



Food for Thought

Integration of environmental and fishery management in Europe

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Policy drivers for integrating environmental and fishery management in Europe have never been so strong. Scientists calling for better integration now have the opportunity to help deliver it. The main challenge is providing relevant evidence on short time-scales using existing knowledge. Policies, scientists, and society largely agree that management targets should be linked to achieving sustainability, but research often fails to show when fishing impacts ‘matter’ in relation to sustainability criteria. If targets for ecosystem functions or processes are to complement more tractable targets for species and habitats, scientists will need to show why impacts ‘matter’ and when they become unsustainable. For now, and to meet ambitious and pressing policy timetables, priority should be given to developing credible targets for impacts with a high risk of compromising sustainability, rather than dissipating research and advisory effort to achieve broader coverage of state, function, and process. Impacts on sensitive species and habitats often compromise sustainability; thus, setting targets for them is a priority. Meeting these targets will often require management measures that are expected to diminish risks of other unsustainable impacts. Fast and significant progress towards integration could be achieved by incorporating measures to meet environmental targets for sensitive species and habitats into fishery management plans.

Keywords: biodiversity, fishing effects, fishery management, habitat, marine protected areas, sensitivity.

Introduction

A policy framework to support the integration of European environmental and fishery management is largely in place. The main policies driving this integration are the Marine Strategy Framework Directive (MSFD; EC, 2008a), the Habitats Directive (EC, 1992), and the Common Fisheries Policy (CFP; EC, 2002). High-level relationships among these policies are increasingly well defined, but many operational issues have yet to be addressed. Issues relate to achieving compatibility among management, assessment, and reporting regions, coordinated and cost-effective monitoring and assessment, and better integration of research and advisory support. Here, we focus on options for developing operational objectives, indicators, and targets, and applying management measures to achieve them.

The MSFD defines the relationship between environmental and fishery management by establishing wide-ranging management objectives for the marine environment and requiring that other sectoral policies, such as the CFP, help to achieve them.

The high-level objective of the MSFD is to put in place measures to achieve good environmental status (GES) for the marine environment as a whole, which follows from putting in place measures to achieve GES for ecosystem components, attributes, and, in some cases, pressures, known as ‘descriptors’ in the MSFD (EC, 2008a). Four of these ‘descriptors’ are substantially affected by fishing and relate to commercially exploited fish and shellfish stocks, biodiversity, foodwebs, and seabed integrity. Implementation of the MSFD requires that indicators and environmental targets to assess status in relation to GES are defined for these descriptors, and that management measures giving a high probability of meeting targets, and thus achieving GES, can be identified and used.

Here, we comment on the development of the operational objectives, indicators, and targets to underpin the integration of environmental and fishery management and how available management measures can best support progress towards meeting targets. We propose some options for providing a reliable, internally consistent, and trusted evidence base to support integration

and try to clarify the roles of scientists and society in defining targets. In part, our commentary challenges scientists and advisers to make best use of available knowledge and to prioritize the assessment and management of those fishing impacts most likely to compromise sustainability. It also asks whether many fishing impacts studies that appear to contribute to the evidence base actually provide useful information for target setting.

Prioritizing impacts and targets

In the MSFD, an ‘environmental target’, hereafter ‘target’, is defined as a ‘statement on the desired condition of the different components of, and pressures and impacts on, marine waters’ (EC, 2008a). In quantitative and practical terms, targets will be expressed as the values of indicators for state, pressure, or impact when GES is attained. As a bottom line, GES means that the ‘use of the marine environment is at a level that is sustainable, thus safeguarding the potential for uses and activities by current and future generations’ (EC, 2008a), but elaboration in the Directive implies a commitment to reduce pressures and impacts below levels needed to ensure sustainability.

Guidance to help EU Member States set indicators and targets for GES proposes an approach that keeps ‘in mind the need to target assessment and monitoring and to prioritise [sic] action in relation to the importance of impacts and threats to marine ecosystems and its [sic] components’ (EC, 2010a). This suggests that the implementation process should focus on a constrained set of priority actions and account for the scale of available and potential resources for monitoring, assessment, and advice to meet challenging deadlines for implementation. Despite this guidance on prioritization, those developing the evidence base have sometimes placed more emphasis on subsequent text that describes a broad range of possible criteria and indicators for each of the descriptors and have interpreted the text as a driver for developing a comprehensive set of indicators and associated targets.

The identification of a broad range of possible criteria and indicators of GES by the EC has been both a strength and weakness of the MSFD. The strength is that ‘everyone feels part of it’, and thus scientists from many backgrounds are now engaging in environmental and fishery management science and want to contribute their expertise and experience. The corresponding weakness is that current ‘understanding’ of the ecosystem cannot always be linked to operational management advice, and the broad range of experts dealing with diverse subject areas from a scientific rather than an operational perspective can complicate advice and decision-making, and confound prioritization. With tight deadlines for the initial phases of MSFD implementation, an emphasis on developing comprehensive lists of indicators and targets, rather than on careful development and selection of a small and tractable set of indicators and targets that will provide sufficient information to guide management, dissipates effort and resources and risks recommendations for numerous, but inadequately conceived and/or tested, indicators and targets that are not appropriate for operational management. Recommendations from such a process may not help to meet the high-level objectives of the MSFD if links between management measures and indicator values are not clear or consistent, or if the relationships between targets and the sustainability of impacts have not been established, with the consequence that the social and economic costs and benefits of meeting targets are unknown or highly uncertain.

Significant steps towards defining indicators and targets for GES and instituting management can be made with existing

knowledge and a pragmatic approach based on selecting a small set of indicators for which pressure–state relationships are well defined, for which targets linked to sustainability can be set, and for which monitoring to detect trends is feasible. We consider that the need for pragmatism is currently being marginalized in some debates about indicators and targets for biodiversity, foodwebs, and seabed integrity, and needs to be reinforced if realistic and meaningful indicators and targets are to be defined and introduced.

In the short term, we suggest that the development of indicators and targets for unsustainable impacts should be prioritized based on the initial assessment of the state of the management regions, knowledge of pressures and impacts in these regions, and scientific analysis that makes best use of available knowledge to assess when impacts are, and are not, sustainable. Likely short-term priorities, based on a range of existing assessments in European seas (e.g. ICES, 2008), would be indicators and targets for sensitive species and habitats impacted by fishing. The identification of additional priorities will be contingent on the outcomes of ongoing research, future assessments of state, and a better understanding of the evolving management system. However, even in the longer term, more science will not necessarily reduce uncertainty about relationships between fishing pressure, ecosystem structures and processes, the sustainability of impacts, and their consequences for society, although it may help us take better account of that uncertainty when developing the management system.

The challenges posed by the European drive to integrate environmental and fishery management are not new. In other jurisdictions, such as Australia, significant progress has been made towards integrating environmental and fishery management with limited knowledge of ecosystem structure and function, and risk-based approaches are being used to prioritize management issues (e.g. Hobday *et al.*, 2011). While the intensity of fishing, human use, and the political complexity of the management system are lower there, the ecosystems are more diverse and the Australian Exclusive Economic Zone is approximately the same size as that of Europe.

Target setting

The MSFD seeks to establish targets for sustainable impacts on biodiversity, foodwebs, and seabed integrity, where ‘sustainable’ is broadly defined in the MSFD as safeguarding options for future use, maintaining the function and resilience of ecosystems, and preventing declines in biodiversity. However, the wording of the MSFD also implies, albeit not consistently, an ambition for less impacted states and lower human pressures than those associated with achieving sustainable use. Scientists have the main role in defining targets for sustainable use, because this is a technical issue, but the extent to which targets are modified to provide for additional ambition is a choice for society, albeit usefully informed by scientific analysis of the consequences of meeting such targets.

In contrast to the MSFD, the existing CFP and associated management plans do not require targets for environmental impacts and instead make general commitments ‘to minimize the impact of fishing activities on marine eco-systems [sic]’, to ‘reduce to a minimum the impact of fishing’, or to support ‘maintenance or improvement of the conservation status of marine eco-systems [sic]’ (e.g. EC, 2002, 2007). Indeed, CFP indicators to measure the effects of fishing on the ecosystem were conceived to show trends

in the environmental performance of fishery management rather than to support targets that defined 'good' performance (EC, 2008b). Only in relation to recovery plans does the CFP suggest that fishing impacts should be 'kept at sustainable levels' rather than minimized (e.g. EC, 2002), an approach that is broadly consistent with meeting sustainability-focused targets for the MSFD.

While there is a growing research literature on fishing impacts, little work has been directed towards defining impacts that 'matter' in relation to sustainability criteria and aspects that 'matter' for society. Rather, most research simply confirms and quantifies the expected, that fishing impacts change ecosystems. Researchers or commentators may conclude that the reported impacts 'matter', but this is often based on authors' opinions rather than on an analysis of consequences or sustainability. For instance, many analyses show that community diversity, size, and trophic structure change with fishing, but do not assess when changes become unsustainable and, beyond the effects on component species (that could be assessed and managed directly), do not show when the change has a consequence that affects goods and services that ultimately matter to society.

Most progress with assessing when fishing impacts are sustainable or not sustainable has been made during studies of fishing effects on species and habitats. However, even in this subject area, more research focuses on describing change than assessing sustainability and consequences. If targets for state indicators can be identified for sensitive species and habitats, and if relationships between state and fishing pressure can be predicted, then targets can also be established for pressure indicators. Pressure indicators tend to have lower signal-to-noise ratios than the corresponding state indicators and are likely to be able to guide short-term management decision-making much more effectively.

Given the pressing time-scale for implementation of the MSFD, we suggest that emphasis on establishing targets for sensitive species and habitats will provide a focused first step for implementation and the integration of environmental and fishery management. Targets for sensitive species and habitats relate to several aspects of biodiversity, foodwebs, and seabed integrity. Further, if fishing impacts on commercially exploited and sensitive species and habitats are all sustainable, then the risk of unwanted changes to processes and functions should be significantly reduced. If subsequent research shows that additional targets linked to ecosystem properties, processes, and services are necessary, then these can be added.

As long as targets for GES are linked to achieving sustainable use, then defining these targets will be a technical job for scientists, with policy and management input to define acceptable levels of risk and precaution. However, parts of the MSFD imply an ambition that targets for GES should be consistent with lower levels of pressure and impact than those needed to achieve sustainable use. In setting any more ambitious targets, managers will need to take account of the political and/or legal interpretation of the policy drivers and the expectations of society. The role of science will be to advise on the consequences of adopting these targets, rather than to recommend values for them.

Meeting targets for fisheries and the environment

Pending the definition and adoption of targets for GES, fishery managers will be trying to reduce fishing mortality rates for commercially fished stocks when they exceed the fishery management targets already adopted in the CFP. As elaborated by the EC (2008c), reductions in fishing mortality rates for commercially

fished stocks usually reduce fishing impacts on the ecosystem. Indeed, it is notable that the surge in studies of, and reports on, the ecosystem impacts of fishing occurred at a time when ecosystem-wide fishing mortality rates were close to historic highs in Europe. These rates are now falling in most regions. Reducing fishing pressure and hence the variety and magnitude of fishing impacts is likely to reduce the number of impacts requiring additional management (EC, 2008c). Resources are best invested in managing those pressures most likely to compromise GES once target mortality rates for the commercially fished stocks managed by the CFP are achieved.

Until targets for GES are defined, it is unclear whether changes in fishing mortality required by the CFP will, in themselves, be sufficient to achieve GES for biodiversity, foodwebs, and seabed integrity, although existing assessments suggest that additional measures will be needed to meet targets for, at least, sensitive species and habitats. Where reductions in fishing mortality are required, they could be implemented in a manner designed to maximize progress towards GES for biodiversity, foodwebs, and seabed integrity, thus reducing the need for further management measures. Stock assessments and consequent advice on total allowable catch (TAC) and quota relate to individual commercially exploited stocks; however, many environmental impacts also occur due to the operations of fleets that impact multiple stocks, areas, species, and habitats. Given that the MSFD identifies the CFP as the policy to manage fisheries to achieve GES, new and modified fishery management plans could provide a mechanism to support progress towards achieving targets for sensitive species and habitats, and hence GES, for aspects of biodiversity, foodwebs, and seabed integrity, pending the emergence of any additional and necessary targets. Further, developing fishery management plans to achieve the greatest reduction in fishing impact for a given reduction in fishing mortality rates would be consistent with the CFP objective 'to minimize the impact of fishing activities on marine eco-systems [sic]'. For instance, in the case of 'seabed integrity', reducing the total area open to fishing with towed bottom gears in line with reductions in catches or fishing effort would substantially reduce impacts on seabed habitats. Ultimately, to achieve compatibility between the MSFD and CFP and to clarify the contents of management plans, the CFP would need to achieve targets for GES rather than minimizing impacts. In different circumstances, meeting targets may increase or decrease the need for additional management measures.

If management plans were used to help achieve GES, then three questions would have to be addressed: (i) how much fishing effort is needed to take the TAC or quota; (ii) can this fishing effort be allocated in space and time, or gears modified, through incentives and regulations, to meet the targets for GES; and, if not, (iii) what further changes to management measures are required to meet the targets? Once targets have been defined, it will be possible for scientists to advise on the measures needed to meet targets and the best process for allocating the contribution to meeting targets among plans. Where additional management measures are required to meet targets, there will be a number of different ways of reducing impacts. Scientists can advise on the costs and trade-offs associated with the different options for reducing impacts. A challenge to relying on management plans as the main mechanism for regulating fishing impacts will be cases where different fleets, predominantly regulated under different management plans, have cumulative impacts on a single indicator of GES. Again, scientists can play a role in informing on trade-offs

associated with different management options, but methods for allocating management measures among plans and fleets will need to be decided.

Management measures

A broad range of management measures can support progress towards targets. Marine protected areas (MPAs), treated here as those areas where there is an intention or action to reduce or exclude some or all types of existing fishing activity, are just one of a number of available management measures, but they require special attention during integration because the Habitats and Birds Directives (EC, 1992, 2010b) identify MPA as their main management measure and because Member States are designating additional MPAs. Under the Habitats Directive, so-called 'Special Areas of Conservation' will be used to maintain or recover some types of habitat to 'favourable' status which means, to paraphrase the Habitats Directive, that (i) extent is stable or increasing; (ii) the specific structure and functions necessary for its long-term maintenance exist and are likely to exist for the foreseeable future; and (iii) populations of typical species associated with the habitat are viable in the long term. So, maintaining or recovering habitat to favourable status will be consistent with meeting targets for sustainable impact at the scale of the Special Area of Conservation. This implies that target fishing pressures by impacting gears in Special Areas of Conservation will be managed so that they are zero or very low on the most sensitive habitats and increase as resilience rises.

The drivers for European and national MPA creation preceded target setting for GES, but the MSFD identifies management measures that influence where and when an activity is allowed to occur as measures to help achieve GES. Therefore, to achieve compatibility among policies and management measures, it would be logical if MPA designations and associated measures had a positive effect on progress towards GES. MPAs that are part of habitat-specific or representative networks and reduce fishing effort on the most sensitive habitats (habitats with the slowest recovery times following a defined impact) are likely to contribute to the objectives of the CFP, MSFD, Habitats Directive, and national policies. This is because fishing impacts on the most sensitive habitats would not be sustainable, and there is no risk that fishing effort is displaced to more sensitive habitats (although there is a small risk that displaced fishing effort would have more impact if it were more widely dispersed). Conversely, for MPAs that reduce fishing pressure on resilient habitats, fishing may be displaced to more sensitive habitats, leading to greater overall impacts.

It is technically inconvenient, but not surprising, that the objectives of policies leading to MPA designation and management are not entirely consistent with the objectives of other policies. Complete compatibility among policy objectives should not be expected; advocacy and lobbying by different groups, along with the changing views of society, national governments, and the EU, all affect the agreed wording of different policies at different times. With the policies in existence, the main role for scientists is to advise on the trade-offs among objectives, the consequences of these trade-offs, the management measures to achieve targets, and their risks, costs, and benefits.

Conclusions

The integration of environmental and fishery management is ongoing, and interactions among policies and targets and national

and international jurisdictions still need to be formalized. In setting targets for fishing impacts, scientists and advisers need to make best use of available knowledge and to prioritize work on impacts that are not sustainable. This will focus the efforts of scientists and advisers on defining targets for sustainable use as rapidly as possible to meet the pressing needs of the MSFD effectively. For impacts on components other than sensitive species and habitats, the evidence base to define the sustainability of impacts is remarkably weak and, until the evidence base is appropriately developed, there is a risk that advocacy rather than scientific evidence may drive target setting. Given that fishing mortality rates for commercially exploited stocks are often too high, there is significant potential to use management plans to increase the rate of progress towards targets for little additional cost.

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References

- EC. 1992. Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora. Official Journal of the European Union, L206: 7–50.
- EC. 2002. Council Regulation (EC) No 2371/2002 of 20 December 2002 on the conservation and sustainable exploitation of fisheries resources under the Common Fisheries Policy. Official Journal of the European Union, L358: 59–80.
- EC. 2007. Council Regulation (EC) No 676/2007 of 11 June 2007 establishing a multiannual plan for fisheries exploiting stocks of plaice and sole in the North Sea. Official Journal of the European Union, L157: 1–6.
- EC. 2008a. 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). Official Journal of the European Union, L164: 19–40.
- EC. 2008b. Commission decision of 6 November 2008 adopting a multiannual Community programme pursuant to Council Regulation (EC) No 199/2008 establishing a Community framework for the collection, management and use of data in the fisheries sector and support for scientific advice regarding the common fisheries policy (2008/949/EC). Official Journal of the European Union, L346: 37–88.
- EC. 2008c. The role of the CFP in implementing an ecosystem approach to marine management. COM(2008) 187 final. 35 pp.
- EC. 2010a. Commission decision of 1 September 2010 on criteria and methodological standards on good environmental status of marine waters. Official Journal of the European Union, L232: 14–24.
- EC. 2010b. Directive 2009/147/EC of the European Parliament and of the Council of 30 November 2009 on the conservation of wild birds. Official Journal of the European Union, L20: 7–25.
- Hobday, A. J., Smith, A. D. M., Stobutzki, I., Bulman, C., Daley, R., Dambacher, J., Deng, R., *et al.* 2011. Ecological risk assessment for the effects of fishing. *Fisheries Research*, 108: 372–384.
- ICES. 2008. Environmental impact of marine fisheries, background document for the 2010 OSPAR Quality Status Report. In Report of the ICES Advisory Committee, 2008. Book 1. Introduction, Overviews and Special Requests, pp. 137–212. ICES Advice, 2008. Books 1–10. ICES, Copenhagen, Denmark. 1842 pp.

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