Title

Risk-based frameworks in ICZM and MSP decision-making processes

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Abstract

The coastal zone is considered as the point of highest interaction between land-based activities and local marine ecosystems. In addition, the coastal zone is a significant contributor to the socio-economic prosperity of local communities supporting a broad base of economic and cultural sectors. As a result, it is also the zone where aquatic ecosystems can be particularly vulnerable to pressures caused by human activities where management operates within a complex jurisdictional backdrop. An integrated management approach to both terrestrial and marine spatial planning aims at reducing conflicts while maintaining the productivity (in a broad sense) of aquatic ecosystems. Although fairly straightforward in the planning process, implementation and follow-up of such plans have proven to be challenging.

Given the complexity of integrating ecosystem, social, cultural and economic demands within a defined geographical area, decision-making approaches using classical risk analysis can provide structure that facilitates and informs the planning and implementation processes. Such an approach also assists fact-based priority setting while adhering to principles of inclusiveness and transparency. This paper presents lessons learned and best practices from integrated coastal zone management projects and how these are converging towards a risk analysis approach and marine spatial planning.

Introduction

The coastal zone is considered as the area of most important and strongest interaction between land-based activities and the local marine ecosystems. Given that a large proportion of the global population lives in proximity to the coast, the coastal marine ecosystem is most vulnerable to drivers of change arising from human activities. Considering the intensity and wide range of types of pressures such as wastewater and runoff arising from the coastal zone and the catchment area, estuarine and coastal marine ecosystems are likely to be the most vulnerable to cumulative adverse environmental effects. Climate change and sea level rise are likely to exert increasing pressures over time.

The coastal zone is a significant contributor to the socio-economic prosperity of local communities supporting a broad base of economic and cultural sectors. In terms of direct users, it is the primary interface between land and marine transportation as well as for the fishery and aquaculture industries. However, it is also the primary interface for land-based tourism and urban development in areas to which the local population attaches profound social and cultural significance. In some countries, demographic trends are increasing the pressures for coastal development as the population seeks retirement or recreational homes near the sea. In response to ever increasing energy demands, emerging renewable energy initiatives such as wind and tidal power generation are adding to the complexity of the marine spatial planning needs from a conflict resolution perspective. Even though sector specific policies and best management practices are adhered to, the jurisdictional complexity of the coastal zone can be poorly adapted mitigate against cumulative adverse environmental effects resulting from segregated planning and management initiatives.

An ecosystem-based approach to governance and management has to take into account the inherent jurisdictional complexity of multiple levels of governments, programs and development objectives. Jurisdictions have established overall strategic ecosystem sustainability objectives, as is the case with the EU Marine Strategy Framework Directive and the Canadian Oceans Act. Although a coastal zone planning process is fairly straightforward to envisage, implementation and follow-up of the resulting plans have proven to be challenging. Integrated management, so to speak, is more likely to succeed through the integration of ecosystem mitigation requirements within sector specific policies and best management practices rather than through an all-encompassing high-level management plan. This approach has been successfully implemented in sectoral activity environmental assessments (e.g. the strategic environmental assessment process) and marine spatial management plans. However, integrated management approaches to the coastal zone require both the planning and management of relevant terrestrial and marine activities, aiming to reduce conflicts between user groups while maintaining the integrity of aquatic ecosystems.

Given the complexity of integrating ecosystem, social, cultural and economic demands within a defined geographical area, classical risk analysis can provide a structure that facilitates and informs the planning and implementation processes and aids the decision-making processes. Risk analysis is a well-established approach in science-based decision-making. It is even enshrined in international agreements such as the Sanitary and Phytosanitary Agreement of the World Trade Organization. Not to be confused with risk assessment, a risk analysis is initiated with the explicit intent of informing a management decision. Classical risk analysis includes activities identified as hazard analysis, risk assessment, risk management and risk communication. From the perspective of an ecosystem-based risk analysis, the hazard analysis phase establishes the scope of the problem by identifying significant ecosystem components and their susceptibility to adverse environmental effects resulting from pressures coming from drivers of human activities. It also identifies which ecosystem goods and services are at risk. Risk assessment aims at identifying the likelihood of occurrence and severity of identified adverse environmental effects. However, a risk assessment must also be conducted to identify the social, cultural and economic repercussions of not mitigating the effects as well as to assess the feasibility of the management options based on existing jurisdictions and sector specific management practices. Risk management is the implementation phase and can include a suite of plans, policies and best management practices delivered under clear accountabilities and monitoring. Risk communication addresses issues of inclusiveness and transparency regarding the entire process. It also involves, however, feedback in terms of the effectiveness of mitigation and efficiency of the implemented plan in effectively adhering to the principles of an adaptive management approach. In a nutshell, a risk analysis process strives at separating the perception of risk from the facts while focusing management efforts where and when required.

Integrated Coastal Management and Marine Spatial Planning

Integrated coastal zone management (ICZM) has evolved to include catchments-coast interactions for the sustainable use of marine resources via integrated governance frameworks. In addition, ICZM brings together coastal zone habitat conservation and socio-economics (e.g. development objectives) which are most often resolved through geo-spatial and temporal plans similar to marine spatial planning (MSP) initiatives. The ICZM Working Group of ICES has recently recognized that ICZM and MSP are tightly linked where one provides the process and governance to the other.

Without clear objectives that allow the estimation of tangible risks to valued goods and services and which are managed under clear accountabilities, the resulting integrated management plan may have very good strategic goals while lacking technical mitigation requirements that can be translated in sector specific management practices. On the other hand, marine spatial plans is commonly focused on one specific activity with the intent of resolving potential ecosystem and socio-economic conflicts mostly from a geo-spatial perspective. In practice, MSP initiatives that are based on strategic environmental assessments generally result in specialized technical management approaches that lack the environmental context in terms of its contribution to cumulative effects. If a given ecosystem is under cumulative pressures of multiple drivers, sector specific mitigation may result in a futile investment. A regional strategic assessment conducted via a risk analysis process that takes into account ecosystem goods and services susceptibilities and the pressures of the implicated drivers of human activities would result in feasible and equitable mitigation requirements. Such a regional strategic assessment would still provide a high level and general approach to planning while providing a tangible purpose. Any new development could then be assessed against such a regional environmental backdrop to determine the consequence of the proposed project in terms of immediate footprint and its contribution to the cumulative pressures. The requirements under the EU Habitats and Species Directives for cumulative and in-combination effects to be taken into account in the assessment impacts on designated (protected) habitats and species is a clear response to this issue.

Case studies

Integrated management, environmental assessments and spatial planning initiatives all contain elements of risk analysis. In most cases, the approaches are similar differing mostly in jargon. Some are more effective at proactive problem formulation and objective setting while others are focused on reactive mitigation of the immediate development project footprint. Few stipulate formal follow-up monitoring and auditing to ascertain the performance of the plan in terms of mitigation effectiveness and implementation efficiencies. Monitoring requirements can arise as a consequence of conditions set during consenting/licensing procedures for individual projects, but links back to broader plans can be difficult to achieve. The following are some examples of integrated management, environmental assessment and marine spatial planning initiatives that contain some elements of risk analysis.

Canadian Oysters Aquaculture Class Environmental Assessment: Operating within federal and provincial regulatory requirements, a class environmental assessment (CEA) was conducted for suspended oyster aquaculture activities on the Eastern coast of the province of New Brunswick, Canada (Canada, 2007). The CEA was initiated as a means of reducing the bureaucratic processes and costs for aquaculture lease applications. Up to that point, individual lease application required an environmental assessment that had to address several federal and provincial regulatory requirements. In addition, concerns were being raised as to the carrying capacity of the bays considered for aquaculture development. The CEA used an integrated management approach to identifying valued ecosystem components (VECs) that comprised of key fish habitat, inter-tidal zones, fisheries, recreational activities, navigation, and migratory birds and their susceptibility to this activity. Subsequently, regulatory and policy requirements were combined using a spatial planning approach. The resulting document identified of zones for aquaculture leases and appropriate mitigation measures in the form of best management practices and buffer zones addressing the susceptibilities of the VECs (Figure 1). Given that the CEA normalizes the environmental requirements; all lease applications do not require an individual environmental assessment. The resulting integrated management plan provides effective and auditable mitigation measures and also enhances the efficiency of the lease approval process in terms of approval time and costs.

Scottish Sustainable Marine Environment Initiative: Running across several government agencies within Scotland and linking directly to other relevant UK initiatives, the Scottish Sustainable Marine Environment Initiative (SSMEI) was initiated by the Scottish Government in 2002 (Scotland, 2002). Its principal aim was to develop and then test the benefits of possible new management framework options for the sustainable development of Scotland's marine resources through the establishment of 4 pilot projects namely for the Shetland Islands, Berwickshire, the Firth of Clyde and the Sound of Mull. The pilots embraced the concepts of an ecosystem-based approach to protection measures, and were designed to investigate different aspects of sustainable marine management, including spatial planning, habitat mapping and conflict resolution. These were tested through the implementation of a number of management schemes. The Shetland pilot used a spatial planning approach (Figure 2) that identified key habitats and their susceptibilities and documented susceptible ecosystem components and socio-economic values through extensive integrated management consultations. Key results include a spatial policy where developers can identify locations, prior to the submission of plans that would be considered unsuitable for a particular development or where a development would be looked on favourably by the regulators leading to long-term protection and use of the marine environment as well as reduced delays and costs in the regulatory process.

Marine renewable energy industries in Scotland: Wave and tidal stream power generation is a high priority for the Scottish Government in meeting its target of 50% of the electricity demand in Scotland to be met from renewable resources by 2020. Renewable energy projects have the potential to interact with the environment (e.g. conservation objectives) and with other uses of the sea (e.g. shipping routes, fishing areas). A significant risk in the regulatory process is that these interactions must be formally assessed (e.g. through EIA and Appropriate Assessment under the EU Birds and Habitats Directives) and reduced to acceptable levels. Marine Scotland collaborated with The Crown Estate (landlords of the UK seabed) to identify areas of wave and tidal stream resource, which avoided sensitive areas and limited impacts on existing marine uses. The identification of potentially suitable development areas was addressed through the application of GIS-based marine spatial planning tools to develop an information framework covering the availability of exploitable resource and a wide range of information on constraints including incompatible current uses, environmental designations, shipping, commercial fishing, recreation, biodiversity, and fish spawning and nursery grounds (Davies et al. 2010). The data layers for constraints were used in restriction models, i.e. treated as giving graduated degrees of constraint on development according to the nature and intensity of the activity. The layers were categorised into a series of 5 sectors being environment, recreation, shipping, commercial fishing and fish spawning and nursery areas. Within each sectoral restriction model, data layers were weighted according to subjective judgements of the relative importance of each layer in relation to other layers within the sector. A range of scenarios were then examined which varied the weighting between sectors (Figure 3). The output was a series of maps identifying the relative degree of constraint on wave and tidal development areas around the Scottish coast, to support decisions on areas to consider for early leasing for wave and tidal power development. The approach used included elements of risk analysis, but was not framed within risk analysis terminology. For example, the weighting and scoring systems applied to data layers and sectors combine elements of hazard identification and risk assessment, while the selection of potential development areas is the outcome of risk management within broad policy guidance. Risk communication with the generality of stakeholders occurred late in the process through public invitation to comment on the proposals.

United Kingdom Continental Shelf: A Bayesian Belief Network and geo-spatial analysis framework was developed to visualise relationships between cumulative human pressures, sensitive marine landscapes and landscape vulnerability (Stelzenmüller et al. 2010), to assess the consequences of potential marine planning objectives, and to map uncertainty-related changes in management measures. The results of the analysis revealed that the spatial assessment of footprints and intensities of human activities have more influence on landscape vulnerabilities than the type of landscape sensitivity measure used. The framework addresses the consequences of potential planning targets, and necessary management measures with spatially explicit assessment of their consequences. The framework is a practical tool allowing the combination of ecosystem sensitivities and management objectives, informing spatial management scenarios via the engagement of different stakeholder views within an integrated decision-making process adhering to adaptive marine management approaches.

Offshore wind farm development and Maritime Spatial Planning in the German North Sea: On the German North Sea coast, more than 60 offshore wind farm projects are currently at the planning stage. 21 have so far (March 2010) received a licence from the Federal Maritime and Hydrographic Agency (Bundesamt für Seeschifffahrt und Hydrographie, BSH) (Gee 2010a). At a federal level, government expects offshore wind energy to play a major role in reaching the German renewable energy target. If current plans go ahead, offshore wind farms could provide between 20 and 25 gigawatts by 2030, meeting about 15% of the German electricity demand. All planned projects are located in the Exclusive Economic Zone (EEZ), more than 30 kilometres from the coast, in order to avoid conflicts with local communities and to protect the Wadden Sea

National Parks, which cover large parts of the territorial waters in the German North Sea. The considerable spatial requirements of offshore wind farming apply in an EEZ where space is already at a premium. Unsurprisingly therefore, offshore wind farming has become the main trigger for the development of spatial plans based on a zoning concept for the German EEZ (Figure 4). However, the debates in and around the public hearings for these spatial plans demonstrate that concurrent growth in different policy fields may lead to an ‘overbooking’ of marine space (Kannen et al. 2010). Shipping, nature conservation and offshore wind farming all lay claims to large parts of marine space, but they are not necessarily spatially compatible. The research project Coastal Futures (Lange et al. 2010) identified some limits to the spatial planning approach, e.g. values associated by local people to the sea show that the sea is more than just its “hard” uses (Gee 2010b). Comprehensive forms of ‘sea management’, as well as MSP and zoning, must take account of multiple sea values (tangibles and intangibles) including optional values rather than limiting themselves to matching up existing demands in a sort of ‘best fit’ approach. Other outcomes from Coastal Futures point to the importance of cumulative impacts of sea use patterns on ecosystem functioning. This implies that future assessments (and also planning and management) need to consider the cumulative impact of many wind farms rather than individual plans and also need to take greater account of the overall pattern of sea use as, for example, some bird species avoid shipping areas as well as wind farms. Similarly, Berkenhagen et al. (2009) identified cumulative effects from wind farms on fisheries. Tools applied in Coastal Futures, such as the ecosystem service approach or the DPSIR framework, might support risk assessments for large-scale development activities in marine areas.

Risk Analysis as a Tool for Modern Beach Management in Spain: From a socio-ecological perspective, beaches are considered as one of the most important shoreline ecosystem goods and services in Spain. Beach social-ecological systems are usually viewed as natural places supporting hedonic socio-cultural activities (e.g. sun and sand). However, beaches are very complex systems that have many other ecological, social, cultural and economic functions and services. Given that these resources and activities are traditionally managed on a sectoral basis, beaches are suffering from large losses. Rather than a one-dimensional approach to management from a physical or recreational perspective, the complexity of these systems requires a multi-dimensional approach to management. A demonstration study was carried out in S´Abanell beach (Blanes, NW Mediterranean Catalan coast). This beach presents two different zones in terms of occupation, beach uses, hinterland, morphodynamics and management. The study consisted of two phases: a risk profile linking hazards and ecosystem services was formalized in an analysis of pathways of effects on the beaches; and, a risk assessment process developed to associate risks to each hazard. The assessment established the main ecosystem services affected facilitating the identification of the riskiest hazards and setting decision-making priorities for the risk management phase. Risk reduction or mitigation measures were then recommended for the risk management that would be based on a clear integrated management principles, strong communication as well as coordination and cooperation between at least three administrative levels involved in beach management. This type of management approach will significantly contribute to enhancing the present situation where beach management is still carried out by different private and public organizations operating without a structured flow of information or clear common medium-term policy objectives, and with dispersed responsibilities.

Conclusion

A risk analysis process applied to integrated management, regional environmental assessment or marine spatial planning initiatives can effectively combine ecosystem susceptibilities with drivers of human activities to identify risks to valued ecosystem goods and services. Establishing pathways of effects, it also facilitates regulatory and policy gap analysis to identify where enhanced management measures are required in light of integrated policy objectives. Given that the process is explicitly initiated to inform management decision-making, it addresses the principles of ecosystem-based management, follow-up monitoring and adaptive management principles.

Various integrated planning and management initiatives, such as are presented above, already include elements of risk analysis. A formalized risk analysis process would enhance the effectiveness of management measures by ensuring that the right measure is applied to the right risk *via* the most effective accountability and governance structure. It would also expedite such initiatives by normalizing the planning and management elements providing an interchangeable suite of management measures.

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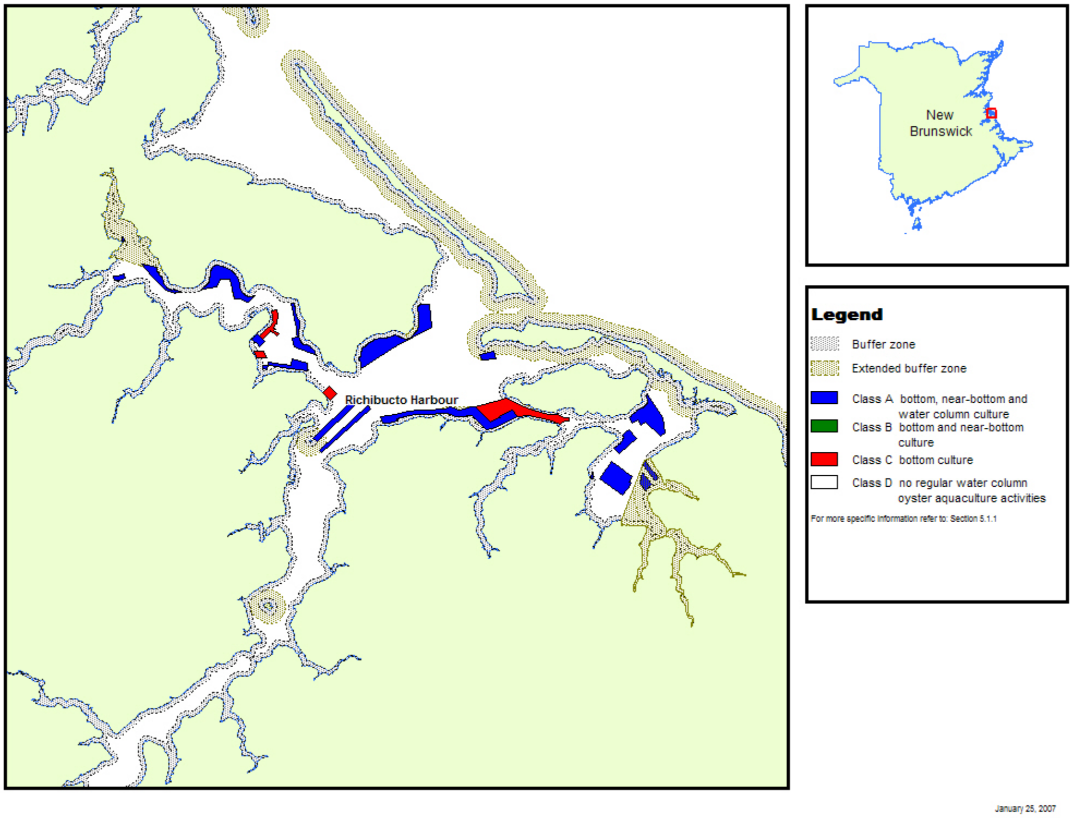

Figure 1: Example of Canadian class screening oyster bay management plan showing buffer zones designed to integrated multiple levels of regulatory requirements.

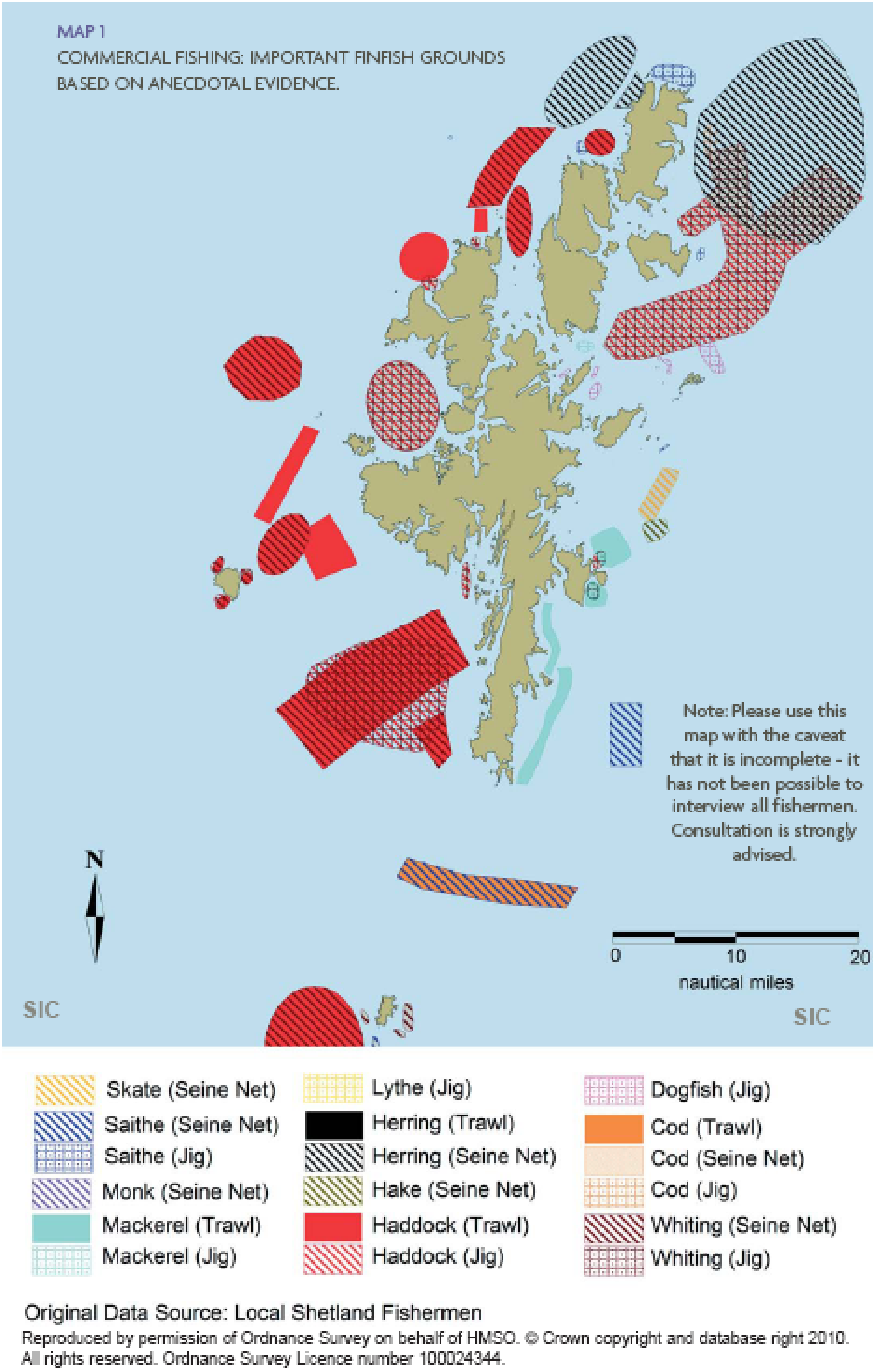

Figure 2: Example of Scottish Sustainable Marine Environment Initiative spatial analysis

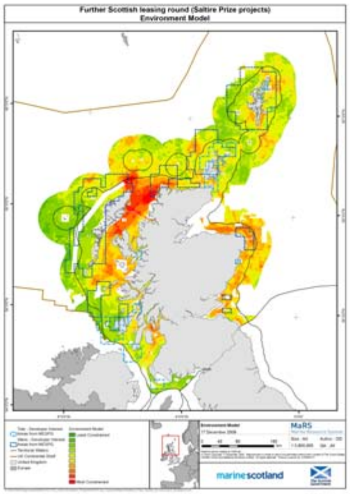

Figure 3: Output from a model that emphasised environmental protection in comparison to industrial uses. Red areas show the highest levels of constraint on wave and tidal power development, whereas green areas show the lowest levels. White areas are exclusions.

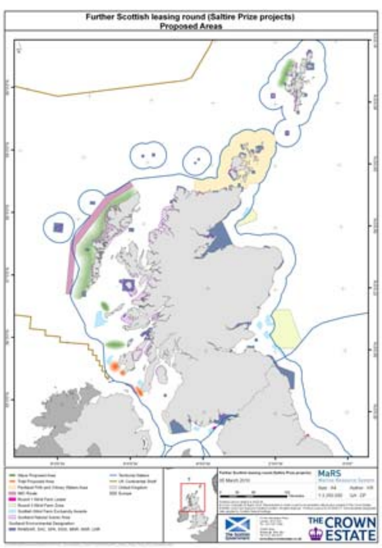

Figure 3: Areas selected for further consideration for marine renewables development, including the west coast of Shetland, west coast of Lewis, north of Tiree and areas around Islay and the Mull of Kintyre.

Figure 4: Spatial Plan for the German EEZ of the North Sea (www.bsh.de/en/Marine_uses/Spatial_Planning_in_the_German_EEZ/documents2/MSP_DE_NorthSea.pdf, accessed 19 August 2010)