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MASTS funding under the 'Fisheries Science Forum' programme enabled me to attend the ICES ASC, this year held in Copenhagen. I presented two papers related to our Orkney based research. The first concerned science in support of industry led initiatives for fisheries management. The second related to innovation in the approach to integrating fisheries with marine spatial planning. The extended abstracts of both papers are attached as Appendices 1 and 2. The papers were well received and contributed to the sessions on 'Science-Industry Partnerships: the value of cooperative research in fisheries and marine management' (Appendix 1) and ' Marine Spatial Planning and fisheries: a stocktake on approaches, examples and future needs' (Appendix 2).

As ever with conferences, the opportunity to network, learn and exchange experience was more valuable than presenting the papers. ICES is the world's oldest intergovernmental organisation concerned with the marine environment. Its main objective is to increase the scientific knowledge of the marine environment and its living resources and to use this knowledge to provide unbiased, non-political advice to competent authorities. Over 700 scientists from all over the world attended the Copenhagen conference where key themes this year included integrated ecosystem assessment and multi-discipline working across the sciences. The social sciences are identified as having an increasingly important role in the work of ICES.

Of three plenary lectures, I found that given by Professor Ratana Chuenpagdee from the Memorial University of Newfoundland to be the most directly valuable to the future of my work. Her lecture entitled '*Too important to fail: creating opportunities in small-scale fisheries*' focused on the social and economic value of small-scale fisheries to vulnerable and peripheral coastal communities. The role of small-scale fisheries in alleviating poverty. She went on to say that research and management too often conflated large and small scale fisheries to the detriment of the latter. Her introduction read:

"An estimated 560 million people, or 8% of the global population, directly or indirectly depend on fishing for a living. According to the Food and Agriculture Organization of the United Nations, more than 90% of these people are involved in small-scale fisheries. These figures suggest that small-scale fisheries are simply "too big to ignore". The contribution of small-scale fisheries to food security, poverty alleviation, employment, and economic development also means that they are "too important to fail." For the most part, research and management efforts have not differentiated small-scale from large-scale fisheries, leaving the former at a disadvantage and worsening their marginalised conditions. New thinking in research, education, policy-making, and governance is necessary, which is what the project "Too Big To Ignore: Global Partnership for Small-Scale Fisheries Research" aims to do. The goals of this network are to elevate the profile of small-scale fisheries, to help rectify their marginalization, and to develop local and global capacity to address governance

challenges facing this sector. This presentation describes the initiatives taken to provide comprehensive information about small-scale fisheries, to gain in-depth knowledge about social and institutional issues affecting their sustainability, and to broaden perspective in research and education.”

Professor Chuenpagdee finished by promoting the web-based Information System on Small-scale Fisheries (ISSF) - www.issf.toobigtoignore.net

The ICES Science Committee (SCICOM) also organised a series of eight open sessions. The session on ‘*Human Dimensions in Integrated Ecosystem Assessments*’ was especially relevant to community based activities such as inshore fisheries. The introduction read:

“The human dimension encompasses the social, cultural, economic, and governance aspects of the Ecosystem Based Approach to Management (EBM). For an integrated understanding of marine socio-ecological systems, methodologies from both natural and social sciences need to be applied, while methodologies that integrate across disciplines need to be developed. In contrast to natural sciences, within ICES, social sciences are less developed and not used to their full extent. If the integrated understanding is to be translated into advice and management, the interface between science and policy, the involvement of wider civil society needs to be taken into account.”

This session was organized by the ICES Working Group on Marine Systems (WGMARS) - an expert group based on interdisciplinary collaborations and understandings of the coupled human/ocean system. It is a forum to articulate interdisciplinary perspectives regarding sustainable ecosystem science, advice and governance. The session was in preparation for a symposium scheduled for Brest in May/June 2016:

“Understanding marine socio-ecological systems: including the human dimension in Integrated Ecosystem Assessments. The focus of the symposium will be on integration and assessment across multiple ocean uses and sectors, including: fisheries, renewable energy, coastal development, oil and gas, transport, and conservation.”

Conclusion

Attendance at the 2015 ICES ASM was an extremely valuable venue both to present our (HWU) work in the fields of fisheries and marine spatial planning, and in learning and sharing the latest thinking about the key themes of the conference - integration and multi-discipline/inter-discipline working.

APPENDIX 1

Science in support of industry-led initiatives in inshore fishery management in Orkney

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Summary

Six Inshore Fishery Management Groups (IFGs) have been established around Scotland, facilitating regional management of fisheries out to six nautical miles, also providing a means for the fishing industry to have a voice in wider marine management issues. The Orkney IFG, led by a cooperative consortium of stakeholders in local fisheries set up as a not-for-profit company, has been proactive in seeking scientific support for the development of sustainable fisheries initiatives, relating particularly to a thriving shellfish sector. We describe how industry is working with university scientists and local and national government agencies to develop fishery monitoring programmes that address two needs: firstly, supporting fishery assessment and management in relation to sustainability criteria; secondly, information to support marine spatial planning in the region, particularly in relation to the emerging wave and tidal energy sector. A Fishery Improvement Project is underway for the brown crab fishery, working towards meeting standards for sustainable fishery management and coordinating closely with local and national agencies on issues of governance and spatial planning. Scientific support for this and other industry-led initiatives in the region is providing a basis for the development of sustainable harvest strategies, with controls potentially provided under existing and future legislative instruments.

Introduction

Inshore fishery management in Scotland has recently been strengthened by the establishment of six Inshore Fishery Groups (IFGs), regional non-statutory bodies with membership drawn from relevant commercial fishing sectors and each with a chair appointed by Marine Scotland as the marine management directorate for Scotland. The remit of the IFGs is to facilitate the development of policy and measures relating to the regional management of fisheries within six nautical miles, in accordance with the Marine Scotland Inshore Fisheries Strategy 2012 and the National Marine Plan (Marine Scotland 2012). TACs and quotas do not apply to many of the species targeted by fisheries in these inshore areas, notably for regionally important crustacean and mollusc stocks, and management has mainly been restricted to vessel licensing and technical measures such as the definition of minimum landing sizes (MLS). Informal stock assessments are undertaken for key shellfish species including brown crab (*Cancer pagurus*), European lobster (*Homarus gammarus*), velvet crab (*Necora puber*) and king scallop (*Pecten maximus*), based on nationally coordinated sampling programmes (Barreto & Bailey 2013), but these provide only indicative status in relation to an F_{MSY} proxy, there are no formally adopted biological reference points and harvest strategies are not defined. In this context there are two essential pre-requisites for the success of fishery management initiatives put forward by the IFGs, namely access to scientific support on a regional basis and the existence of legislative instruments for effective implementation of management actions. We describe the development of an industry-led programme of scientific monitoring, assessment and research in support of sustainable fishery management initiatives by Orkney Sustainable Fisheries Ltd, which is now recognised as the IFG for Orkney.

Materials and Methods

Orkney Sustainable Fisheries Ltd (OSF) is led by a cooperative consortium of stakeholders in local fisheries, set up in 2006 as a not-for-profit company to run the local lobster hatchery and take forward research initiatives to support development of the local shellfish sector. We describe the evolution of scientific monitoring, assessment and research in support of fishery sustainability in Orkney since 2006.

Results and Discussion

A proposal to establish management of inshore shellfish fisheries in Orkney waters through the establishment of a Regulating Order under the Sea Fisheries (Shellfish) Act 1967 was rejected by a majority of Orkney fishers in 2001 (Johnson 2004). This followed the establishment of the first Scottish

Regulating Order in Shetland in 1999, providing for management of shellfisheries within the six nautical mile limit. Orkney has since pursued other avenues for inshore fishery management, with the setting up in 2006 of OSF as a cooperative consortium of local stakeholders. One of the first actions of OSF was to commission a pre-assessment for the creel fisheries (brown crab, European lobster and velvet crab) against the Marine Stewardship Council (MSC) standard for sustainable fishing (Hough, 2006), which identified three main issues: defining the extent of stocks, particularly the inshore and offshore components in brown crab; the lack of explicit objectives and effort controls; recording of catches and bycatch. OSF employed its first full-time shellfish researcher in 2010, initiating a tagging programme to characterise the offshore spawning migrations of female brown crabs and undertaking biological sampling at ports and observer trips to characterise catch, landings and bycatch in terms of size and species composition and catch per unit effort in the creel fishery. These monitoring programmes continue to date, providing an accumulating time series of detailed monitoring data. In more recent years, research and monitoring activities have stepped up considerably with the initiation of the Orkney Shellfish Project in 2013, with two prime motivations: the licensing of areas of Pentland Firth and Orkney Waters for wave and tidal energy developments; and a second pre-assessment of the creel fisheries against the MSC standard, which identified the main issues as being the lack of biological reference points, harvest control rules and monitoring of fishing effort (Bell & Gascoigne 2012). The Crown Estate, a public body which manages UK assets including the seabed, funded the monitoring of spatial patterns of fishing effort in Orkney waters with vessel monitoring systems supplied by Marine Scotland, their interest being in developing a resource for wave and tidal energy developers in informing consenting activities. At the same time, the project has involved the development of a Fisheries Improvement Project to formally progress the brown crab fishery towards meeting the MSC standard for sustainable fishing, this being supported by WWF-UK and Marks & Spencer as a retailer working towards sourcing of sustainable seafood products. Two full-time and two seasonal shellfish scientists are employed, working under the direction of a scientist at Heriot-Watt University's International Centre for Island Technology in Orkney, who is also providing scientific support for the development of stock assessments and relevant research. This has provided significant knowledge transfer to OSF, whilst the university has benefited from an increasing portfolio of fishery related research, including research projects for MSc and PhD students. Through this relationship, OSF is developing a sound basis for evidence-based management, highlighting the needs for legislative instruments to define the necessary controls. The Sea Fish (Conservation) Act 1967 enables legislation, e.g. for MLS, with further controls possible through the Inshore Fishing (Scotland) Act 1984; limitations for effective development of management tools are currently being discussed with a view to moving forward strategies for inshore fishery management in Scotland.

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APPENDIX 2

Innovation in the approach to integrating fisheries with MSP in Scotland

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Summary

This study has explored integration of the fisheries sector into marine planning in Scotland. Focus has been on Scotland's first regional marine spatial plan of the statutory model under the Marine Scotland Act 2010. The Pentland Firth and Orkney Waters (PFOW) MSP is driven by the intention to site large scale arrays of wave and tidal energy devices in local waters. The 2010 announcement of proposals coincided with the start of plan development and created early tensions with the inshore fishing industry. The fishery is lightly regulated and largely managed by the fishermen themselves. It is of great significance to the local economy and culture. The study demonstrates the measures, such as small vessel VMS, taken to integrate the fishery into the plan. The work on the plan has acted as a catalyst to draw the fishermen and the renewables industry into dialogue to achieve greater understanding although not necessarily accord. Other factors, such as the requirements of retailer customers like Marks and Spencer, have acted to speed the introduction of measures to support a sustainable fishery. Also important is the type of marine spatial plan which has resulted - one based on policy criteria for development and protection.

Introduction

Scotland is home to two thirds of the UK fishing effort and to international plans for the roll out of wave and tidal energy. Statutory marine spatial planning (MSP) has been introduced as one tool to manage the interfaces and to integrate the diverse interests of the respective marine activities. The Pentland Firth and Orkney Waters (PFOW) pilot regional marine spatial plan was published for consultation in March 2015 [Marine Scotland 2015] having been five years in preparation. The PFOW was selected by the Scottish Government as their pilot for statutory regional MSP because of advanced plans for marine renewable energy in the region - it is a designated Marine Energy Park and the main international testing centre for wave and tidal power with plans for large scale commercial arrays by 2020. It is also an area with a high level of other maritime activity, including fisheries, and a near pristine marine environment. Integrating fishing activity into the PFOW plan generated heated debate and required additional spatial data about fishing areas. This paper tracks the development of the fishing sector relationships with management and the innovative measures taken to integrate the sector into marine plan development.

Materials and Methods

Study of the Orkney inshore fisheries sector is made over fifteen years (2000-2015) including literature review [Noble 2003], workshops [Kerr *et al.* 2006], interview and direct participation in the PFOW plan process of consultation [Marine Scotland 2013]. In particular the MSP consultation process has been tracked over the five years of the plan development.

Results and Discussion

The inshore fisheries sectors (up to six nautical miles from the coast) of Orkney and Shetland in Northern Scotland are primarily focused on creeling (potting) for lobster and crab and diving for scallops. About 300 owner operator <15m vessels work the island groups with a fishery worth about £15 million per year. It is also of social and cultural importance. Strong fisheries management legislation has not been introduced. The two most relevant Acts of Parliament focus on separation of fixed and mobile gears and powers to control the fishery on human health grounds. Traditional and contemporary management of the fishery has been undertaken cooperatively by the fishermen. In 2000, Shetland fishermen took advantage of an opportunity to take cooperative statutory control of their fishery under an arrangement allowed under a 1967 Act of Parliament. Orkney fishermen, in a vote,

rejected this opportunity and the management remains largely informal by the fishermen themselves [Noble 2003]. An ESRC funded study under their 'science and society' programme investigated relationship between the Orkney fishery and fisheries science revealing a relatively high degree of fisherman trust in science, but a low degree of trust in fisheries scientists [Kerr *et al.* 2006].

In 2010 The Crown Estate (TCE), administrators of the seabed in the UK, announced development areas for marine renewables in the PFOW region. At the same time Marine Scotland (MS), the Scottish government marine agency, started work on the PFOW regional MSP following enactment of the Marine Scotland Act 2010. The fishing sector response was anger at a perceived lack of consultation which came to a head at a lively consultation meeting in March 2011 [Johnson 2011]. TCE and MS then moved to improve dialogue with the fishers and to gather spatial data about the fishery and its potential interaction with marine energy. An early priority was to ask fishers where they actually fished and to understand the socio-economic consequences of individual fishers being displaced from their grounds. Spatial distribution was investigated by fishery officer interview with fishermen and the results were presented in Marine Scotland's 'ScotMap'. At the same time other initiatives included the introduction by the government of advisory inshore fisheries groups (IFGs) and a project with the fishermen to achieve the equivalent of MSC standards for a sustainable fishery. This latter project which established Orkney Sustainable Fisheries Ltd. (OSF) is funded by MS, TCE, the fishing sector and Marks and Spencer plc (M&S) [<http://www.orkneysustainablefisheries.co.uk/>]. It is also supported by WWF-UK in the development of Fishery Improvement Plans. This project has continued study of spatial distribution of the fishery with the introduction of VMS on small vessels (<15m).

The completed pilot PFOW Marine Spatial Plan is policy based and rejects zoning, at least for the time being. It says of itself that it is a guide: "*The pilot Plan will not provide decisions on proposed development and management...It is intended... (to be)...one of a number of material considerations in the determination of consent applications...It should be viewed as part of an ongoing marine planning process*" [Marine Scotland 2015]. The policy based approach is in common with all MSP development in the UK. The marine plan sets out a process. It is not a decision making instrument. Spatial decisions at sea are made, however, under environmental legislation (MPAs and SPAs) and the development consenting regime. In the case of the fisheries sector the PFOW plan sets out a) The required considerations to be given to the fishing sector in development consent applications; b) Specific fisheries factors to be taken into account when deciding uses of the marine environment; and c) Requirements for consultation, safeguarding and mitigation of fisheries interests. "*This policy seeks to safeguard the commercial fisheries industry and its associated benefits*" [Marine Scotland 2015].

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