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'Whose science?' Precaution and power-play in European marine environmental decision-making.

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Abstract

This paper explores the science-policy interface in environmental decision-making in the European Community (EC²) as it moves towards its stated aims of implementing a precautionary and ecosystem-based approach to marine environmental management. Whilst recent EC case law has clarified some questions of Member State responsibilities under international environmental obligations, recent case studies at the crossing point between marine nature conservation and fisheries management in EC waters raise questions about the role of science in policy-making in Brussels. This has important implications for the developing EC Integrated Maritime Policy and Marine Strategy Framework Directive, and the concept of Maritime Spatial Planning as a whole. A new paradigm for bridging the science-policy gap is required in light of the developing legislative framework and given the complex nature of the marine environment.

Keywords

EC Marine Strategy Framework Directive; EC Integrated Maritime Policy; Precautionary Principle; Ecosystem Approach; Maritime Spatial Planning; Good Environmental Status; Science-Policy Interface.

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² This article refers to the European Community (EC) rather than European Union (EU) as fisheries are exclusively within the jurisdiction of the EC whilst the EU comprises the three 'pillars' of (i) the EC, (ii) justice and home affairs, and (iii) a common Foreign and Security policy.

1. Introduction

More often than not, environmental policy decisions have to be made on the basis of imperfect information about the problem itself and/or the impact of alternative options [1]. This necessity leads quite logically to a precautionary approach to environmental management, which provides that *‘where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation’* [2].

‘Precautionary’ and ‘ecosystem-based’ approaches to marine environmental management have been enshrined in European legislation and it is worth examining how these commitments are developing, using recent case studies of marine conservation. Achieving these commitments is especially challenging given the need to take decisions under the relatively high degrees of uncertainty related to complex marine ecosystems [3]. As previously described by De Santo and Jones [4, 5], the 2003 closure of the Darwin Mounds area of cold-water coral (*Lophelia pertusa*) off the coast of Scotland and the 2004 attempt by the UK to ban pair-trawling for sea bass in the English Channel met with different outcomes despite following the same legal mechanism, *i.e.* using the revised Common Fisheries Policy emergency closure mechanism. Following a detailed legal analysis and semi-structured interviews with stakeholder representatives from the regulatory, epistemic, user and NGO communities, several key challenges for European environmental decision-making became apparent. One concern of particular relevance to the Darwin Mounds and pair-trawl ban cases was the question of ‘whose science’ proved more effective in the policy process. This issue is further explored below in the context of the science-policy interface in EC environmental decision-making.

The key legal instruments for addressing marine nature conservation and fisheries in the EC have been, respectively, the Habitats Directive and the Common Fisheries Policy (CFP). The 2002 ‘revised’ CFP (Basic Regulation 2371/2002 [6]) emphasizes the use of both precautionary and ecosystem-based approaches (Article 2, paragraph 1) and it provides for stakeholder engagement through the establishment of Regional Advisory Councils (RACs). Since the release of the revised CFP and the extension of the Habitats Directive’s jurisdiction over EC Member States’ Exclusive Economic Zones (EEZs) following the 1999 Greenpeace Judgment [7] and recent Judgments of the European Court of Justice [8, 9], new marine-focused legislation has developed in the European Community. These include a Marine Strategy Framework Directive (MSFD) under the auspices of the Directorate General for the Environment (DG Environment) and an Integrated Maritime Policy (IMP) under the Directorate General for Maritime Affairs and Fisheries (DG Mare³).

The 1991 Maastricht Treaty on European Union incorporated the precautionary principle as both a legal obligation and required objective for environmental policy (Article 130r(3)), and this commitment was further amended by the 1997 Amsterdam Treaty and 2001 Treaty of Nice as follows: *‘Community policy [...] shall be based on the*

³ Formerly known as the Directorate General for Fisheries and Maritime Affairs (DG Fish), until a reorganization of the department in 2008.

precautionary principle and on the principles that preventative action should be taken, that environmental damage should as a priority be rectified at source and that the polluter should pay. Environmental protection requirements must be integrated into the definition and implementation of other Community policies' (2001 Treaty of Nice, Article 174(2)). Whilst the MSFD refers to this commitment (Preamble paras. 27 and 44) the IMP does not. However both refer to an ecosystem-based approach to management (MSFD at Preamble paras. 8 and 44 and Art. 1 para. 3; and IMP at pages 3 and 10), and this latter concept forms the basis of Maritime Spatial Planning (MSP) for Europe.

A successful ecosystem-based approach depends upon an effective relationship between science and policy-making. The aim of this paper is to examine developing European marine conservation legislation in tandem with recent case studies that elucidate the role of science in the decision-making process, with implications for the way precautionary and ecosystem-based approaches to environmental management are playing out. As will become evident later in the paper, a new way forward is needed to take the complex-adaptive physical nature of the marine environment into account and incorporate uncertainty as a motivating factor rather than a licence for inaction.

2. Developing an Integrated Maritime Policy and Marine Strategy for Europe

The European Commission's Strategic Objectives for 2005-2009 focus on delivering prosperity, solidarity and security for all Europeans. With regard to the marine environment, the Objectives state that *'in view of the environmental and economic value of the oceans and seas, there is a particular need for an all-embracing maritime policy aimed at developing a thriving maritime economy and the full potential of sea-based activity in an environmentally sustainable manner'* [10]. This commitment materialized in the development of a Maritime Green Paper Towards a Future Maritime Policy, which was released in June 2006 and open to consultation for a year thereafter. In line with the 2000 Lisbon Agenda⁴, the Green Paper focuses on stimulating growth and jobs in the wider maritime sector in a sustainable manner, ensuring the protection of the marine environment. This commitment to economic growth and jobs represents the first pillar on which the Commission envisages its new Maritime Policy will rest. Following the Green Paper consultation, the Commission released an Integrated Maritime Policy in October 2007 (IMP, also known as the 'Blue Book'), accompanied by an action plan, impact assessment, and a report detailing the results of the stakeholder consultation [11].

The IMP lays the foundation for an overarching maritime policy, encompassing all sectors and is thus quite an ambitious framework. In terms of environmental objectives, the IMP emphasises the need for fish stock recovery, moving towards multi-annual planning, implementing Maximum Sustainable Yield approaches to management, and eliminating Illegal, Unregulated and Unreported (IUU) fishing. It also reiterates the CFP's commitment to the ecosystem-based approach and requires Member States to draw

⁴ The Lisbon Agenda was agreed in 2000 when European leaders set the European Union the goal of becoming 'the most dynamic and competitive knowledge-based economy in the world' by 2010.

up national integrated maritime policies and implement maritime spatial planning (MSP), under the guidance of a roadmap on MSP released in 2008 [12].

Figure 1: Development of Recent EC Marine Legislation

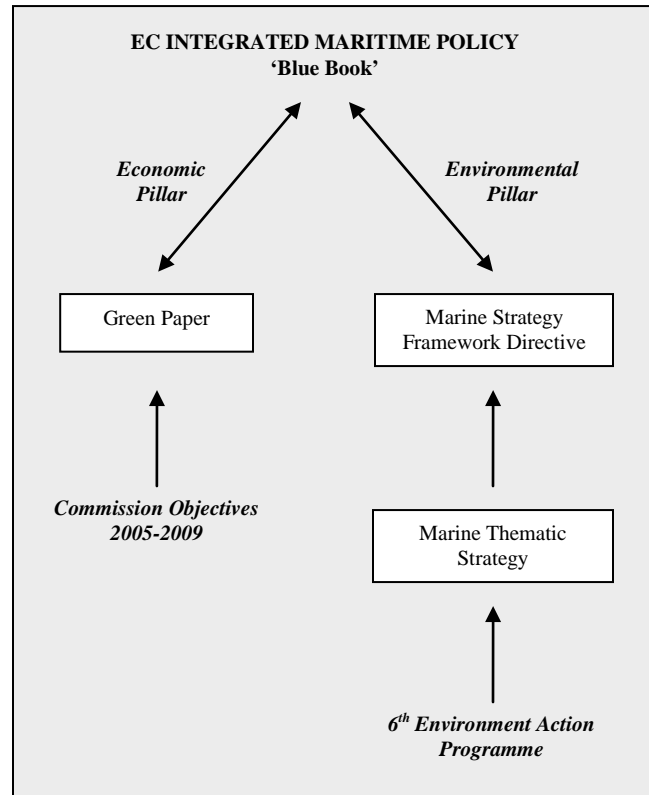


Figure 1 outlines the relationship between the Green Paper and the Marine Thematic Strategy and Directive and how these fall within the developing EC Integrated Maritime Policy. The environmental, pillar of the IMP is comprised of a European Marine Thematic Strategy and related Marine Strategy Framework Directive. The European Marine Thematic Strategy for the Protection and Conservation of the European Marine Environment is one of seven thematic strategies proposed by the European Commission in 2005-2006 to address various environmental issues⁵. These strategies are intended to be the key mechanisms for delivering the objectives set out in the 6th Environmental Action Programme adopted by the Council and Parliament for the period from 2002-2012. The Marine Thematic Strategy was released on 24 October 2005 [13] as a package, including a Proposal for the Marine Strategy Directive [14] and an impact assessment [15].

The development of the Marine Strategy package began in 2002 with the release of a Commission Communication entitled ‘Towards a strategy to protect and conserve the

⁵ The other thematic strategies address: air quality, the sustainable use of resources, waste prevention and recycling, pesticides, soil quality, and the urban environment.

marine environment' which was open to an extensive consultation process from 2002-2004. The main objective of the Directive is to achieve 'good environmental status' of Europe's marine environment by 2021. It establishes European Marine Regions⁶ as management units for implementation, within which Member States are obliged to develop Marine Strategies and cooperate among each other (and with non-EC countries where relevant). Following the draft Directive's release in October 2005, the UK held a consultation on the document until April 2006. Three key issues were raised by this process: first, there was a lack of certainty regarding the definition of 'good environmental status', and a need for better understanding of likely requirements up front. The second concern focused on the need for integration between the proposed Directive and other EC legislation, particularly the Water Framework Directive [16] and the CFP. Third, the consultation raised the issue of how the Directive will be implemented, including arrangements for coordination between Member States and the role of the Commission in approving strategies and programmes. The final, revised version of the Marine Strategy Framework Directive (MSFD) was agreed by the European Parliament and Council at the end of 2007 and released in June 2008 [17].

Previous discussions of the MSFD have incorrectly stated that it lacks reference to the precautionary principle [18] and criticized its lack of coherency with respect to stakeholder involvement [19]. Indeed, during its development, the Directive was quite harshly criticized in the literature, including being characterized as 'highly inadequate' to address European marine conservation due to its reliance on Member States to develop their own environmental objectives and marine protection activity programs [20]. However, all of these critiques focused on draft versions of the Directive. The final version contains Annexes that may help with its interpretation, especially with regard to defining and measuring 'good environmental status' (Annex I) and engaging in communication, stakeholder involvement and raising public awareness (Annex VI). Annex I in particular sets out qualitative measures that overlap with requirements under other EC legislation such as the Common Fisheries Policy, Habitats Directive and Water Framework Directive. These and other initiatives and legislation and their overlap with the MSFD Annex I criteria are listed in **Table 1**. Consequently there is potential for harmonisation of efforts between different legislative requirements, provided that Member States are properly guided by the Commission and have the opportunity to share best practices among one another.

⁶ The Directive lists the following four regions: the Baltic Sea, the North East Atlantic Ocean, the Mediterranean Sea and the Black Sea. These regions are further subdivided as appropriate, see Article 4(2).

Table 1: MSFD Annex I Guidelines and Relevant EC legislation Member States can implement towards ‘good environmental status’ assessments

MSFD Annex I qualitative descriptor	Relevant EC legislation and initiatives
(1) Biological diversity is maintained. The quality and occurrence of habitats and the distribution and abundance of species are in line with prevailing physiographic, geographic and climatic conditions.	Habitats Directive, WFD, EU discards policy
(2) Non-indigenous species introduced by human activities are at levels that do not adversely alter the ecosystems.	EU strategy on invasive species (in development)
(3) Populations of all commercially exploited fish and shellfish are within safe biological limits, exhibiting a population age and size distribution that is indicative of a healthy stock.	CFP
(4) All elements of the marine food webs, to the extent that they are known, occur at normal abundance and diversity and levels capable of ensuring the long-term abundance of the species and the retention of their full reproductive capacity.	CFP, Habitats Directive, EU discards policy
(5) Human-induced eutrophication is minimised, especially adverse effects thereof, such as losses in biodiversity, ecosystem degradation, harmful algae blooms and oxygen deficiency in bottom waters.	WFD
(6) Sea-floor integrity is at a level that ensures that the structure and functions of the ecosystems are safeguarded and benthic ecosystems, in particular, are not adversely effected.	Habitats Directive
(7) Permanent alteration of hydrographical conditions does not adversely affect marine ecosystems.	SEA, EIA
(8) Concentrations of contaminants are at levels not giving rise to pollution effects.	WFD, Bathing Water Directive (76/160/EEC), Dangerous Substances Directive (76/464/EEC), EC and regional legislation on marine pollution (various)
(9) Contaminants in fish and other seafood for human	Dangerous Substances

consumption do not exceed levels established by Community legislation or other relevant standards.	Directive (76/464/EEC)
(10) Properties and quantities of marine litter do not cause harm to the coastal and marine environment.	Dangerous Substances Directive (76/464/EEC), Packaging and Packaging Waste Directive (94/62/EEC)
(11) Introduction of energy, including underwater noise, is at levels that do not adversely affect the marine environment.	Environmental Noise Directive (2002/49/EC)

In addition, the critique that the Directive relies too much on Member States to develop their own programs fails to take into account that unlike Regulations, which are immediately binding on Member States, Directives must be implemented by Member States via the creation of national legislation to that effect. This refers back to the aforementioned bifurcation between fisheries management and nature conservation, whereby responsibility for fisheries management was transferred to the European commission in 1970s [21], whilst Member States have retained jurisdiction over the conservation of nature within their territories [4, 22]. Consequently in the case of the UK, one must look to the developing Marine and Coastal Access Bill to know how effectively the principles of the MSFD will be implemented on the national level. A significant issue noted by Jones [23] is that the consultations on the Bill stressed the importance of the precautionary principle but the Bill itself does not refer to this principle, stating instead that an evidence-based approach must be adopted, which will have a negative impact on the potential for designating highly protected marine reserves in UK waters.

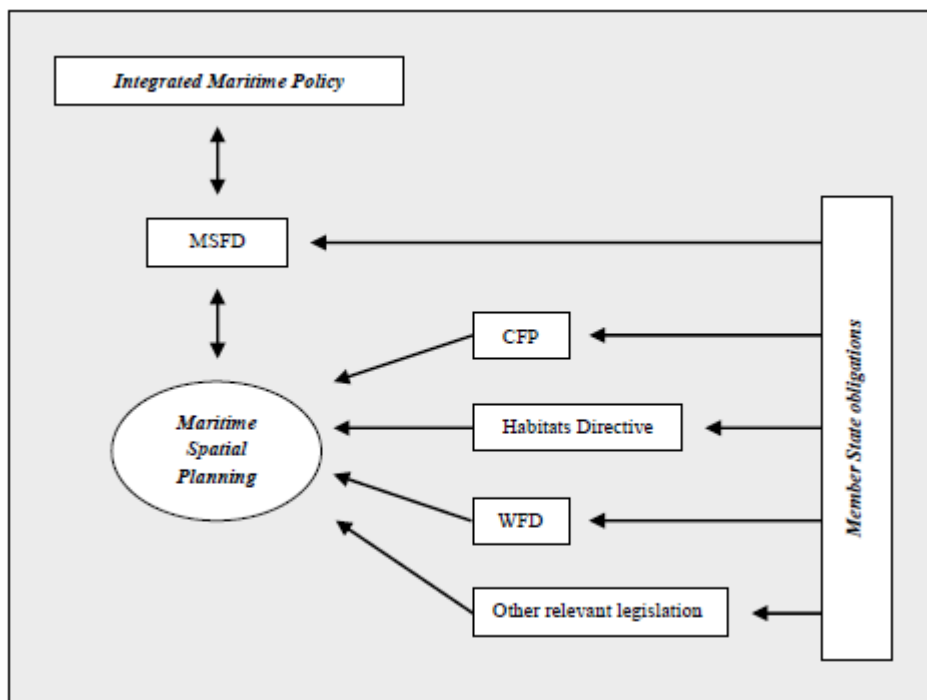
Nevertheless, the MSFD remains the key piece of newly minted European legislation designed to formalize an ecosystem-based approach to marine environmental management in European waters, on both the national and regional levels. In combination with the Integrated Maritime Policy, this package aims to join the ranks of overarching Ocean Plan type programs in Australia, the US, Canada, Japan and Norway.

The IMP has been designed to be holistic and it should serve as a framework for coordinating European marine environmental management, overseeing the progress of individual Member States and regional efforts towards MSP. The IMP's cross-sectoral approach and the MSFD's regional focus complement one another, in terms of a comprehensive approach to European marine conservation. **Figure 2** illustrates the interactions between Member States, their obligations under EC environmental law, and the relationship between these institutions and MSP. Member States are accountable to EC legislation, which should be coordinated within a MSP framework, under the authority of the IMP, but also through the MSFD to provide baseline information for measuring 'good environmental status'. Member State obligations to Directives and Regulations provide the backbone of attaining environmental objectives in marine

European environmental management. However, there need to be reflexive, adaptive review processes built into these instruments, and into the MSP process as a whole, in order to meet the underlying obligation of implementing a precautionary and ecosystem-based approach to marine management in European waters.

The IMP provides an opportunity for harmonisation beyond what has been achieved to date with the CFP Basic Regulation's incorporation of stakeholder participation, with the intention of establishing networks of best practices between maritime stakeholders and cross-fertilisation between different sectors. This is an important step towards adaptive management, but it remains to be seen how well this will work. Whereas the CFP has previously had overarching authority over conserving fish stocks, this new institutional arrangement has shifted the balance of power to some degree, given the key environmental role the MSFD will play in the IMP and given its requirement for fish stock data as part of determining 'good environmental status'. The focus on MSP and integrating economic and environmental concerns inherent in the IMP is an important step forward and must be followed through.

Figure 2. Inter-relationships between the CFP, MSFD, IMP and other relevant initiatives involved in Maritime Spatial Planning



The MSFD will provide a checklist for Member States to show whether they are taking conservation objectives seriously, but if the underlying criteria for 'good environmental status' are beyond their reach (*i.e.* if fishing does not become more sustainable) then Member States will be at a loss to meet their obligations under the MSFD whilst at the

same time being held accountable for areas of mismanagement outside their control. Given the MSFD's comprehensive approach, requiring data on species, habitats, water quality *etc.*, it will be difficult for Member States to meet all of these criteria without strong support from the Commission via the IMP, and through a unified approach with other Member States. For this reason, the sharing of best practices between countries and regions will be key to the success of both the IMP and MSFD.

3. Whose science?

A successful transition to ecosystem-based management requires institutions in tune with feedback about the impact of human activities, something that is best achieved by having multi-scale institutions whose organisation mirrors the complex nature of the ecosystem being addressed [24]. Up till now, the institutional framework for European marine conservation did not evolve with an ecosystem approach as a target; rather this priority has developed as a subsequent objective and has only been incorporated in recent legislation. The role of science in policy-making provides a key indicator for assessing the implementation of ecosystem-based management, where institutional capacity may seem limited and/or is still developing.

As described by De Santo and Jones [4, 5] recent use of the revised CFP Basic Regulation emergency closure mechanism has had mixed results. Whereas the Darwin Mounds area of cold-water coral off the north-west coast of Scotland was closed to bottom-trawling under Article 7 of this Regulation, a subsequent attempt by the UK to ban pair-trawling for sea bass (which results in the bycatch of cetaceans) in the English Channel was less successful. The UK was unable to gain Commission support for an EC-wide ban on pair-trawling in the English Channel, and as a result passed a unilateral Order which only bans the practice for UK fishermen. A key reason for this difference in outcome can be seen in the wording of Article 7, which allows for the Commission to apply emergency measures '*if there is evidence of a serious threat to the conservation of living aquatic resources, or to the marine ecosystem resulting from fishing activities and requiring immediate action*'. The issue of 'evidence' played an important role in the decision-making process that took place in the Commission. Whilst the evidence of bottom-trawling damage to the Darwin Mounds came to the Commission from the International Council for the Exploration of the Seas (ICES), the UK's Sea Mammal Research Unit (SMRU) provided the data on cetacean bycatch used by the UK as the foundation for its request for emergency measures. The 2004 SMRU report showed a three-fold increase since the 1990s in the number of stranded carcasses of common dolphins and harbour porpoises in South West England as evidence of bycatch due to the pair-trawl fishery for sea bass. This analysis indicated that the bycatch rate in the 2003-2004 season was 12 times higher than in 2001-2002 and more than twice the amount reported for 2000-2001. The SMRU also observed a shift in bycatch occurrence towards inshore waters for the 2003-2004 season, but were unable to provide certainty as to whether the high rate and geographical shift of bycatch during that season was an anomaly or would be repeated.

This difference in outcome can be explained as a matter of politics and political will, given the obvious gap between protecting a sessile species from a small fishery, versus closing a larger, profitable fishery. It also highlights a key issue that holds relevance for European environmental decision-making, *i.e.* ‘whose science’ was more highly valued, trusted, and more effective in getting the message across, and whether this was a factor in the Commission’s decision.

A recent review of the science-policy interface in international development [25] highlighted six general areas of tension that can arise between the production of science and determination of relevant policy. These include: (1) the politicisation of science and scientisation of politics; (2) scientific engagement versus objectivity; (3) space for risk and uncertainty versus demand for certainty in policy-making; (4) scientists’ versus policy makers’ focuses and timescales; (5) specialised expertise versus democratised but diluted knowledge; and (6) indigenous knowledge versus western scientific knowledge. In examining the development of institutions aimed at marine conservation and fisheries management in Europe, the third and fourth of these tensions are most apparent and will now be explored in more depth and in relation to the issue of ‘whose science’ earned a positive outcome in recent European environmental decision-making.

3.1 Interpreting risk and uncertainty

With regard to the issue of providing space for risk and uncertainty in the decision-making process, the Darwin Mounds closure and the attempted pair-trawl ban highlight some interesting interpretations of ‘precaution’, given it is one of the stated goals of the revised CFP and the MSFD, not to mention the Lisbon Treaty on European Union (at Article 174(2)). If a precautionary approach can be deemed as implying that conservation action should still be pursued in the face of scientific uncertainty, a flaw can be seen in the emergency measures provisions of the CFP Basic Regulation, which require a degree of certainty, *i.e.* that ‘evidence of a serious threat’ must already exist. The difficulty of determining what degree of damage or threat is required to have occurred before action can be taken remains an issue. In the sea bass pair-trawl ban example, the Commission’s rejection of the UK’s proposal for a closure under Article 7 of the Basic Regulation was justified on the basis of lack of evidence as required under the Article, but this requirement is arguably inconsistent with the interpretations of the precautionary principle outlined earlier and now incorporated into the EU Treaty. If evidence of damage is required before conservation measures can be introduced, how is this requirement allowing for a preventative/precautionary approach to management?

It can be argued that the concept of ‘uncertainty’ and its value in the decision-making process has been misinterpreted by the regulatory community, which is not unusual in situations where the public and policy-makers have little access to the underlying science behind an environmental problem. Whilst risks are more quantifiable, uncertainty is harder to pin down and consequently these two parameters are not interchangeable and need to be better distinguished in the discourse on environmental management. A lack of certainty should be a call for gathering more information, not for hesitation or inaction.

The deficiency of adequate data on dolphin populations during deliberations on the proposed pair-trawl ban should have been an indication that better information was needed and that interim precautionary measures should be taken, not that the proposal itself was invalid.

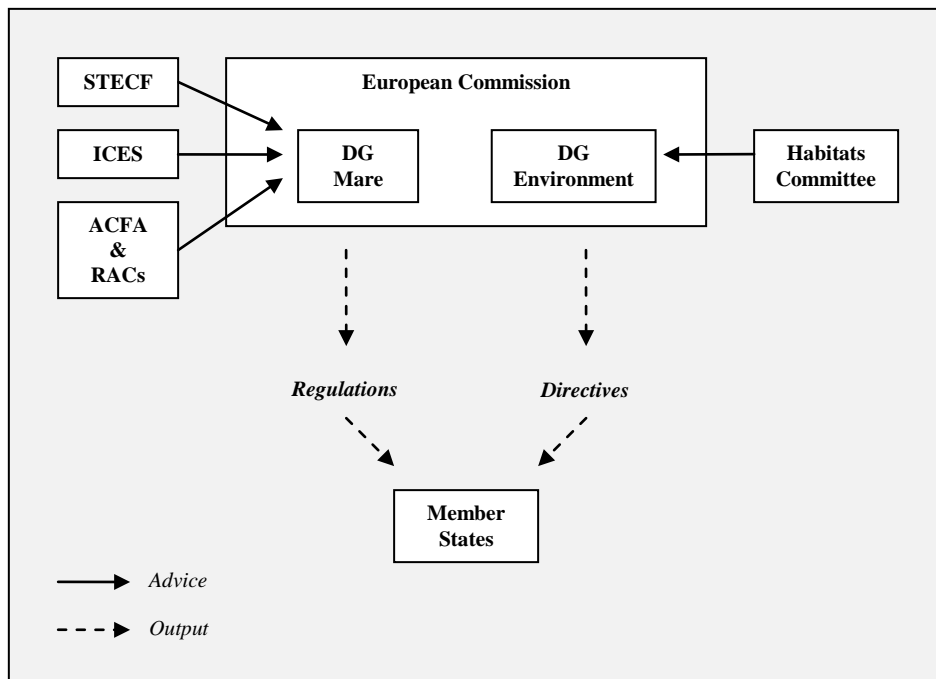
It is evident that in recent years, the European courts have been increasingly placing scientific risk assessment at the core of precautionary intervention by requiring evidence of ‘scientifically verified’ as opposed to hypothetical risk. [26]. This is in contrast to earlier judgments, and in line with a more ‘American, science-based risk management’ approach to handling uncertainty [27]. The importance of correctly interpreting uncertainty should not be overlooked: the absence of proof of harm is not the same thing as proof of the absence of harm. A truly precautionary approach is not about running forward without a scientific basis, it is about *better* science – science that is transdisciplinary, holistic and in line with ecological complexity. Consequently it can be argued that a precautionary approach to the adverse effects of pair-trawling in the English Channel would have involved putting a temporary closure on the fishery whilst better data could be obtained, if that was what was required for the Commission to make a well-informed conclusion. The emergency measures provided by the Basic Regulation could have provided this six month hiatus.

An added tension in the science-policy interface comes from the portrayal of the scientific community in the media as debating the parameters of science, for example ‘debates’ about the extent and severity of climate change impacts and models. This results in an outside perception of ‘uncertainty about uncertainty’ which is further hindered by the intricacies and inaccessibility of models associated with assessing complex systems [28]. The new risks to human welfare posed by modern complex phenomena such as environmental problems do not conform to our usual expectations about risk management. The impact of new risks is unprecedentedly large, both in terms of physical scale and time frame. They also possess a greater amount of uncertainty than more simple risks, and some of the most serious environmental risks result in a displacement of responsibility whereby it is difficult to build moral responsibility and political will for situations that are geographically and temporally distant [27]. As a result, there needs to be a conscious effort on the part of scientists and policy makers to realign the definition of uncertainty to reflect its more positive aspect, *i.e.* uncertainty as information, as a call to action, as a reason for research – not as a reason to delay a precautionary approach to environmental management. In an ideal world, the perfect relationship between science and policy is one where knowledge is communicated undistorted to decision-makers who then utilize it as factual premises for policy decisions. The process whereby scientific knowledge is transformed into decision premises is neither pure science nor pure politics [29]. Clearly the role of risk and uncertainty undermines this relationship, and it will now be argued that the institutional structure underlying environmental decision-making also has an important role to play.

3.2 The role of institutions and advisory bodies

As mentioned earlier, another important tension in the science-policy interface with direct relevance to the cases discussed here involves the difference between scientists' and policy makers' focuses and timescales. Indeed, whilst scientific research is usually aimed at an objective pursuit of the truth over a long time-scale, the political arena is much more a factor of election cycles and special interests. Clearly the Darwin Mounds closure was 'easier', as it involved a sessile, benthic species with clear evidence of damage, it concerned a relatively small portion (0.13%) of the UK Continental Shelf and there was not a lot of fishing going on in the area to begin with [4, 5]. In contrast, banning pair-trawling for sea bass in the English Channel faced a powerful fishing lobby from Brussels and France (who greatly outnumbered UK fishermen using this method in the area) and it addressed mobile species and greater uncertainty about the magnitude of the fishery's effects on cetaceans. Nonetheless, politicians are bound by the will of their electorate, and it is somewhat surprising that an issue involving charismatic megafauna washing up on Britain's shores did not have a more successful public relations campaign.

Figure 3. Disconnect within the European Commission



It is therefore worth examining the relative roles of European and national scientific advisory bodies and the institutional dynamics of environmental decision-making in Brussels. As outlined in **Figure 3**, there exists a fundamental bifurcation between fisheries management and nature conservation in Europe, which has its roots in the European Treaty. Whilst the European Commission retains exclusive jurisdiction over fisheries (following a shift in the 1970s after the designation of Exclusive Economic Zones), Member States are responsible for nature conservation within their borders, and

as mentioned earlier, this responsibility now extends throughout their EEZs [7, 8, 9]. Whilst the Directorate General for Maritime Affairs and Fisheries (DG Mare in **Figure 3**) produces Regulations that are immediately enforceable as is, measures emanating from the Directorate General for the Environment (DG Environment) are typically Directives, which require Member States to come up with their own national legislation in order to enact them. This process can cause quite a delay, as was the case for the Darwin Mounds candidate Special Area of Conservation (SAC). Whilst the UK was required to protect the area under the Habitats Directive following the 1999 Greenpeace Judgment [7] the UK could not put the site forward to the Commission as a candidate SAC until after it had amended its national implementation legislation for the Habitats Directive to apply offshore, in 2006. Consequently, with the release of the revised Common Fisheries Policy and its emergency closure provisions in 2002, the UK had a mechanism for closing the site immediately.

The Darwin Mounds and pair-trawl ban cases highlight another issue relevant to the science-policy interface. As illustrated in **Figure 3**, the Commission receives scientific input from two expert bodies with respect to fisheries, the Scientific, Technical and Economic Committee for Fisheries (STECF), and the International Council for the Exploration of the Sea (ICES), and it receives stakeholder input from the Advisory Committee for Fisheries and Aquaculture (ACFA) and Regional Advisory Councils (RACs). In comparison, the Commission is advised on nature conservation issues by a Habitats Committee comprising representatives from all Member States and the Commission. This Committee includes a Habitats Scientific Working Group and is aimed at helping implement the Habitats Directive. However, given its membership, it is not an independent scientific authority, nor is it a true stakeholder forum. This disparity between nature conservation and fisheries can also be seen in the distribution of resources on the Commission level: the Directorate General for Maritime Affairs and Fisheries outweighs the Directorate General for the Environment in terms of staff and resources and is leading the IMP and MSP processes.

In addition to this disproportionate advisory capacity in the Commission, the differing results of the Darwin Mounds closure and attempted pair-trawl ban also highlight the issue of how Member State scientific advisory bodies are viewed in comparison with international bodies. Whilst evidence of damage to the Darwin Mounds was presented to the Commission via ICES, the data on cetacean bycatch in the pair-trawl ban negotiations came from the UK's own SMRU, rather than an international body such as the Agreement on the Conservation of Small Cetaceans of the North and Baltic Sea (ASCOBANS) which has a more international status. In 2004, when the UK approached the Commission requesting emergency measures, ASCOBANS had not undertaken a recent survey of cetaceans in the region; this occurred in 2005 and the results were released only in 2006. However, even if the UK had had supportive data from ASCOBANS, this may not have been enough from the Commission's perspective, as they looked to ICES for advice, which concluded that (i) other fisheries were also responsible for bycatches in that region, and (ii) that a prohibition on pair-trawling in UK territorial waters would result in the displacement of fishing effort into adjacent areas without necessarily reducing bycatch [30].

The discrepancy in outcome between the Darwin Mounds closure and the attempted pair-trawl ban raises the question of how one Member State's scientific advisory bodies are viewed on the Commission level, and in the case of the UK, which is often seen as 'gold-plating' EC environmental legislation, this outcome can be seen as particularly unjust. UK fishermen line-fishing for sea bass in the English Channel, banned from pair-trawling by the UK's unilateral Order can now observe Belgian and French pair-trawling vessels in operation. This kind of environmental decision-making at the Commission level leads to a greater sense of mistrust within industry, and the perception of any kind of 'level playing field' being lost.

This bifurcation between fisheries management and nature conservation is not an easily resolved issue, and it poses a serious challenge for Member States to enact marine nature conservation in the face of threats occurring from fishing activities, as evidenced in the different outcomes between the Darwin Mounds closure and attempted ban on pair-trawling for sea bass. However, the developing framework for an Integrated Maritime Policy discussed earlier allows for some integration of these objectives, and there may be potential for more synergy as the MSFD and MSP processes progress. In addition, the CFP is entering a new review process which should result in a revised version being released in 2012. Given the direct regulatory authority of the CFP over Member States, and the obvious need for further nature conservation measures to be built into it, this may be an opportunity for further harmonisation between fisheries management and nature conservation, but this remains to be seen.

However it must also be noted that in terms of terminology, Europe is progressing towards 'maritime' spatial planning, rather than simply 'marine'. This can be deemed to imply that economic objectives and sustainability will be the way forward, and whether or not the developing framework for an Integrated Maritime Policy will find a balanced approach, meeting stakeholder needs, nature conservation objectives, and providing a level playing field for industry, will be a significant challenge. This developing legal framework also provides an opportunity for synergy and enhanced conservation of Europe's marine environment, if handled carefully. In particular, the science/policy interface must be further explored, and this paper has raised some issues that warrant further exploration as more cases at the interface between fisheries management and marine nature conservation come to light.

4. Conclusion: Towards a new paradigm for marine conservation

The complex-adaptive physical nature of the marine environment and land-sea interface make it difficult to predict the effects of human-based impacts, and thus attaining a 'precautionary' and 'ecosystem-based' approach to marine management is particularly difficult. Whilst the physical complexity of the marine environment is acknowledged in the science behind marine conservation [24, 31, 32], it needs to be better built into the decision-making process.

Although it may be somewhat of a cliché to call for yet another ‘paradigm’ for management, the EC is at a critical point in the protection of its marine environment, and the developing legislative and institutional framework provides an important opportunity for addressing current and future needs. The MSP process should allow for synergy between fisheries and nature conservation legislation if they are harnessed correctly, and if the upcoming CFP review results in a new Regulation that goes further than the latest iteration. Whilst the emergency closure mechanism introduced in the CFP Basic Regulation represented an important shift towards nature conservation, its strict requirement for evidence-based decision-making has proven to be an impediment to conservation efforts. Truly precautionary and ecosystem-based conservation will only happen by better incorporating uncertainty into the science-policy interface, via a wider acceptance of ‘uncertainty as information’, *i.e.* as a call for collecting more and better information before making decisions.

The developing institutional framework may help remedy the split between fisheries management and nature conservation in European marine management. However the role of the CFP and Habitats Directive in determining ‘good environmental status’ will be an important indicator of this. The CFP and Habitats Directive provide enforcement capability that can strengthen the IMP and MSP process if integrated effectively. The MSFD would benefit from close linkages to the Habitats Directive, which has already been implemented in most Member States, and it is now applicable throughout Europe’s 200nm EEZs, and it would benefit from a clear integration of the revised CFP in the determination of ‘good environmental status’ of Europe’s fisheries.

The question of ‘whose science counts’, both within the scientific advisory realm in Brussels and between Member States, is an issue that will continue to play out as the EC builds its MSP process. As this process is meant to be achieved both nationally and regionally, there will likely be several occasions where conflict arises between players. It is hoped that this paper has contributed to the debate by raising this issue early in the process in order to help ameliorate further conflicts and impediments to achieving effective marine conservation. It would be interesting to broaden this study to look at the role of non-governmental organisations at the interface between science-communication and policy-development, both as a driving force for change and as a link to stakeholder participation.

From a wider perspective, the questions raised in this paper about the role of science and power-play in environmental decision-making have important ramifications for the future environmental security of the EC. Whilst there has been progress towards developing a degree of adaptability into management (*i.e.* ‘adaptive management’) there needs to be a greater recognition of the inherent complexity in some systems, such as the global climate and the marine environment. Building more flexibility and a more ‘*complex* adaptive management’ process for marine systems will be key to achieving progress and securing both nature conservation and economic objectives in the coming decades.

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