The “mapping out” approach: effectiveness of marine spatial management options in European coastal waters

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Marine spatial management is challenged by complex situations in European countries where multiple stakeholder interests and many management options have to be balanced. EU policy initiatives such as the proposed Marine Spatial Planning Directive, are in different ways targeting area allocation in European waters. In this circumstance, EU marine management needs assessments based on a satisfactory evaluation framework design that can ensure a transparent treatment of different types of information including interests, values, and facts.

The main goal of this article is to introduce an evaluation framework applicable to marine management in European countries. This so-called CoExist framework maps out different types of relevant knowledge to assess future possibilities for use or no-use of marine areas and links this with appropriate management measures. The CoExist framework is based on the principles of ensuring transparent treatment of different types of information as well as appropriate stakeholder representation which can ensure legitimacy. Empirical findings in six European case studies have been obtained while conducting the CoExist framework. Applying the basic principles of the CoExist framework when planning future management directions of the coexistence of multiple activities in the long-run will expectedly affect the ecological and social-cultural goals by counterbalancing the economic ones.

Keywords: aquaculture management, coastal-zone management, CoExist, European coastal waters, fisheries management, marine spatial planning, multicriteria analysis, sustainable development.

Introduction

Coastal zones provide complex environments in terms of physical and ecological resources accompanying multiple value dimensions of, among others, income profitability, ecosystem values, as well as good living standards. The close attachment of many European citizens to their seas, coasts, and marine areas is heavily affected by increasing conflicts among competing users (Douvere, 2008). Frequently, the demand for marine space exceeds what is available (Barry et al., 2003). In response to the challenges, the EU’s proposed Marine Spatial Planning (MSP) Directive is aiming and anticipating...
at providing the legal support for integrated management to secure sustainable growth and preserve coastal and marine ecosystems for future generations. Moreover, other EU initiatives, such as the legal binding Marine Strategy Framework Directive (MSFD), and the more policy-related Integrated Maritime Policy (IMP) as well as the Common Fisheries Policy (CFP) appear relevant. The challenges of coordination and integration of different objectives and activities are plentiful.

Therefore, the EU calls on national states to set up spatial planning processes (European Commission, 2013). Several countries have taken the initiative to develop and implement such plans (Douvere, 2008). For instance, in the Dutch North Sea, they have developed an integrated management plan, a welcomed policy contribution given their long history of dealing with challenging competition and conflicts related to space and resource allocation (Degnbol and Wilson, 2008).

Although efforts are made to develop marine spatial plans in European countries, it is still not always clear how the future possibilities of use or no-use of marine areas should be designed and defined (Gilliland and Lafsoley, 2008). Some problems are related to traditional EU policies being sector oriented, resulting in difficulties in the coordination and integration of different activities in a specific location. Ecosystem-based management is therefore launched as an alternative focusing on location and areas instead of the traditional sector driven policy approach for coastal and marine areas (Douvere, 2008).

Other challenges are related to lack of adequate information. Provision of information as decision support is often discrepant from what is actually needed (Pastoors et al., 2012); and in addition, sufficient information availability is crucial for successful stakeholders dialogues aiming at, for instance, conflict resolutions or legitimate policy formulations (Pinkley et al., 1995). Major challenges remain to obtain social acceptance while searching for appropriate priorities for policy-making (Wüstenhagen et al., 2007).

Consequently, there is an increasing need for appropriate methods to evaluate and understand the effectiveness of relevant measures (Stelzenmüller et al., 2013), while emphasising involvement and information selection processes which eventually can guide towards specific policy recommendations.

The main goal of this article is to introduce a framework (from now on CoExist framework) which is a method developed for dealing with the challenges appearing for MSP. An effectiveness analysis of marine spatial management options is structured around an involvement process which explicitly is dealing with relevant objectives, differences in stakeholder views, and is location oriented to allow integration and coordination of different activities. The CoExist framework is based on the view that “a mapping out” of information is needed before specific information is selected based on what is “relevant”, and not just because the information is “available”. Hence, the main intention of the CoExist framework introduced in this article is to provide an overview of different types of information, including interests, values, and facts, to allow reflection about what is actually needed for informed MSP processes in support of the proposed MSP Directive.

A general interest in effectiveness evaluations is reflected by earlier applications evaluating objectives to assess future needs and adapt current practices (Pomeroy et al., 2005). Effectiveness can be understood as the degree to which management actions are achieving the relevant goals and objectives (adapted from Hockings et al., 2000). Effectiveness encompasses essential properties including “salience”, “credibility”, and “legitimacy” (Fritz, 2010). Whereas “salience” relates to the perceived relevance of information, the extent to which the system provides information for the decision-makers, “credibility” addresses the perceived technical quality of the information in terms of validity and accuracy. “Legitimacy” concerns the perception of interested parties in terms of supporting the policy decision, which will depend on the fairness of the process (Varjopuro et al., 2008). Assessments of long-term impacts on natural resources are central to effectiveness (Kaplan and McCay, 2004). Effectiveness evaluations also incorporate improvements through learning, adaptation, and the diagnosis of specific issues influencing whether goals and objectives are being achieved. Moreover, evaluations of effectiveness that are socially contentious or under frequent public scrutiny involve a strategy to encourage accountability.

This article consists of five additional sections. In the following section, we briefly introduce six European case study locations where the CoExist framework was tested. Thereafter, we introduce the CoExist framework, before we provide some lessons learned from case study applications. We then provide some main reasons why this CoExist framework could benefit ongoing European marine planning processes. Finally, we provide some concluding remarks.

**Briefing the six case study characteristics**

The CoExist framework has been applied in six European case study locations. They include: the Hardangerfjord in Norway, the Atlantic coast of Ireland, the Algarve coast in Portugal, the Adriatic Sea coast of Italy, the coastal North Sea (Denmark, Germany, the Netherlands), and the Baltic Sea (Finland) (Bergh et al., 2012; CoExist, 2013). The locations are indicated in Figure 1.

The case studies reflect the very different contexts where the CoExist framework has been applied. Context differences appear in terms of activities, geographical size, and appearance within or beyond a nation’s Exclusive Economic Zone (EEZ). Regarding the geographical size, the coastal North Sea includes a total of three nations (Denmark, Germany, and the Netherlands), whereas the remaining five case studies appear within a country (the Hardangerfjord, the Algarve coast, the Atlantic coast of Ireland, the Adriatic coast, and the Baltic Sea). Activities differ; for instance, in the Hardangerfjord, they are more related to the aquaculture sector, which is characterized by the large scale and contribution to the overall welfare at the national level, whereas small-scale aquaculture production appears in the Irish, Dutch, Finnish, and Italian areas. In Portugal, Ria Formosa in Algarve, traditional methods of small-scale bivalve cultivation take place within conservation areas and appear to enhance the cultural landscape dimensions (Wallace, 1999; Joaquim et al., 2008).

In several case study areas, a central conflict between aquaculture and fisheries was documented. For example, in the coastal North Sea, aquaculture, including mussel seed collectors and oyster cultivation, reported conflicting situations with mobile forms of fisheries such as different forms of trawling in German and Dutch waters (CoExist, 2013). In the Baltic Sea, the main reported conflict and challenge for the aquaculture sector is related to run-offs from agriculture production on land, which impacts the water quality, so essential for aquaculture (CoExist, 2013).

Furthermore, conflicts are often related to newcomers claiming more marine space. The increasing demands for green energy sources located at sea, be it waves, wind, or coastal waterfalls, appear to increasingly compete for space with the traditional users of the coastal and marine domain. In addition, nature conservation
interests are claiming more marine space in many case study areas, by the Marine Protected Areas (MPAs), or in some cases related to open landscapes and recreation, which often conflicts with other established marine activities located in those particular areas (Bergh et al., 2012; CoExist, 2013).

In each case study, a range of stakeholders were consulted throughout a series of steps of the CoExist framework, which are described more in detail in the following section. Operational, policy, regulatory, science, and advocacy stakeholders were consulted throughout the process by face-to-face interviews and discussions, as well as telephone calls. In each case study, stakeholders responded to a questionnaire survey about their actual preferences of specified objectives. Total numbers of respondents to the questionnaire survey in each case study are presented in Table 1.

Table 1. Number of stakeholders attending the questionnaire survey in step 4 in the CoExist framework.

<table>
<thead>
<tr>
<th>Case study</th>
<th>Number of questionnaire-based interviews</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hardangerfjord</td>
<td>7</td>
</tr>
<tr>
<td>Atlantic Sea coast</td>
<td>8</td>
</tr>
<tr>
<td>Algarve coast</td>
<td>25</td>
</tr>
<tr>
<td>Adriatic Sea coast</td>
<td>14</td>
</tr>
<tr>
<td>Coastal North Sea</td>
<td>43</td>
</tr>
<tr>
<td>Baltic Sea</td>
<td>10</td>
</tr>
</tbody>
</table>

Case study details in each step of the framework, and also the presentation of case study results, are far too comprehensive to be fit in this article. (Another article is being prepared that will provide details from these case studies; by Ramos et al., Multiple interests across European coastal waters: the need for a common language. Submitted.) The next sections of the article utilize the findings from the detailed case study reports (available online from the CoExist website www.coexistproject.eu) to illustrate the Coexist framework. It appears that the most comprehensive case study is the one conducted in the coastal North Sea. Therefore, results from this particular case study are more frequently provided for the illustrations in the following.

The CoExist framework step by step
The CoExist framework is specified into a total of eight steps (Figure 2). These steps are explained more in detail in the following. The case study details can be found in case study reports (www.coexistproject.eu).

In “step 1”, the main idea is to address the relevant objectives in regulations and laws for the specific case study locations. In each case study, a summary text was addressing the main intentions and objectives with each regulation, which included international, regional, EU, national, and local level regulations. The law and regulation documents were identified by Internet search, expert knowledge, and regulatory stakeholder involvements. The main intention of this exercise is to ensure that ongoing initiatives with implications for MSP in the specific locations are known and
clarified before conducting the CoExist framework to make sure that outcomes are linked to and can complement the ongoing policy strategies.

Generic to all case studies are the global agreements (include the Johannesburg Declaration of Sustainable development and FAO Code of Conduct for Sustainable Fishery). At lower levels, the relevant regulations and laws differ between case studies. The EU directives are relevant to most case studies (exception for the Hardangerfjord in Norway, which is not part of the EU). A list of relevant regulations to respective case studies can be seen in Table 2. All in all, the laws and regulation relevant to European marine areas are plentiful and complicated.

“Step 2” is based on the comprehensive material selected in step 1, combined with stakeholder consultation, aiming at specifying the marine spatial management objectives identified for respective case study contexts and locations.

Objectives are often unclear or too generalized to serve directly as a basis for evaluating effectiveness (Day et al., 2003). Therefore, it is important to articulate these more generic higher order objectives into clearer more specific objectives, which define the tangible results that would be expected if the objectives were fully achieved. The strategy is to specify, for instance, “sustainable development” by applying categories of “economic”, “social-cultural”, and “ecological” objectives and possibly reformulate or replace by others. For instance, social-cultural objectives could be replaced by “recreation” or governance-related objectives could be added. The exact specifications of objectives depend on the context, together with the people being involved, the communication and the relevant regulation and laws.

Of particular importance to this step is the systematic annotation of sources to ensure accountability. Ideally, the specification of objectives should be adaptable over time, contributing to encourage debate. Within the CoExist context, only a snap shot was possible due to time and resource constraints.

“Step 3” is based on step 2 with the main intention to specify and structure what is of importance to a specific context. The relevant objectives identified in step 2 are therefore arranged into a hierarchy, with the more general objectives at the highest level, and these are further specified into lower levels (Figure 3). Whereas the more general objectives are comparable across case studies, the more specific objectives are adapted to case study contexts to ensure relevance to particular circumstances. The vague and general aims and objectives provided in laws and regulations are in this way specified into context-dependent objectives which in a transparent manner can be visible and encourage further discussions. Hence, a hierarchy only provides information about what is more or less specific and has no meaning what so ever to the extent which something is more or less important. Given that contexts change over time, ideally, iterative discussions allowing feasible updates and changes should take place when new information becomes available.

Presentations of objectives in a hierarchy also facilitate an open and systematic consideration of all relevant aspects and assist by informing and structuring different arguments during the procedure (Saaty, 2001; Soma, 2003). The process of articulating general objectives into more specific objectives may require additional interaction with different stakeholders, such as those from different industries (i.e. operational stakeholders), but also policy, regulatory, science, and advocacy stakeholders. Notably, the specified objectives are interrelated, but reflect differentiated aspects and the possibility to enhance eventual conflicting aspects, as well as agreements.

All case studies have developed their own hierarchy, defined the main aim as to “sustaining a viable coastal area or sea”, and further specified into economic, ecological, and social-cultural goals as a starting point for additional specifications. In some instances,
other wordings were applied for these three specification categories, such as for instance in Algarve as well as in the coastal North Sea case studies, the three goals were referred to as ensure profitable enterprises, conserve healthy ecosystems, and preserve high living qualities. These main goals were again specified two or three more times into more context relevant objectives. Figure 3 provides an example of objectives at different specification levels in a hierarchy as they appeared in the coastal North Sea case study.

The main intention in “step 4” is to find relative importance of the specified objectives in the hierarchy according to contexts and stakeholder preferences across case studies. The outcome of this step, i.e. knowing what is more important in a specific context to who, is useful as decision support itself. This information is also applied in the effectiveness analysis in the further steps.

The method applied in this step is to conduct a questionnaire survey to identify different stakeholder preferences for the relevant objectives by a pairwise comparison technique comparing two objectives at a time on a scale of importance (Sparrevik et al., 2011). The method is explained in detail in www.coexistproject.eu. By comparing two objectives at a time on a
semi-quantitative scale, the priorities are spread over the relevant objectives. [Computer programs (e.g. Excel, Expert Choice, or Definite) can be used for calculating the relative preferences, as well as consistencies of the responses (Janssen, 1992).] This approach is based on the assumption that a total of 100% importance priorities exists for an individual stakeholder (or stakeholder group).

Notably, the complete preference overview is too comprehensive to present here due to a large number of stakeholders as well as objectives (www.coexistproject.eu). The maybe most surprising finding across case studies was the overall high priorities provided to social-cultural objectives, which in practice often are seen less important compared with ecological and economic objectives. Looking, for instance, at the Adriatic coast, it appeared that the social-cultural objectives got the highest priority by most groups (aquaculture, tourism, NGOs, and public sector), although not by researchers who gave highest priority to the ecological objectives, and fishers who gave ecological and economic objectives equally much priority (see for instance Table 3 further below).

Also, the ecological objectives got high preferences in some case studies. For instance, the Dutch, the Danish, and the German wind energy representatives in the North Sea case study put the ecological objective first, followed by the social-cultural, and at last the economic objectives. This was actually also the case for wind energy representatives in Ireland and the hydropower representatives in Norway. In Norway, the fishery representative gave very high priority to the ecological objectives, whereas in the other case studies, the fishers’ representatives perceived the economic objectives most important to future developments, followed by the social-cultural objectives, and finally the ecological objectives.

Several stakeholders gave equal importance to economic, social-cultural, and ecological objectives, with the rationality that these objectives are interlinked and not possible to separate about importance. This was for instance the case for the fishers and aquaculture representatives at the Atlantic coast in Ireland, as well as tourism in the Algarve coast in Portugal.

In the case studies, also the more specific objectives in the hierarchy obtained priority scores. For instance, in the coastal North Sea, for the Dutch fishers, the specified economic objectives referred to as “strengthening the fishing as enterprise” scored the highest, whereas for the Danish fishers, “the improvements of infrastructure”, and foremost “improve harbours”, was seen the most important of the economic objectives. For the ones favouring the ecological objectives, the specified objective referred to as “conserving biodiversity” was favoured the most. Whereas “conserving benthic ecosystems” and “avoiding bycatch of fish, birds, and mammals” were further specifications of the biodiversity objective which obtained high importance by Dutch and German stakeholders, the “reduction of discards of fish” was more important to the Danish stakeholders. For the Danish wind representatives favouring the social-cultural objective the most, the “open landscapes” (with

Figure 3. Example of a hierarchy of objectives including different specification levels, an example from the coastal North Sea case study.
wind parks) as well as “aesthetics” was seen as the most important social aspects.

“Step 5” is central, as here we define what we actually are going to evaluate in terms of effectiveness. The aim is to specify some 4–6 scenarios to be evaluated. A selected collection of specific policy options, here thus referred to as measures, are combined in different relevant possibilities. Possible measures would include spatial closures, or governmental interventions in the forms of subsidies for certain purposes, taxes, regulations, enforcement, and laws. In each scenario, the collection of adequate measures is to be defined in specific locations, which address different relevant future possibilities. A benchmark scenario, referred to as a status quo, is indicating the appearance of the selected measures at present. Thus, the scenarios are combinations of measures, which would be relevant in a future context.

In four case studies, the scenarios were developed by using maps, whereas two case studies used textual descriptions (Hardangerfjord and the Adriatic Sea). An example illustrating the possibilities of scenarios applied is provided by the coastal North Sea case study in Figure 4 illustrating some variations of areas used for wind parks. In all, three alternative wind park areas are marked with different colours, including the status quo (in red). The 100% wind park scenario refers to a situation where all areas planned or suggested as possibilities for this purpose will be used, and the 50% scenario indicates that only 50% of such an area will be used for this purpose. These differences combined with possible MPAs, resulted in five alternatives that were used in the impact assessments in the following step (see case study reports, CoExist, 2013).

In “step 6”, the relative effectiveness of each scenario identified in step 5 are to be assessed by an impact assessment combined with the preferences identified in step 4. Effectiveness is thus the degree to which a scenario contributes to achieving the most important objectives of spatial management. The outcome can assist as relevant information in ongoing marine policy processes.

In the following, we introduce two different ways of preparing the impact assessments: (i) by identifying relevant indicators and estimating effect scores quantitatively (substep 6A) and (ii) by assigning qualitative impact scores on objectives directly (substep 6B). A combination of quantitative and qualitative effect scores is also possible. In substep 6C, the scenarios specified in step 5 are evaluated by combining the impact assessments with the stakeholder preferences in step 4.

Table 3. Assigned preferences for main objectives at level 1 in the hierarchy for selected individuals or groups, for each adding up to 100% preference scores.

<table>
<thead>
<tr>
<th></th>
<th>Priority score (%)</th>
<th>Danish</th>
<th>Dutch</th>
<th>German</th>
<th>Wind park entrepreneurs (e) and public sector representatives (p)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Economic objectives</td>
<td>&gt;40</td>
<td>v</td>
<td>v</td>
<td></td>
<td>v</td>
</tr>
<tr>
<td></td>
<td>20–40</td>
<td></td>
<td></td>
<td></td>
<td>v</td>
</tr>
<tr>
<td></td>
<td>10–20</td>
<td></td>
<td></td>
<td></td>
<td>v</td>
</tr>
<tr>
<td></td>
<td>&lt;10</td>
<td></td>
<td></td>
<td></td>
<td>v</td>
</tr>
<tr>
<td>Social objectives</td>
<td>&gt;40</td>
<td>v</td>
<td></td>
<td></td>
<td>v</td>
</tr>
<tr>
<td></td>
<td>20–40</td>
<td>v</td>
<td>v</td>
<td></td>
<td>v</td>
</tr>
<tr>
<td></td>
<td>10–20</td>
<td>v</td>
<td>v</td>
<td>v</td>
<td>v</td>
</tr>
<tr>
<td></td>
<td>&lt;10</td>
<td>v</td>
<td>v</td>
<td>v</td>
<td>v</td>
</tr>
<tr>
<td>Ecological objectives</td>
<td>&gt;40</td>
<td>v</td>
<td>v</td>
<td>v</td>
<td>v</td>
</tr>
<tr>
<td></td>
<td>20–40</td>
<td>v</td>
<td>v</td>
<td>v</td>
<td>v</td>
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<tr>
<td></td>
<td>10–20</td>
<td>v</td>
<td>v</td>
<td>v</td>
<td>v</td>
</tr>
<tr>
<td></td>
<td>&lt;10</td>
<td>v</td>
<td>v</td>
<td>v</td>
<td>v</td>
</tr>
</tbody>
</table>

An example from the coastal North Sea case study.

The three substeps are specified and addressed in the following. In “substep 6A”, an impact assessment is conducted to prepare for the effectiveness analysis in substep 6C. The idea is to identify relevant indicators for each objective at lowest specification level in the hierarchy (step 3) and to estimate the effect on each indicator with each scenario from step 5. Whereas an objective is too broad for estimating effect values as such, with related indicators, quantitative effect values can be estimated and allow a precise comparison of the scenarios. The Belfiore et al., 2006 defines indicators as quantitative/qualitative statements or measured/observed parameters that can be used to describe existing situations and measure changes or...
trends over time. Central to the impact assessment is the view that objectives not covered by certain policies can indirectly be impacted. To obtain the full overview of total impacts on economic, social-cultural, and ecological objectives with a policy strategy, indirect effects can also be estimated by indicators. The total impacts of a scenario explain the extent to which a scenario is favourable to respective objectives/indicators.

In each case study, the feasibility and importance of the indicators are evaluated separately and in relation to the particular context. Two of the six case studies, including the Atlantic coast of Ireland and the coastal North Sea, chose to identify indicators. The choice of using indicators relies on the availability of appropriate datasets that can be used for the estimates, which may be based on outputs of spatial bioeconomic models. For instance, in the coastal North Sea case study, an indicator referred to as “gross value added per year of main fish species” (Euro) and “biomass value” (tonnes) were identified as two of a total of nine economic indicators, for which effect scores were estimated by a bioeconomic model referred to as the Fishrent model (www.coexistproject.eu) for each scenario. This bioeconomic model was also used to estimate “discards” (tonnes) as one of several ecological indicator and “landed fish from the North Sea” and “crew costs” included as relevant social-cultural indicators.

Although the indicators can allow more specific comparison across scenarios by providing the quantitative estimates, overall uncertainty to outcomes may also increase because of the additional uncertainties associated by the selection of indicators, the number of indicators, but also uncertainties implicit in the estimates, for instance, by the bioeconomic models.

“Substep 6B” provides an alternative option to substep 6A to conduct an impact assessment by qualitative effect scores assigned directly on each objective. This can be relevant because of the uncertainties related to indicator estimates, and also the lack of data for some objectives which are important to a specific context. Hence, all objectives can be assessed by qualitative effects which can be determined with the help of policy, science, and advocacy stakeholders. For example, an ordinal scale ($-3$, $-2$, $-1$, $0$, $1$, $2$, $3$) can be applied where $-3$ is large negative impact, $-2$ is moderate negative impact, $-1$ is low negative impact, $0$ is no impact, $1$ is low positive impact, $2$ is moderate positive impact, and $3$ is large positive impact.

Four of the six case studies used solely qualitative impact scores in their impact assessment, including the Algarve, the Adriatic, the Hardangerfjord, and the Baltic Sea case studies. Although the main reason for choosing this approach to start with was the lack of time and resources for the comprehensive indicator work in substep 6A, this qualitative alternative also provided some other advantages. For instance, in the Hardangerfjord in Norway, the impact scores for each objective with the different scenarios were so obvious that experts were not needed to judge on these. Notably, because of the complexity involved by using indicators in substep 6B, the two case studies including indicators in the impact assessment, i.e. the North Sea and the Irish Atlantic coast, ended up with a combination of qualitative and quantitative effects.

“Substep 6C” is combining the effect values determined in substeps 6A and 6B with the preference values in step 4 for each management scenario developed in step 5 with the intention to evaluate the effectiveness of marine spatial management options. The purpose of this step is thus to find which combination of measures is most favourable to the most preferred objectives. Aggregation may assist in making such relations more apparent, but aggregation is not necessarily, because it is enough to directly look at the effect values and weights presented in a table. If effect values are incomensurable, it can be misleading to do the aggregation in this step. Even so, for the learning possibilities, all case studies completed this aggregation. Multicriteria aggregation (e.g., weighted summation; for additional information, see Janssen, 1992) were thus applied repeatedly by including different sets of stakeholder preferences at the time, resulting in a series of different rankings of the spatial management scenarios identified in step 5.

A remarkable finding across case studies regarding the effectiveness of policy options was that marine closures were advantageous to the objectives favoured by most stakeholders. This appears because of the overall high preferences provided to the ecological and social-cultural objectives. For instance, in the coastal North Sea, particularly in the Netherlands and Germany, it occurs that the objectives with highest priority are accomplished with fisheries being excluded from large areas for nature conservation and offshore wind parks. In the other case studies, similar findings appeared, such as in the Hardangerfjord in Norway. Whereas public representatives favoured more environmental restrictions and less aquaculture, this was not the case for the aquaculture and the tourism industries. At the Adriatic coast in Italy, the more comprehensive ban of trawling inside 6 nm from the coast was most advantageous to most of the objectives favoured, particularly when combined with the largest number of artificial reefs and some mussel farm production. At the Algarve coast in Portugal, a distinct increase in space for aquaculture and/or fishery was defined in different scenarios. It appeared that a conflict exists, or at least is latent, between the fishery and aquaculture sectors as they disfavoured the expansions of each other. The tourism and NGO representatives disfavoured increased space of both aquaculture and fishery in this case study, and the authority and research representatives showed a slight preference for expansion of both groups. In Finland the results differed with the other case studies to some extent, because the measures enhancing aquaculture and fishery industries were favourable to the most preferred objectives.

“Step 7” is determining the costs of marine spatial management, which can be split into two categories, namely personnel and material costs. Whereas personnel costs include salaries, material costs refer to the costs for all materials (housing, equipment, etc.) needed to implement a scenario with a collection of different measures (Levin and McEwan, 2001). If monetary costs cannot be calculated, estimates of relative differences of relevant scenarios need to be made based on data on relative investments needed for material, personnel, and time. This step appeared complicated in most case studies, although most cases provided some non-accurate figures of possible future costs.

In “Step 8”, the outcomes of all steps provide “the mapping out of information”, applicable to be provided as a basis for further dialogues about most appropriate policy options. While evaluating relevant measures and proposed improvements, the effectiveness of the different scenarios is discussed based on outcomes of the steps 3–6 constituting a baseline for proposing improvements, together with the estimates of implementation costs in terms of public sector costs in step 7.

**Briefing some case study experiences**

The case study variations in scale, institutions, future outlook, issues, and sectors, allowed the framework applications to be experienced in different contexts. The adaptability of the framework was seen appropriate due to the context differences, in which it was not seen possible to apply one universal defined process. This
implies that direct comparisons across case studies are not the foremost result, but rather to discuss differences and similarities of outcomes given the discrepancies observed.

Based on the applications of the CoExist framework in the six case studies, some challenges became apparent and obviously need some more clarification. They are mostly related to the preference elucidation (step 4), as well as to the effects and the aggregation (step 6), and can be summarized in some seven points.

First, related to representation, it appears that the preference estimates by weights are provided by one or just very few people actively representing the same group at the time. Even when representatives have been elected by majority votes of a group, it has been questioned whether these few people actually represent the group’s view. This can be checked by statistical tests, interviewing a representative sample, often consisting of some 35 randomly selected people, to find the discrepancies to the representatives’ preferences. This is far beyond the scope of this article and also beyond the case studies. Alternatively, and particularly relevant to a larger scale focus such as in the coastal North Sea case study, it could be appropriate to involve citizens to represent a more general opinion of the society, besides the operational stakeholders who focus on specific locations of the coastal North Sea only (Soma, 2010; Soma and Vatn, 2010).

Second, it has been questioned whether a simplified version of the AHP can be seen as the most logical and appropriate method to obtain stakeholder preferences in the CoExist framework (step 4). This is related to the fact that the original pairwise comparison scale developed by Saaty (2001) is modified when assigning stakeholder preferences, including the stages 4, 3, 2, 1, 0, 1, 2, 3, 4, instead of stages going the whole way up to 9 (Soma, 2010). The numbers 4 to 0 translate into “extremely much preferred”, “highly preferred”, “moderately preferred”, “some more preferred”, “a little bit more preferred”, and “equally much preferred”, a scale which in case study applications were seen appropriate. The pairwise comparison technique is seen applicable foremost because respondents only have to consider two options at the time, which is not the case of some other techniques, including selection of ranking orders by assigning numeric values (Janssen, 1992). A related criticism to a pairwise comparison technique is about context influences and biased interpretations of the objectives to be compared, which may result in not comparable outcomes across stakeholders. This type of bias appears to be more likely in larger areas such as the coastal North Sea case study than in smaller locations, because respondents associate respective objectives to different locations and contexts within the large case study.

Third, the outcomes of the preference survey are sometimes inconsistent, and a main challenge with a pairwise comparison technique is to obtain consistent responses (step 4). For given numeric answers (integers): “a”, “b”, and “c”, consistency of answers implies that: if a > b, b > c, then a > c. However, if the responses from the survey shows that a > b, b > c, and a < c, then there is some degree of inconsistency (e.g. Janssen and van Herwijnen, 2011). Note that in many instances inconsistency can be corrected by just adapting the strength of preference, for instance, from “highly preferred” to “some more preferred”, and therefore, an inconsistency does not necessarily imply that results are useless. Higher consistencies also appeared when more than one person was representing a stakeholder perspective.

Fourth, another weakness may be related to the preference outcomes being made visible in absolute values (step 4). This can be seen too precise compared with reality, given the influence by the question interpretation and context at the specific moment. Because of possible biases and uncertainties related to the absolute values, potential framework improvements could be the possibility of showing preference results by probability intervals and not as absolute values.

Fifth, related to accomplishments of effect values (step 6), challenges appeared related to gathering information, for instance, the stakeholder representatives for the industry did not always have an incentive to share their information. Expectedly, they would be less reluctant to keep information secrets on effect values (e.g. expected profit) as they were, for instance, in the coastal North Sea case study, if the framework was institutionalized in real world policy settings. Framework applications could be realized by public administration or by firms specialized in applying the method, hired to the application. This would again contribute to an open discussion that everyone could be part of, resulting in more legitimacy in terms of policy-making.

Sixth, assigning and identifying effect values (step 6) could be challenging because of technical difficulties. For instance, in the coastal North Sea case study, we were confronted with a “scale bias”, particularly when filling in effect values, as for instance, relevance to a Danish context differed from what was relevant in Germany, and the other way around. Moreover, many stakeholders are operating at a local scale. It appears that less complication appeared for case studies applying qualitative effect scores directly on objectives instead of identifying indicators. In other case studies, for instance in the Hardangerfjord, qualitative effects were so obvious that involvement of external experts to judge on them was not necessary.

Seventh, identification of which scenarios are favourable to most preferred objectives can be drawn from a table including objectives (and indicators if applicable), scenarios, weights, and effect values directly (step 6). In the case studies, aggregation of weights and effects took place to find such pattern, but were seen particularly problematic in cases when indicators accomplished incommensurability in effect values. Related to the multicriteria aggregation, it is important to know of a “standardization bias” appearing when the effects provided with different units (euro, megawatt, area, etc.) are standardized into one scale, for instance from −4 to 4, before cross aggregating them. Standardization implies that information gets lost. No single rule exists which can define how to standardize different units in “the right way”.

A more general finding was the importance of relating outcomes to particular contexts. For instance, the strong economic contribution by aquaculture in Norway compared with aquaculture in the other case studies can explain why aquaculture representatives in the Hardangerfjord case study gave very high priority to the objective called “market solutions”, which was one of the five objectives specified for the economic objectives in this case study. Moreover, in the Baltic Sea in the Finish case study, the regulatory and policy stakeholders, in particular, are very favourable to obtaining combined usage options due to the crowded activities in this particular marine area.

Hence, every case study and context needs to make their own rules, adapted to a right context. While objectives were specified into more context-dependent objectives throughout the steps 1–3, stakeholders within different case studies reflected on relative importance of these within each context in step 4. The context-specific objectives, in some instances further specified to context-dependent indicators (substep 6A), were also used for the impact assessment of the relevant case study-specific scenarios identified in step 5. All these findings were finally included in the effectiveness analysis in...
Discussing the main principles of the evaluation framework in an European context

At present, in most of Europe’s coastal waters, Marine Spatial Plans are still to be implemented or improved as introduced by the proposed MSP Directive (European Commission, 2013). Therefore, well founded information, included throughout a stakeholder process, is needed for discussing alternative policy options for allocation on rights to marine space. Relevant information can be made accessible by the CoExist evaluation framework in a “mapping out phase”, which clarifies and specifies context-dependent information, including identification of objectives, stakeholder preferences, assessments of economic, social-cultural, and ecological objectives, as well as effectiveness of management options. This can contribute to ensure informed dialogues (Pinkley et al., 1995).

The CoExist framework introduced in this article is developed with the intention to ensure good and transparent information management in complex situations. The framework complies with some of the main requirements identified for effective MSP (Ehler and Douvere, 2009), including that it is: (i) ecosystem-based by balancing ecological, economic, and social-cultural goals and objectives towards sustainable development, (ii) integrated across sectors and agencies, and among levels of government, (iii) place-based or area-based, (iv) adaptive, capable of learning from experience, (v) strategic and anticipatory, focused on the long term, and (vi) participatory, stakeholders actively involved in the process.

This framework has potentials of advancing European MSP for several reasons, of which some are related to the information inclusion and management and others for more process-related qualities. The advantages can be addressed by some six main points.

First, because of the structure, the CoExist framework allows to consider many different forms of relevant knowledge in terms of interests, values, and facts. A multidisciplinary approach is ensured by the participatory approaches that typically stem from the social and the political fields of sciences combined with multicriteria analysis, which originate from, among others, the mathematical, the economic, the social, or the psychological fields of expertise, depending on which MCA approach is considered (Banville et al., 1998; De Marchi et al., 2000; Munda, 2004; Soma, 2010, Sparrevik et al., 2011). Although some information is simulated by models, some information important to stakeholders and urgent to policy-makers can be less logical to estimate, including ethical and aesthetic considerations (Keulartz et al., 2004; Soma, 2006). For instance, in the coastal North Sea case study, hard facts are used related to the indicator’s effect scores when assessing changing policy strategies specified in different scenarios. However, specific social-cultural objectives can be assessed based on ethical judgements when assigning effect scores, for instance when judging on the objective “preserve cultural identity aspects”. Hard facts are thus complemented with qualitative information to provide a complete picture of the complex situation in an interdisciplinary environment.

Fritz (2010) refers the inclusion of different types of knowledge by the concept “internal pluralism”, implying that a broad range of expertise and disciplines are included, but also clarifications of normative questions about what is “good” and “bad” with respect to relevant practices, governance, developments, and balance of interests. The relevant values within economic, social-cultural, and ecological dimensions are not always comparable on one scale, for instance, market values are not necessarily reflecting ethical aspects of future appearance of biodiversity (Munda, 2004; Soma, 2010). The CoExist framework thus facilitates the inclusion of such incommensurable values by the inclusion of economic, ecological, and social-cultural value dimensions.

Notably, alternative models exist that graphically and probabilistically represent correlative and causal relationships among a wide range of variables, accounting for uncertainty, include for instance, the application of Bayesian Belief Networks (BBN) to management (McCann et al., 2006). BBNs have been successfully applied to natural resource management assessing impacts of alternative management measures (Varis et al., 1990; Marcot et al., 2001; Nyberg et al., 2006). For instance, recent study by Stelzenmüller et al. (2010, 2011) combined GIS analysis and BBNs to support marine planning tasks by assessing scenarios for different planning objectives related to management interventions. The CoExist framework could possibly be developed into a BBN approach. However, the intention with the CoExist framework in its present format is to map out different relevant information, including what objectives are relevant to a specific context, how important they are to different stakeholders, and impacts on such objectives with different policy scenarios, as illustrated by the respective steps. Instead of aggregating different views to find average views, the diversity of results based on different views can be used to ensure informed dialogues searching for practical win–win solutions. The reason for not estimating any solutions directly is linked to uncertainties appearing during the aggregation exercises, of which some are related to information losses of incommensurable values.

Second, transparency is important to information management particularly in instances of participation, to make visible how different types of knowledge are elucidated and integrated during the processes, how decision outcomes are considered, and how uncertainty and complexity are taken into account. Transparency throughout a decision-making process implies that all relevant interests are included during the process in a structured manner, and that rules and assumptions are known and explained to users and people being impacted by outcomes (Soma, 2010). For instance, relevant assumptions of time frame and geographical scale applied, as well as assumptions made on information availability and of individual behaviour, should be obvious to participants and end-users. Furthermore, related to transparency is the importance of procedures and outcomes being compatible with existing legislation and of someone being held accountable for procedures and outcomes. When ad hoc and personal interests among policy-makers influence the policy outcomes as a result of, for instance, pressures from strong lobbying groups or personal concerns about own positions in near the future, transparency can ensure that hidden agendas are no longer unseen but become obvious to others.

Third, the CoExist framework can be seen as a tool useful for identifying which information actually is needed to address the specific circumstances. For instance, in the coastal North Sea case study, it can be argued that policy options may fail if basing decisions on economic impacts only, as ecological and social-cultural objectives were seen more important to most stakeholders. In some occasions, we would only need to consider, for instance, some maps, or most advantageous solutions by including only one sector. At other times, we would need to look at objectives and preferences, or the effects of each policy scenario on one or another selection of objectives. In such situations, we would not need to fulfill all steps in the framework, but the framework can assist in clarifying what the exact needs are.
Fourth, the CoExist framework can assist throughout a decision-making process aiming at accomplishing social acceptance. Van Meegeren (2001) explains that social acceptance depends on what affected people think of measures imposed, which relates to the compliance with the behavioural norm imposed, as well as whether an individuals’ attitude is positive or neutral. Similarly, legitimacy refers to the degree to which a policy decision is considered to be respected, obeyed, and in concordance with accepted rules held by impacted people. While a decision is legitimate if its outcome is considered in accordance with such substantial rules, it might also be considered not legitimate if it contradicts with accepted procedural rules of decision-making (Deutsch, 1975).

Instead of finding one solution in terms of an average opinion, the mapping out approach of opinions makes the outcome more legitimate by the inclusion of the different actors’ priorities to the very end of the framework process, as illustrated by the respective steps. For instance, it could be possible to apply an average of all preferences obtained in the case studies. Instead, different preferences are provided of all respondents as information itself, but also to conduct the effectiveness analysis. The idea is to analyse with respect to illustrating the diversity of either positions, interests, or aspects; and/or focus on convergence of interests and uptake of conclusions, decisions, or any other output (Varjopuro et al., 2008). The CoExist framework provides an overview of all relevant objectives arranged into a hierarchy and identification of what objective is relatively more important to whom.

Fifth, as it is neither possible nor intended to involve every single person, a central question is related to how the different views should be represented during the processes and by whom. Representation might be thought to be a question of statistical representation. However, when dealing with normative and political questions, statistical representation is not the most central issue, but rather establishing procedures by which representatives are acknowledged to act legitimately on behalf of others—and of the society (O’Neill, 2001; Vatn, 2009). In the political system, groups of people are often represented by elected chairs. Although statistical representativeness is a possibility within the framework, the approach applied in the case studies was to include some representatives of the different views, for example, operational stakeholders of the aquaculture, fishery, and wind energy sectors in the coastal North Sea case study, as well as the public sector employees, policymakers, and researchers.

Sixth, the CoExist framework in its present format is intended for mapping out different relevant types of information as a basis for further discussions, not necessarily for providing final policy recommendations. This is because multiple variations in contributions and contexts of participatory planning are not necessarily resulting in one final advice, as there is no such thing as one outcome when the complexity is high (Varjopuro et al., 2008). Therefore, in complex situations, subjective interpretations about “what is the better thing to do” in a long term would be relevant considerations during a planning process (Soma and Vatn, 2010). Application of the CoExist framework in the mapping out phase can assist in the creation of the right conditions by clarification of complementing possibilities, and facilitation of structured dialogues in interdisciplinary research teams, to be followed up by dialogues aiming at win–win situations. Win–win situations can be understood as a “synergy”, where the outcome can be seen as more than the aggregate of the individual shares (Covey, 2004). While compromise is a low form of synergy, a higher form of win–win can be achieved if the process is based on sound principles and commonly understood future perspectives. Creating the right conditions for creativity and collaboration to address possibilities and to find the most synergies can advance and improve MSP processes and outcomes. Obviously, to be successful in such a strategy, dialogues must be based on trust, and cooperative creativity as well as value differences must be applicable.

The case study applications must be regarded as a try-out of a new methodological approach to European marine spatial management, implying that results cannot be used directly in policy-making at this stage. However, in one respect, the results might still be useful at this stage; a main lesson learned from this comprehensive exercise applying the framework in a total of six European case studies is the indication that social-cultural and ecological aspects are considered relatively a lot more important than economic aspects by many stakeholders (Table 3).

This study is based on the view that applications of the CoExist framework should become part of the scientific domain, implying that scientific knowledge can have a much greater impact when scientists not only calibrate their tools on scientific evidence, but also tune their methods to problem-solving in practical cases (Opdam, 2010). Ideally, marine spatial management is a continuing, iterative process that adapts over time when new knowledge becomes available.

Concluding remarks

The EU is promoting sustainable growth of maritime and coastal activities, as well as sustainable use of coastal and marine resources (European Commission, 2012, 2013). Challenges are attached to the developments of proposed national plans in terms of ensuring transparency of information management throughout processes with stakeholder inclusion and consultation. Moreover, finding ways to combine different types of information in effectiveness analysis of future marine spatial management at national levels appear delicate, but in the context of a proposed MSP Directive and future legal implications of such a Directive for EU member states such analyses will become crucial and will need to be adaptable and applicable to diverse situations that vary in geographic extent, scale of activities, and social context. The CoExist framework could contribute to assist European nations to provide improved qualities for marine management proposals and could encourage cooperation among sectors and integration of activities in ecosystem-based management approaches.

By the CoExist framework, separate scientific disciplines can contribute with important insights for the implementation of the EU Maritime Policy. In cases of high complexity, uncertainties, and incommensurable value dimensions, aggregation of different value dimensions will result in information loss, and because of this, informed dialogues are necessarily to reflect on best policy options. The CoExist framework can assist with contributions of information needed in a transparent manner to ensure good qualities of such dialogues.

Informational governance is related to different types and flows of information which are impacting policy processes and roles of societal actors (Mol, 2006). The CoExist framework provides a means to appropriately “mapping out” information, based on the principles of transparency, legitimacy, and representation. The value of these principles is reflected by the possibility to clearly structure information throughout a process framed for stakeholder involvement and impact analyses. Depending on what is needed as decision support, the main outcomes of the framework include mapping out of relevant objectives and their concurrence with
relevant management measures presented in future scenarios, overview of stakeholder preferences informing of relative importance of the relevant objectives, and assessment of implications for respective objectives with the different future scenarios. Coexistence of multiple activities in the long run will require an adequate encompassed stakeholder strategy to obtain sustainable MSP in European coastal waters.

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References


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