Accepted refereed manuscript of:

Caveen AJ, Gray TS, Stead SM & Polunin NVC (2013) MPA policy: What lies behind the science?. Marine Policy, 37 (1), pp. 3-10.

DOI: https://doi.org/10.1016/j.marpol.2012.04.005

© 2012, Elsevier. Licensed under the Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 International
http://creativecommons.org/licenses/by-nc-nd/4.0/

MPA policy: what lies behind the science?

Alex Caveen[a*], Tim Gray[b], Selina Stead[a]

[a]School of Marine Science and Technology, Newcastle University, NE1 7RU a.j.caveen@newcastle.ac.uk
[b]School of Geography, Politics and Sociology, Newcastle University, Newcastle, NE1 7RU t.s.gray@ncl.ac.uk
*Corresponding author

Abstract

What the current policy debate on marine protected areas (MPAs) and marine reserves (MRs) has failed to address is the fact that protection of the marine environment has as much to do with scientists' and others' values as it has to do with science. To date science has played a dominant role in the implementation of MPAs, yet normative considerations which are embedded in the way scientists and the wider community think about the condition the marine environment should be in, and which may influence decision-making, are rarely acknowledged or discussed. This paper seeks to correct that deficiency by investigating the values that lie behind the science of MPAs. With the aid of three theories of policy networks: 1) epistemic communities; 2) advocacy coalitions; and 3) discourse coalitions, this article explores the role science and scientists have played in influencing policy on MPAs at the global and national level, and looks at the extent to which normative conceptualisations within and beyond natural science have influenced the debate.

1. Introduction

Key threats to marine ecosystems include climate change, pollution, overfishing, and increased user conflict, all of which transcend scales of governance. Overfishing has been well documented from both a food security [1] and loss of biodiversity [2,3] standpoint affecting economies of industrial and developing countries alike. Marine protected areas (MPAs) are regarded by many marine scientists as a principal management tool needed to tackle fisheries collapse [4] and continued loss of marine biodiversity [5]. The term 'MPA' is often used generically to describe both spatially delineated areas of sea that still allow multiple users (herein referred to as 'MPA'), and areas that are completely off limits to commercial and recreational fishermen (and perhaps also non-extractive marine resource users such as tourists) often referred to as no-take marine reserves (herein referred to as 'MR').

Since the 1970s, the number of MPAs designated has been steadily rising [6], coinciding with the development of international legislation that required countries to designate protected areas to conserve wetlands of international importance (RAMSAR, 1971) and the publication of non-binding guidelines and recommendations on establishing MPAs by the International Union on the Conservation of Nature (IUCN). Some countries have designated substantial areas of their seas as MPAs, including the US, which was a leader in designating national marine sanctuaries through its Marine Protection, Research and Sanctuaries Act (1972), and Australia, which designated the Great Barrier Reef Marine Park in 1975.

During the past decade there has been an explosion of interest in using the MPA approach to conserve marine biodiversity, as illustrated by contemporary international (e.g. CBD, WSSD[1]), regional (OSPAR, MSFD[2], EU Habitats Directive) and national legislation (e.g. Marine and Coastal Access Act) which gives government the powers to establish MPA networks. Why has there been such a surge in interest for MPAs? One reason is that scientists have endorsed the idea of MPAs; indeed, many scientists have become high profile enthusiasts for MPAs [7,8], often calling for MRs on the premise, to quote one of three scientific consensus statements[3], that "existing science justifies the immediate application of fully protected marine reserves as a central management tool" [9]. These scientific consensus statements reflect the linear model of science-policy – i.e. that achieving agreement on scientific knowledge is a prerequisite for a political consensus to be reached and policy action to occur. In other words, science should 'trump' politics.

This article explores the role that natural science has played in establishing MPAs as the preferred approach to marine resource management on the international and UK domestic policy agenda, through an examination of three theories of policy networks; the epistemic community [10]; the advocacy coalition [11]; and the discourse

[1] Convention on Biological Diversity (CBD), World Summit on Sustainable Development (WSSD).
[2] Marine Strategy Framework Directive (MSFD).
[3] For further information see the three consensus statements on Marine Reserves from America, Europe and Australia (AMSA 2008; NCEAS 2001; Roberts 2007).

coalition [12]. All three theories help to account for the popularity of MPAs in international and national policy, though each conceptualises the science-policy interface differently, and presents a different role for the scientist and science in the policy process. In evaluating the role played by these policy networks in the MPA decision-making process, two questions arise: 1) how has each network contributed to persuading policy-makers to adopt MPAs?; and 2) how far have these networks based their arguments for MPAs on science alone?

2. Three policy networks

The following explanatory models ~~theories~~ were identified from a review of a growing literature that attempts to explain the process at which new policies on environmental protection emerge. Each model ~~theory~~ makes different assumptions (Table 1), combining them provides a useful framework through which to explain the development of the science-policy interface on MPAs/ MRs.

2.1 Epistemic communities

Haas [10,13] first coined the term 'epistemic community' to describe the emergence of some international environmental regimes. An important feature of such regimes, in addition to their embodiment of rules and norms [14], is that they facilitate international learning and produce convergent state policies [10]. Typically the notion of an epistemic community has been used to explain the co-ordinated response of states to a collective action problem that has arisen at the regional (e.g. pollution control in the Mediterranean) or global (e.g. the regulation of CFCs) level [10,15]. At the heart of the epistemic community is a group of experts who form around consensual knowledge, and share a policy enterprise (the action that needs to be taken to resolve an issue; e.g. the regulation of a hazardous chemical). The epistemic community is a useful model for explaining policy responses to highly technical international problems where official decision makers are unfamiliar with the technical details, and thereby unable to define state interests and develop viable solutions [13]. This opens the door for a group of motivated individuals who through their expert understanding of the problem area, technical credentials, and common policy enterprise can offer potential solutions. The members of the epistemic community who are initially responsible for bringing states together to negotiate the regime have sufficient influence within their own governments to introduce regulation to their own domestic policy agenda [10]. The epistemic community is thus a good demonstration of the linear-model in action, in that science is its fundamental bedrock (Table 1), bringing to light new environmental problems and helping decision makers identify their underlying causes. What distinguishes an epistemic community from other transnational knowledge networks such as the International Convention for the Exploration of the Sea is that they offer more than scientific advice which states may/ may not choose to follow; epistemic communities set the policy agenda. However, epistemic communities have had mixed success: for example, the Montreal Protocol has clearly been very successful in limiting CFC emissions, but the Kyoto Protocol has failed to curb global CO_2 emissions.

2.2 Advocacy coalitions

Epistemic communities are successful when their core policy enterprise remains unchallenged at all levels of government, and little significant opposition exists to refute their causal and normative assumptions. They are less successful where the problem area is less clearly defined with respect to its causal underpinnings, or where irreconcilable differences exist in actors' fundamental normative beliefs (e.g. commercial ~~International~~ whaling). In such cases, the advocacy coalition [11,16][4] is likely to be more effective [17,18]. Unlike epistemic communities, advocacy coalitions are not limited to 'knowledge experts', but in addition to academics, elected officials and civil servants, they include non-governmental organisations (NGOs), think tanks, journalists and members of civil society. Whereas the social norms of the epistemic community manifest themselves in a 'regime' that imposes its rules and regulations on others, the norms of the advocacy coalition are manifested in a less formal 'common cause'. Nevertheless, actors belonging to the advocacy coalition are bound together by shared values, dense exchanges of information and services, and a shared discourse [19], and the coordinated action of all these actors is a powerful stimulus to policy change. Typically, however, there will be several advocacy coalitions within the policy community competing to get their voices recognised by government, and policy change is a result of shifts in power between competing advocacy coalitions [20]. The relationship between knowledge and power in the advocacy coalition reflects the notion of "interest group pluralism" where scientists best serve society by aligning themselves with their favoured faction or interest group, offering their expertise as an asset in political battle [19,21].

[4] The term 'advocacy coalition' has been used by Sabatier (1988) and other authors to explain the actions of advocacy networks solely at the domestic level. However, this article uses the term to explain the actions of international advocacy groups that are named elsewhere as 'transnational advocacy networks' [16].

2.3 Discourse coalitions

Both the epistemic community and advocacy coalition approaches suggest that, in principle, we can separate science from values, but in some policy debates this may not always be possible. The discourse coalition is the only policy network approach of the three to recognise the difficulties of separating science from values, and the fact that many environmental issues are incomprehensibly complex allowing a number of different plausible perspectives to exist on the potential solution to a problem [22]. Indeed, discourse analysis suggests that facts are meaningless until they are viewed in the context of the wider policy argument of which they are part [12]. Whilst discourse is mentioned in the advocacy coalition framework, it is viewed there only as a means through which learning is communicated rather than as a medium through which actors create the world [12,23]. By contrast, in the case of the discourse coalition, instead of viewing policy change as a result of the influence of a group whose members are bound together by a coherent set of beliefs, policy change occurs when a new discourse becomes dominant [12,22,24]. A 'discourse' refers to a set of shared storylines that help a person make sense of the world [22], and are essential in framing political debates; what is discussed and what is not. Hajer (1993) writes that "such storylines are the medium through which actors try to impose their view of reality on others, suggest certain social positions and practices, and criticise alternative social arrangements". Politics viewed from this perspective is the result of conflict between competing discourses [24]. Conflict arises when a 'hegemonic discourse' already embedded in existing institutions is opposed by a 'challenging discourse' that offers an alternative understanding of a problem [12,24].

Table 1 The major characteristics of each policy network

	Epistemic community	**Advocacy coalition**	**Discourse coalition**
Membership	Scientists/ experts, and senior bureaucrats	Scientists, bureaucrats, elected officials, lobbyists, grass-roots activists, industry, wider civil society	Anybody who subscribes to a particular set of storylines and who engage in policy debates
What binds members together?	Common body of knowledge	Principled beliefs	A shared discourse
Is there consensus in normative values across the political spectrum?	Yes	No	No
Ontology: what is fundamental to policy change?	Actions of people	Actions of people	Language
How does policy change occur?	Integration of experts of the international regime into their respective national governments, and who hold their own governments to account	Policy change reflects the influence of competing advocacy coalitions, and unless one coalition is overwhelmingly dominant, a policy compromise usually results	The institutionalisation of a challenging discourse
Influence of the scientist	The scientist is central to policy change; they analyse the problem and set the policy agenda	Scientists align themselves with their preferred interest groups and offer their expertise in policy debate	Scientists may/ may not form part of the discourse coalition.
Examples	Mediterranean pollution control; control of CFCs	MPAs in California; tropical deforestation	Acid rain; North Sea fisheries management

3. Methodology

The empirical data used in this paper (*in italics*) comes from 14 key informant interviews with civil servants in the UK government's Department for Environment Food and Rural Affairs (DEFRA), senior staff from the Statutory Conservation Agencies (SCAs) and Environmental Non-Governmental Organisations (ENGOs),

senior spokespersons in the fishing industry, and four marine scientists. Interviews followed a semi-structured format, eight were carried out face-to-face and six carried out over the phone from April-December, 2011. The average length of each interview was ~ 50 minutes. Typical questions included: can MPAs play a role in fisheries management in the UK? Do MPAs need conservation objectives? Should we designate MPAs when there is uncertainty in the underlying data? Will MPAs have any benefits to fishermen? All interviews were recorded and then transcribed. In this article the verbatim words of the interviewee are used. In addition to the planned key informant interviews, informal conversations with MPA scientists and practitioners at an international MPA conference in Bergen, April 2011 was undertaken and also at local stakeholder meetings for planning England's North Sea marine conservation zones (MCZs[5]). Only the broad stakeholder category (e.g. marine ecologist, fisheries scientist, civil servant, environmentalist etc) was used to identify interview data. Secondary data sources that were used in writing this article included *Fishing News* (the main weekly newspaper for the UK's fishing industry), excerpts from the peer-reviewed and grey scientific literature, meeting minutes, and HANSARD debates sourced from the internet.

4. Application of the three network models ~~theories~~ to MPA science-policy relations

This section examines the role science and scientists have had in shaping international and UK policy on MPAs through the three policy network models ~~theories theoretical framework~~ previously explained.

4.1 Epistemic communities

Evidence of an epistemic community in the MPA debate includes the fact that in getting provisions for MPAs written into international regimes and agreements, leading roles were taken by a group of like-minded individuals in UNEP, FAO, IUCN, secretariat members of current regimes, marine scientists, and MPA planners and managers [25-27]. This network of marine experts can be regarded as an epistemic community, in that it was united in its recognition of the excellence of the MPA as an approach to protect biodiversity and conserve essential ecosystem functions [28], with the aim of systematically protecting representative[6] habitats across each of the major marine provinces. The policy recommendations of this epistemic community have been extensive: a number of guidelines and best practices have been provided by academics, NGOs, and individual governments for the planning, development, management and evaluation of such an MPA network [26,29,30]. Initially the effects of this network of experts were strongest in the USA because a high proportion of its actors originated there (Caveen, unpub), with many having influence on federal policy to designate an MPA network [31]. However as the network expanded, and as experts from other countries became involved and subsequently integrated into advisory committees in their own governments, the domestic policies of these countries have begun to reflect the policies of the initial group of experts; i.e. through designing networks of MPAs to conserve nature by adopting ecological design criteria [32,33]. This is reflected in the UK through the adoption of Natural England's Ecological Network Guidance [34].

Normative elements in the MPA epistemic community are revealed in the mismatch between the (sometimes light) weight of the empirical science that has been produced to justify MPAs, and the (consistently heavy) emphasis of the officially recognised use of the MPA as an approach to conserve marine biodiversity. For example, a large amount of the natural science has focused on the use of MPAs (primarily MRs) as a fisheries management tool, rather than as a tool to conserve biodiversity and threatened species [35]. Yet whilst there is sound evidence that MPAs/MRs are a useful fisheries management tool in tropical and warm temperate reef fisheries where most fish species are site- attached [36,37], there is considerable controversy over their efficacy in cold temperate waters [38,39]. Equally, while MPAs are acknowledged to have fisheries benefits when they are used to protect 'critical fish habitat' (e.g. habitat that plays an important role in the health of the stock, such as nursery grounds that provide shelter to juveniles and spawning adults [40]), their wider use as a general tool to allow fish stocks to recover is much in dispute. Therefore, it is not self-evident from the science why MPAs should follow as the policy instrument of choice over more traditional fisheries management tools in the conservation of mobile fish species [39] in UK waters. Significantly, in international legislation only the WSSD makes provisions for the use of MPAs[7] in a fisheries context, and even then only to protect nursery grounds

[5] MCZs means Marine Conservation Zones, and is the nomenclature used by the UK government to denote MPAs created under the Marine Conservation and Access Act 2009.

[6] Stevens (2002) says "representativeness" means that a sample of each habitat occurring in the area under consideration should be included in a MPA, though he points out that this implies, controversially, that each habitat type has an intrinsic functional position in marine ecosystems and thus has intrinsic conservation value irrespective of characteristics such as diversity, uniqueness, and endangered species habitat [76].

[7] Notably referred to as 'closed areas'. One delegate raised this issue at a conference in Bergen 2011 suggesting that this term (rather than marine protected area) is less politically contentious in fisheries management.

~~where it can be argued that MPAs will have some benefit to stock conservation~~ [40]. So arguments that MPAs are legitimate tools for fisheries conservation are highly dependent on ecological and social context, and ~~indeed calls for the implementation of MPAs in certain regions~~ may be based more on subjective preferences for closed areas over other management tools than on empirical proof of their efficacy.

4.2 Advocacy coalitions

Evidence of advocacy coalitions for and against MPAs is found in the highly coordinated networking that has occurred within both the global environmental movement (e.g. IUCN, WWF, PEW trusts) and the opposed (if much weaker) networking in the global fishing industry manifested in the International Coalition of Fisheries Associations (ICFA) which met on 13-14th November, 2007 to identify and address issues of common interest in international fisheries and called on their governments to recognise the limitation of a Marine Protected Area (MPA) as a fish stock protection measure. The increasing designation of MPAs [41,42] seems in part to reflect the efforts of the pro-MPA international advocacy coalition consisting of environmental groups, NGOs, and conservation biologists, to significantly increase the scale of protected marine habitat [43]. Several calls by major environmental groups to protect certain percentages of the ocean are well known - for instance, the IUCNs recommendation for 20-30% to be protected, and the Marine Conservation Biology Institute's call for 20% of the world's seas to be protected from threats by 2020. Such percentage targets have also been incorporated into the CBD which states that "at least 10% of each of the world's marine and coastal ecological regions to be effectively conserved" by 2010 [44], though clearly this was not achieved, since the current percentage is around 1% [41]. Other examples of the effects of the advocacy coalition are the PEW Environmental Trust's global ocean legacy scheme that aims to establish a worldwide system of very large (>300,000 sq km) no-take MRs, four of which have now been established. The Partnership for Interdisciplinary Studies of Coastal Oceans (PISCO) also runs a campaign for MRs, producing a series of educational booklets showcasing their ecological effects. In the UK, the Marine and Coastal Access Act (2009) has given government the power to establish networks of marine conservation zones (MCZs). In writing the act and carrying out its obligations in designating MCZs, the policy community was composed of central government (comprising bureaucrats, politicians, and statutory advisers), plus two advocacy coalitions, one comprising environmentalists (including the Marine Conservation Society (MCS), the Friends of the Earth Marine Group (Marinet), the Wildlife Trusts, WWF, RSPB, Natural England[8], committed scientists and the other comprising the fishing industry (mainly the MPA Fishing Coalition, headed by Dr Stephen Lockwood, an ex-CEFAS fisheries scientist, established in January 2010 to scrutinise the scientific basis for designating a UK network of marine conservation zones). The environmentalists' advocacy coalition pressed the scientific credentials of MPAs, while the fishing industry's advocacy coalition criticised the policy recommendations of the environmentalists, pointing to the ecological impacts and socioeconomic costs of the displacement of fishing effort after an MPA is established.

Normative elements in the pro-MPA advocacy coalition are revealed, first, in the fact that the 10% target adopted by the CBD was political rather than scientific. To paraphrase one senior scientist:

> "*We were originally considering 5% as this was more realistic, however we settled on 10% as the 5% target was thought to be too small to encourage government action*". [senior conservation scientist]

Second, the targets set for fisheries conservation have been equally variable. The US Plan Development Team (2002) recommended that a minimum of 20% of the southern Atlantic coast of the United States should be included in MRs on the basis that it would protect 20% of the spawning biomass, a threshold below which stocks were likely to collapse [40,45]. Several authors argue that between 10-50% (modal value of 30%) of the ocean should be designated as MRs to sustain fisheries [46-50]. But Agardy et al. (2003) pointed out that the 20-30% 'rule of thumb' has originated from modelling studies that have principally focused on coral reefs [51], while when a fisheries scientist was asked about the scientific basis for such percentage targets he said that

> *"5,10 or 20% is a subject we could debate, I have an open mind, and I don't want to see the marine ecosystem bugged up. However when we start suggesting that such figures emerge from science I think this extreme hubris as it implies we know everything when in fact we don't."*

Third, although it could be argued that campaigns run specifically for MRs - for instance, by MCS and Marinet here in the UK - have their origins in the science literature (when one environmental lobbyist was asked why

[8] Though their advocacy role has subsequently become redundant and they now only fulfil their statutory requirements to offer government scientific advice.

they believe MRs are the only effective management tool, their response was "*because the science says so*"), and many eminent marine conservation scientists and ecologists have become involved in advocacy for MRs [9,52,53], nevertheless, advocacy for the universal designation of MRs on the premise that they will have net benefits to fisheries is highly- controversial, and some commentators argue that such advocacy is based on very limited empirical science [54]. Claims that are generally regarded to be strongly supported by evidence (such as MRs increasing fish abundance and biomass) have their origins in data collected from very specific habitats, namely coral and rocky reefs (Caveen, in press). The argument for 'spillover'- that there is a net movement of fish across MR boundaries to replenish the lost catches of fishermen [55] - - is widely cited both in the scientific literature [56,57], and certain policy discourses (see section 4.3), -- but it is highly dependent on the layout of habitat [58] , and mobility [59,60] and life-history [61,62] of the species in question .

Fourth, some authors suggest that the underlying thrust of advocacy for MRs is less the science than the preservationist value-system held by some advocacy scientists [7,63] which has confused the fact-value distinction that science strives to maintain [7]. For example, the assumption by some scientists that fully protected ecosystems (through designating MRs) will have the greatest range of benefits is presented as scientific fact in two statements from the Scientific Consensus Statement on Marine Reserves and Marine Protected Areas [9]:

> "Full protection is critical to achieve this full range of benefits (i.e. rapid increases in abundance, diversity and productivity of marine organisms etc). MPAs do not provide the same benefits as MRs (therefore)… existing scientific information justifies the immediate application of fully protected marine reserves." NCEAS (2001)

However, the term 'benefits' is value-laden, and hides the fact that MRs cause some disbenefits or harm to groups such as fishers. So the above statement contains an implicit value-judgement that conservation benefits outweigh fishers' disbenefits. This is a normative, not a scientific, claim, and raises the question of whether it is acceptable for scientists to couch their policy arguments purely within the medium of scientific parlance, without explicitly stating their underlying environmental values [21,64] which have influenced their intention of achieving a certain policy outcome[9]. Indeed, one fisheries scientist made the following comment

> *"that members of these campaigns for MRs/ MPAs have sometimes betrayed their lack of scientific objectivity in the wording of their reports; i.e. that an activity is causing damage (a value-judgement) rather than fishing has caused a habitat to change (a scientific fact)."*

No such reservations were expressed by one environmental lobbyist who welcomed scientists becoming involved with their campaigns:

> *"by adding academic knowledge, research to that and persona to that, it adds profile and gains publicity- it essentially gives it a bit of kudos at the end of the day"* (ENGO lobbyist)

But such blatant scientific advocacy for MRs may damage constructive policy dialogue between environmentalists, fishermen and policy brokers in that it makes MPA designations seem to fishers and communities, as to be motivated by preservationist concerns [63]. For example, in the UK planning process for MCZs the initial calls for fully protected marine reserves by certain environmentalists (partly because they believed science justified their policy preference), may have increased the fishing industries' scepticism of the impartiality of scientists involved in the process (Caveen, pers observ). This widespread advocacy for MRs by some environmental groups may also contribute to fishermen's perception of the MPA as an area where all fishing is banned (Caveen, pers observ), rather than as an area that restricts the access of certain users to achieve biodiversity objectives, and such a perception could delay the implementation of MPAs in places where a strong argument could be made for their designation.

4.3 Discourse coalitions

Evidence of discourse coalitions in the MPA debate can be found in the further confusion of the boundary between science and values. Indeed, it could be argued that the drive to establish MPAs is not so much to do with the scientific evidence *per se* as with the way in which people conceptualise marine ecosystems [65] and the underlying value priorities that shape their views of the condition in which they would like the marine

[9] There was a debate in *Conservation Biology* (2006) volume 20(3), on this issue.

environment to be [66,67]. There are three interpretations of MPAs that the discourse coalition approach has produced (Table 2), listed below in order of intensity of support for MPAs, beginning with the most intense.

4.3.1 Marine reserves now[10](MRN)

MPAs are conceptualised by this discursive interpretation like terrestrial nature reserves – ie where all commercial activity such as fishing is prohibited. To quote one environmental lobbyist:

> *"Well, the term marine protected area gets used in a number of different ways depending on who you talk to. We don't really use the term MPA but marine reserve (MR), in the same way a nature reserve on land, so you have a marine reserve on the sea. That's the nomenclature we use… Because if you take a nature reserve on the land, a nature reserve is not going to have commercial activities taking place inside it."*

At the heart of this discursive interpretation is a storyline that documents the decline in the productivity and perceived quality of marine ecosystems, and predicts catastrophic fisheries collapse [3,68-70][11] and food insecurity [71]. In this narrative, catch and effort restrictions are not working, and areas permanently closed to fishing are essential to allow fish stocks to rebuild [71-75][12]. A member of the House of Lords said that

> "The primary purpose of MCZs is to ensure the conservation of our fish stocks[13] so that they can develop and rebuild after centuries of depredation by man… the fish stock that is built up successfully within the marine reserve area will spread out beyond that and provide happy hunting ground for fishers. It is natural that this should happen and I do not deny that it will happen." (12/03/2009) Committee (6th day)

Such a storyline has been picked up in the media[14], implying that fish stocks are in crisis, and are in dire need of the protection which only MPAs can provide. A fisheries industry opponent of MRs attacked this discourse as fundamentally misconceived:

> *"The Marine Bill was very much promoted on terms of well, fish stocks are crashing, there's a lack of regulation, marine conservation zones (MCZs) are the solution, and none of those propositions are correct… I think that they've jumped the gun because of this moral panic that was about saving the marine environment, you've got to do it, you've got to do it now, don't wait another minute. Whereas MCZs should have fitted neatly into marine spatial planning, it is the only way that really makes any sense, whereas it is all out of sync, so I think that is a big mess…"*

However, adherents of this discourse suggest that current policy in the UK privileges commercial interests over conservation of the environment.

> *"The Department for the Environment, Food and Rural Affair's respect for socio-economic elements exceeded in our view the responsibility to future generations in ensuring a wholesome environment in our seas"* (Environmental lobbyist)

At both the international and national level, the main actors who are associated with this interpretation are politicians, major ENGOs, local environmental groups, journalists, and celebrities.

4.3.2 No trawling (NT)

In this second discourse, MPAs are considered to be areas where no mobile fishing gears can be used, but static gear, including drift nets and shellfish pots, is acceptable.

> *"the most damaging gears for my money are dredging and trawling and they've done immense harm both to the sustainability of the stocks that they catch but also the habitats that those stocks occupy so I think*

[10] Also the name of the campaign for marine reserves run by the Marine Conservation Society (MCS) and the Cooperative.
[11] Though such claims have been generally refuted by the wider scientific community.
[12] Also see the recommendations made by the RCEP report 'Turning the Tide' that marine reserves should be created to protect 30% of the seas around the UK from the environmental impacts of fishing.
[13] Which is officially not true.
[14] E.g. BBC News article 'Only 50 years left for sea fish' (02/11/2006)

we need to shrink the footprint of these mobile fishing gears by a lot and there are conservation benefits to be had from static gear only areas… but for me an MCZ that doesn't protect against mobile gears is not worth having it will just be a paper park." (Marine ecologist)

The main actors who are associated with this interpretation are ENGOs, some marine scientists, static gear fishermen, and until recently the SCAs. A civil servant also expressed sympathy with it:

"It doesn't take an awful lot of scientific evidence to be able to say sea bed trawlers are trashing the environment, unless we protect some of the environment there is going to be nothing left."

4.3.3 Spatial planning (SP)

In this third discourse, MPAs are viewed as part of a wider strategy of spatial planning in the marine environment. On this view, an MPA is simply

"Any defined area within or adjacent to the marine environment, which has been reserved by legislation or other effective means, with the effect that its marine and/or coastal biodiversity enjoys a higher level of protection than its surroundings." [Fisheries scientist]

Under this definition, MPAs are tools to be designated for specific purposes and at specific times when the need arises – eg to protect spawning stocks of commercial fish. So MPAs are viewed as merely one of a suite of tools that could potentially be applied to improve the state of commercial fish stocks. As a fishing industry spokesperson put it:

"I don't think MCZs are a very significant tool in the toolbox in terms of improving commercial fish stocks, improving the management of commercial fish stocks. I think that there may be some incidental benefit or indeed disadvantage, but I think it will be a margin, the main tools in the toolbox are long term management plans, harvest control rules, technical measures, the size of the fleet, the capacity deployed, the Total Allowable Catches, all of those have got a much more direct affect I think on fisheries management."

Moreover, on this view, the use of MPAs should be flexible – even allowing trawling where ~~n~~ appropriate. One fisheries scientist adherent said that

"on highly mobile sediment, the evidence of beam trawling disappears within days, and even on stable substratum does not necessarily mean trawling will cause irreparable damage…"

though he also said that he

"would not defend the indefensible, if scallop dredging will knock 9-bells out of a feature I would not hesitate to recommend such an activity being restricted".

So, on this interpretation, rather than taking the representative network approach which attaches equal importance to each habitat [76], sites that are known to be sensitive to fishing should be prioritised for protection. There is some evidence that the SP discourse may have increased its sway in the debate, much to the disappointment of adherents of the MRN discourse, since it is now unlikely that substantial areas will be designated as no-take MRs[15], which MRN adherents claim is necessarily to allow the recovery of UK seas.

The main adherents of this discourse are a significant fraction of the fishing industry and some fisheries scientists.

Table 2 A summary of the major characteristics of the three discourses.

	MARINE RESERVES NOW (MRN)	**NO TRAWLING (NT)**	**SPATIAL PLANNING (SP)**
Understanding of an	An area where no	An area where no	Any area that has a greater

[15] Though a small proportion of the MCZ-network has been designated as reference areas (which are essentially no-take MRs).

MPA	commercial activity takes place.	trawling takes place.	degree of protection than the surrounding sea. Includes seasonal closures.
Objectives of MPAs	To conserve the ecosystem.	For the conservation and restoration of impacted habitats with fishing benefits assumed to follow.	To establish MCZs where objectives require them.
MPAs as a fisheries management tool	MRs should be a central management tool (i.e. all fishing banned over 30% of the North Sea). Only then will stocks recover.	Trawling must be limited through MPAs to allow seabed to recover.	Not a significant tool. Though MPAs may be useful in protecting spawning and nursery grounds. Also used as an emergency tool to reduce fishing mortality.
Story lines	Ecosystem collapse. Wide-spread overfishing. Food insecurity. Spillover benefits.	Undesirable ecosystem change caused by human activity (principally fishing). Shifting baselines. Spillover benefits.	Ecosystem change (though natural as much as human). Stocks can recover to MSY without having to damage the economic interests of the fishing industry. The designation of MPAs will cause displacement. Ecosystems are dynamic.
Adherents	More radical members of the green lobby	Green lobby, some scientists, some static gear fishermen	The fishing industry, some scientists
Salience of MPAs on overarching policy agenda	High	High	Low (emphasis on CFP reform and process of governance)
Extent of value-laden language	High. Strong conflation between the positive and normative.	Medium.	Negligible
View of science-policy-role of science?	Linear model (administrative rationalism?). Science should lead decisions. The science says that MRs are the best tool.	Linear model. Decisions should be based on science. Though the designation of MPAs may just be the right thing to do (though this is not often made clear).	Stakeholder model (democratic pragmatism?). Robust evidence should inform decisions, though need to take socio-economic impacts into account.
Uncertainty	MRs should be designated on the basis of the precautionary principle in addition to their scientific benefits.	Stop all trawling in a designated MCZ regardless of what type of habitat exists.	Stop fishing where we know a habitat feature exists that is likely to be susceptible to disturbance.
Criticisms from opposing discourses	Highly subjective, tendency to 'dress' dialogue up in scientific terminology, very emotive, scientifically flawed.	Science-policy boundary blurred particularly with respect to conservation objectives.	Down plays the historic impact of fishing on the ecosystem, and lack of willing to establish areas where trawling is completely banned due to lack of evidence.

Normative elements in the MPA discourse coalition vary across the three discourses: strong in MRN; medium in NT; and weak in SP (Table 2). In the MRN discourse, the argument for MRs is based less on hard evidence than on the precautionary principle and perhaps a moral commitment to marine restoration. In the NT discourse, scientific evidence provides some support for banning trawling , if current trawling were ~~was~~ shifted from sensitive to less sensitive habitats it is predicted that there would be an increase in benthic invertebrate production (though this may have some impact on the catches of fishermen) [77,78] – but the calls for a blanket ban on trawling in all MCZs ~~is~~ are partly based on subjective aversion to scarification of the seabed by many environmentalists. In the SP discourse, reliance is placed on scientific evidence to demonstrate where particular fishing methods do not damage the habitat, though there is also some emotional opposition to the precautionary principle.

5. Conclusion

In this paper, we have examined the way in which three policy network models ~~s~~ can be used to explain the debate over MPAs. ~~We argue~~ T~~t~~here is a sequential pattern discernible between these models: initially, an epistemic community paved the way for MPAs through building an extensive international literature showing their effects, and also providing guidance on their design and management. Subsequently this community managed to make a strong case for MPAs internationally through pooling their expertise, which led to calls for MPAs in significant pieces of international legislation and non-binding policy. Some members of this initial epistemic community then joined forces with advocacy groups who lobbied governments for MPAs/MRs at the international and national level. Advocacy at the national level from a coalition of NGOs, journalists, civil society, and some lobbying scientists was necessary to persuade national governments to fulfil their international obligations to establish MPAs. However, when scientists relied on the perceived prestige of science to further their policy agenda for MRs, the science-policy boundary was blurred with respect to the role MPAs/MRs can play in fisheries management, particularly with regards to some exaggeration of their fisheries benefits. Nevertheless, the efforts of the advocacy coalition brought the idea of the MPA to the attention of the wider marine policy community, although it was not until MPAs became foremost in the fishing industry's mind that the policy debate began to mature, and a more nuanced narrative around their potential use started to develop through the engagement of the three competing discourse coalitions.

Acknowledgements

Alex would like to thank NERC-ESRC for financial support during his research, and all interviewees for kindly sharing their views. Also special thanks to Ms Estelle Jones for looking over an initial version of the draft, and the very useful suggestions of two anonymous reviewers.

References

[1] Garcia S.M.,Rosenberg A.A. Food security and marine capture fisheries: characteristics, trends, drivers and future perspectives[J]. Phil. Trans. R. Soc. B,2010, 365:2869-2880.

[2] Sala E.,Knowlton N. Global marine biodiversity trends[J]. Annu. Rev. Environ. Resour,2006, 31:93-122.

[3] Worm B et al. Impacts of biodiversity loss on ocean ecosystem services[J]. Science,2006, 314(5800):787-790; <Go to ISI>://000241729800037.

[4] Clark C W. Marine reserves and the precautionary management of fisheries[J]. Ecological Applications,1996, 6(2):369-370; <Go to ISI>://A1996UH48500007.

[5] Attwood C G et al. Review of the state of marine protected areas in South Africa[J]. South African Journal of Marine Science-Suid-Afrikaanse Tydskrif Vir Seewetenskap,1997, 18:341-367; <Go to ISI>://000168676500031.

[6] Wood L J. MPA Global: A database of the world's marine protected areas. Sea Around Us Project.[J]. 2007; www.mpaglobal.org.

[7] Polunin Nicholas V C. Marine protected areas, fish and fisheries[D]. . *Handbook of fish biology and fisheries. Volume 2: fisheries.* P.J.B. Hart and J.D. Reynolds, eds. Blackwell Publishing. 2002. pp. 293-318; <Go to ISI>://ZOOREC:ZOOR13900003833.

[8] Agardy T et al. Dangerous targets? Unresolved issues and ideological clashes around marine protected areas[J]. Aquatic Conservation-Marine and Freshwater Ecosystems,2003, 13(4):353-367; <Go to ISI>://000184638000006.

[9] NCEAS. Scientific Consensus Statement on Marine Reserves and Marine Protected Areas[J]. Annual Meeting for the American Association for the Advancement of the Sciences, 17 Feb 2001,2001.

[10] Haas P M. Do regimes matter- epistemic communities and Mediterranean pollution-control[J]. International Organization,1989, 43(3):377-403; <Go to ISI>://A1989AF20600002.

[11] Sabatier P A. AN ADVOCACY COALITION FRAMEWORK OF POLICY CHANGE AND THE ROLE OF POLICY-ORIENTED LEARNING THEREIN[J]. Policy Sciences,1988, 21(2-3):129-168; <Go to ISI>://A1988Q549900002.

[12] Hajer M. Discourse coalitions and the institutionalisation of practice: the case of acid rain in Britain[D]. . *The Argumentative Turn in Policy Analysis and Planning*. F. Fischer and J. Forester, eds. London: UCL Press. 1993.

[13] Haas P M. Epistemic communities and international-policy coordination- introduction[J]. International Organization,1992, 46(1):1-35; <Go to ISI>://A1992HA30300001.

[14] Krasner Stephen D. International regimes[M]. , Ithaca, NY: Cornell University Press. 1983.

[15] Haas P M. POLICY RESPONSES TO STRATOSPHERIC OZONE DEPLETION[J]. Global Environmental Change-Human and Policy Dimensions,1991, 1(3):224-234; <Go to ISI>://A1991FY86200004.

[16] Keck M,Sikkink K. Activists beyond borders: advocacy networks in international politics.[M]. , Ithaca, NY: Cornell University Press. 1998.

[17] Sabatier P A. The advocacy coalition framework: revisions and relevance for Europe[J]. Journal of European Public Policy,1998, 5(1):98-130; <Go to ISI>://000072732900005.

[18] Weible C M,Sabatier P A. Comparing policy networks: Marine protected areas in California[J]. Policy Studies Journal,2005, 33(2):181-201; <Go to ISI>://000228750000005.

[19] Stone D. Introduction: global knowledge and advocacy networks[J]. Global Networks,2002, 2(1):1-11.

[20] Schlager E. Policy-making and collective action- defining coalitions within the advocacy coalition framework[J]. Policy Sciences,1995, 28(3):243-270; <Go to ISI>://A1995RT06800001.

[21] Pielke Jr R A. The Honest Broker: Making Sense of Science in Policy and Politics[M]. , Cambridge: Cambridge University Press. 2007.

[22] Dryzek J S. The politics of the earth: Environmental Discourses[M]. , Oxford: Oxford University Press. 1997.

[23] Bulkeley H. Discourse coalitions and the Australian climate change policy network[J]. Environment and Planning C-Government and Policy,2000, 18(6):727-748; <Go to ISI>://000166080500007.

[24] Fischer F. Reframing public policy. In: Discursive Politics and Deliberative Practices.[M]. ,Oxford University Press, Oxford. 2003.

[25] Kelleher Graeme,Kenchington Richard. Guidelines for establishing marine protected areas[M]. ,Iucn. 1991; <Go to ISI>://ZOOREC:ZOOR13300069643.

[26] Salm R V et al. Marine and coastal protected areas: a guide for planners and managers. 3rd ed. Washington, DC: IUCN[J]. 2000.

[27] IUCN. Establishing Resilient Marine Protected Area Networks- Making It Happen.[J]. 2008.

[28] Toropova C. et al. Global Ocean Protection: Present Status and Future Possibilities.[M]. ,Brest, France: Agence des aires marines protégées, Gland, Switzerland, Washington, DC and New York, USA: IUCN WCPA, Cambridge, UK : UNEP-WCMC, Arlington, USA: TNC, Tokyo, Japan: UNU, New York, USA: WCS. 96pp. 2010.

[29] Kelleher Graeme. Guidelines for Marine Protected Areas[J]. Best Practice Protected Area Guidelines Series,1999, 3:i-xxiv, 1-107; <Go to ISI>://ZOOREC:ZOOR13700049979.

[30] Pomeroy Robert S et al. How is your MPA doing? A guidebook of natural and social indicators for evaluating marine protected area management effectiveness[D]. . *How is your MPA doing? A guidebook of natural and social indicators for evaluating marine protected area management effectiveness.* Iucn. 2004. pp. i-xvi, 1-215; <Go to ISI>://ZOOREC:ZOOR14102010739.

[31] NOAA. Framework for the national system of marine protected areas of the United States of America[M]. ,2008.

[32] Ardron J A. The challenge of assessing whether the OSPAR network of marine protected areas is ecologically coherent[J]. Hydrobiologia,2008, 606:45-53; <Go to ISI>://000254903400005.

[33] Roberts C M et al. Application of ecological criteria in selecting marine reserves and developing reserve networks[J]. Ecological Applications,2003, 13(1):S215-S228; <Go to ISI>://000181742700017.

[34] Ashworth J et al. Delivering the Marine Protected Area Network: Ecological Network Guidance to regional stakeholder groups on identifying Marine Conservation Zones[M]. ,2010.

[35] Edgar G. Does the global network of marine protected areas provide an adequate safety net for marine biodiversity?[J]. Aquatic Conservation-Marine and Freshwater Ecosystems,2011, 21:313-316.

[36] Russ G R et al. Marine reserve benefits local fisheries[J]. Ecological Applications,2004, 14(2):597-606; <Go to ISI>://000220392500022.

[37] Goni R. et al. Net contribution of spillover from a marine reserve to fishery catches[J]. Marine Ecology Progress Series,2010, 400:233-243.

[38] Sale P F et al. Critical science gaps impede use of no-take fishery reserves[J]. Trends in Ecology & Evolution,2005, 20(2):74-80; <Go to ISI>://000226964300006.

[39] Hilborn R et al. When can marine reserves improve fisheries management?[J]. Ocean & Coastal Management,2004, 47(3-4):197-205; <Go to ISI>://000222976500006.

[40] Guenette S et al. Marine reserves: from Beverton and Holt to the present[J]. Reviews in Fish Biology and Fisheries,1998, 8(3):251-272; <Go to ISI>://000077486400003.

[41] Spalding M. et al. The 10% Target: Where Do We stand?[M]. ,In C. Toropova, I. Meliane, D. Laffoley, E. Matthews and M. Spalding (eds.) Global Ocean Protection: Present Status and Future Possibilities. Brest, France: Agence des aires marines protégées, Gland, Switzerland, Washington, DC and New York, USA: IUCN WCP. 2011.

[42] Wood L J et al. Assessing progress towards global marine protection targets: shortfalls in information and action[J]. Oryx,2008, 42(3):340-351; <Go to ISI>://000258862300010.

[43] Sanchirico J N,Wilen J E. A bioeconomic model of marine reserve creation[J]. Journal of Environmental Economics and Management,2001, 42(3):257-276; <Go to ISI>://000172241700002.

[44] UNEP. Conference of the Parties to the Convention of Biological Diversity (COP9) Decision IX/20: marine and coastal biodiversity.[J]. 2008.

[45] PDT. The potential of marine fishery reserves for reef fish management in the U.S. Southern Atlantic.[J]. 1990,:40 pp.

[46] Ballantine W J. Marine reserves - the need for networks[J]. New Zealand Journal of Marine and Freshwater Research,1991, 25(1):115-116; <Go to ISI>://A1991FK52400010.

[47] Dayton P K et al. Environmental-effects of marine fishing[J]. Aquatic Conservation-Marine and Freshwater Ecosystems,1995, 5(3):205-232; <Go to ISI>://A1995TG18800004.

[48] Gell F R,Roberts C M. Benefits beyond boundaries: the fishery effects of marine reserves[J]. Trends in Ecology & Evolution,2003, 18(9):448-455; <Go to ISI>://000185311800010.

[49] Nowlis J S,Roberts C M. Fisheries benefits and optimal design of marine reserves[J]. Fishery Bulletin,1999, 97(3):604-616; <Go to ISI>://000081432700016.

[50] Kendall M S et al. The influence of bottom type and shelf position on biodiversity of tropical fish inside a recently enlarged marine reserve[J]. Aquatic Conservation-Marine and Freshwater Ecosystems,2004, 14(2):113-132; <Go to ISI>://000220495900002.

[51] Bohnsack J A et al. A rationale for minimum 20–30% no-take protection.[D]. . *Proceedings of the 9th International Coral Reef Symposium; Bali, Indonesia*. 2000.

[52] Roberts C M. European Scientists' Consensus Statement on Marine Reserves[J]. 2007.

[53] AMSA. NSW AMSA Position Statement on Marine Protected Areas and No-take Marine Sanctuaries[J]. 2008.

[54] Willis T J et al. Burdens of evidence and the benefits of marine reserves: putting Descartes before des horse?[J]. Environmental Conservation,2003, 30(2):97-103; <Go to ISI>://000184979500001.

[55] Lizaso J L S et al. Density dependence in marine protected populations: A review[J]. Environmental Conservation,2000, 27(2):144-158; <Go to ISI>://000089515000007.

[56] Roberts C M et al. Effects of marine reserves on adjacent fisheries[J]. Science,2001, 294(5548):1920-1923; <Go to ISI>://000172465000057.

[57] Russ G R,Alcala A C. Do marine reserves export adult fish biomass? Evidence from Apo Island, central Philippines[J]. Marine Ecology-Progress Series,1996, 132(1-3):1-9; <Go to ISI>://A1996UD22300001.

[58] Freeman D J et al. Habitat patches that cross marine reserve boundaries: consequences for the lobster Jasus edwardsii[J]. Marine Ecology-Progress Series,2009, 388:159-167; <Go to ISI>://000269892700014.

[59] Shipp R L. A perspective on marine reserves as a fishery management tool[J]. Fisheries,2003, 28(12):10-21; <Go to ISI>://000187121200006.

[60] Willis T J et al. Protection of exploited fish in temperate regions: high density and biomass of snapper Pagrus auratus (Sparidae) in northern New Zealand marine reserves[J]. Journal of Applied Ecology,2003, 40(2):214-227; <Go to ISI>://000182118700003.

[61] Hutchings K,Griffiths M H. Life-history strategies of Umbrina robinsoni (Sciaenidae) in warm-temperate and subtropical South African marine reserves[J]. African Journal of Marine Science,2010, 32(1):37-53; <Go to ISI>://WOS:000278447700003.

[62] Sumpton Wayne D,Jackson Stuart. Reproductive biology of snapper (Pagrus auratus) in subtropical areas of its range and management implications of reproductive differences with temperate populations[J]. Asian Fisheries Science,2010, 23(2):194-207; <Go to ISI>://ZOOREC:ZOOR14705040959.

[63] Jones P J S. Marine protected area strategies: issues, divergences and the search for middle ground[J]. Reviews in Fish Biology and Fisheries,2001, 11(3):197-216; <Go to ISI>://000178213500003.

[64] Schneider S.H. Science as a contact sport: the battle to save earth's climate[M]. ,National Geographic Society. 2009.

[65] Gray T et al. New cod war of words: "Cod is God" versus "sod the cod" - Two opposed discourses on the North Sea Cod Recovery Programme[J]. Fisheries Research,2008, 93(1-2):1-7; <Go to ISI>://000258994700001.

[66] Fanshawe S et al. Restored top carnivores as detriments to the performance of marine protected areas intended for fishery sustainability: A case study with red abalones and sea otters[J]. Conservation Biology,2003, 17(1):273-283; <Go to ISI>://000180846200032.

[67] Mee L D et al. How good is good? Human values and Europe's proposed Marine Strategy Directive[J]. Marine Pollution Bulletin,2008, 56(2):187-204; <Go to ISI>://000254101900014.

[68] Jackson J B C et al. Historical overfishing and the recent collapse of coastal ecosystems[J]. Science,2001, 293(5530):629-638; <Go to ISI>://000170204600040.

[69] Lotze H K et al. Depletion, degradation, and recovery potential of estuaries and coastal seas[J]. Science,2006, 312(5781):1806-1809; <Go to ISI>://000238452800061.

[70] Pauly D et al. Fishing down marine food webs[J]. Science,1998, 279(5352):860-863; <Go to ISI>://000071923500043.

[71] Pauly D et al. Towards sustainability in world fisheries[J]. Nature,2002, 418(6898):689-695; <Go to ISI>://000177305600056.

[72] Pauly D,Amer Fisheries Soc Natl Sea Grant Coll. On the need for a global network of large marine reserves[D]. . *Symposium on Aquatic Protected Areas as Fisheries Management Tools*. J.B. Shipley, ed. Quebec City, CANADA: Amer Fisheries Soc. 2003. p. 63; <Go to ISI>://000223814600007.

[73] Pauly D et al. The future for fisheries[J]. Science,2003, 302(5649):1359-1361; <Go to ISI>://000186683500041.

[74] Allison G W et al. Marine reserves are necessary but not sufficient for marine conservation[J]. Ecological Applications,1998, 8(1):S79-S92; <Go to ISI>://000072166600009.

[75] Hilborn R. Reinterpreting the state of fisheries and their management[J]. Ecosystems,2007, 10(8):1362-1369; <Go to ISI>://000252089200011.

[76] Stevens T. Rigor and representativeness in marine protected area design[J]. Coastal Management,2002, 30(3):237-248; <Go to ISI>://000176393500004.

[77] Hiddink J.G. et al. Cumulative impacts of seabed trawl disturbance on benthic biomass, production, and species richness in different habitats[J]. Can. J. Fish. Aquat. Sci.,2006, 63:721-736.

[78] Hiddink J.G. et al. Assessing and predicting the relative ecological impacts of disturbance on habitats with different sensitivities[J]. Journal of Applied Ecology,2007, 44:405-413.