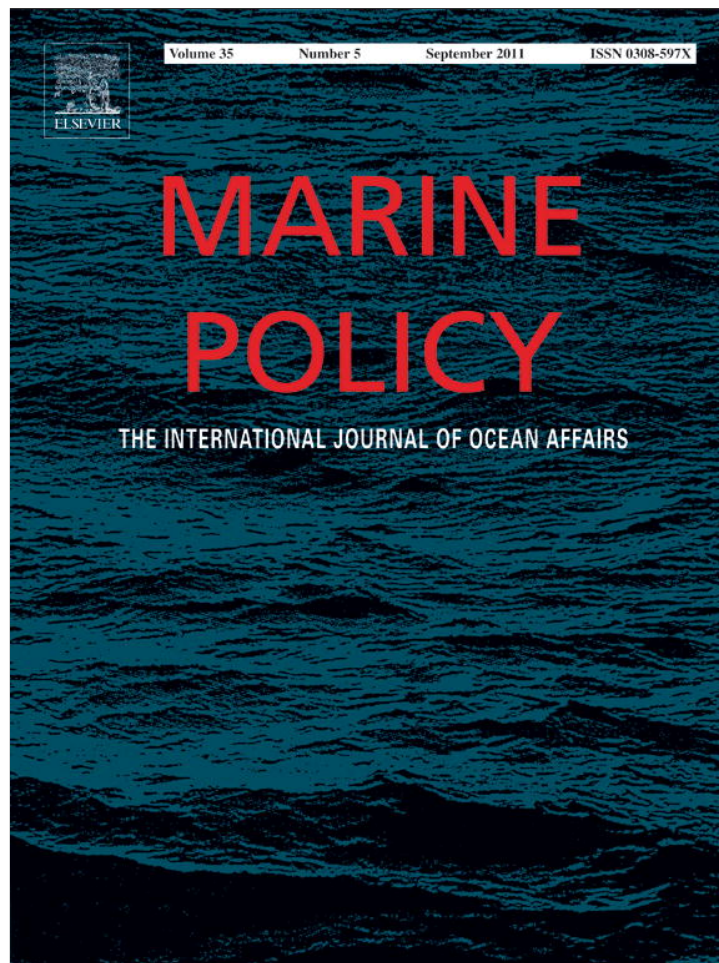


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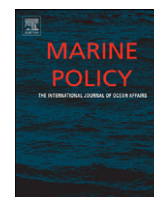


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Incentives, social–ecological feedbacks and European fisheries

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ABSTRACT

The European Common Fisheries Policy (CFP) has failed to deliver on social, economic and ecological goals. This failure is in part the result of a number of social–ecological feedback mechanisms. The policy is currently undergoing reform, with unknown practical outcomes. Here, relatively successful fisheries policies outside the European Union are reviewed. Through interviews and workshops with scientists, managers and other stakeholders, complemented with literature reviews, practices that can create incentives for long-term sustainability are investigated. The focus is on how the provision of clear and trusted scientific evidence can stimulate defensible decisions, in turn creating incentives for compliance, leading to positive social–ecological outcomes. Despite differences between Europe and the investigated case studies, the prospects of an increased regionalization within the European CFP provides the best starting point for implementing best practice identified in this study.

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1. Introduction

The Common Fisheries Policy (CFP), which underpins the governance of marine fisheries in the EU is widely acknowledged to have been unsuccessful in achieving its objectives, and is currently undergoing reform. The scientific literature on fisheries is replete with a range of perspectives on the fisheries 'crisis' and prescriptions for moving towards sustainability. This paper adopts the framework of 'resilience' to examine the current European governance regime as a linked social–ecological system [1], i.e. a system with strong interconnection between social and ecological dynamics [2]. This study focus particularly on feedbacks and incentives of actors within the system compared to more successful fisheries governance regimes in Norway, the USA and Canada. Such an analytical lens lends itself to understanding the dynamics of the regime, in terms of stasis, and potential transformations for improved stewardship of marine ecosystems [3].

Hollings' [4] ecological theory of ecosystem dynamics and resilience (persistence in the face of change) provides insights for understanding the challenge of managing complex social–ecological systems, like fisheries. Work on resilience is expanding from focusing on ecological persistence only to addressing the

capacity of social–ecological systems to adapt to change and even transform into more desirable development directions [3,5,6]. This perspective highlights the importance of internal dynamics (feedback loops) as well as external drivers on a system. Feedback loops exist where components of a system mutually affect one another, and can stabilize the system within a particular state, or cause it to change to an alternative state [7]. It has been argued that the failure to recognize the importance of social–ecological feedback loops is a critical explanation for many management failures [8]. The resilience framework also focuses on the interactions between gradual and fast change and how systems behave in the face of change. A resilient social–ecological system is able to adapt to change and maintain its basic structure and function. The capacity to deal with change has been described as both adaptability and transformability [8]. Adaptability implies changing within the current development trajectory, whereas transformability refers to shifting into fundamentally new development trajectories [6].

There is an increasing interest in studying transformative change processes [8,9]. Transformative change can benefit from experiments at small scales, which can function as areas for innovation, which can in turn lead to tipping points and transformative change at larger scales [8]. The interaction between geographical scales is therefore critical for understanding how successful transformations can be achieved [8].

Here, the European fisheries management system is investigated, particularly with a focus on how a number of social–ecological

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feedbacks [10,11] sustain the present unfavourable social–ecological regime in Europe (resulting in poor economic performance and depleted fish stocks as leading indicators). An analysis of existing incentives and feedbacks within the management system can create the capacity to change system trajectory away from unfavourable social–ecological regimes.

Perverse incentives [12] and other aspects contributing to failures in fisheries policies [13,14] have been well described, with a growing interest in understanding new and innovative management approaches that focus on the behaviour of and incentives for fishermen [15,16] with a particular focus on economic incentives. This study attempt to move beyond addressing the incentives for fishers and instead evaluates existing incentives within the social–ecological system and their role in stabilizing governance systems in sustainable or unsustainable trajectories. Feedbacks that can be manipulated to contribute to a transformation of the European Common Fisheries Policy are suggested. These feedbacks are addressed by using innovative examples from other countries (primarily the US, Canada and Norway).

1.1. Methods

There are indications that North American and Norwegian fisheries are performing relatively well, as measured by sustainability of fish stock exploitation, e.g., [17–19] and adherence to the FAO code of conduct for sustainable fisheries [20]. Existing incentives that appeared to contribute to sustainability in the three countries were investigated by 41 interviews with scientists, managers, policy makers, and representatives from fishing industry and environmental non-governmental organizations, in order to get a diverse perspective from the respective countries [21]. The information obtained was complemented with literature reviews (recent scientific peer review articles, edited books and OECD and FAO reports) and two workshops focussed on scientific and management issues, see Ref. [21]. The information obtained was used to investigate incentives and social–ecological feedbacks that support (social, economic and ecological) sustainability. The main areas of investigation were (a) the provision of evidence (the scientific basis for assessments and quotas), (b) the process of making policy decisions and (c) the incentives for complying with decisions. The potential applicability of the identified “best practices” to create incentives, which support long-term sustainability in a European context, was investigated. The importance of the historical and contextual nature of fisheries management is recognized, and that best practices may therefore depend on ecological, economic and social conditions. Nonetheless, in illustrating different forms of devolved decision-making, all three countries have relevance for the situation in the EU. Some might argue that the federal systems of governance in North America have particular lessons for the EU, though it is important to recognize that the EU is a community of independent member states which have shared interests in the management of very many fish stocks.

2. Social–ecological feedbacks in fisheries management regimes

The European Common Fisheries Policy (CFP) has failed to deliver on its social and ecological goals. The sector is suffering from poor profitability and 88% of assessed European stocks are overfished [22], compared to the global average of 28% [18]. Several factors have been identified that contribute to such development [23,24]. The objectives of the policy are broad and un-prioritized, there is no transparency in the (highly centralized) decision making process and the decisions are only weakly linked to the scientific advice [25]. The scientific advice also suffers from a lack of transparency and has low legitimacy among stakeholders from industry. The scientific

community has not primarily been organised to provide holistic–ecosystem-based advice, thus complex ecosystem dynamics are not taken into account in quota setting. The centralized, top-down management structure commonly resorts to micromanaging [26], due to the capacity of the industry to circumvent rules [27], thereby operating in legal grey zones. Overcapacity and poorly defined rights for the industry also contribute to the problems and create a race to fish. Enforcement is weak and incoherent, leaving a pronounced absence of a level playing field. The substantial problems with IUU (Illegal, Unreported and Unregulated) fishing in many regions [15,28] are aggravating the problems for over-worked scientists and managers, unable to account for the wide regional diversity within the Community. These dynamic interactions between society (science, decision making and compliance) and ecosystems can be illustrated as a number of social–ecological feedback loops (Fig. 1), which go some way to explain the persistence of the current undesirable state. The figure illustrates an overall systemic feedback loop ranging between science, decision making and compliance, but also three partial feedback loops within the described system (Fig. 1). One partial feedback loop can be described as a *decision-overcapacity feedback* (Fig. 1(A)). Technological development has produced overcapacity, which is aggravated by subsidies. Overcapacity leads to greater pressure for short-term decision-making, which also inhibits attempts to address overcapacity, will sustain a strong pressure for maintained overcapacity and unsustainable quotas. As stocks are fished down, they produce less, leaving less fish available to catch. This results in poor economic efficiency, which may force some actors to resort to fishing illegally, thereby creating a *stock status-compliance feedback* (Fig. 1(B)). Low status and credibility of the underlying science, low transparency in the highly politicized decisions making process and resultant lack of legitimacy of decisions, may also contribute to reducing the incentives for compliance. The subsequent high levels of IUU, high grading and discard make quantitative stock assessments very difficult, while the dominance of younger year-classes of fish in overexploited stocks increase variability, and uncertainty around forecasts. These issues undermine the legitimacy of the science, further contributing to pressure for unsustainable decision-making. This can be considered an *evidence-decision-stock status feedback* (Fig. 1(C)). The result is a political pressure for subsidies and higher quotas, reinforcing the overcapacity, thereby creating the overall feedback-loop that further contributes to this undesired trajectory [26,27].

By the way of contrast, our interviews suggest the existence of a very different social–ecological feedback structure in Norwegian and North American fisheries (Fig. 2), where the decision making process has a stronger focus on ecological sustainability and an emphasis on reducing subsidies and overcapacity. Sustainable quotas are contributing to recovering stocks, which is reducing the incentives to cheat, coupled with strong enforcement and monitoring. Improved scientific legitimacy is creating a strong argument for a decision-making process focussing in ecological sustainability. In the following, it is argued that it is possible to transform the unsustainable European fisheries regime, to one that is more sustainable, by investigating the types of incentives that can change direction of existing social–ecological feedbacks [21].

3. Examples of best practices in creating positive incentives and desirable feedbacks

Examples from successful fisheries management [21] suggest how social–ecological feedbacks can help the system to achieve desirable trajectories. These involve mutual learning, trust building, and ensuring accountability. The three national case studies emphasise the importance of positive incentives for science, decision-making and

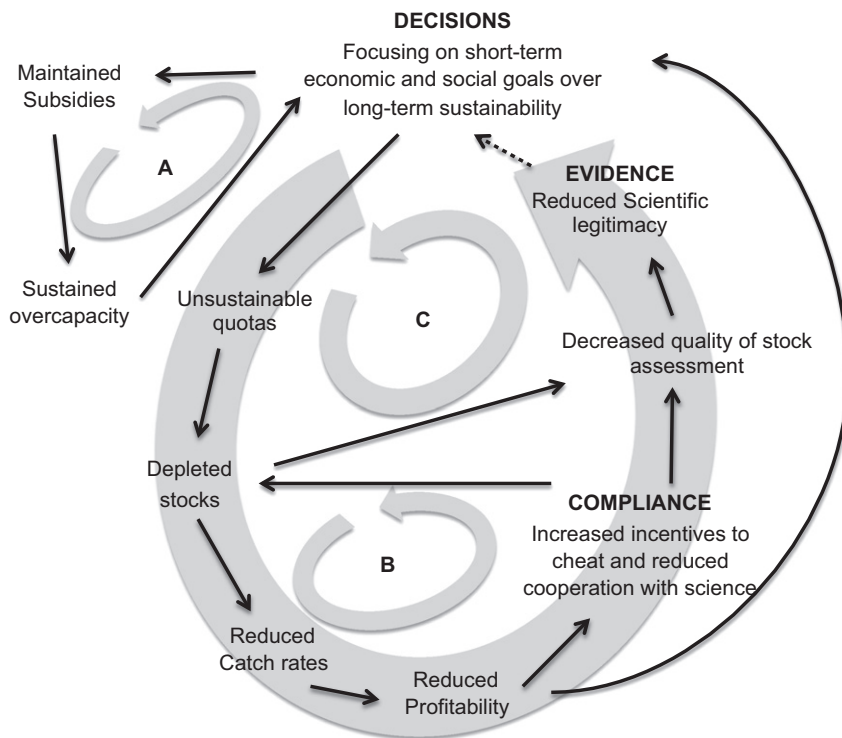


Fig. 1. Social–ecological feedbacks stabilizing an unfavourable European fisheries policy. In addition to the overall Evidence–Decision–Compliance feedback loop, there is also an (A) decision-overcapacity feedback, a (B) stock status-compliance feedback and a (C) evidence-decision-stock status feedback.

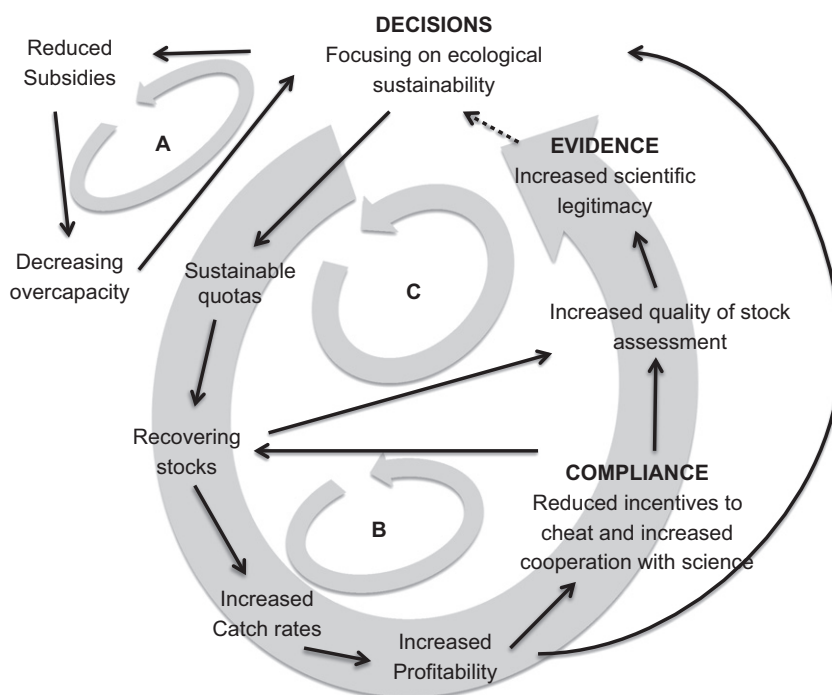


Fig. 2. Social–ecological feedbacks stabilizing a sustainable fisheries policy (see Fig. 1 for definitions of identified feedbacks).

compliance, in adaptive co-management regimes. Below, the identified incentives that can stimulate the following issues are reviewed:

- Clear and trusted evidence
- Defensible decisions

– Compliance with decisions

Table 1 summarizes the findings from the three case studies in respect of six selected incentives: (i) clarity of operational objectives; (ii) transparency of decision making; (iii) regionalization and/or

co-management; (iv) allocation of fishing rights; (v) the precautionary approach and (vi) compliance.

3.1. Clear and trusted evidence

Strong incentives for producing ecosystem-based advice have been created in the three countries, and the scientific communities are being reorganized to create the necessary capacity. This development has been particularly evident in Norway [29], where the Institute of Marine Research (IMR) has been restructured to create an integrated institute working with a novel approach for

conducting ecosystem-based research [30]. In the US and Canada [21], marine research programs are changing and a range of ecosystem parameters is incorporated in monitoring and management plans. Research in the three countries is mainly government funded and conducted in agencies or institutes closely linked with the respective governments. All three countries have some type of industry-funded component relevant for the provision of trusted evidence, e.g., industry funding of onboard observers, cost-recovery schemes from fisheries revenues or licensing fees, or the existence of a quota used specifically for research. The participation of industry in funding research can increase ownership and perceived credibility of data. In some

Table 1

Characteristics of Best Practices for fisheries management in relation to positive incentives for (1) trusted and transparent evidence, (2) defensible decisions and (3) compliance.

	(1) Evidence	(2) Decisions	(3) Compliance
(i) Operational objectives and guidelines: Making clear what to do, and how to do it.	<ul style="list-style-type: none"> Guidance on the standards of evidence (uncertainty and quality) needed for decision-making. Clear mandate and structures for ecosystem-based science and advice. 	<ul style="list-style-type: none"> Knowledge of what is allowed, and what is not. Clear priorities between sustainability, profitability and social objectives. Rules about documenting processes. 	<ul style="list-style-type: none"> Penalty schedules to create a deterrent against violations. Clear expectations of reporting obligations.
(ii) Transparency Increasing understanding and trust.	<ul style="list-style-type: none"> Scientific advice that is understood and trusted by stakeholders. Pre-decision analysis of options that are available for stakeholder comment. Peer review to improve reliability of the evidence. Stakeholder involvement in the collection of data, including cooperative projects between scientists and the fishing industry. 	<ul style="list-style-type: none"> Decision makers can be held accountable if they do not follow objectives. Stakeholder involvement with and representation to decision-making bodies. Making decisions (and the basis they are based on) more transparent. Decisions from within the range of pre-decision analyses so that the implications are known. 	<ul style="list-style-type: none"> More trust in evidence and decisions leading to improved willingness to comply. Stakeholders believing in the evidence and decisions, such that they are intolerant of others violating regulations. Documentation of the source of seafood products making regulations more enforceable.
(iii) Regionalization and co-management: Instilling a sense of ownership and responsibility at geographic scale people understand.	<ul style="list-style-type: none"> Regional understanding of the specific context and the type of evidence that is needed. Support for evidence because regional co-managers understand they need it to make decisions. 	<ul style="list-style-type: none"> Regional knowledge and perspectives leading to better decisions. Regionalization allowing more stakeholder participation in the process, leading to more trust in the outcome. Co-managers with responsibility to find solutions rather than criticise top down decisions of others. Regional co-managers sharing the overwhelming workload that now falls on the central authority. 	<ul style="list-style-type: none"> Regional decision making with more stakeholder involvement improving willingness to comply. More willingness to comply, leading to less tolerance for violators. Regional knowledge leading to regulations that are more enforceable.
(iv) Rights: Allocated fairly and transparently, but not to everyone, thus mitigating the race for the fish" which is the root cause of wasteful excess fishing capacity.	<ul style="list-style-type: none"> Incentive to protect long-term value of right by getting the science right. Incentive to use right in an economically efficient way, which makes the fishing industry profitable enough to invest in evidence. 	<ul style="list-style-type: none"> Incentive to protect long term value of rights by advocating decisions that value long term conservation and sustainability. A more profitable fishing industry, which can afford to make short-term sacrifices in favour of long-term conservation and sustainability. 	<ul style="list-style-type: none"> Incentive to protect long-term value of right creating an incentive to comply with regulations. An incentive for self-enforcement by the fishing industry to protect the value of their rights.
(v) Precautionary approach and reversal of burden of proof (including results based management): Requiring that long term sustainability be given priority over short term needs, and that access to publically owned resource is contingent on fulfilling obligations (e.g., providing data).	<ul style="list-style-type: none"> The incentive to provide evidence and to improve its precision because fishing opportunities is reduced by uncertainty. Clear understanding that providing data is an obligation associated with the right to use a public resource. 	<ul style="list-style-type: none"> Requiring decisions that favour long term conservation and sustainability over short-term economics. Results based decision where proponents of a decision have to demonstrate it will work. 	<ul style="list-style-type: none"> Regulations designed to be enforceable even if this places an additional burden on the fishing industry. Member states documenting their enforcement capability to ensure comparability.
(vi) Accountability and Penalties: The capability to identify violations of the public trust, and to penalize for violations.	<ul style="list-style-type: none"> Incentive to provide fishery dependent data to avoid penalties. 	<ul style="list-style-type: none"> Decision makers that are held accountable to public opinion. Decisions that are subject to judicial review. 	<ul style="list-style-type: none"> Penalties that are severe enough to be more than "the cost of doing business." Serious or repeated violations penalized by loss of right.

countries, industry is also an active partner in identifying the kind of research that can be relevant. Collaborative research projects between scientists and the industry (sometimes using fishing vessels as research platforms) have generated important new knowledge (by incorporating local knowledge and detection of ecosystem developments in real time) and are important in generating trust, which can increase the legitimacy of scientific advice (compare feedback in Figs. 1(C) with 2(C)). The ecological science backing the advice is transparent and subject to peer review in North America, and in the US, is also supported by socio-economic assessments of different options. All three countries put strong emphasis on monitoring of catches and discards to generate quality data for assessments using technology (e.g. video surveillance of catches in particularly valuable fisheries) and on-board observers. The universal problem with unselective fishing gear has been addressed by Norway, and in some Canadian fisheries, with a discard ban. This enables monitoring of the full mortality of fisheries, not just landed quantities.

3.2. Defensible decisions

The US and Canada put a strong emphasis on a regional decision-making structure, with a high degree of participation from stakeholders in consultations or decision making processes. US regional fisheries councils are responsible for developing fishery management plans, subject to approval by the federal agency, National Marine Fisheries Service (NMFS). Stakeholder consultations and co-decision also play an important role in Norway, where councils of fishing industry and environmental NGOs have contributed by inputting to the development of legislation.

Management decisions in the USA are guided by national legislation. The 10 National Standards in the US Magnuson-Stevens Fishery Conservation and Management Act (MSA, Public Law 94–265, p. 58) is an example of defining a clear priority between different objectives, emphasising the ecological sustainability as having highest priority above other goals (compare feedback in Figs. 1(C) with 2(C)). The guidelines for implementation are also well defined in the US system. Legitimacy in the decision making process is facilitated by stakeholder representation in the Regional Fisheries Management Councils, responsible for development of operational management. This provides for transparency in the decision making process, where all decisions follow the priorities set out by the MSA and are backed by transparent advice (with associated legal accountability), taking into account social-economic aspects, as well as uncertainty in stock assessments and further, ensuring that the best available scientific information is used. These components are also aspects of a precautionary approach to management decisions.

3.3. Compliance with decisions

The devolved management in USA and Canada and co-management in Norway provide important legitimacy of, and trust in, the overall policy-making process and therefore contribute to compliance. Industry-led initiatives (e.g. to reduce bycatch) have further increased the legitimacy of decisions and contributing substantially to a culture of compliance (compare feedback in Figs. 1(B) with 2(B)). All countries are increasingly using limited access programs, often in combination with transferable quotas, which can provide a more long-term perspective for industry and potential future pay-off from restrictive management and high levels of compliance. Certification schemes, encouraged by managing authorities in the countries surveyed, can provide incentives to comply with regulations, and there is an ongoing development

of methodologies for tracking products throughout the entire supply chain, from landings through sales, processing, transportation and marketing. Sales organizations are increasingly contributing to information relevant for compliance and transparency. All three countries have strong, coherent enforcement programs, including the requirement of Vessel Monitoring System (VMS) equipment in many fisheries, onboard observers and matching of vessel log books, landings and sales data. Government agencies with responsibility for fisheries management or related issues (coastguard, customs, police, fisheries agencies, tax authorities) are improving their cooperation in order to address non-compliance. Substantial fines are associated with non-compliance. Excess capacity is being removed, and the US and Norway, have scrapping of vessels as a key component in their management strategies. A “no subsidies” approach in Norway [31] led to a dramatic decrease in excess fishing capacity, while a modified quota-trading scheme prevented consolidation of ownership of quotas to balance efficiency with social objectives (compare feedback in Figs. 1(A) with 2A).

3.4. Conclusions from case studies

The studied countries illustrate characteristics that potentially can create incentives for sustainable fisheries, thereby stimulating feedback loops that strengthen and maintain sustainability (summarized in Table 1). Incentives for all three components (Evidence, Decision and Compliance) need to be addressed in order to change the direction of existing social–ecological feedbacks in the European CFP. In the following section, it is argued that, in a European context, these characteristics could effectively be considered at a regional scale.

4. Implementing best practices in the Common Fisheries Policy

4.1. Reforming the Common Fisheries Policy

The four social–ecological feedback loops identified in Fig. 1 illustrate a number of factors contributing to an institutional inertia and path-dependency in the European CFP, which have hindered the potential for transformative change of fisheries governance and management towards an ecosystem-based approach at the European level [32]. Earlier attempts to reform the CFP in 1992 and 2002 did not confront the centralized command and control [33] approach. However, a more radical institutional change is part of the debate for reforming the CFP in 2012. Central to the proposed changes [34] is a rebalancing of decision-making responsibilities between the European institutions (Commission, European Parliament and Council of Ministers) and the member states in ways that will devolve more technical aspects of management to the regions, member states and the fishing industry. Meta governance functions – defining the principles, standards, goals and objectives and outlining the broad strategy for sustainable fisheries – would still remain with the European institutions. The task of translating these principles into long-term management plans, could however, be delegated to member states working in collaboration at a regional level.

The basic aim is to remove much of the burden of centralized micromanagement that has earned the Commission a reputation of being remote, unresponsive and insensitive in relation to specific regional contexts. If decisions are difficult to understand, implement and enforce, they reduce the incentives for sustainable behaviours and feed into undesirable trajectories. One clear example is the high levels of discarding in the mixed demersal fisheries of the North Sea and West of Scotland, which have existed simply to allow fishing to

remain within the rules. These legal discards are the unavoidable consequence of an inappropriate combination of restricted quota, minimum landing sizes and catch composition rules.

Experience has shown that where member states are able to work in close consultation with their fishing industries, the regulatory system can be improved and levels of discard reduced [35]. One example is the voluntary scheme for real time closures which has operated in Scotland since 2007 [36]. The expectation, therefore, is that with regionally sensitive management framed by member states working in collaboration with their fishing industries, simpler and more appropriate systems can evolve. This can potentially lead to a stronger culture of compliance and improved legitimacy of the science underpinning decisions. Ongoing European experimentation with cameras for monitoring catches [37] and integrated scientific assessments [38] are also examples of innovations, with potential to contribute to transformative change, as they have been described for socio-technical regimes [39]. Although such experimentation is unlikely to address the full range of social-ecological feedbacks, these innovations can contribute to developing niches and change in sub-systems.

4.2. Regionalizing the CFP

The CFP has increasingly focused on regional seas as an appropriate scale for management, and the European environmental Marine Strategy Framework Directive [40] also puts a strong emphasis on this geographical scale, which is likely to influence the policies and practice also related to fisheries. A first step towards a regionalization of the CFP was taken in 2002 with the setting up of five Regional Advisory Councils (RACs), providing a platform for stakeholder involvement and dialogue, but little direct impact on policy formation [41]. In preparation for the 2012 reform, the Commission appears to take a more positive view on regionalization. DG Mare (responsible for the CFP in the European Commission, but also for the Maritime Strategy, in which the Marine Strategy Framework Directive is an integral part) has recently undergone internal restructuring to introduce three regional directorates alongside those dealing with more general policy requirements. A coherent regional approach could potentially address some of the identified incentives, and stimulate a change in direction of feedbacks in Europe's regional seas while taking full account of the social-ecological contexts of respective regions.

In its Green Paper [22] however, the Commission still presents the concept in soft focus mainly because of anticipated problems in the implementation of a regionalized CFP in a legal landscape where the Treaties recognize only the EU institutions and member states as formal partners in the policy process. Nonetheless, regionalization is seen as the essential means of transferring responsibility for detailed management from the Commission to member states working together in a regional context, though the details of the organizational apparatus, including collaboration with existing regional environmental governance regimes, have still to be worked out.

A regional framework commensurate with large ecosystems (Baltic Sea, North Sea) is a prerequisite for developing a truly precautionary ecosystem-based approach to fisheries management. It would offer a realistic context for schemes to reduce fleet capacity and ease the transition from single species to multi-species management. Long term regional management plans should provide the platform for a more advanced form of co-management based on an objective led approach (Table 1). The regional plans would set objectives, including specific targets for achieving sustainable catches while self-defining groups of vessel owners are encouraged to set out their own detailed multi-annual fishing plans for meeting these objectives, reducing by-catch and discards to acceptable levels, as a means of gaining access to the

fishery. Such plans would thus equate to reversing the burden of proof (Table 1). In theory, the new approach would create the conditions for nurturing regionally sensitive, adaptive management systems capable of incorporating many of the incentives identified in the case studies and initiating a significant change of direction for the feedback loops towards sustainable fisheries (Fig. 2).

Implementing regionalized management areas across the EU will be challenging; not all regions are at the same state of readiness. One option might be to trial the idea in either the Baltic or North Sea where thinking on these lines is already well advanced. The Baltic Sea could serve well as a pilot area. There is a long history of stakeholder interaction, a growing culture of dialogue in the Baltic RAC, an emerging vision of integrated environmental management [42], an articulated will to follow scientific advice, a strong scientific capacity and strong demand for policy integration in the environmental directives [40,43] widely applicable to member states. A Baltic pilot for regionalized fisheries management would start with a stakeholder-defined vision of the future of fisheries in the Baltic Sea basin, including the most suitable form of management organization in the region. A regional analysis of incentives with regard to evidence, decision-making and compliance could demonstrate the likely potentials and impacts of different options in terms of biological, economic and social outcomes, and the preferred options then be translated into operational objectives. The resulting long-term management plans would need to be carefully designed to ensure not only transparency and legitimacy, but also adaptability in the face of changing social and ecological conditions.

However, the task of implementing reform must take account of legal competences as defined by the European Treaties and here lies a potential stumbling block for regionalization of the CFP. There appears to be little scope within the Treaties for recognizing a regional management organization with delegated powers for implementing Community policy. This may thus provide a substantial challenge for any attempts to increase the management responsibility at the regional level.

5. Navigating a transition towards a sustainable fisheries policy

The current overcapacity, and low stock biomass status of EU fisheries have proven to be a resilient but regressive social-ecological system, very likely as an outcome of the social-ecological feedback loops identified here. Despite attempts to address sub-components of the systems, it has maintained its essential structure and function, and continues to yield undesirable outcomes. There are currently no indications of this social-ecological system shifting in a fundamentally new direction. However, innovations within the system and stimulus from best practice identified elsewhere could potentially improve transformability at other geographical scales. Addressing feedback loops at a regional scale may prove a viable strategy for reducing the undesirable resilience of the system. If successful, such experimentation can contribute to transformative change at a European level.

Transitions to social and ecologically desirable regimes require institutional and political leadership that can navigate windows of opportunities [3]. Such windows can be created by a readiness to act (problem awareness), and trust among stakeholders in the mandate for and legitimacy of reform processes. Crises (perceived or real) can also provide an important window of opportunity for system transitions [3]. Examples include the development of collaborative research in Canada followed the collapse of the Northern Cod, and the establishment of Norway's successful 'no-discards' policy (contrary to most advice) was in response to a public outcry over a widely reported period of acute discarding.

There is a widespread acceptance of the need for change in the European Common Fisheries Policy. The current reform of the CFP, initiated in April 2009 and due for completion in 2012 is a window of opportunity. Economic panacea approaches [44,45] are unlikely to be sufficient to address the diversity of the social-ecological feedbacks in European regional seas, cf. [46]. Studies of large-scale socio-technical transitions illustrate the importance of benefiting from innovation and the use of niche markets to provide seeds for change at larger scales [39]. Translated into a fisheries governance context, this could be equated to piloting best practices at regionalized scales [35]. The Baltic Sea could, for example, provide a learning platform for understanding the capacity of an ecosystem-based adaptive approach to fisheries [47]. Regional co-management approach to fisheries management in the Baltic Sea, drawing on innovative approaches from elsewhere, may stimulate the necessary innovation of the European fisheries policy.

Analysis of incentives and feedbacks, as conducted here, helps to stimulate a debate and practical examples of novel approaches to the governance of social-ecological systems. By understanding incentives that sustain or break down desirable social-ecological feedbacks, important practices that need to be changed to allow transformation of EU fisheries governance may be addressed.

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