there exists a lot of overlap, and that it is possible to simplify the metrics (Berg et al., 2015).

The use of indicators to measure the state of the ecosystem has a central part in the theoretical literature. The use of ecosystem services has also been put forward as a way of measuring the human impact on the marine environment. In line with the theoretical literature most of the cases during the policy phase had the intention of developing metrics. Currently very few of the cases studied here have functional metrics, but in several of the cases there are development projects under way to implement such metrics as part of the plan. The Norwegian and EU case has progressed furthest when it comes to applying indicators (Fig. 3).

It should be made sure that MEBM is consistent and possible to evaluate. International guidelines and recommendations in the field ought to be followed in constructing and making sure that MEBM can be evaluated. Metrics are an important mechanism in MEBM for evaluating performance, coordination, integration and track the environmental state of the planning area.

5. Conclusions

In this article different aspects of similarities and differences in holistic marine management has been discussed. Recommendations on MEBM have been suggested based on a comparative analysis and the theoretical literature on MEBM. Future research ought to explore the connection between plan and implementation of metrics, i.e. ecological and societal indicators, evaluation of goals and setting targets, and the role of sectoral approaches to MEBM. Most of the plans are given a function as advisory for planned activities. Stronger regulatory mechanisms ought to be considered when constructing HMR. Policies have a high degree of similarity when constructing HMR, but implementation challenges are related to lack of functional metrics, weak spatial measures, weak integration and lack of adaptive management. Improving these aspects can strengthen the path to sustainable ocean management.

MEBM is still an important step forward to enhance sustainable management of the ocean. It is also a promising approach offering a solution to challenges that requires integration. Currently MEBM is concentrated on initiatives dealing with planning areas limited by the exclusive economic zones. This is a valuable start that can be expanded to larger areas as knowledge and experience are gained. There is a need for more international cooperation in line with the CBD and UNCLOS, since they refer to the cooperation between countries on preserving marine biological diversity. There is also a need to address areas beyond national jurisdiction to a higher extent, and across borders through bilateral cooperation. A recommendation would be to negotiate a cooperative framework for MEBM at the UN level.

Acknowledgments

The author thanks supervisors Rune Rosland (Theoretical Ecology Group, Department of Biology, University of Bergen, Norway) and Sigrid Eskeland Schütz (Faculty of Law, University of Bergen) for comments and consultation in preparation of an early draft of this article. I thank also supervisor Erik Olsen (Institute of Marine Research, Norway) for consultation on a later draft. Interpretations, mistakes or any errors are the sole responsibility of the author.

References

Agardy, T., Davis, J., Sherwood, K., Vestergaard, O., 2011. Taking Steps toward Marine and Coastal Ecosystem-based Management - an Introductory Guide. UNEP Regional Seas Reports and Studies No. 189. http://www.unep.org/pdf/EBM_Manual_r15_Final.pdf (last accessed 22.12.2016).

Anonymous, 1996. Canada's Oceans Act (S.C. 1996, c. 31). Act Current to 2016-12-08 and Last Amended on 2015-02-26. Government of Canada. http://laws-lois.justice.gc.ca/eng/acts/o-2.4/ (last accessed 22.12.2016).

Anonymous, 1998. Australia's Oceans Policy: Caring, Understanding, Using Wisely. Environment Australia, Commonwealth Government, Canberra. http://www.spc.int/Coastfish/Asides/Ocean/aus_ocnpol1.pdf (last accessed 22.12.2016).

Anonymous, 2000. US Executive Order 13158 of May 26, 2000: Marine Protected Areas. The White House, USA. http://marineprotectedareas.noaa.gov/pdf/eo/execordermpa.pdf (last accessed 22.12.2016).

Anonymous, 2002a. Canada's Ocean Strategy: Our Oceans, Our Future. Fisheries and Oceans Canada, Government of Canada. http://waves-vagues.dfo-mpo.gc.ca/Library/264675.pdf (last accessed 22.12.2016).

Anonymous, 2002b. Report No. 12 (2001-2002) to the Norwegian National Assembly (Storting). Protecting the Riches of the Seas Ministry of Environment, Norway. https://www.regjeringen.no/en/dokumenter/report-no.-12-to-the-storting-2001-2002/id195387/ (last accessed 22.12.2016).

Anonymous, 2003. In: Olsen, E., von Quillfeldt, Cecilie H. (Eds.), Identifisering Av Særlig Verdifulle Områder I Lofoten-barentshavet ['Identification of Particularly Valuable and Vunerable Areas in the Barents Sea and Areas off Lofoten']. Institute of Marine Research, Norway. http://www.npolar.no/npcms/export/sites/np/no/arktis/barentshavet/forvaltningsplan/filer/yp.pdf (last accessed 22.12.2016).

Anonymous, 2004a. An Ocean Blueprint for the 21st Century (Final Report). U.S. Commission on Ocean Policy Washington, DC. http://www.opc.ca.gov/webmaster/ftp/pdf/docs/Documents_Page/Reports/U.S.%20Ocean%20Comm%20Report/FinalReport.pdf (last accessed 22.12.2016).

Anonymous, 2004b. South-east Regional Marine Plan - Implementing Australia's Oceans Policy in the South-east Marine Region. National Oceans Office, Australian Government, Hobart, Australia. https://www.environment.gov.au/system/files/resources/83f69107-6e52-4876-b724-74eff9cdf347/files/sermp.pdf (last accessed 22.12.2016).

Anonymous, 2005a. Canada's Oceans Action Plan. Communication Branch. Fisheries and Oceans Canada, Government of Canada, Ottawa, Ontario. http://waves-vagues.dfo-mpo.gc.ca/Library/315255e.pdf (last accessed 22.12.2016).

Anonymous, 2005b. National Marine Bioregionalisation of Australia. Department of the Environment and Heritage (National Oceans Office), Australia. https://www.environment.gov.au/system/files/resources/b163a19d-d71b-4da6-ae67-436447a13401/files/nmb.pdf (last accessed 22.12.2016).

Anonymous, 2006a. Brochure: Marine Bioregional Planning: a New Focus for Australia's Marine Planning. Department of the Environment and Heritage, Commonwealth of Australia. http://www.environment.gov.au/system/files/resources/5aa4ff80-e0d7-4ec8-8e39-d58e9352eeeb/files/mbp-brochure.pdf (last accessed 22.12.2016).

Anonymous, 2006b. Report No. 8 to the Storting (2005-2006). Integrated Management of the Marine Environment of the Barents Sea and the Sea Areas off the Lofoten Islands. Ministry of the Environment, Norway. https://www.regjeringen.no/no/dokumenter/Report-No-8-to-the-Storting-20052006/id456957/ (last accessed 22.12.2016).

Anonymous, 2007a. Canada's Eastern Scotian Shelf Integrated Management Plan. Ocean and Habitat Branch. Fisheries and Oceans Canada, Government of Canada. http://www.dfo-mpo.gc.ca/Library/333115.pdf (last accessed 22.12.2016).

Anonymous, 2007b. 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. COM(2007) 575 Final. Commission of the European Communities. http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52007DC0575 (last accessed 22.12.2016).

Anonymous, 2008a. Roadmap for Maritime Spatial Planning: Achieving Common Principles in the EU. COM(2008) 791 final. Brussels, 25.11.2008. Communication from the Commission. Commission of the European Communities. http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A52008DC0791 (last accessed 22.12.2016).

Anonymous, 2008b. Directive 2008/56/EC of the European Parliament and of the Council of 17 June 2008 Establishing a Framework for Community Action in the Field of Marine Environmental Policy (Marine Strategy Framework Directive). European Parliament. http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2008:0791:FIN: EN:PDF (last accessed 22.12.2016).

Anonymous, 2008c. In: Olsen, E., Auran, Jo Anders (Eds.), Helhetlig Forvaltningsplan for Norskehavet: Sårbarhet for Særlig Verdifulle Områder I Forhold Til Petroleumsvirksomhet, Fiskeri, Skipstrafikk Og Annen Påvirkning ['Identification of Particularly Valuable and Vunerable Areas in the Norwegian Sea']. Institute of Marine Research, Norwegian Environment Agency, The Norwegian Coastal Administration, Directorate of Fisheries and Norwegian Petroleum Directorate, Norway. http://www.miljodirektoratet.no/old/dirnat/attachment/902/S%C3%A5rbarhetsrapport%20Norskehavet.pdf (last accessed 22.12.2016).

Anonymous, 2009a. Development of a Framework and Principles for the Biogeographic Classification of Canadian Marine Areas. Science Advisory Report 2009/056. Canadian Science Advisory Secretariat, Fisheries and Oceans Canada. http://www.dfo-mpo.gc.ca/csas-sccs/publications/SAR-AS/2009/2009_056_e.pdf (last accessed 22.12.2016).

Anonymous, 2009b. Integrated Ocean Management Plan for the Beaufort Sea: 2009 and beyond. Beaufort Sea Partnership. Beaufort Sea Planning Office, Canada. http://www.beaufortseapartnership.ca/wp-content/uploads/2015/04/Integrated-Ocean-Management-Plan-for-the-Beaufort-Sea.pdf (last accessed 22.12.2016).

Anonymous, 2009c. Massachusetts Ocean Management Plan: Volume 1 Management and Administration. Executive Office of Energy and Environmental Affairs, The Commonwealth of Massachusetts, USA. http://public.dep.state.ma.us/EEA/eeawebsite/mop/final-v1/v1-complete.pdf (last accessed 22.12.2016).

Anonymous, 2009d. Massachusetts Ocean Management Plan: Volume 2 Baseline Assessment and Science Framework. Executive Office of Energy and Environmental Affairs, The Commonwealth of Massachusetts, USA. http://public.dep.state.ma.us/EEA/eeawebsite/mop/final-v2/v2-complete.pdf (last accessed 22.12.2016).

Anonymous, 2009e. Report No. 37 (2008-2009) to the Storting: Integrated Management of the Marine Environment of the Norwegian Sea. Ministry of the Environment, Norway. https://www.regjeringen.no/en/dokumenter/report-no.-37-to-the-storting-2008-2009/id560159/ (last accessed 22.12.2016).

Anonymous, 2010a. Final Recommendation of the Interagency Ocean Policy Task Force, July 19, 2010. The White House Council on Environmental Quality, USA. https://www.whitehouse.gov/files/documents/OPTF_FinalRecs.pdf (last accessed 22.12.2016).

Anonymous, 2010b. Rhode Island Ocean Special Area Management Plan (Ocean SAMP), 1. A management program of the Rhode Island Coastal Resources Management Council, USA. http://seagrant.gso.uri.edu/oceansamp/pdf/samp_crmc_revised/RI_Ocean_SAMP.pdf (last accessed 22.12.2016).

Anonymous, 2010c. Rhode Island Ocean Special Area Management Plan (Ocean SAMP), 2. A management program of the Rhode Island Coastal Resources Management Council, USA. http://seagrant.gso.uri.edu/oceansamp/pdf/appendix/full_volume2_osamp_4.26.13.pdf (last accessed 22.12.2016).

Anonymous, 2010d. US Executive Order 13547: National Policy for the Stewardship of the Ocean, Our Coasts, and the Great Lakes. The White House, Office of the Press Secretary, USA. https://www.whitehouse.gov/files/documents/2010stewardship-eo.pdf (last accessed 22.12.2016).

Anonymous, 2011. Meld. St. 10 (2010-2011) Report to the Storting (White Paper): First Update of the Integrated Management Plan for the Marine Environment of the Barents Sea-lofoten Area. Ministry of the Environment, Norway. https://www.regjeringen.no/en/dokumenter/meld.-st.-10-20102011/id635591/ (last accessed 22.12.2016).

Anonymous, 2012a. Scientific Basis for an Integrated Management Plan for the North Sea and Skagerrak. Proposed indicators for a monitoring programme. Norwegian Environment Agency, Norway (Summary). http://www.miljodirektoratet.no/old/klif/publikasjoner/2926/ta2926.pdf (last accessed 22.12.2016).

Anonymous, 2012b. Scientific Basis for an Integrated Management Plan for the North Sea and Skagerrak. Vulnerability of Particularly Valuable Areas (Summary). Institute of Marine Research and Norwegian Environment Agency, Norway. http://www.miljodirektoratet.no/old/klif/publikasjoner/2927/ta2927.pdf (last accessed 22.12.2016).

Anonymous, 2012c. Marine Bioregional Plan for the North-west Marine Region. Department of Sustainability, Environment, Water, Population and Communities. Australian Government. https://www.environment.gov.au/system/files/pages/1670366b-988b-4201-94a1-1f29175a4d65/files/north-west-marine-plan.pdf (last accessed 22.12.2016).

Anonymous, 2012d. Marine Bioregional Plan for the North Marine Region. Department of Sustainability, Environment, Water, Population and Communities. Australian Government. https://www.environment.gov.au/system/files/pages/0fcb6106-b4e3-4f9f-8d06-f6f94bea196b/files/north-marine-plan.pdf (last accessed 22.12.2016).

Anonymous, 2012e. Marine Bioregional Plan for the South-west. Department of Sustainability, Environment, Water, Population and Communities. Australian Government. https://www.environment.gov.au/system/files/pages/a73fb726-8572-4d64-9e33-1d320dd6109c/files/south-west-marine-plan.pdf (last accessed 22.12.2016).

Anonymous, 2012f. Marine Bioregional Plan for the Temperate East Marine Region. Department of Sustainability, Environment, Water, Population and Communities. Australian Government. https://www.environment.gov.au/system/files/pages/1e59b6ec-8b7e-42a8-9619-b5d728f878b2/files/temperate-east-marine-plan.pdf (last accessed 22.12.2016).

Anonymous, 2012g. Placentia Bay/Grand Banks Large Ocean Management Area: Integrated Management Plan (2012-2017). Placentia Bay/Grand Banks Large Ocean Management Area Secretariat, Oceans Division, Ecosystems Management Branch, Newfoundland and Labrador Region, Fisheries and Oceans Canada. http://www.icomnl.ca/files/PBGB%20LOMA%20IM%20Plan.PDF (last accessed 22.12.2016).

Anonymous, 2013a. Guidance for Marine Plans (Primary Reference: National Ocean Council, Marine Planning Handbook, July 2013). National Ocean Council, USA. https://www.whitehouse.gov/sites/default/files/microsites/ostp/guidance_for_marine_plans_final_151001.pdf (last accessed 22.12.2016).

Anonymous, 2013b. Gulf of St. Lawrence Integrated Management Plan. Ocean Managment Division. Fisheries and Ocean Canada. Quebec, Gulf and Newfoundland and Labrador Regions, Canada. http://www.icomnl.ca/files/GOSLIM%20Plan.PDF (last accessed 22.12.2016).

Anonymous, 2013c. Marine Planning Handbook. National Ocean Council, Federal Government of the United States of America, The White House. https://www.whitehouse.gov/sites/default/files/final_marine_planning_handbook.pdf (last accessed 22.12.2016).

Anonymous, 2013d. Meld. St. 37 (2012-2013) Report to the Storting (White Paper): Integrated Management of the Marine Environment of the North Sea and Skagerrak (Management Plan). Ministry of the Environment, Norway. https://www.regjeringen.no/en/dokumenter/meld.-st.-37-2012-2013/id724746/ (last accessed 22.12.2016).

Anonymous, 2013e. National Ocean Policy Implementation Plan. Executive Office of the President, National Ocean Council, USA. https://www.whitehouse.gov/sites/default/files/national_ocean_policy_implementation_plan.pdf (last accessed 22.12.2016).

Anonymous, 2013f. In: McCuaig, Julia, Herbert, Glen (Eds.), Review and Evaluation of the Eastern Scotian Shelf Integrated Management (ESSIM) Initiative. Canadian Technical Report of Fisheries and Aquatic Sciences 3025. Fisheries and

Oceans Canada, Government of Canada. http://publications.gc.ca/collections/collection_2013/mpo-dfo/Fs97-6-3025-eng.pdf (last accessed 22.12.2016).
Anonymous, 2014a. Directive 2014/89/EU of the European Parliament and of the Council of 23 July 2014 Establishing a Framework for Maritime Spatial Planning European Parliament and the Council. http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32014L0089&from=EN (last accessed 22.12.2016).
Anonymous, 2014b. Petition: Progress in Implementing Integrated Management of Canada's Oceans. Office of the Auditor General of Canada. http://www.oag-bvg.gc.ca/internet/English/pet_354_e_39108.html (last accessed 22.12.2016).
Anonymous, 2014c. Regional Oceans Plan: Scotian Shelf, Atlantic Coast and Bay of Fundy. Background and Program Description. Oceans and Coastal Management Division. Ecosystem Management Branch. Fisheries and Oceans Canada. http://publications.gc.ca/collections/collection_2016/mpo-dfo/Fs104-32-1-2014-eng.pdf (last accessed 22.12.2016).
Anonymous, 2014d. Regional Oceans Plan: Scotian Shelf, Atlantic Coast and Bay of Fundy: Implementation Priorities 2014-2017. Oceans and Coastal Management Division. Ecosystem Management Branch. Fisheries and Oceans Canada. http://publications.gc.ca/collections/collection_2016/mpo-dfo/Fs104-32-2-2014-eng.pdf (last accessed 22.12.2016).
Anonymous, 2015a. Central Coast Marine Plan. Marine Planning Partnership Initiative, Canada. http://mappocean.org/wp-content/uploads/2015/08/MarinePlan_CentralCoast_10082015.pdf (last accessed 22.12.2016).
Anonymous, 2015b. Haida Gwaii Marine Plan Marine Planning Partnership Initiative, Canada. http://mappocean.org/wp-content/uploads/2015/04/MarinePlan_HaidaGwaii_WebVer_21042015-opt.pdf (last accessed 22.12.2016).
Anonymous, 2015c. Massachusetts Ocean Management Plan, 1. Management and Administration. Executive Office of Energy and Environmental Affairs, Commonwealth of Massachusetts, USA. http://www.mass.gov/eea/docs/eea/oceans/ocean-plan/2015-ocean-plan-v1-complete-low-res.pdf (last accessed 22.12.2016).
Anonymous, 2015d. Massachusetts Ocean Management Plan, 2. Baseline Assessment and Framework. Executive Office of Energy and Environmental Affairs, Commonwealth of Massachusetts, USA. http://www.mass.gov/eea/docs/eea/oceans/ocean-plan/2015-ocean-plan-v2-complete.pdf (last accessed 22.12.2016).
Anonymous, 2015e. North Coast Marine Plan. Marine Planning Partnership Initiative, Canada. http://mappocean.org/wp-content/uploads/2016/07/MarinePlan_NorthCoast_WebVer_20151207_corrected.pdf (last accessed 22.12.2016).
Anonymous, 2015f. North Vancouver Island Marine Plan. Marine Planning Partnership Initiative, Canada. http://mappocean.org/wp-content/uploads/2015/11/MarinePlan_NorthVancouverIsland_28072015_corrected.pdf (last accessed 22.12.2016).
Anonymous, 2015g. Report on the Implementation of the National Ocean Policy (March 2015). The White House, Washington, USA. https://www.whitehouse.gov/sites/default/files/docs/nop_highlights__annual_report_final_-_150310.pdf (last accessed 22.12.2016).
Anonymous, 2016a. Marine Plan Partnership for the North Pacific Coast: Regional Action Framework. Province of British Columbia, Coastal First Nations, Central Coast Indigenous Resource Alliance, Council of the Haida Nation, Nanwakolas Council, North Coast-skeena First Nations. Marine Plan Partnership Initiative, Canada. http://mappocean.org/wp-content/uploads/2016/05/raf_mapp_v2.22_web.pdf (last accessed 22.12.2016).
Anonymous, 2016b. Northeast Ocean Plan. Northeast Regional Planning Body, New England, USA. http://neoceanplanning.org/wp-content/uploads/2016/10/Northeast-Ocean-Plan_Full.pdf (last accessed 22.12.2016).
Arkema, K.K., Abramson, S.C., Dewsbury, B.M., 2006. Marine Ecosystem-Based Management: From Characterization to Implementation. Front. Ecol. Environ. 4, 525–532.
Bailey, M., Favaro, B., Otto, S.P., Charles, A., Devillers, R., Metaxas, A., Tyedmers, P., Ban, N.C., Mason, T., Hoover, C., Duck, T.J., Fanning, L., Milley, C., Cisneros-Montemayor, A.M., Pauly, D., Cheung, W.W.L., Cullis-Suzuki, S., Teh, L., Sumaila, U.R., 2016. Canada at a crossroad: The impreative for realigning ocean policy with ocean science. Mar. Policy 63, 53–60.
Bailey, R.G., 2014. Ecoregions: the Ecosystem Geography of the Oceans and Continents, second ed. Springer.
Balgos, M.C., Cicin-Sain, B., VanderZwaag, D.L., 2015. A Comparative Analysis of Ocean Policies in Fifteen Nations and Four Regions. In: Cicin-Sain, B., VanderZwaag, D.L., Balgos, M.C. (Eds.), Routledge Handbook of National and Regional Ocean Policies. Routledge.
Barange, M., Merino, G., Blanchard, J.L., Scholtens, J., Harle, J., Allison, E.H., Allen, J.I., Holt, J., Jennings, S., 2014. Impacts of climate change on marine ecosystem production in societies dependent on fisheries. Nat. Clim. Change 4, 211–216.
Beeton, R.J.S.B., Buxton, C.D., Cochrane, P., Dittmann, S., Pepperell, J.G., 2016. Commonwealth Marine Reserves Review: Report of the Expert Scientific Panel. Department of the Environment, Commonwealth of Australia, Canberra. http://www.environment.gov.au/system/files/pages/23061bf8-df19-4b74-b867-5a57ccbc5c8b/files/cmrreviewexpertscientificpanelreportfinal.pdf (last accessed 22.12.2016).
Beh, E.J., 2004. Simple Correspondence Analysis: A Bibliographic Review. Int. Stat. Rev. 72, 257–284.
Berg, T., Fürhaupter, K., Teixeira, H., Uusitalo, L., Zampoukas, N., 2015. The Marine Strategy Framework Directive and the ecosystem-based approach - pitfalls and solutions (Viewpoint). Mar. Pollut. Bull. 96, 18–28.
Blatter, J., Haverland, M., 2012. Designing Case Studies: Eplanatory Approaches in Small-N Research. Palgrave Macmillan.
Boehnert, J.M., 2013. Zoning the Oceans: the Next Big Step in Coastal Zone Management. American Bar Association.
Borja, A., Elliott, M., Andersen, J.H., Berg, T., Carstensen, J., Halpern, B.S., Heiskanen, A.-S., Korpinen, S., Lowndes, J.S.S., Martin, G., Rodriguez-Ezpeleta, N., 2016. Overview of Integrative Assessment of Marine Systems: The Ecosystem Approach in Practice. Frontiers in Marine Science.
Carneiro, G., 2013. Evaluation of marine spatial planning. Mar. Policy 37, 214–229.
CBD, 1993. The Convention on Biological Diversity. The Secretariat of the Convention on Biological Diversity, Montreal, Canada.
CCAMLR, 1980. The Convention on the Conservation of Antarctic Marine Living Resource. Commission for the Conservation of Antarctic Marine Living Resources.
Cleasby, I.R., Wakefield, E.D., Bearhop, S., Bodey, T.W., Votier, S.C., Hamer, K.C., 2015. Three-dimensional tracking of a wide-ranging marine predator: flight heights and vulnerability to offshore wind farms. J. Appl. Ecol. 52, 1474–1482.
Collie, J.S., Adamowicz, W.L.V., Beck, M.W., Craig, B., Essington, T.E., Fluharty, D., Rice, J., Sanchirico, J.N., 2012. Marine spatial planning in practice. Estuarine. Coast. Shelf Sci. 117, 1–11.
Crowder, L., Norse, E., 2008. Essential ecological insights for marine ecosystem-based management and marine spatial planning. Mar. Policy 32, 772–778.
Douvere, F., 2008. The importance of marine spatial planning in advancing ecosystem-based sea use management. Mar. Policy 32, 762–771.
Ehler, C., 2014. A Guide to Evaluating Marine Spatial Plans. UNESCO, Paris. http://unesdoc.unesco.org/images/0022/002277/227779e.pdf (last accessed 22.12.2016).
Ehler, C., Douvere, F., 2009. Marine Spatial Planning: a step-by-step approach toward ecosystem-based management. In: IOC Manual and Guides No. 53, ICAM Dossier No. 6. UNESCO, Intergovernmnetal Oceanographic Commission and Man and the Biosphere Programme. http://unesdoc.unesco.org/images/0018/001865/186559e.pdf (last accessed 22.12.2016).
Fath, B.D., 2015. Quantifying economic and ecological sustainability. Ocean Coast. Manag. 108, 13–19.
Fogarty, M.J., McCarthy, J.J., 2014. An Overview of Marine Ecosystem-Based Management. In: Fogarty, M.J., McCarthy, J.J. (Eds.), Marine ecosystem-based Management. The Sea: Ideas and Observations on Progress in the Study of the Seas. Harvard University Press.
Foley, M.M., Armsby, M.H., Prahler, E.E., Caldwell, M.R., Erickson, A.L., Kittinger, J.N., Crowder, L.B., Levin, P.S., 2013. Improving Ocean Management thorough the Use of Ecological Principles and Integrated Ecosystem Assessments. Bio Sci. 63, 619–631.
Foley, M.M., Halpern, B.S., Micheli, F., Armsby, M.H., Caldwell, M.R., Crain, C.M., Prahler, E., Rohr, N., Sivas, D., Beck, M.W., Carr, M.H., Crowder, L.B., Duffy, J.E., Hacker, S.D., McLeod, K.L., Palumbi, S.R., Peterson, C.H., Regan, H.M., Ruckelshaus, M.H., Sandifer, P.A., Steneck, R.S., 2010. Guiding ecological principles for marine spatial planning. Mar. Policy 34, 955–966.
Fowler, C.W., 2009. Systemic Management: Sustainable Human Interactions with Ecosystems and the Biosphere. Oxford University Press.
Greenacre, M., 2013. The contributions of rare objects in correspondence analysis. Ecology 94, 241–249.
Grumbine, R.E., 1994. What is Ecosystem Management? Conserv. Biol. 8, 27–38.
Halpern, B.S., Selkoe, K.A., Micheli, F., Kappel, C.V., 2007. Evaluating and Ranking the Vulnerability of Global Marine Ecosystems to Anthropogenic Threats. Conserv. Biol. 21, 1301–1315.
Haward, M., Vince, J., 2008. Oceans Governance in the Twenty-first Century: Managing the Blue Planet. Edward Elgar.
Halpern, B.S., Walbridge, S., Selkoe, K.A., Kappel, C.V., Micheli, F., D'Agrosa, C., Bruno, J.F., Casey, K.S., Ebert, C., Fox, H.E., Fujita, R., Heinemann, D., Lenihan, H.S., Madin, E.M.P., Perry, M.T., Selig, E.R., Spalding, M., Steneck, R., Watson, R., 2008. A global map of human impact on marine ecosystems. Science 319, 948–952.
Jones, P.J.S., Lieberknecht, L.M., Qiu, W., 2016. Marine spatial planning in reality: Introduction to case studies and discussion of findings. Mar. Policy 71.
Jonge, V.N.d., Pinto, R., Turner, R.K., 2012. Integrating ecological, economic and social aspects to generate useful management information under the EU Directives' 'ecosystem approach'. Ocean Coast. Manag. 68, 169–188.
Judd, A.D., Backhaus, T., Goodsir, F., 2015. An effective set of principles for practical implementation of marine cumulative effects assessment. Environ. Sci. Policy 54, 254–262.
Kelly, C., Gray, L., Shucksmith, R.J., Tweddle, J.F., 2014. Investigating options on how to address cumulative impacts in marine spatial planning. Ocean Coast. Manag. 102, 139–148.
Kidd, S., Maltby, E., Robinson, L., Barker, A., Lumb, C., 2011. The Ecosystem Approach and Planning and Management of the Marine Environment. In: Kidd, S., Plater, A., Frid, C. (Eds.), The Ecosystem Approach to Marine Planning and Management. Earthscan.
Kienstra, N.H.H., Heijden, P.G.M.v.d., 2015. Using Correspondence Analysis in Multiple Case Studies. Bull. Methodol. Sociol. 128, 5–22.
Korpinen, S., Meski, L., Andersen, J.H., Laamanen, M., 2012. Human pressures and their potential impact on the Baltic Sea ecosystem. Ecol. Indic. 15, 105–114.
Laugen, A.T., Engelhard, G.H., Whitlock, R., Arlinghaus, R., Dankel, D.J., Dunlop, E., Eikeset, A.M., Enberg, K., Jørgensen, C., Matsumura, S., Nusslé, S., Urbach, D., Baulier, L., Boukal, D.S., Ernande, B., Johnston, F.D., Mollet, F., Pardoe, H., Therkildsen, N.O., Uusi-Heikkilä, S., Vainikka, A., Heino, M., Rijnsdorp, A.D., Dieckmann, U., 2014. Evolutionary impact assessment: accounting for evolutionary consequences of fishing in an ecosystem approach to fisheries management. Fish Fish. 15, 65–96.

Leslie, H., Sievanen, L., Crawford, T.G., Gruby, R., Villanueva-Aznar, H.C., Campbell, L.M., 2015. Learning from ecosystem-based management in practice. Coast. Manag. 43, 471–497.
Levin, P.S., Fogarty, M.J., Murawski, S.A., Fluharty, D., 2009. Integrated Ecosystem Assessments: Developing the Scientific Basis for Ecosystem-Based Management of the Ocean. PLoS Biol. 7, 23–28.
Long, R.D., Charles, A., Stephenson, R.L., 2015. Key principles of marine ecosystem-based management. Mar. Policy 57, 53–60.
Misund, O.A., Olsen, E., 2013. Lofoten-Vesterålen: for cod and cod fisheries but not for oil? ICES J. Mar. Sci. 70, 722–725.
Olsen, E., Fluharty, D., Hoel, A.H., Hostens, K., Maes, F., Pecceu, E., 2014. Integration at the Round Table: Marine Spatial Planning in Multi-Stakeholder Settings. PLoS One 9, e109964.
Olsen, E., Holen, S., Hoel, A.H., Buhl-Mortensen, L., Røttingen, I., 2016. How integrated ocean governance in the Barens Sea was created by a drive for increased oil production. Mar. Policy 71, 293–300.
Petrachenko, D., Addison, B., 2015. Australia's Oceans Policy. In: Cicin-Sain, B., VanderZwaag, D.L., Balgos, M.C. (Eds.), Handbook of National and Reigonal Ocean Policies. Routledge, pp. pp, pp. 132–161.
Ragin, C.C., 1989. Comparative Method. University of California Press.
Ragin, C.C., 1992. What is a case? In: Ragin, C.C., Becker, H.S. (Eds.), What Is a Case? Exploring the Foundation of Social Inquiry. Cambridge University Press.
RD, 2001. The Reykjavik Declaration on Responsible Fisheries in the Marine Ecosystem. Food and Agriculture Organization of the United Nations.
Rice, J., Trujillo, V., Jennings, S., Hylland, K., Hagstrom, O., Astudillo, A., Jensen, J.N., 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. International Council for the Exploration of the Sea. http://www.ices.dk/sites/pub/Publication%20Reports/Cooperative%20Research%20Report%20(CRR)/crr273/crr273.pdf (last accessed 22.12.2016).
Rosenberg, A.A., Mooney-Seus, M.L., Kiessling, I., Mogensen, C.B., O'Boyle, R., Peacey, J., 2009. Lessons from National-Level Implementation Across the World. In: McLeod, K., Leslie, H. (Eds.), Ecosystem-based Management for the Oceans. Island Press.
Rothwell, D.R., Stephens, T., 2011. The ErnaInttional Law of the Sea. Hart Publishing.
SAB, 2011. Strategic Advice on Designing and Implementing Coastal and Marine Spatial Plans: a Report from the NOAA Science Advisory Board. NOAA Science Advisory Board. ftp://ftp.oar.noaa.gov/SAB/sab/Reports/CMSP%20Report%20to%20NOAA%20Final.pdf (last accessed 22.12.2016).
Samhouri, J.F., Haupt, A.J., Levin, P.S., Link, J.S., Shuford, R., 2013. Lessons learned from developing integrated ecosystem assessments to inform marine ecosystem-based management in the USA. ICES J. Mar. Sci. 71 (5), 1205–1215.
Sartori, G., 1991. Comparing and miscomparing. J. Theor. Polit. 3, 243–257.
Setälä, O., Fleming-Lethinen, V., Lehtiniemi, M., 2014. Ingestion and transfer of microplastics in the planktonic food web. Environ. Pollut. 185, 77–83.
Sherman, K., 2014. Toward ecosystem-based management (EBM) of the world's large marine ecosystems during climate change. Environ. Dev. 11, 43–66.
Skern-Mauritzen, M., Ottersen, G., Handegard, N.O., Huse, G., Dingsør, G.E., Stenseth, N.C., Kjesbu, O.S., 2015. Ecosystem processes are rarely included in tactical fisheries management. Fish Fish. 17, 165–175. http://dx.doi.org/10.1111/faf.12111.
Spalding, M.D., Fox, H.E., Allen, G.R., Davidson, N., Ferdaña, Z.A., Finlayson, M., Halpern, B.S., Jorge, M.A., Lombana, A., Lourie, S.A., Martin, K.D., McManus, E., Molnar, J., Recchia, C.A., Robertson, J., 2007. Marine Ecoregions of the World: A Bioregionalization of Coastal and Shelf Areas. BioScience 57, 573–583. http://dx.doi.org/10.1641/B570707.
Spalding, M.D., Meliane, I., Milam, A., Fitzgerald, C., Hale, L.Z., 2013. Protecting Marine Spaces: Global Targets and Changing Approaches. Ocean. Yearb. 27, 228–241.
Stake, R.E., 2006. Multiple Case Study Analysis. The Guilford Press.
Teh, L.S.L., Sumaila, U.R., 2014. Trends in global shared fisheries. Mar. Ecol. Prog. Ser. 530, 243–254.
Vince, J., 2015. Integrated policy approaches and policy failure: the case of Australia's Oceans Policy. Policy Sci. 48, 159–180.
Vince, J., Smith, A.D.M., Sainsbury, K.J., Cresswell, I.D., Smith, D.C., Haward, M., 2015. Australia's Oceans Policy: Past, present and future. Mar. Policy 57, 1–8.
Westgate, M.J., Likens, G.E., Lindenmayer, D.B., 2013. Adaptive management of biological systems: A review. Biol. Conserv. 128–139.
White, C., Halpern, B.S., Kappel, C.V., 2012. Ecosystem service tradeoff analysis reveals the value of marine spatial planning for multiple ocean uses. PNAS 109, 4696–4701.
Yin, R.K., 1994. Case Study Research: Design and Methods. Sage.