



Viewpoint

Science for sustainable fisheries management: An interdisciplinary approach

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ABSTRACT

One of the greatest weaknesses of the current research system is that it remains fragmented, introspective and lacking in creative connectivity, both between the participating disciplines and with wider sources of knowledge and expertise. It has been apparent for many years that the future for policy related research in fisheries and the marine environment lies in an interdisciplinary approach incorporating the natural, economic and social sciences. This will be central to broadening the objectives of policy to include such diverse notions as ecosystem integrity, economic viability and social equity, and to develop effective approaches to integrated management and marine spatial planning. But why are truly interdisciplinary perspectives still slow to develop, and how can such an approach to knowledge production be enabled and realised? In this paper we review the case for interdisciplinary research and call for renewed and deliberate efforts to build capacity for interdisciplinary working within research projects, programmes and institutions.

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1. Introduction

There is growing awareness that a full understanding of the key issues relating to managing natural resources is unlikely to emerge from within any one research perspective. This is the case in many complex areas of public policy, ranging from sustainable food production and terrestrial land use, to the management of animal and plant diseases (Phillipson and Lowe, 2008; Wilkinson et al., 2011). Fisheries are no exception. In all these fields narrowly based technical decision making can generate unintended environmental, biological, social and economic consequences and there is a need for a broader scoping of the problems and a more integrated evidence base (Degnbol et al., 2006).

In fisheries, monodisciplinary research and scientific paradigms have approached their limits, both in terms of costs and utility. It has been apparent for many years that the future for policy related research lies in an interdisciplinary approach incorporating the natural, economic and social sciences, together with the expertise of the fishing industry itself and of other stakeholders. This will be central to broadening the objectives of fisheries policy to include such diverse notions as ecosystem integrity, economic viability and social equity. But why are truly interdisciplinary perspectives still slow to develop in fisheries and how can such an approach to knowledge production be enabled and realised? In fisheries there is a growing body of evidence that disciplinary boundaries are

being breached, and that multidisciplinary approaches are becoming more widespread. There is, we would argue, a need to move beyond reciprocal exchanges of knowledge to a more unified and integrated approach, through interdisciplinary research, urged on by calls for integrated management and the demands of marine spatial planning.

2. Outlining the case for an interdisciplinary approach

The growing case for interdisciplinarity is more than an intellectual fashion. It is a logical outcome of the complexities of fisheries management and the limitations of research and advice arising from discrete and monodisciplinary contexts. It also reflects the positioning of 'sustainable fisheries' within a much broader framework of decision making regarding the management of the marine environment and the maritime economy. Seen in this light the potential foci for interdisciplinary research are manifold.

Both social and natural sciences must look beyond their disciplinary perspectives to address contemporary policy and research agendas. Interdisciplinary research moves beyond disciplinary and multidisciplinary approaches by emphasising cooperation and joint working between disciplines in addressing common problems. In this approach each discipline contributes its own epistemology, methodology and theoretical constructs, and subjects them to learning and reframing from the perspective of others (Klein, 2004; Petts et al., 2008; Tress et al., 2005). It requires a deep level of understanding and respect for the conventions of the other disciplines involved (Oughton and Bracken, 2009). The claims for this type of work are that it can lead to the avoidance of partial

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framings of questions and complex problems as well as introducing new perspectives. It can enable the contextualisation of technological and environmental constraints and opportunities in their social and economic settings and provide more holistic solutions. Interdisciplinary working may also improve the accountability of research and fisheries management, by opening up processes of problem definition, by enabling stakeholder and public participation in the scientific process, and by bringing social considerations to bear within technical research. By factoring in the often divergent views and values of different stakeholders, using deliberative participatory research methods from the social sciences, interdisciplinary research can also offer methodologies and tools for mitigating conflicts, or help policy makers effectively negotiate complex positions.

Interdisciplinary research is not necessarily about inventing new topics but about reflecting upon and reframing existing themes from different disciplinary perspectives. It involves dealing with a wide array of information, expertise, scientific conventions and working in several different disciplinary languages. It therefore requires integrated programmes, and depends upon the particular chemistry of individuals involved and their ability to respect and creatively harness a plurality of research methods and epistemologies (Raymond et al., 2010).

The reality of marine spatial planning is, for example, posing many seemingly intractable questions. Each warrants interdisciplinary inquiry involving social and natural sciences and calls for multiple forms of expertise. This will be central in developing and applying tools and approaches to managing diverse spatial needs of marine users, for negotiating conflicts, for creating synergies and trade-offs between ecosystem services, and for reconciling priorities. Developing the appropriate institutional arrangements that can work across social and ecological scales and which ensure appropriate mechanisms for public and stakeholder participation requires the attention of the sciences, administrations and industry. The establishment and management of marine conservation zones is a case in point, which need to be developed on a broad evidence base if the distributional effects, costs and benefits are to be understood, and if the uncertainties posed by environmental change and behaviours of affected interests are to be appreciated.

New fisheries paradigms are also accompanied by advocacy of a move from science-centric and centralised management frameworks, to decentralised systems, with an implied switch to strategic and adaptive management approaches and recognition of other sources of expertise among resource users. These considerations are infused by coupled socio-ecological questions, including how we understand and act upon risks and uncertainties, the processes of environmental change and associated adaptation and mitigation responses of fishing communities and businesses, and the development of resilient and flexible institutions (Berkes, 2010). The accountability and operation of the fisheries science and management system (its data needs, cognitive basis, modelling approaches and institutional arrangements), and the way in which scientific research and the prevailing methods of fisheries management are co-produced and self-perpetuated, is itself ripe for interdisciplinary inquiry (Degnbol, 1999).

3. Progress to date

Fisheries management is a domain hitherto dominated by the inputs of biological science and to a lesser extent economics. Its primary concern has been the sustainability of fish stocks in the context of economic viability. But within these mainstays of the evidence base there has been a broadening of disciplinary outlook. Over the last 20 years an incremental shift has occurred within the biological and environmental sciences from a narrow

preoccupation with fish stock assessment to a much broader concern for ecosystem management. In fisheries economics too there has been a move towards a more holistic analysis. Economic sciences are insisting on the need to develop closer links between economic performance and the state of the marine ecosystem, human behavioural patterns and on valuing the ecosystem impacts of fishing, in a much broader way than in the past. Operationalising an ecosystem approach assumes incorporating the value of a range of marine ecosystem services and public goods.

Whilst this broadening of disciplinary outlook has led to a vanguard of collaboration among biologists, ecologists and economists, there remains a significant gap in linkages to the wider social sciences, which represents a largely unexploited frontier of interdisciplinary collaboration. Fisheries social sciences – spanning a broad church of disciplines including, *inter alia*, sociology, anthropology, political science, human geography, science and technology studies – have historically been a minor player, which has mirrored and partly contributed to the low priority and ill-defined nature of social objectives within fisheries management. To some extent their lack of traction and marginal status has been due to the much smaller and more fragmented nature of the fisheries social science community and the preferred role of many social scientists as an independent critical conscience in locating the failures of modern management and science.

The marginal position of fisheries social scientists is also a reflection of the heavy dependency on and support for biological, and increasingly economic and ecological, evidence by ‘demand side’ management and policy stakeholders locked into quantitative systems of resource management. The implication is that fisheries managers and policy makers rarely encourage or source substantial social science inputs. Even when social research has been commissioned, research customers can often find it difficult to understand and act upon its outcomes, or they can be unwilling to accept social research findings that highlight uncomfortable truths or question established interests and approaches.

However, there may be some signs that social science is beginning to carry more weight in broader debates on fisheries governance – see, for example, the growing emphasis on demands for regionalised approaches to European fisheries management. The ‘demand side’ is beginning to recognise the need for a more holistic evidence base. Policy makers at national or international levels, who are looking for research projects that can shed light on the future directions of fisheries and marine governance and closer integration of the biological, economic and social policy objectives, are likely to be the key customers for interdisciplinary research.

In the UK, for example, where there is emerging interest in and demand for interdisciplinary and social science evidence coming from many technical research agencies and government departments wishing to resolve outstanding ‘wicked’ problems (see, for example, Defra, 2007, 2010a), marine science and evidence strategies are starting to follow suit. According to the UK Marine Science Strategy (Defra, 2010b: p. 14) effective “integration across natural, social, economic and technological science will be key to the delivery of the marine science required by policy makers. Such an integrated approach would be needed, for example, in order to understand how sustained behavioural changes can be achieved that help to reduce the negative impacts of human activity on the marine environment”. The strategy goes on to argue that “an integrated and sustainable policy approach requires an understanding of the associated coupled social and ecological systems” (p. 19).

The European Commission too, in its recent Framework Programmes, has shown a strong interest in multidisciplinary and interdisciplinary research, but for reasons largely (but not exclusively) related to its organisation, the research community has been less well prepared to take up the challenge. A recent review of EU funded research on fisheries (Symes and Hoefnagel, 2009)

noted that the nature of research had altered with fewer but larger projects, a strengthening of a multidisciplinary approach and an increased focus on policy related topics. Multidisciplinarity, however, still involved the different disciplines working in parallel – and not always as equal partners – in order to bring their own epistemologies, methods and constructs to bear on a shared problem. Interdisciplinary research, requiring much closer coordination, less independence and a genuine working together on an integrated project, was still quite rare.

One such project that was featured in the review – CEVIS (Comparative Evaluations of Innovative Solutions in European Fisheries) seeking to evaluate innovations that had been successfully introduced into fisheries management elsewhere and were currently under consideration in the EU – may offer a valuable insight. The project is a particularly useful example to highlight. Not only was it a substantial project in its own right within EU fisheries research funding, but also it uniquely aimed to explicitly experiment in finding ways for different disciplines to work together in informing debates on fisheries policy. The outcomes and lessons from the project have been comprehensively reviewed (see Haugen and Wilson, 2009). CEVIS had hoped to use an interdisciplinary approach to frame common concepts and new investigative methods to formulate ‘new’ research questions. This was eventually abandoned in favour of simpler multi and crossdisciplinary approaches when it became apparent that an interdisciplinary framework risked generating results that were either ‘too abstract or too trivial’ to be of practical use to policy makers. Difficulty in reconciling the methodologies deployed by the biological and economic sciences, with those favoured by the social sciences, proved a major stumbling block.

According to Haugen and Wilson (2009), interdisciplinary cooperation is achievable when there is similarity of analytical method and a long-term commitment to turning that similarity into practical products, as in the development of bio-economic analysis in fisheries. Otherwise, effective collaboration will require a much longer lead-time and a fundamentally different methodological approach. This somewhat pessimistic conclusion may well reflect the particular circumstances of CEVIS which brought together more than 40 biological, economic and social scientists from 10 different countries to explore a range of innovations in several non-EU locations.

However experiences from other fields suggest that interdisciplinary research can be productive, both in enhancing the relevance of research to policy and practice (Meagher, 2012) and leading to scientific and methodological innovation. For example research projects in the UK Research Councils’ Rural Economy and Land Use programme (Relu) have led to strengthened collaboration between environmental and social sciences, bringing together qualitative and quantitative methods and novel disciplinary collaborations (e.g. hydrology and sociology; ecology and political science), and new links between the social and biological sciences (Meagher and Lyall, 2007). Projects adopted a variety of approaches for interdisciplinary collaboration (Relu Data Support Service, 2011). This included providing integrated assessments of technologies and systems, offering synoptic perspectives on geographical areas and problems, and developing methods for participatory and joint modelling of systems. Other research projects designed approaches for spatial integration of social and natural science datasets, developed tools and methods to support decision making, and facilitated joint scrutiny of concepts. A survey of 100 ecologists in Relu highlighted collaboration with social scientists in decision making on research design, data collection, analysis and dissemination (Phillipson et al., 2009). Many said that collaboration with social sciences had helped to cross-fertilise models, reframe ecological problems, provide holistic solutions, and prioritise research around societal challenges.

Although social scientists are sometimes cast as the ‘awkward partners’ in multidisciplinary research, they can have a valuable enabling role to play. Hitherto, where social scientists have taken their place within multidisciplinary research projects or contributed evidence into policy, this has often been in an auxiliary, contained and ‘end of pipe’ role, with their contribution used primarily in the *ex post* analysis of the ‘socio-economic’ impacts of fisheries policy or in facilitating the uptake of new technical research findings and technologies. These contributions are important, and indeed increasingly so as marine planners seek to socially proof the introduction of such measures as marine protected areas and spatial plans. However, a more ‘upfront’, integrated and critically engaged role for social sciences is also called for, in shaping the formative choices in the development of fisheries management policies, measures and technological advances, and in underpinning more socially robust and participatory approaches to fisheries and ecosystem management. Within interdisciplinary research social scientists need to promote, and be valued for, their full potential repertoire of research approaches and roles.

4. Enabling interdisciplinary working

Conventional knowledge practices of disciplines are commonly presented as the fundamental obstacle to mutual understanding between the sciences. These often mean that interdisciplinary research is by no means a straightforward choice of research design and method. However, such a position underplays several key issues that may work for or against interdisciplinary working (Lowe and Phillipson, 2009). These include the institutional relationships, structures and practices that recreate disciplinary divides. The strategies chosen by natural scientists to take on board the human dimensions of their work can also be vital, with many natural scientists choosing to do this by involving stakeholders directly in fisheries: science partnerships rather than engaging with social scientists (Lowe et al., 2009). As Haugen and Wilson (2009) also concluded, methodological and philosophical affinities and differences within disciplines but also transcending disciplinary boundaries are also important (Phillipson et al., 2009). Although collaboration with qualitative social science can be rewarding, many scientists feel better equipped to collaborate with social researchers using quantitative approaches which mean that common methodologies, techniques and principles can be pursued. Others find contrasting epistemologies and approaches to be a source for creativity within the research process.

Specific actions are needed to increase the scope, capabilities and prospects for interdisciplinary working between social, economic and natural sciences and to reduce the risk of ill-matched partners being forced to work within artificially contrived interdisciplinary projects. The needs and priorities of interdisciplinary research must be considered at a range of levels. For example, consideration is needed to the career development of individual researchers, including training on interdisciplinarity, social and natural science research methods, and approaches to data integration. Project design considerations are also vital, though there is a need to guard against prescribing the form of collaboration and integration between disciplines. Project teams should develop their own approaches to interdisciplinary working and pursue an approach that will creatively combine research staff and perspectives. This relates to scientific and methodological dimensions as well as project management, the creation of sufficient space and resources for interdisciplinary training and exchange, as well as integration of analysis and synthesis. There is need for clarity of thinking about the role of different researchers in an interdisciplinary team. Each scientist will need to be clear about what they bring to the interdisciplinary table.

Deliberate efforts may be needed within programmes of research to build relations and capacity for interdisciplinary working. This can include, for example, seed-corn funding mechanisms to forge links across disciplines and with stakeholders; and workshops carefully orchestrated to promote shared perspectives on cross-cutting strategic themes, to avoid researchers retreating into their disciplinary enclaves. Assessment processes need to be carefully planned. Rigorous peer review by relevant experts of the strengths of the scientific components of projects should be carried out separately from an overall assessment of the quality of integration of projects and the strategic importance of their interdisciplinary collaboration. Assessors should have a breadth of understanding and, ideally, experience of interdisciplinary research. Finally, the organisation of scientific institutions is typically along disciplinary lines. Interdisciplinarity calls for strategic collaboration and structures for joint decision making between institutions, but also integrated management structures, data management and archiving systems, funding streams, and policies which can facilitate interdisciplinary research.

Looking ahead the challenge is how and whether innovation in our fisheries and marine research institutions and funding base can make truly interdisciplinary collaborations more routinised and common. Government and other 'demand side' stakeholders have an important role to play in encouraging this, as they seek ways forward in relation to the complex problems they face. However they too must develop their capability for navigating and accessing high quality interdisciplinary and social science expertise, and build their internal capacity as proficient commissioners and customers of interdisciplinary research.

5. Conclusion

While the challenges of interdisciplinary research should never be underestimated, especially in circumstances where contrasting cultural backgrounds and language difficulties may create added complications, future prospects are quite promising. The emergence of multidisciplinary research institutes, the opening up of learned societies, academic journals and conference themes to a wider range of scientific expertise and the accumulated wisdom contained in the growing case history of multi and interdisciplinary research, all contribute to a more conducive environment. And the new generation of scientists is likely to be less inhibited than their elders, more familiar with developments in other disciplines and more adept at interpreting different approaches to research. Nevertheless, the idea of interdisciplinarity as a preferred approach to problem solving in fisheries still needs to be carefully nurtured.

In most disciplinary areas considerable progress has been made in refining the basic approach, developing the information base, increasing the mathematical sophistication and improving our knowledge of specific aspects of fisheries and their management. In all disciplines there are opportunities to fine-tune the research methodologies, identify new topics for investigation and improve the dissemination of research findings. But such intrinsic developments can only bring a marginal benefit to the fisheries management process. Possibly the greatest weakness of the current research system is that it remains fragmented, introspective and somewhat lacking in creative connectivity between the participating disciplines and with wider sources of knowledge and expertise. As a result, the value of the research contribution to fisheries management faces self-imposed constraints.

There is a need to complete the dismantling of systems presently dominated by simple and partial relationships and the building of more comprehensive (and, therefore, more complex) understanding, which brings together the biological, economic and socio-cultural factors and engages all relevant disciplines in a more integrated and purposive way. Realisation of this essential change will not be easy but the benefits of a broader approach to major issues within the domain of fisheries and marine policy may be considerable. Not only is the emergence of interdisciplinarity an inevitable consequence of the perceived limits to research conducted within the frameworks of particular disciplines. It will also serve to enrich the research experience, create a better understanding of the highly complex fisheries system and provide greater utility for those responsible for fisheries management. This may pave the way for finding solutions to fundamental problems of marine governance. It depends on a commitment to develop a more informed awareness and understanding of the other disciplines, to pool results and to discuss the findings openly and without prejudice.

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