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Food for Thought

Advocacy science and fisheries decision-making

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Science advice is supposed to meet idealistic standards for objectivity, impartiality, and lack of bias. Acknowledging that science advisors are imperfect at meeting those standards, they nonetheless need to strive to produce sound, non-partisan advice, because of the privileged accountability given to science advice in decision-making. When science advisors cease to strive for those ideals and promote advocacy science, such advice loses the right to that privileged position. There are temptations to shape science advice by using information that "strengthens" the conservation case selectively. Giving in to such temptation, however, dooms the advice; science advice becomes viewed as expressions of the biases of those who provide it rather than reflecting the information on which the advice is based. Everyone, including the ecosystems, loses. There are ways to increase the impact of science advice on decision-making that do not involve perverting science advice into advocacy: peer review by diverse experts, integrating advice on ecological, economic, and social information and outcomes, and focusing advisory approaches on risks, costs, and trade-offs of different types of management error. These approaches allow the science experts to be active, informed participants in the governance processes to aid sound decision-making, not to press for preselected outcomes. Everyone, including the ecosystems, wins.

Keywords: advocacy, fisheries advice, marine conservation, science-policy interaction.

Introduction

Many papers have stressed the importance of separating policy advocacy from science advice (e.g. Gitzen, 2007; Scott *et al.*, 2007, and responses therein). Nonetheless, concern over the boundary between science and advocacy seems pervasive, and debate on how science should inform policy continues in many fields, for instance in climate change (Jasanoff, 2010), health (Shadish, 2010), and food safety (Gill and Johnston, 2010). Advocacy science is a subtly nuanced issue. Society benefits from well-informed experts participating in public dialogue on policy issues, and providing information on how consistent policy alternatives are with the scientific information in their area of expertise. However, when those experts place their desired policy outcomes ahead of the basic principles of sound, objective science, an important boundary is crossed. Not only are the benefits reduced, but public dialogue actually suffers because the factual basis of the dialogue is distorted.

There has been increasing demand for coherence between policies for marine conservation and fisheries management (Ridgeway and Rice, 2009). Policy-makers in those fields claim that their policies are based on sound science. However, given the same body of information, experts from the two perspectives often support contrasting positions on policy issues, e.g. the debate about the use of IUCN/CITES criteria for evaluating the risk of extinction of harvested marine species (Powles *et al.*, 2000; Hutchings, 2001; Reynolds *et al.*, 2005). When seemingly well-intentioned experts with excellent credentials give policy-makers contrasting advice on the same issue, the science becomes part of the policy debate rather than providing a unifying foundation on which well-informed policy debate can take place. In those circumstances, it is necessary to tease apart how much of the disagreement among experts is attributable to uncertainties in the scientific and technical information itself, and how much to differences in the risk tolerances of various experts, tolerances that are often unstated and applied subjectively because the risks are difficult to quantify. This differentiation is important because the first source of potential disagreement among experts is within the domain of sound science, whereas the second is the domain of policy.

Here, I address the issue of advocacy science as it currently affects policy-making on marine fisheries and biodiversity conservation. First, I consider the privileged place of science advice in policy debate, explaining why science has that place only because of its unique characteristics, and what would be the cost of losing that privileged place if science advice loses its unique characteristics. Then, I illustrate how and suggest reasons why policy advocacy is increasingly contaminating scientific contributions to dialogue on marine policy. To conclude, I present alternative strategies that respect the special role of science in policy debate, and how they can increase the profile and impact of science advice, and address the reasons why legitimately concerned scientists might be biasing their advice by resorting to inappropriate advocacy.

The privileged role of science advice

Science is not special because of its topics. Science can study essentially all physical, social, and even mental phenomena. Nor is it special because it tries to explain how the world works; the arts and religion may also try to explain how the world works. Science is special because of how it conducts studies and seeks answers. The principles of empiricism, objectivity, falsifiability, and unbiased interpretation of results are the heart of sound science. Critics from the social sciences correctly point out that science is practiced by humans who individually may be imperfect in adhering to these principles (Wilson, 2005; Collins, 2009). However, that is not an excuse to abandon those principles. Rather, it is the rationale for challenge-format peer review, with reviewers drawn from as wide a range of appropriate perspectives as possible.

It is these principles that differentiate science from other ways of explaining how the world works. Graduate science students learn that engaging in practices that violate those principles is irresponsible and unprofessional. Scientists are not allowed to make things up, design studies guaranteed to produce preselected outcomes, or selectively report only the results that match the chosen storyline. There is an alarming trend for at least the latter of these practices to be acceptable if an expert is presenting information to some public forum and/or to headline-hungry media. This trend can be found in recent reports on global marine ecosystem status and trends, "greening" of marine fisheries, and destructive fishing practice. I use the last of these examples to illustrate the pattern of concern. For an expert workshop jointly sponsored by the Convention on Biological Diversity and the UN Food and Agriculture Organization (FAO), both the UN Environment Programme (UNEP) and FAO contracted background overview papers on the theme of destructive fishing practices and each selected half the invited experts. The FAO contribution attempted to summarize the available literature, reporting both success stories and failures at conservation and sustainable use, and the conclusions section addressed the circumstances under which various management approaches and/or resource uses were likely to be sustainable and when they often were not. The other contribution had not only a different but also a consistent structure. For each topic addressed, case histories were presented that demonstrated either social and ecological harm associated with some fisheries practice, or social and ecological benefits associated with an alternative practice, whereas the conclusions section designated the first type of practice as categorically harmful and the second as categorically sustainable, and often benign. The expert meeting to review and provide advice on which fishing practices are destructive received both papers. When the differences between background papers were discussed (Table 1), the experts invited by UNEP focused on conservation issues, arguing that the policy choices consistent with their agency's goals were clear, and they viewed their job as guiding the policy debate among Member States to the appropriate outcome. Experts associated with FAO focused on the sustainable use, reporting that they tried to use value-neutral language to report what they found in the literature, and considered it not their role but that of Member States to choose the preferred policy options, informed by, but not steered by, the science report. Further information about the meeting and its products are available in FAO and UNEP (2010).

Table 1. Conclusions of working papers prepared by two different IGOs with regard to which fishing practices were "destructive" for an expert consultation in 2009.

Fishing practice	IGO with a mandate equally for conservation and sustainable use	IGO with a mandate primarily for environmental and biodiversity protection
Poisons and TNT	Destructive	Destructive
Bottom trawling	Case specific	Destructive
Longlining	Case specific	Often destructive
Small scale	Case specific	Usually benign

These are two very different approaches to complex issues. Past criticisms that fisheries science was failing to pay adequate attention to uncertainty (Harwood and Stokes, 2003; Caddy and Seijo, 2005) have been met by new analytical methods which embrace a variety of types of uncertainty in quantitative outputs and advice (Hilborn and Walters, 1992; Butterworth and Punt, 2003; Holt and Peterman, 2008). However, for interpreting the phrase destructive fishing practices, the concern is the degree of complexity needed in science advice to policy-makers, not about improved representations of the probabilities of a suite of possibly different outcomes under differing policy choices. The impacts of a given fishing gear actually differ depending on where, when, and how it is deployed, possibly causing detrimental impacts on bycatch species or habitats in one place and time, but not in another (Løkkeborg, 2005). The dialogue leading to appropriate policy decisions needs to be informed of these complexities. It is policy-makers, not scientists, who may decide to treat a particular gear as categorically harmful or acceptable, or to address the complexities in management conditions.

The need to address uncertainty poses a challenge for science advisors. While adequately communicating uncertainty, advisors need to keep their messages clear and simple. Clarity cannot be overdone, but simplicity can be. The increasing use of advisory frameworks built around probabilistic advice on the likelihoods of achieving explicit objectives under different policy choices and environmental conditions is an effort to find a reasonable balance between complexity and clarity. Providing clear probabilistic advice is not simple, because there are both uncertainties regarding which of several alternative hypotheses about ecological and social processes may be valid, and uncertainties about the likelihood that a particular objective can be achieved by a particular policy choice, if a particular process is assumed to be represented correctly. In modern advisory frameworks, however, advice can be readily structured as the likelihood of various outcomes contingent on which of several policy options is chosen, capturing both types of uncertainty (Pestes *et al.*, 2008; De Lara and Martinet, 2009).

Even such modern frameworks may be challenged to represent complexities that arise when individually sound studies produce contrasting results. Care must be taken to avoid interpreting such situations as if one of the multiple formulations is correct but that knowledge is inadequate to determine which one. Rather, any of several formulations of a process may be correct in a particular context, depending on externalities or pure chance. It is this type of uncertainty where simplification risks becoming bias.

Effectively communicating this final form of uncertainty opens the door for protagonists of a particular policy to exploit the uncertainties for partisan benefits. Commitment to the precautionary approach (FAO, 1996a, b), intended to improve the ability of decision-makers to deal with uncertainty, does not protect against such partisanship. In probabilistic advice, legitimate debate can occur on what are the appropriate risk tolerances to be achieved by the structured decision rules (Butterworth and Punt, 2003; Kraak *et al*., 2010). However, the precautionary approach and the decision rules supporting it still require impartial advice on the possible outcomes associated with the policy options. Failure to use all relevant information available in statistically appropriate ways may introduce bias into exactly the estimates of probabilities that were intended to reflect the complexity of the fishery and the ecosystem. Biasing the science inputs to the policy dialogue to favour studies reporting a particular outcome takes the application of precaution away from decision-makers and embeds it inappropriately in the expert advisory processes, so making supposedly rigorous decision rules produce the outcomes predetermined by the biases in selecting the information on which decision rules depend.

The sources and dangers of advocacy biases in science

The frustration many experts feel about fisheries decision-making is understandable. The track record of necessary conservation measures being deferred or diluted is well documented (Sissenwine and Mace, 2003; Rice, 2006), consistent with assertions that industry interests exploit scientific uncertainty for their partisan goals, and that decision-makers give more weight to short-term outcomes than to longer term consequences. Advocates can manipulate decision-making processes to be biased towards any perspective, of course. The combination of scientific uncertainty and commitments to precaution can be exploited strategically, e.g. to insist repeatedly on the deferral of decisions to allow harvesting in the belief that new hypothetical scenarios can be proposed that have not been explored analytically (Butterworth, 2007; Punt and Donovan, 2007).

When scientists who care strongly about the conservation of biodiversity and healthy ecosystems (or who oppose harvesting some species) are confronted with decision-making processes that seem to put conservation (or sustainable use) well behind other policy objectives, there may be a strong temptation to close the door on exploiting the inconsistencies among studies and to make the advice precautionary (or permissive) ahead of the policy decision.

That temptation must be resisted for reasons more important than just an idealistic view of pure science. It is hard to quantify how much lobbying goes on with regard to major fisheries decisions. However, many more than 200 documents were provided in response to a request under the Canadian Access to Information Policy (http://www.tbs-sct.gc.ca/atip-aiprp/index-eng.asp) for external submissions made to the Minister of Fisheries and Oceans regarding Newfoundland cod (*Gadus morhua*) between 1990 and 1992. It is unlikely that partisan lobbying has decreased in the ensuing 20 years. Rather, conservation advocacy groups have become more numerous and more active, and fishing organizations (companies, unions, community groups, etc.) use even more media and political tools to promote their interests.

In the midst of all that lobbying, science advice has had a privileged place in decision-making. Science advice is not an invincible weapon, although able to overcome all opposition (by analogy from Wagner's Ring of the Nibelungen cycle, not Siegfried's sword Nothung). Rather, it has a position of superior guidance simply because it is a product of a special set of rules which need to be obeyed (like Wotan's rune-encrusted spear). Not being invincible, its privileged role should not be measured by how often science advice dictates the outcomes of complex decisions, but by how it is reflected in the accountability of decision-makers when their decisions go counter to science advice (at least in the regions where I have always worked). With hundreds of partisan documents being submitted on major decisions, policy-makers have to make choices that please some interests more than others. Which interests are chosen to please and which to upset is a test of political instinct, with short-term political risks knowingly taken when a decision is made. If the decision-maker chooses options that are inconsistent with science advice, however, it is the wisdom and judgement of the decision-maker that is questioned. Challenges come from all quarters and persist long after the decision, as demands for accountability continue 20 years after the key decisions on Canadian Atlantic groundfish stocks (Rose, 2007; Bavington, 2010). This standard of accountability for not heeding science advice means that from the hundreds of documents that may be on a decision-maker's desk, the science advice is always up front, and responsible decision-makers always read that advice carefully.

Despite its privileged position, science advice often does not dominate the decision-making process. Moreover, if the advice realistically covered the diversity of results relevant to complex issues, articulate decision-makers may explain a wide range of decisions made for political ends as consistent with the science advice. This could increase the science advisors' frustration, and again increase the temptation to practice advocacy science: illustrating the advice only with those case histories and analyses that would lead to the preferred outcomes, and downplaying evidence contrary to the outcome they want from the decision-making process.

However, this type of strengthening the science advice makes it no different from any other advocacy document that the decision-maker received. Each competing interest group has done its best to sift through the scientific evidence of the portion that supports their preferred outcome. When science advisors also take that strategy, there is no higher accountability to adhere to the (now biased) science advice than there is for any other document. Moreover, once an advocacy science strategy is adopted, to win against advocates of other options, the science advisors need to play partisan tactics better than their competitors. Advocates of competing views are not bound by expectations of balance and objectivity in their arguments, and are often experienced lobbyists. Hence, when science advisors adopt partisan tactics, to be effective they must increasingly bias the advice, further distancing it from the principles of sound science. Eventually, science advice on high-profile issues will be scrutinized by partisans on all sides, and the lack of balance and objectivity will be discovered and publicized. As this happens, the special attention that science advice gets in decision-making becomes compromised, with lasting consequences.

Other options

Other strategies exist for increasing the impact of science advice on decision-making, while still preserving the principles that entitle science advice to its privileged role. More rigorous standards for selecting science advisors and running advisory processes can be valuable, but they cannot be implemented by the science community itself. I now describe two practical steps that are within the domain of science to implement, and constitute constructive alternatives to advocacy and partisanship.

The first step is to make the science advice more inclusive of the range of considerations that are relevant to the decision. Historically, science advice in fisheries has largely been synonymous with ecological advice. Although, for some time, bioeconomic studies have resulted in some integration of the ecological and economic aspects of policy decisions (Hannesson, 1993; Seijo *et al.*, 1998), integration of the advice from social, economic, and ecological studies is rare, although every important fisheries decision has social outcomes that need to be weighed by decision-makers (Swan and Gréboval, 2005). Policy-makers have requested more integrated advice for more than a decade (UNGA Resolution 57/141), and frameworks for doing so exist (UNEP and IOC–UNESCO, 2009), as do processes for multi-criterion decision-making (Belton and Stewart, 2002; De Lara and Martinet, 2009).

Some ecologists have criticized the notion of integrating social and economic considerations with ecological considerations, implying that it will somehow compromise or degrade the ecological considerations and even the quality of the science (ICES, 2004). However, with advisory processes increasingly using frameworks that report the likelihood of achieving specified objectives under different policy options, there is little basis for such fears. Succinctly, the list of objectives and outcomes for which likelihoods are reported under alternative policy choices is longer and more consistent with the factors that will be considered in the actual decisions (see the more than 20 objectives for a Canadian snow crab, *Chionoecetes opilio*, fishery at http://www.dfo-mpo.gc.ca/fm-gp/peches-fisheries/ifmp-gmp/snow-crab-neige/snow-crab-neiges2009-eng.htmn5).

If the advice on ecological, social, and economic outcomes is provided piecemeal, then the decision-makers themselves have to interconnect the consequences of each option without the benefits of a structured framework. Laying out the complete set of outcomes associated with the options available does not degrade the quality of information on any of the individual dimensions of the decision. Rather, it adds value by showing what trade-offs have to be made socially and economically if the ecologically optimal decision is taken, and what costs have to be paid ecologically for *status quo* or increased social and economic benefits to be taken. The provision of analytically integrated advice is not easy, and does not ensure any particular orientation of outcomes (pro-conservation or pro-use), because the time scales over which costs must be paid and benefits will accrue is not the same along the ecological, economic, and social dimensions of the decision. However, integrated advice at least makes the trade-offs transparent and allows public debate about the major dimensions of the decision in a single science-based framework.

Making science advice more integrated across the major dimensions of a policy decision produces at least two benefits. First, it encourages the science advisors to explore a wider range of policy alternatives in developing the advice, because the shortcomings of individual options may be more apparent. Second, advisors may cease to focus on determining the optimal outcome on a single dimension, and identify the options that produce acceptable (or "viable", *sensu* Cury *et al.*, 2005; De Lara *et al.*, 2007; Chapel *et al.*, 2008) outcomes on all of them. If the outcome associated with an option is ecologically viable, even if it is not the best possible one, the benefit of being chosen and implemented rather than being lost in an all-or-nothing choice between alternatives, one ecologically ideal but socially unacceptable, and others socially welcomed but ecologically harmful, is still a major benefit (cf. Frid *et al.*, 2005; Scott, 2006).

The other step that can be taken is to present advice using approaches designed specifically for decision support rather than hypothesis testing. Advisory frameworks try to maintain a low probability that advice will lead to management error, but errors are still possible and their nature matters. Approaches such as signal detection theory (Wickens, 2001) are designed to use information to address both the nature and the likelihood of different types of decision error, rather than to estimate the probability that one view of the world is true and alternative ones are false. The distinction is subtle but useful. Particularly in complex ecological systems that may not have deterministic outcomes for a given set of conditions (Cury *et al.*, 2003; Gamble and Link 2009), the notion that one hypothesis is true and the alternatives false is not a particularly helpful basis for policy advice. Signal detection theory differentiates explicitly the likelihood that decisions may lead to false alarms (management interventions which were unnecessary) from misses (not taking a management action when one was necessary). It also allows quantitative exploration of the trade-offs inherent in allowing the probability of one type of error to increase to achieve a lower probability of the other type, given that such trade-offs are rarely symmetrical (Wickens, 2001). The framework is easy to use in fisheries advice, and highly flexible for other types of application (Piet and Rice, 2004).

This differentiation of types of management error helps decision-makers in two circumstances. One is when the two types of error have different costs. Failing to protect critical habitat (a miss) may have lasting impacts on stock productivity (a high cost), whereas if ample fishing opportunities exist outside an area of concern, prohibiting fishing in it unnecessarily (a false alarm) may at worst result in a small increase in travel time to open fishing grounds (a low cost). On the other hand, closing a fishery based on a single low-stock status indicator that turns out to reflect a change in distribution rather than an abundance of the stock (a false alarm) may cause great hardship to dependent communities (a high cost), whereas a modest reduction in quota while gathering more information about actual stock status to use in the next assessment (a miss) may have little lasting impact on stock dynamics as long as the additional information really is gathered and used (a low cost). These examples illustrate that the costs of misses and false alarms are case specific, and indeed part of what decision-makers should consider. Signal detection theory structures science advice in a way that facilitates such considerations. Many of these features can be found in well-designed management strategy evaluations, and the compatibility of the two frameworks needs to be developed further.

Such frameworks also help decision-makers deal with partisan issues where different sectors of society have different tolerances for misses and false alarms. For example, in fisheries decisions related to threatened or endangered species, the conservation science community is highly risk-averse to misses, but willing to tolerate a high rate of false alarms to keep the miss rate very low, arguing that the cost of extinction is extremely high. The fishing industry, though agreeing that misses are undesirable, bears the costs of false alarms and seeks a more equitable balance of misses and false alarms (Rice and Legace, 2007). Moving discussion between the two interest groups from accusations of extreme outcomes to discussion of trade-offs between misses and false alarms led to a more constructive exchange of views, and gave decision-makers a less-partisan context in which to explain their decisions. There is no guarantee that signal-detection-type frameworks will always result in constructive dialogue between groups with strongly contrasting risk tolerances, but it is at least a basis for dialogue where the potential benefits and shortcomings of all options are explicit in non-judgemental language.

Conclusions

Partisan groups lobbying for preferred outcomes have a long history of the selective use of information to support predetermined conclusions. This is acceptable in politics, but not in *science. Nonetheless, it is happening with increasing frequency. The motivations for such advocacy science may be a sincere desire to improve the protection of marine ecosystems and frustration with decision-making processes that seem to give too little weight to longer term environmental considerations, or a cynical strategy to exploit the challenges that uncertainty poses to decision-making. Whatever the cause, making science advice itself partisan means it no longer deserves to be treated in any special way in the decision-making process. There is a serious risk that the long-term costs of merging advocacy with science advice would outweigh any short-term benefits of greater impact on a particular decision. If scientists do wish to increase the impact of science advice on decision-making, there are alternatives to advocacy in doing so. These approaches make the advice more amenable to decision-makers, while avoiding turning science advisors into partisan lobbyists.

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